CITY OF MISSISSAUGA

# MECHANICAL AND VARIOUS BUILDING LIFECYCLE RENEWALS

## TOMKEN TWIN ARENA
## 4495 TOMKEN RD, MISSISSAUGA, ON L4W 1J9

**ISSUED FOR TENDER**
**DECEMBER, 2024**

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**Mechanical Specifications**

**FIND**

## PART 1 GENERAL

### 1.1 WORK INCLUDING IN THIS SECTION

.1 Refer to drawings for detailed demolition scope of work.

.2 All existing building services not affected by this work shall be maintained in operation during and after the demolition work is complete. Any accidental interruption of existing building services not required by this project will be promptly repaired at no additional cost to the City of Mississauga.

.3 Prior to removing any piping, ensure the system is completely isolated and is not live.

### 1.2 QUALIFICATIONS

.1 Refer to City front end.

### 1.3 EXAMINATION

.1 Examine existing property. Determine the nature of materials to be removed.

### 1.4 SALVAGE

.1 The City of Mississauga Representative will review the Site prior to commencement of demolition and instruct the Contractor, in writing, as to the items to be retained for re-use or be turned over to the City of Mississauga. In the absence of such specific instructions, materials from demolition shall become property of Mechanical Contractor who shall promptly remove all salvageable material and debris from Site.

.2 Remove and store indicated items for future use by the COM. Remove, handle and transport such items to storage area designated by the City of Mississauga Representative. Perform such work carefully and with diligence to prevent any damage to the items during removal and in storage. Store material to be salvaged, neatly on wooden pallets, where directed by City of Mississauga.

### 1.5 MAINTAINING TRAFFIC

.1 Maintain and preserve City of Mississauga's access requirements within, to and from existing building in areas where demolition and removal work is being carried out.

.2 Do not close, obstruct, place or store material in City of Mississauga's driveways and passageways.
Conduct operations with minimum interference with roads, streets, driveways, user traffic and passageways.

## 1.6 HAULING OPERATIONS

.1 Maintain roadways and paving in the hauling areas clean on a daily basis and as required by Municipal Authorities.

## 1.7 INTERRUPTIONS TO City of Mississauga'S OPERATIONS

.1 There will be absolutely no interruptions to the building schedule during demolition work.
Therefore, it is imperative that operations and machine and equipment movements, deliveries and removals are executed at time or times that will permit uninterrupted City of Mississauga 's operations in and around the building, including parking, receiving areas, deliveries and site and access and egress.

.2 Where interruptions of domestic cold and hot water are necessary, coordinate with the building Representatives the timing and duration of such interruptions.

## 1.8 SAFETY REQUIREMENTS

.1 Coordinate posting of danger signs conspicuously around property. Close doorways and thoroughfares giving access to area of demolition with barricades.

.2 Provide a competent, experienced supervisor in charge of the Work and on Site while work is in progress.

.3 Should any suspect designated substance not already identified, be encountered, cease work in the immediate area and immediately report, to the City of Mississauga. City of Mississauga is responsible for removal of designated substances.

## 1.9 PROTECTION

.1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, and parts of existing building to remain. Make good any collateral damage caused by demolition.

.2 Take precautions to support affected structures and, if safety of building being demolished or adjacent structures or services appears to be endangered, cease operations and notify the City of Mississauga.

.3 Prevent debris from blocking drainage systems (floor drains) or other mechanical and electrical systems that must remain in operation.

.4 Protect building floors against damage from demolition work. Use ½" plywood covers over floor where lifting, moving, and rolling of removed equipment is

anticipated. Be responsible for repairing any damage to flooring caused by the work defined in this section. Execute repairs to the satisfaction of the City of Mississauga at no cost to the City of Mississauga.

## PART 2 PRODUCTS

Not Applicable.

## PART 3 EXECUTION

### 3.1 DEMOLITION

.1 At the end of each day's work, leave site in a safe condition and erect safety barriers and lights as required. Ensure that no parts of the existing building are in danger of collapsing.

.2 Review the requirements of new equipment to be installed. Perform all demolition work required to allow for the new equipment to be installed, whether shown on the drawings or not.

.3 Control dust and dirt produced during demolition.

.4 Provide any additional labour, materials and services not specifically indicated on the drawings but required to complete the work.

.5 Dispose of demolished materials in accordance with the requirements of authorities having jurisdiction.

.6 At the end of demolition work, leave site in broom-clean condition. Clean existing surfaces specified to receive new applied finishes to ensure proper adherence.

.7 Do not disturb adjacent structures or equipment designated to remain in place.

.8 Confine operations and workers to those parts of the building which are defined on the drawings and exercise great care not to damage existing construction beyond that necessary for the carrying out of new work. Make good any such damage in every respect, to the satisfaction of the City of Mississauga.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 GENERAL

.1 This section of the specification is an integral part of the Contract Documents and shall be read accordingly.

.2 Where applicable, all portions of the Mechanical Supplementary Tender Form shall be submitted by bidders.

### 1.2 DUTIES OF MECHANICAL CONTRACTOR

.1 The mechanical contractor shall assume the responsibilities and duties including, but not limited to, the ones described below.

.2 Superintendence

1. Provide full time on-site superintendent personnel and supporting staff with proven experience in project of similar value and complexity.

2. Site superintendent shall have over-all authority to speak for and represent the mechanical contractor.

.3 Coordination

1. Coordinate the work with all the sub-trades involved to ensure that the work will be carried out on schedule and in proper sequence.

2. Take complete responsibility for all remedial work that results from failure to coordinate any aspect of the mechanical work prior to its fabrication and/or installation.

3. Take responsibility for the delivery of equipment necessary to complete the work in accordance with the approved schedule.

.4 Staffing and Scheduling

1. Within seven days after the award of the contract, the Mechanical Contractor shall provide to the Owner's representative the following information:

   a. Appointment of official representatives in the project.
   b. Schedule of work.
   c. Delivery schedule for specified equipment.
   d. Requirements for temporary facilities, site signs, storage, etc.

.5 Work Completion Meeting

1. Prior to application for Substantial Performance of the Work, the mechanical

contractor shall participate in the take-over meeting. Agenda to include the following:

a. Review of outstanding deficiencies.
b. Submission of maintenance manuals, warranties and as-built drawings. (AutoCAD 2017 or higher)
c. Results of performance tests and described further in this section.
d. Scheduling of training to Owner's personnel.

## 1.3 INTENT

.1 Bidders for this work shall include for all labor, material, equipment and all other related cost including all applicable taxes (except HST) and fees to provide the work as indicated on the drawings.

.2 Misinterpretation of any requirement of the drawings and specifications will not relieve the Mechanical Contractor of responsibility. If in any doubt, the Mechanical Contractor shall contact the Consultant for written clarification prior to submitting a bid for the Work.

## 1.4 INTERFERENCE

.1 The mechanical drawings do not show all the architectural and structural details, and any information involving accurate measuring of the building shall be taken from the building drawings or at the building. Make without additional change, any necessary changes or additions to the runs of drains, pipes, ducts, etc., to accommodate the above conditions. The location of equipment may be altered without charge providing the change is made before installation and does not necessitate major additional material.

.2 Wherever differences occur between specifications, riser diagrams or schematics and drawings, the maximum conditions shall govern and the bid shall be based on whichever information indicates the greater cost.

.3 Field verifications of dimensions on plans shall be made since actual locations, distances, and levels will be governed by actual field conditions.

.4 Discrepancies between different plans, or between plans and actual field conditions, or between plans and specifications shall promptly be brought to the attention of the Consultant for a decision.

.5 Install all mechanical services including but not exclusive to drains, pipes, and ducts, to conserve headroom and interfere as little as possible with the free use of the space through which they pass. All drains, pipes, ducts, etc., particularly those which may interfere with the inside treatment of the building, or conflicting with other trades, shall be installed only after the locations have been approved by the Consultant. Special care shall be taken in the installation of all mechanical services

including, but not exclusive to drains, pipes, and ducts, which are to be concealed, to see that they come within the finished lines of floors, walls, and ceilings. Where such drains, pipes, ducts, etc., have been installed in such a manner as to cause interference, they shall be removed and re-installed in suitable locations without extra cost to the Owner.

.6 Before commencing work, check and verify all grade and invert elevations, stacks, levels, and dimensions, to ensure proper and correct installation of the work.

.7 In every place where there is space indicated as reserved for future or other equipment, leave such space clear, install blank offs, shut off valves with blind flanges and other work so that the necessary connections can be made without any stoppages to the system. consult with the Consultant whenever necessary for this purpose.

.8 In addition to the work specifically mentioned in the Specifications and shown on the drawings, provide all other items that are obviously necessary to make a complete working installation, including those required by the Authorities Having Jurisdiction over the work.

.9 The mechanical plans show approximate locations for wall mounted devices. Obtain Consultant's approval of mounting heights and locations before commencement of work.

## 1.5 EXAMINE SITE

.1 Examine the site and the local conditions affecting the work. Examine carefully all drawings and the complete specifications to ensure that the work can be satisfactorily carried out as shown. No allowance will be made later for any expenses incurred through the failure to make these examinations or to report any such discrepancies in writing to the Consultant.

## 1.6 SUBCONTRACTOR'S SHOP

.1 Provide job site office, work-shop, tools, scaffolds, material storage, etc., as required to complete the work.

## 1.7 CLEANING

.1 During the performance of the work and on the completion, remove from the place of the work all debris, rubbish and waste materials caused by the performance of the work. Remove all tools and surplus materials after completion and acceptance of the work.

.2 All equipment shall be thoroughly vacuumed out at the time of final acceptance of the work.

## 1.8 DELIVERY, STORAGE, AND HANDLING

.1 Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.

2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Consultant. Such repair or replacement shall be at no additional cost to the Owner.

3. Protect interiors of new equipment and piping systems against entry of foreign matter.
Clean both inside and outside before painting or placing equipment in operation.

4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

.2 Cleanliness of Piping and Equipment Systems

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.

2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.

3. Clean interior of all tanks prior to delivery for beneficial use by the Owner.

4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

## 1.9 INSTALLATION OF WORK

.1 Be responsible for:

1. The layout of the work shown on the drawings and specified herein and for any damage caused to the Owner by improper location or carrying out of this work.

2. The prompt installation of the work in advance of concrete pouring or similar work.

3. The condition of all material and equipment supplied and for the

protection and maintenance of work completed.

.2 Coordinate with other trades and schedule all work to suit the date for the substantial performance established in the construction contract.

.3 Furnish items to be "built-up" in ample time and give necessary information and assistance in connection with the building in of the same.

.4 Proceed with the work as quickly as practical so that construction may be completed in as short a time as possible and in accordance with the building schedule.

.5 Ensure that all equipment and material is ordered in time to meet the building schedule.
Provide a schedule of equipment deliveries to the Owner within the time limit stipulated.

.6 Furnish promptly information required for the construction schedule.

.7 Manufactured products supplied with instructions for their installation shall be installed in strict accordance with those instructions.

## 1.10 CODES, PERMITS, FEES, AND CONNECTIONS

.1 Conform to Federal, Provincial and Municipal regulations and perform work in accordance with requirements of By-Laws and Regulations in force in area where the building is to be erected.

.2 Building Permit issued and will be handed over to the successful bidder.

.3 In particular, coordinate with and pay for the local gas Supply Company to adjust/modify/replace the existing gas meter assembly and PRV as required to ensure that the available gas pressure is adequate for all gas fired equipment to operate simultaneously at maximum capacity. The minimum gas pressure at the boiler shall not be less than 8" w.g. under simultaneous maximum operating condition of all gas-fired equipment.

.4 For information, a specific code or standard might be mentioned. This information must not be taken as the only code or standard applicable.

.5 When part of equipment does not bear the required CSA label, the contractor shall obtain from CSA or Hydro Electric Power Commission, when that part of the equipment is an electric component, a special approval and pay the applicable fees.

.6 Furnish necessary certificates as evidence that the work installed conforms to laws and regulations of Authorities having jurisdiction. Changes in work requested by an Authority having jurisdiction shall be carried out without charge.

## 1.11 MATERIALS

.1 Where materials, equipment, apparatus, or other products are specified by the manufacturer, brand name, type or catalogue number, such designation is to establish standards of desired quality style or dimensions and shall be the basis of the Bid. Materials so specified shall be furnished under this Contract, unless changed by mutual agreement. Where two or more designations are listed, the contractor shall choose one of those listed and state the choice made on the Bid Form or Supplementary Tender Form (where applicable).

## 1.12 EQUIVALENTS AND ALTERNATIVES

.1 Unless requests for changes in base bid specifications are received and approved as per timelines noted under Appendix A, section 6.5, the Contractors will be held to furnish specified items under the base bid.

.2 Unspecified materials and/or rejected alternates built into the work shall be replaced with specified or accepted materials at no additional cost to the Owner.

## 1.13 MATERIAL SUBSTITUIONS

.1 After execution of the Contract, requests for substitution of materials of makes other than those specifically named in the Contract Documents may be approved by the Consultant, subject to Owner's review and acceptance of the financial credits involved.

.2 In the absence of such express approval by the Consultant, the Mechanical Contractor will be held to furnish specified items under the base bid.

## 1.14 SHOP DRAWINGS AND SAMPLES

.1 Submit to the Consultant detailed dimension shop drawings and installation wiring diagrams for all mechanical equipment. Further details and special requirements called for in these specifications shall be shown on the shop drawings.

.2 Ensure that copies of all reviewed shop drawings are available on the job site for reference.

.3 Provide samples of mechanical equipment as requested in the specification at the same time as the shop drawing submission.

## 1.15 AS-BUILT DRAWINGS

.1 Maintain up to date "as built" drawings on site.

.2 At the conclusion of the project, the Consultant will forward to the Contractor a

set of electronic files of the project. The Contractor shall modify the files as required, to reflect the as-built conditions, mark them conspicuously in the title block as "as-built drawings" and submit the modified files to the Consultant for review.

.3 Upon certifications by the Consultant that the as-built files are correct, the files shall be transferred on a CD and handed over to the Owner as part of the Operations and Maintenance manuals.

.4 Any subsequent changes found by the Consultant shall remain the responsibility of the Contractor at no charge to the Owner.

## 1.16 TEMPORARY AND TRAIL USAGE

.1 After any part of the work has been completed, the Consultant will make an inspection, and performance tests of such parts shall be carried out under the direction of the Consultant. If deficiencies are found, they shall be immediately rectified to the satisfaction of the Consultant. After such deficiencies have been rectified, the work shall be placed in service at such time and in such order as the Consultant may direct. If, in placing a portion of the equipment in service, it is necessary to make temporary connections in the wiring in order to obtain proper operation, such connections shall be provided to the extent and in the manner required by the Consultant.

.2 Temporary or trial usage of any mechanical devices, machinery, apparatus, equipment or materials shall not be construed as evidence of the acceptance of same.

.3 No claims for damage will be considered for injury to, or the breaking of any parts of such work which may be used.

## 1.17 CONSULTANT'S INSTRUCTIONS

.1 During construction the Consultant will issue such instructions as may be necessary for verification and corrections of the work. These instructions shall be binding as part of the specification.

## 1.18 ADDITIONAL WORK AND CHANGES

.1 Unless a written order, reviewed by the Consultant and countersigned or otherwise approved by the Owner Representative, no additional work shall be undertaken by the Contractor.

## 1.19 WARRANTY

.1 The Mechanical Contractor shall guarantee all work and apparatus installed under his contract against all defects of workmanship and material for a period of one (1)

year after the Substantial Performance of the Work, unless otherwise mentioned in the Specifications, and shall make good any and all defects developing during such time without expense to the Owner. Any materials shall be further guaranteed as may be called for in these specifications. Where warranties on equipment extend beyond one (1) year the Mechanical Contractor shall honor the extended warranty.

## 1.20 ITEMIZED PRICES

1. Refer to City front end.

## 1.21 SEPARATE PRICE

1. Refer to City front end.

## 1.22 CASH ALLOWANCES

.1 Expenditures from the cash allowances may be made only upon receipt of an order signed by the Consultant and counter-signed by the Owner Representative. Payments shall be made only upon submission of the invoice for the work.

.2 Any unspent balance of the cash allowances shall be credited from the contract value and returned to the Owner.

## 1.23 SCHEDULING OF WORK

.1 For all work to be performed under this contract, adhere to Construction Schedule agreed upon with the Owner Representative.

## 1.24 ENERGY CONSUMPTION

.1 The Consultant may reject equipment submitted for approval on basis of performance or energy consumed or demanded.

.2 All equipment installed on the project shall conform to the requirements outlined in ASHRAE 90.1 latest edition.

## 1.25 ELECTRIC MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 If delivery of specified motor will delay delivery or installation of any equipment, install an acceptable motor for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

.3 All motors shall be manufactured and installed in accordance with CSA requirements.

.4 Motor speed shall be 1750 rpm unless otherwise specified.

.5 All motors shall be "T" frame CEMA Standard Design "B" with Class "B" insulation, 40 degs. C ambient, standard drip-proof with a 1.15 service factor, or as otherwise specified. Motors in air stream or exposed shall be TEFC type.

.6 Motors shall be of adequate size to operate associated equipment and drive mechanisms under all conditions of load and service and to bring equipment up to operating speed within 13 seconds without overloading, and be not less than the nameplate HP specified or indicated on the Drawings.

.7 Integral HP motor sizes ½ HP and above shall be squirrel cage induction motors rated 575 volt or 230 volt, 3 phase, 60 hertz, unless noted otherwise.

.8 Fractional HP motors up to but not including ½ HP shall be rated 120 volt, single phase, and 60 hertz and will be capacitor start, induction motors, with adequate thrust capacity when used with direct mounted equipment, and shall be provided with integral overload and overheating protection. Shaded pole starting devices will not be accepted.

.9 Multi-speed motors and associated switching devices shall be circuited to protect the motor at each speed.

.10 All motors, 1 HP and up shall comply with the Ontario Hydro EnerMark Motor Efficiency Level as tested either CSA 390 M 1985, or IEEE 112B, and be approved under the Canadian Electrical Safety Code.

.11 All starter panels shall be lockable and supplied with locks.

.12 Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Owner.

2. Assemblies of motors, starters, controls, and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.

.13 Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:

1. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.

2. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.

3. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.

.14 Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non- overloading at all points on the pump performance curves.

.15 Motors utilized with variable frequency drives shall be rated “inverter-ready” per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.

.16 Insulation Resistance: Not less than one half meg-ohms between stator conductors and frame, to be determined at the time of final inspection.

## 1.26 EQUIPMENT REQUIREMENTS AND INSTALLATION

.1 Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping and duct systems and without interference from building structure or other equipment.

.2 Provide accessible means for lubricating equipment including permanent lubricated bearings.

.3 For all base mounted boilers, pumps, compressors, air handling units, fans and other rotating equipment, provide chamfered edge housekeeping pads a minimum of 4" high and 4" larger than equipment dimensions all around. Work shall be performed by the trades specializing in this work.

.4 Pipe drain lines, overflows and safety relief vents to drains. If the horizontal drains present a tripping hazard, use aluminum checkered plate covers.

.5 Line-up equipment, rectangular cleanouts and similar items with building walls wherever possible.

## 1.27 LIFTING ATTACHMENTS

.1 Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

## 1.28 THERMOMETERS AND PRESSURE GAUGES

.1 General

1. Locate direct reading thermometers and gauges for reading from floor or platform.

2. Provide remote reading thermometers and gauges where direct reading instruments cannot be satisfactorily located.

3. Locate engraved lamacoid nameplate as specified in Section Identification, identifying medium adjacent to thermometers and gauges.

.2 Thermometers

1. Industrial, 9" adjustable angle cast aluminum case, CGSB standard CAN/CGSB-14.4- M88 red reading mercury, lens front tube, white scale black embossed figures, clear glass or acrylic window, tapered aluminum stem.

2. Scale shall be suitable for 2 times the temperature range of service. Scale shall be combined Celsius and Fahrenheit.

3. Standard of Acceptance: Weiss, Ashcroft, Trerice.

.3 Pressure Gauges

1. 5" dial, solid front blow out back, fiberglass reinforced polypropylene case, phosphor bronze bourdon tube and brass 1/4" N.P.T. socket, bottom connection, stainless steel rotary type movement, gauge to be registered with the Provincial Boiler and Pressure Vessel Safety Branch with a registration number and conform to ANSI B40.1. Accuracy to be grade "A".

2. On pumps liquid filled gauges shall be utilized.

3. Standard of Acceptance: Weiss, Ashcroft, Trerice.

4. Provide bronze stop cock, bronze bar stock 1/4" N.P.T. bronze porous core pressure snubber for pulsating operation and diaphragm for corrosive service.

5. Use materials compatible with system requirements.

6. Gauges shall have combined kilopascal and psi scales.

## 1.29 PIPE HANGERS AND SUPPORTS

.1 General

1. Pipe Supports: Comply with MSS SP 58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP 69.

.2 Attachment to Concrete Building Construction

1. Concrete insert: MSS SP-58, Type 18.

2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the Consultant for each job condition.

3. Power driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (four inches) thick when approved by the Resident Engineer for each job condition.

.3 Attachment to Steel Building Construction

1. Welded attachment: MSS SP 58, Type 22.

2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C clamp may be used for individual copper tubing up to 23mm (7/8 inch) outside diameter.

.4 Attachment to Metal Pan or Deck

1. As required for materials specified Steel Decking section of the specification.

.5 Attachment to Wood Construction

1. Wood screws or lag bolts.

.6 Hanger Rods

1. Hot rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP 58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn buckles shall provide 38 mm (1 1/2 inches) minimum of adjustment and incorporate locknuts. All thread rods are acceptable.

.7 Hangers Supporting Multiple Pipes (Trapeze Hangers)

1. Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1 5/8 inches by 1 5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.

2. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).

3. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4 inch) U bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

.8 Supports for Piping Systems

1. Select hangers sized to encircle insulation on insulated piping. To protect

insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.

.9 Piping Systems (MSS SP 58)

1. Standard clevis hanger: Type 1; provide locknut.
2. Riser clamps: Type 8.
3. Wall brackets: Types 31, 32 or 33.
4. Roller supports: Type 41, 43, 44 and 46.
5. Saddle support: Type 36, 37 or 38.
6. Turnbuckle: Types 13 or 15. Preinsulate.
7. U bolt clamp: Type 24.
8. Copper Tube:

    a. Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non-adhesive isolation tape to prevent electrolysis.

    b. For vertical runs use epoxy painted or plastic coated riser clamps.

    c. For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.

9. Insulated Lines:

    a. Provide pre-insulated calcium silicate shields sized for copper tube.

10. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.

.10 Piping with Vertical Expansion and Contraction

1. Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.

2. Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.

.11 Heat Exchanger and Expansion Tank Hangers

1. May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.

## 1.30 PIPE PENETRATIONS

.1 Install sleeves during construction for other than blocked out floor openings for

risers in mechanical bays.

.2 To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.

2. For blocked out floor openings: Provide 40 mm (1 1/2 inch) angle set in silicone adhesive around opening.

3. For drilled penetrations: Provide 40 mm (1 1/2 inch) angle ring or square set in silicone adhesive around penetration.

.3 Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Consultant.

.4 Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

.5 Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

.6 Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms. Except in mechanical rooms, connect sleeve with floor plate.

.7 Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

.8 Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

.9 Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

## 1.31 SPECIAL TOOLS AND LUBRICANTS

.1 Furnish, and turn over to the Owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

.2 Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.

.3 Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Owner.

.4 Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

## 1.32 WALL, FLOOR, AND CEILING PLATES

.1 Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

.2 Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3 inch pipe), 0.89 mm (0.035-inch) for larger pipe.

.3 Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

## 1.33 EXCAVATION AND BACKFILL

.1 Grade the bottom of the pipe trench excavation as required.

.2 In firm, undisturbed soil, lay pipes directly on the soil, and shape soil to fit the lower one- third segment of all pipes and pipe bells. Ensure even bearing along the barrels. Backfill excess excavation with 25 mPa concrete.

.3 Where rock or shale is encountered, arrange to have this excavated and removed. After excavation, backfill with a bedding of 10 mm crushed stone.

.4 Prepare new bedding under the pipe in unstable soil, in fill, and in all cases where pipe bedding has been removed in earlier excavation, particularly near perimeter walls of buildings, at manholes and catch basins. Compact to maximum possible density and support the pipe by 200 mm (8 inches) thick firm supports. Install reinforcing steel in cradle or construct piers every eight feet or closer, down to solid load bearing strata. Provide a minimum of one pier per length of pipe. Use same method where pipes cross.

.5 Where excavation is necessary in proximity to and below the level of any footing,

backfill with 25 mPa concrete to the level of the highest adjacent footing. Proximity is determined by the angle of repose as established by the Consultant.

.6 Provide support over at least the bottom one third segment of the pipe in all bedding methods.

.7 Do not open trench ahead of pipe laying and backfilling more than weather will permit.
Keep walls of trenches straight to at least 450 mm (18") above the top of the pipe to keep the diameter load within the pipe design limits. Have excavations inspected at least once a week by authorities.

.8 Before backfilling, obtain approval. Remove all shoring during backfill.

.9 Backfill trenches within building, with clean sharp sand or gravel in individual layers of maximum 150 mm (6") thickness, compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12") above the top of pipe. Hand or machine compact the balance up to grade, using approved equipment.

.10 Backfill trenches outside buildings, not under roads, parking lots, or traffic areas, up to a compacted level of 450 mm (18") above the pipes with individual layers of material 150 mm (6") thick, hand compacted to a density of 95% Standard Proctor, using approved 10 mm (3/8") crushed stone. Backfill the balance with 150 mm (6") layers of approved excavated material, compacted to 95% Standard Proctor, using approved equipment.

.11 Backfill all other trenches outside buildings with 150 mm (3/8") crushed stone in layers not exceeding 6" thickness compacted to 100% Standard Proctor density up to grade level. Manual compaction up to 450 mm (18") above the pipe with approved equipment for the balance.

.12 Fill all depressions to a correct grade level with appropriate material. After a period has passed adequate to reveal any settlement, use maximum possible compaction. Pay all costs required to make good all damages caused by settlement.

.13 Dispose of excavated materials in accordance with the requirements of the Authorities having Jurisdiction.

## 1.34 TESTS

.1 Do not insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests.

.2 Conduct tests in presence of Consultant.

.3 Bear costs including retesting and making good.

.4 Pipe pressure:

1. Hydraulically test piping systems at 1.5 times system operating pressure or minimum 125 psi, whichever is greater.

2. Maintain test pressures without loss for 4 hours unless otherwise specified.

3. Test natural gas systems to requirements of authorities having jurisdiction and as per Ontario Gas Utilization Code O.Reg. 452/89.

4. Test drainage, waste and vent piping to code.

.5 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures.

## 1.35 PAINTING

.1 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.

.2 Provide minimum three (3) coats of urethane-based paint to boiler room floor and all equipment pads. Colour to be battleship grey or as directed by Owner. Contractor to provide colour samples for review prior to application.

.3 Touch-up paint all damaged equipment with products matching original finish in quality and appearance.

.4 Paint the entire gas line where with two coats of yellow paint.

## 1.36 SPECIAL TOOLS AND SPARE PARTS

.1 Furnish spare parts as follows:

1. One set of packing for each pump.
2. One glass for each gauge glass installed.
3. One set of v-belts/bolts for each piece of machinery.
4. One spare set of filters for each filter bank installed.

.2 Upon completion of project and immediately before hand-over, replace all filters.

## 1.37 DIELECTRIC COUPLINGS

.1 Provide wherever pipes of dissimilar metals are joined.

.2 Provide insulating unions for pipe sizes larger than 2" diameter and under; same for flanges of pipe sizes over 2" diameter.

.3 Cast brass adapters may be used on domestic water systems and where approved by the Consultant.

.4 Provide rubber gaskets to prevent dissimilar metals contact.

## 1.38 INSTRUCTION OF OPERATING STAFF

.1 Supply certified personnel to instruct Owner operating staff on operation of new mechanical equipment. Supply maintenance specialist personnel to instruct operating staff on maintenance and adjustment of mechanical equipment and any changes or modification in equipment made under terms of guarantee.

.2 Provide minimum 6 hrs of instruction time during regular work hours prior to acceptance and turn-over to operating staff for regular operation.

.3 Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn manuals over to the Consultant.

.4 Scheduling of the timing for the training of the operating staff shall be arranged 10 days prior to the completion of the project.

.5 For training on controls, refer to Section 15900.

## 1.39 MAINTENANCE MANUALS

.1 Provide minimum of two (2) copies of Mechanical Maintenance Manuals, in accordance to the following:

1. Mechanical Maintenance Manuals to be delivered to the Consultant's office 10 days prior to the substantial completion of the Contract.

.2 Manuals to be bound in a hard cover neatly labeled: "OPERATING AND MAINTENANCE INSTRUCTIONS".

.3 The Maintenance Manuals shall be divided into sections with neatly labeled and tabbed dividers between each section. The sections to be included in the manual are:

1. Section I - General
2. Section II - Piping and Pump Systems, Plumbing Fixtures and Accessories
3. Section III - Boilers, Heat Exchangers, Pool Filters and Accessories
4. Section IV - Automatic Controls
5. Section V - Air and Water Balancing

.4 The following information shall be contained within the sections:

1. SECTION I: A list giving name, address and telephone number of the Consultant, Engineers, and General Contractor, Mechanical Trade and Controls Trade. Written guarantees for the Mechanical Systems. A copy of the Valve directory giving number, valve location, normal valve position, and

purpose of valve (a framed copy of Valve Directory to be hung in Boiler Room). Equipment lists and certificates shall be provided - certificates shall be signed and sealed by the appropriate suppliers.

2. SECTION II, III: A copy of all pressure tests and operational tests. A copy of Gas Operational Tests for gas fired equipment. A list giving name, address and telephone number of all suppliers. Details of chemical treatment equipment and substances. A copy of all reviewed Shop Drawings for all mechanical equipment and ancillary devices (valves, expansion tanks, pumps, strainers, plumbing, etc.). Copies of warranties.

3. SECTION IV: Complete Control Diagrams, Wiring Diagrams and description of Control system and the functioning sequence of the system. Also refer to section 15900.

4. SECTION V: For balancing reports and formats, refer to section 15015 of these specifications.

## 1.40 CONCRETE

.1 All concrete work required to complete this project, whether shown on the drawings or not, shall be the Contractor's responsibility.

.2 Refer to this specification section for requirements for housekeeping pad.

## 1.41 METALS

.1 All steel construction required for the completion of this project, whether shown on the drawings or not, shall be the Contractor's responsibility.

## 1.42 CUTTING, PATCHING, ROOFING, AND X-RAY

.1 All cutting, patching, roofing and X-Rays required for the completion of this project whether shown on the drawings or not, shall be the Contractor's responsibility. The cutting and patching work shall be performed in accordance with the following:

1. All cutting and patching shall be done by the trades specializing in the materials to be cut.

2. All flashing and equipment supports on the roof shall be done in strict accordance with the Owner standards by Owner-approved roofing contractors only.

.2 Should any cutting, roofing and/or repairing of finished surfaces be required, the Sub-trade contractor for the Contractor shall employ the particular trades engaged on the site for this type of work to do such cutting and/or repairing. Obtain the

approval of the Consultant before doing any cutting. In the event that tradesmen required for particular cutting and/or repairing are not already on the site, bring to the site tradesmen to do this work.

.3 Supporting members of any floor, wall or the building structure shall be cut only in such a location and manner as approved by the Consultant.

.4 Where slabs in the portions of the building which are existing must be saw-cut or core drilled, all locations shall be x-rayed prior to saw-cutting or core-drilling. All x-raying shall be done by personnel qualified in the use of the type of equipment required to x-ray the saw-cuts shall be permitted to perform this work on the site. No allowance will be made later for expenses incurred through the failure of performing these x-rays.

## 1.43 MECHANICAL PROJECT COMPLETION

.1 Ten (10) days prior to substantial performance of work obtain documentation and/or prepare certification of the following items and submit them to the Owner's representative:

1. All inspection certificates including drainage, Plumbing, and refrigeration.
2. Guarantee certificates as called for under "Warranty".
3. Record drawings.
4. Operating and Maintenance Manuals.
5. Test certifications as called for under "Testing".
6. Provide a signed statement to the effect that all tests for mechanical systems and equipment have been completely carried out in the Trade Sections of these specifications and to the manufacturer's recommendations, and in accordance with the requirements of all authorities having jurisdiction.

## 1.44 PERFORMANCE TESTS AND EQUIPMENT START-UP

.1 After all equipment has been installed, adjusted, balanced and started up, subject equipment to a series of performance tests, as soon as conditions permit.

.2 The timing of the tests shall be arranged to suit the convenience of the Consultant, and the manner and duration shall be as the Consultant deems necessary. Record the daily start and stop times, operating hours and functions performed. Ensure that the performance tests are witnessed by the Consultant.

.3 All major equipment including but not limited to boilers, pumps, sand filters are to be inspected by the manufacturer to ensure that the equipment has been installed in accordance with their recommendations.

.4 Operate equipment under varying load conditions, demonstrate start-up sequence, normal shutdown, simulated emergency shutdown, operation of temperature, etc., and safety controls. Operate switches and electrical devices for correct wiring

sequences. Adjust components to achieve a proper functional relationship among all the components of all the systems. Repeat these functions as many times as deemed necessary by the Consultant to achieve reliable operation.

.5 Repair defects and repeat tests as necessary. During test maintain lubrication schedule, set, align and tension drives.

.6 At the successful completion of Performance Tests and all testing and balancing, make the systems ready for final inspection and subsequent acceptance of the Owner. Replace and clean filters, flush out lines and equipment, remove and clean strainers, fill liquid systems and purge air. Provide water treatment to pipes and report in accordance to Section 15602. Disinfect all domestic water as required by current by-laws and Authorities Having Jurisdiction.

.7 Conduct tests to demonstrate operation and ability to meet requirements of all equipment and freedom from undue noise and vibration at the time of final inspection, having ensured that it has previously been subjected to Performance Tests.

## PART 2 PRODUCTS

Not Applicable.

## PART 3 EXECUTION

Not Applicable.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 DESCRIPTION

.1 Testing, adjusting, and balancing (TAB) of heating and ventilating systems. TAB includes the following:

1. Systems Inspection Report.
2. Duct Air Leakage Test Report.
3. Balancing air and hot water distribution systems; adjustment of total system to provide design performance.
4. Recording and reporting results.

## 1.2 DEFINITIONS

.1 TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.

.2 AABC: Associated Air Balance Council.

.3 Hydronic Systems: Includes heating hot water, domestic hot water recirculation, chilled water, condenser water, and glycol water systems, as applicable to the project.

.4 Air distribution systems: Includes all grilles, diffusers, terminal units (bypass/VAV).

.5 Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

## 1.3 QUALITY ASSURANCE

.1 Qualifications:

1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
2. The TAB agency shall be either a certified member of AABC to perform TAB service for HVAC and water balancing equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the Consultant and the Owner and submit another TAB firm for approval.
3. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency.

.2 TAB Agency shall be identified by the General Contractor within 60 days after the award of the contract.

.3 The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Consultant. The responsibilities would specifically include:

1. Shall directly supervise all TAB work.

2. Shall sign the TAB reports that bear the seal of the TAB Agency. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC.

3. Would follow all TAB work through its satisfactory completion.

4. Shall provide final markings of settings of all HVAC adjustment devices.

5. Permanently mark location of duct test ports.

.4 Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards and or by the instrument manufacturer.

.5 Tab Criteria:

(a) Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.

(b) Flow rate tolerance:

a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 5% to plus l0%.
b. Grilles, diffusers and air terminal units (maximum values): -5% to +l0%.
c. Exhaust hoods/cabinets: 0 % to + l0 %.
d. Minimum outside air: 0 % to +10 %.
e. Individual room air outlets and inlets, and air flow rates not mentioned above: -5 % to +l0 % except if the air to a space is 100 CFM or less the tolerance would be 0 to plus 5 %.

## 1.4 SUBMITTALS

.1 Submit the following for review to the Consultant:

1. Systems inspection report on equipment and installation for conformance with design.

2. Duct Air Leakage Test Report.

3. Final TAB reports covering flow balance and adjustments, performance tests.

4. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.

## 1.5 APPLICABLE PUBLICATIONS

.1 The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.

.2 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE): HVAC Applications ASHRAE Handbook, Testing, Adjusting, and Balancing.

.3 Associated Air Balance Council (AABC): AABC National Standards for Total System Balance.

.4 Sheet Metal and Air Conditioning Contractors National Association (SMACNA): HVAC Systems Testing, Adjusting and Balancing.

## PART 2 PRODUCTS

### 2.1 PLUGS

.1 Provide plastic plugs to seal holes drilled in ductwork for test purposes.

### 2.2 INSULATION REPAIR MATERIAL

.1 Coordinate with the mechanical Contractor the TAB activity such that it does take place before the insulation is installed on ductwork and piping.

.2 In the absence of such coordination, the mechanical contractor shall be responsible for the repair to the ductwork and or piping insulation removed for TAB purposes, including the integrity of the vapor barrier material and the insulation jacket.

## PART 3 EXECUTION

### 3.1 GENERAL

.1 Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

### 3.2 SYSTEMS INSPECTION REPORT

.1 Inspect equipment and installation for conformance with design.

.2 The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.

.3 Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB is installed. Provide a report to the Consultant.

.4 Reports: Follow check list format developed by AABC or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance

with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

## 3.3 TAB REPORT

.1 Format to be in accordance with referenced standard listed above, but using design drawing units.

.2 Produce "as-built" full system schematics. Use as-built drawings for reference.

.3 Submit 1 copy of preliminary TAB reports, each in “D" ring binders, complete with index tabs for verification and approval of Consultant.

.4 Submit copies of final TAB reports after approval by the Consultant, to be incorporated into the Maintenance and Operations Manual, as indicated in section 15010.

## 3.4 PROCEDURES

.1 Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified.

.2 Start final TAB only when building is essentially completed, including:

1. Installation of ceilings, doors, windows and other construction affecting TAB.

2. Application of sealing, caulking and weather-stripping.

3. Normal operation of mechanical systems affecting TAB.

.3 General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

## 3.5 AIR BALANCE AND EQUIPMENT TEST

.1 Include all air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets, as applicable to this project.

.2 Adjust fan speeds to provide design air flow.

.3 Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.

.4 Parameters to be measured:

1. Air flow.

2. Air velocity.
3. Static pressure.
4. Velocity pressure.
5. Temperature.
    a. Wet bulb.
    b. Dry bulb.
6. Cross-sectional area.
7. Fan's RPM.
8. Electrical power.
    a. Voltage.
    b. Current draw.

.5 Locations of measurements:

1. Inlet and outlet of each:
    a. Fan.
    b. Coil.
    c. Filter.
    d. Balancing damper.
    e. Other auxiliary equipment.
2. Main ducts.
3. Main branch ducts.
4. Sub-branch ducts.
5. Each supply, exhaust, and return air inlet and outlet.
6. Before and after the silencers.

## 3.6 WATER BALANCE AND EQUIPMENT TEST:

.1 Adjust flow rates for equipment to the values indicated on the drawings and schedules. Set balancing valves and circuit setters to the values on indicated on the equipment schedules

.2 Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures to convectors. Make air and water temperature measurements at the same time.

.3 Parameters to be measured:

.1 Water
.2 Pressure.
.3 Temperature.
.4 Specific gravity.

.4 Locations of Measurements

.1 Inlet and outlet of each
    .1 Balancing valve.
    .2 Automatic control valves

## 3.7 VERIFICATION

.1 Reported measurements shall be subject to verification by Consultant. Provide

instrumentation and manpower to verify results of up to 30 % of all reported measurements. Number and location of verified measurements to be at discretion of Consultant.

.2 Bear costs to repeat TAB, as required, to satisfaction of Consultant.

## 3.8 MARKING OF SETTINGS

.1 Following approval of TAB final Report, the setting of all HVAC adjustment devices including balancing valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the Consultant.

## 3.9 IDENTIFICATION OF TEST PORTS

.1 The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 DESCRIPTION

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 15010 General Requirements.

### 1.2 QUALITY ASSURANCE

.1 Welding materials, fabrication standards and labour qualifications to Provincial Labour Board Regulations. All welders must be licensed by Provincial authorities.

.2 Work performed under this section must be carried out by licensed tradesmen regularly employed and experienced with the type of work being installed under the contract. Work performed on pressure piping systems 15psi and greater must be performed by licensed steamfitter/pipefitters.

.3 Natural Gas Systems: CAN1-B149.1, installation code for Natural Gas Burning Appliances and Equipment.

.4 Propane Systems: CAN1-B149.2, installation code for Propane Burning Equipment.

.5 Fuel Oil Systems: CSA Standard B139, installation code for Oil Burning Equipment.

.6 High Pressure Steam and Compressed Air Systems (over 103 kPa): Requirements of the Department of Labour, CAN B 51, Pressure Vessel Act and CAN B31.1 Power Piping.

.7 Sprinkler Systems: NFPA 13, Standards for the installation of Sprinkler Systems.

.8 Standpipe and Hose Systems: NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

.9 Plumbing Systems: National and Provincial Codes and Municipal By-laws.

.10 Medical Gas and Vacuum Systems: CSA Z305.1, Non Flammable Medical Gas Piping Systems. Refer to Section 15490.

.11 Refrigerant Piping: CSA B52.

.12 Fibreglass Drainage Piping: ASTM D2310

.13 Commercial Gas Hot Water Heaters Efficiency Standard: ANSI Z21.10.3, CSA 4.3-1998.

.14 Non-specified piping and jointing systems such as T-Drill are not allowed.

### 1.3 SUBMITTALS

.1 Submit shop drawings on access doors, valves, strainers, expansion tanks, thermometers, vibration isolators, gauges, expansion compensators, gasket materials, and all other system components.

.2 Submit shop drawings for review of anchor systems and expansion compensator/loops including calculations and locations.

.3 Submit for review isometric drawings and load calculations for all steam relief vent piping.

## PART 2 PRODUCTS

### 2.1 ACCESS DOORS

.1 Division 15 - Mechanical Subcontractor and his Sub-Trades to supply and arrange for the installation of access doors where valves, dampers, and/or any other mechanical equipment requiring access are built-in.

.2 In general terms, mechanical sub-trade responsible for supplying the valve, dampers, etc. shall provide the access door required to get to the valve, damper, etc.
.3 Lay-in type tiles, properly marked, may serve as access panels where previously approved by Architect.
.4 Access doors shall suit wall surface or type of construction.
.5 Access doors located in fire rated ceilings and walls shall be an approved ULC labeled, fire rated door.
.6 Doors shall be flush type with lock, anchor straps and concealed hinges.
.7 Access doors shall be constructed of welded 12-gauge steel with prime finish.
.8 Access doors to be a minimum size of 450mm x 450mm (18" x 18"), with concealed hinges, anchor straps, plaster lock and without screws. Where it is necessary for persons to enter through door, doors to be at least 600mm x 600mm (24" x 24").
.9 In applied tile or exposed glaze or unglazed structural tile, access doors shall take the tile and be sized and located to suit tile patterns. In plaster ceilings, doors shall take the plaster. In masonry walls access doors to be sized and located to suit masonry unit sizes. In lay-in acoustic tile ceilings, no access doors are required, but install a Lamacoid label on the ceiling grid identifying the concealed device. Refer to Architectural Room Finish Schedule and details on Architectural Drawings.
.10 Supply access doors for concealed valves or groups of valves, dampers, fire dampers, flush valves, shock arrestors, trap seal primers, etc.

## 2.2 AIR PURGERS

.1 Air purgers shall be installed in each hydronic system and be full line size.
.2 All units shall have flanged connections and be installed with isolation valves on all connection points.
.3 Purgers to be of cast iron construction and have ASME rating suitable for application.
.4 Each purger to be provided with a top air vent connection and bottom drain connection.
.5 Top connection to be provided with isolation valve and float-type air vent.
.6 Bottom drain connection to be valved and piped to suitable drain location.

## 2.3 AIR VENTS

.1 Install air vents at high points in piping systems, and where specified, where shown on the drawings, and where required to fully vent piping systems.
.2 Provide air vents as manufactured by Maid-O-Mist No. 7 series or Braukmann. Where system pressure exceeds 345 kPa (50 psig) provide air vents with 1035 kPa (150 psig) rating.
.3 Install ball valve in the piping to each air valve.
.4 For all vents, except for screwdriver-operated type at convectors and unitary heating equipment, provide 9mm (3/8") copper drains to nearest floor drain.
.5 Install drain piping to nearest suitable approved drain or location and terminate so discharge is visible.

## 2.4 AUTOMATIC FLOW CONTROL VALVES

.1 Automatic flow control valve cartridges shall automatically control flow rates with ±5% accuracy over operating pressure differential range.
.2 Pressure ranges shall be available with the minimum range requiring less than 3 PSID to actuate the mechanism.

.3 Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.

.4 Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance.

.5 All flow control valve cartridges shall be warranted by the Manufacturer for five years from date of startup.

.6 Automatic flow control valves shall be rated at no less than 300 PS1/250°F.

.7 The body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections. The valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.

.8 Dual pressure or pressure/temperature test valves for verifying accuracy of flow performance shall be provided for all valve sizes.

.9 Y-Strainers

.1 12 mm (½") through 50mm (2") strainer shall be Y-type configuration made of bronze with a brass cap. 65mm (2½"), 75mm (3"), 100mm (4"), and 150mm (6") Y-strainer shall be made of iron (ASTM A126-61T, Class 30) Maximum pressure rating of 2070 kPa (300psig).

.2 Strainer screen shall be stainless steel and rated for 20 mesh, easily accessible for cleaning.

.3 Y-Strainer shall have blowdown and pressure/temperature test valve.

.10 Accessories

.1 One double-hose portable meter kit shall be provided; pressure gauge with 4-1/2" dial shall have range of -14.7 to 150 PSI; portable kit shall be provided with end connections for pressure/temperature test valves and shall include carrying cases; all kits shall include flow rate chart for determining flow rate.

.2 Identification tags shall be provided for all valves; tags shall be indelibly marked with flow rate, model number, and zone identification: tags shall be 3" x 3" aluminum.

.3 Hoses

.1 Hoses shall meet or exceed flame retardant testing per standards UL #723, NEPA #225, ANSI 2.5, UBC 42-1, and ASTM-E84A.

.2 All hoses shall be equipped with swivel end connections at terminal unit. All end connections shall be crimped to meet stated pressure ratings. Serrated/slip fit connections are not acceptable.

.3 Flame Retardant Hoses

a. Hose materials shall be stainless steel braided over a synthetic polymer liner.

b. Hoses shall meet or exceed the ASTM-D380-83 standard and withstand working pressures of 375psi (1/2"), 300psi (3/4"), 225psi (1"), 200psi (1¼") at 211°F and 175psi (1½") and 150psi (2") at 200°F.

## 2.5 BYPASSES

.1 Bypasses shall be provided around all water meters, control valves, and pressure reducing stations. Specified valves to be used in these applications.

## 2.6 CLEARANCES

.1 Provide 1m (39") clearance around all systems, equipment and components for observation of operation, inspection, servicing, maintenance and replacement.

.2 Provide space for disassembly, removal of equipment and components as recommended by Manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.

.3 Connection points (flanges, unions, etc.) shall be installed such that devices can be removed when connection broken without additional disassembly.

## 2.7 DATA SHEETS

.1 Contractor shall complete equipment data sheets for each individual backflow prevention device, heat exchanger, and steam trap.

.2 Sample data sheets are provided at the end of this Section.

## 2.8 ELECTRIC MOTORS

.1 Provide electric motors for all equipment supplied in this Division. Motors to operate at 1800 rpm, unless noted otherwise. Motor design shall comply with Canadian Electrical Code requirements. All electric motors supplied shall be capable of being serviced locally.

.2 CSA labelled, and except where specifically noted, all motors below 560 Watt (3/4 HP): 120 volt, single phase, 60 cycle. 560 Watt (3/4 HP) and over: **575** volt 3 phase, 60-cycle - refer to Electrical Drawings and Mechanical Equipment Schedules for exact details. Motors to meet NEMA standards for maximum sound level ratings under full load. Service factor on all motors to be 1.15.

.3 Motor bearings: to be permanently lubricated ball type for motors up to and including 3725 W (5 hp). Bearings for all motors over 3725 W to be self aligning greaseable ball bearings sized to provide life of at least 50,000 hours under belt driven service.

.4 Single Phase Motors: Provide permanent split capacitor type. Motors 14.9 kW (20 hp) and greater: Provide thermistor over temperature protection for each winding, wire in series, with leads terminated in the motor junction box.

.5 All three phase motors shall have a service factor of 1.15 times nominal rated horsepower of the motor.

.6 Operating voltages to CAN 3-C235-83. Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.7 All motors over 186 W (1/4 HP) to be **TEFC.** Motor 0.75 kW (1 hp) and larger shall be high efficiency motors as defined in CSA C390 or IEEE 112B Nominal Standards. All motors over 1 HP to be high efficiency type with ratings based on statistically valid Quality Control procedures conforming to ANSI/IEEE 112-1984 (Ref. 10), Test Method B (dynamometer), using NEMA MG1-1987 (MG1-12.54 and MG1-12.55) (Ref.11), and be approved under the Canadian Electrical Safety Code and conforming to efficiency levels as tabulated below:

| Motor Size HP | % Efficiency @ 900 RPM | % Efficiency @ 1200 RPM | % Efficiency @ 1800 RPM | % Efficiency @ 3600 RPM |
|---|---|---|---|---|
| **1.0** | **74.4** | **81.1** | **82.5** | **79.0** |
| **1.5** | **77.0** | **85.5** | **84.0** | **82.5** |
| **2.0** | **82.5** | **87.5** | **87.5** | **85.5** |

| Motor Size HP | % Efficiency @ 900 RPM | % Efficiency @ 1200 RPM | % Efficiency @ 1800 RPM | % Efficiency @ 3600 RPM |
|---|---|---|---|---|
| 3.0 | 84.0 | 87.5 | 87.5 | 85.5 |
| 5.0 | 85.5 | 87.5 | 87.5 | 87.5 |
| 7.5 | 85.5 | 89.5 | 89.5 | 88.5 |
| 10.0 | 88.5 | 89.5 | 89.5 | 89.5 |
| 15.0 | 88.5 | 90.2 | 91.0 | 90.2 |
| 20.0 | 89.5 | 90.2 | 91.0 | 90.2 |
| 25.0 | 89.5 | 91.7 | 92.4 | 91.0 |
| | | | | |
| 30.0 | 91.0 | 91.7 | 92.4 | 91.0 |
| 40.0 | 91.0 | 93.0 | 93.0 | 91.7 |
| 50.0 | 91.7 | 93.0 | 93.0 | 92.4 |
| 60.0 | 91.7 | 93.6 | 93.6 | 93.0 |
| 75.0 | 93.0 | 93.6 | 94.1 | 93.0 |
| 100.0 | 93.0 | 94.1 | 94.5 | 93.6 |
| 125.0 | 93.6 | 94.1 | 94.5 | 94.5 |
| 150.0 | 93.6 | 95.0 | 95.0 | 94.5 |
| 200.0 | 94.1 | 95.0 | 95.0 | 95.0 |
| Over 200.0 | 95.0 | 95.0 | 95.0 | 95.0 |

.8 Determine from electrical drawings and specifications, voltage characteristics applying to each individual motor. Where motor voltages are mentioned in this specification, confirmation to be made by reference to electrical drawings and specifications ordering motors.

.9 Division 16 to provide starters for all motors, except as otherwise noted. Division 16 shall wire from starters to motors.

.10 Wiring required between starters and switching apparatus such as wiring from starters to float switches, pressure switches and all control wiring to be by Division 16, except as noted otherwise on drawings and in specifications. Provide proper terminal connections and lead wires at motors and other apparatus ready for connection by Division 16.

.11 Wiring required under Section 15900/901 to be performed by Division 15 except as noted otherwise. Refer also to Section 15900 for further requirements.

.12 Division 16 to perform all wiring and make final connections to all controls where controls are supplied with equipment.

.13 Division 15 shall provide wiring diagrams indicating all power and control wiring requirements for equipment supplied by Division 15, with accurate locations of electrical connection points and all necessary schematic and other drawings to facilitate electric work.

.14 For motors used with variable speed drives, provide Class H motor winding insulation and be inverter duty type manufactured to NEMA Standard MG-1 part 31 “Definite purpose inverter-fed motors”. Ensure that drive Manufacturer reviews motor shop drawings prior to releasing order.

## 2.9 EXPANSION COMPENSATORS

.1 Expansion shall be managed through properly sized expansion loops throughout all systems. Where expansion cannot be managed with loops, expansion compensators may be used with written permission from Physical Plant.

.2 For pipe sizes 75 mm (3") and under and operating pressures up to 1380 kPa (200 psi) provide shrouded compensators with 2-ply stainless steel bellows, anti torque device, limit stops and internal guides.

.3 For operating pressure up to 585 kPa (85 psi) provide compensators with 2-ply phosphor bronze stainless bellows and brass protective shroud.

.4 For pipe sizes over 75 mm (3") provide corrugated controlled flexing expansion joints with cast steel rings and stainless steel pressure carrier.

.5 Expansion compensators are not required on piping systems utilizing Victaulic couplings provided they are installed to Manufacturer's requirements to offset expansion. Provide Manufacturer's design data for acceptance by the Consultant. If Zero Flex style couplings are used, expansion compensators are required to the same conditions as specified for welded steel pipe.

## 2.10 EXPANSION TANKS

.1 Provide pre-pressurized, replaceable bladder expansion tanks meeting current ASME and CSA code requirements designed for a minimum working pressure of 860 kPa (125 psi).

.2 Tanks to be constructed of mild steel with finish painted surface and complete with all necessary tappings in combination with Filtrol valve and automatic vent, angle cocks and guards.

.3 Bladders to be Butyl or EPDM.

.4 Sizes to be as shown on the drawings and as specified.

.5 Adjust expansion tank pressure to suit design criteria and as directed by the Owner/Consultant.

.6 Install pressure gauge and lockshield valve at inlet to tank.

.7 Provide drain connection on tank side of expansion tank isolation valve.

.8 Provide union connection and lock shield valve at each tank to allow removal of tank without disrupting service.

## 2.11 FIRE STOPPING

.1 Fire stop all pipe and duct penetrations through all rated separations.

.2 Fire stopping materials to meet ULC CAN 2S115 and be ULC listed.

.3 Provide firestopping for all openings in fire separations for passage of pipes, ducts, etc. to maintain integrity of fire separations. Installations to conform to approved ULC details and standards.

.4 Firestopping

- .1 Firestopping to be equal to Dow-Corning or Hilti fire stop systems.
- .2 Material shall be Dow-Corning silicone Elastomer Fire Stop penetration Seal and/or Dow-Corning liquid silicone Elastomer Fire Stop Foam of density, width and depth to maintain assembly fire resistive rating. Hilti products are equal.

.5 Installation

- .1 Prepare all surfaces so they are clean, dry, and frost free, as per Manufacturer's published recommendations.
- .2 Use Sealant around single pipes and/or ducts.
- .3 Use Foam for multiple pipe installation.
- .4 Follow Manufacturer's published installation instructions precisely including field quality control after installation.
- .5 Submit to Consultant, suitable document signed by Manufacturer's local representative, stating:

.1 Div. 15 sub-contractor received sufficient installation instruction from Manufacturer's representative.

.2 Manufacturer's representative witnessed installation procedures on site.

.6 Remove firestopping assembly for random inspection by Consultant and replace at no extra cost to Owner.

.7 Issue report to Project Manager, Owner and Consultant stating that all mechanical openings have been fire stopped in accordance with fire stop Manufacturer's methods to maintain integrity of fire separation being penetrated.

## 2.12 FLASHING

.1 Where pipes or ducts go through a roof or wall, they shall be boxed-in and flashed as per Division 3. Allow for expansion and contraction of pipe. Flashing shall be waterproof.

## 2.13 FLEXIBLE EQUIPMENT CONNECTORS

.1 Provide flexible piping connections at moving equipment. Flexible connections to be stainless steel as manufactured by Flex Tech Industries Model #MFN3/4, 300mm (12") long, rated for 6550kPa (950psi) at 21°C (70°F).

## 2.14 GASKET MATERIAL

.1 Provide gasket materials as follow:

| SYSTEM | GASKET MATERIAL / DESCRIPTION |
|---|---|
| Compressed Air (100 Psi) | 1/8" Red Sheet Rubber |
| Cold Water | 1/8" Red Sheet Rubber |
| Domestic Hot Water | 1/8" Expanded Teflon Style = Sq-S |
| R.O. Water | 1/8" Expanded Teflon Style = Sq-S |
| Fuel Oil | 1/8" Nitrile Rubber |
| Glycol - Cool/Warm | 1/8" Red Sheet Rubber |
| Natural Gas | Spiral Wound Gasket "Wr" Series<br>Carbon Steel Outer Ring 304SS Windings<br>Flexible Graphite Filler |
| Sprinkler | 1/8" Red Sheet Rubber |
| Vacuum | 1/8" Red Sheet Rubber |
| Storm/Waste Water | 1/8" Red Sheet Rubber |

## 2.15 HANGERS AND PIPING SUPPORTS

.1 An adequate pipe suspension system shall be designed and installed in accordance with recognized practices, using standard, commercially accepted pipe hangers and accessories. The use of pipe hooks, chains, or strapping for pipe supports is not acceptable.

.2 All piping shall be arranged to maintain the required pitch, shall provide for proper expansion and contraction, and shall include all necessary anchors, guides and slides.

.3 All hangers for piping shall have a means of vertical adjustment. If adjustment is not incorporated in the hangers, turnbuckles are acceptable.

.4 Piping suspension systems with vibration isolation capability shall be provided as required.

.5 Vibration isolation shall be provided for the following:

- .1 All piping connected to equipment mounted on vibration isolators for a distance of 20 feet or 50 pipe diameters, whichever is longer.
- .2 All piping connected to pumps, including the main supply and return risers, for 20 feet from the branch connection at each floor.
- .3 Vibration isolation shall be provided where there are flexible connections between equipment and piping.
- .4 Hanger vibration isolators shall be selected for not less than the deflection provided for the equipment to which the piping is connected. The vibration isolator units selected shall provide for the thermal movement of the piping systems. Spring hanger isolators shall be substituted for elastometric type supports when their permissible hanger rod angular deflection will be exceeded.

.6 General

- .1 Piping, ductwork and equipment securely supported from building structure. Perforated strap or wire hangers not permitted.
- .2 Supports welded directly to pipes and equipment are not acceptable.

.7 Installation - Horizontal

- .1 Hangers to adequately support piping system. Locate at changes in piping direction and at concentrated loads. Provide vertical adjustment to maintain pitch required for proper drainage. Allow for piping expansion and contraction. Piping weight and stresses to be supported independent of any equipment.
- .2 Maximum spacing between pipe supports:
  - .1 Hangers shall be installed not more than 12” (300mm) from each change in direction of pipes.
  - .2 Where there are concentrations of valves and fittings, closer spacing will be necessary. Hangers shall be installed not more than 12” (300mm) from each change in direction of pipes.
  - .3 Steel Pipe:
    - .1 Up to 50mm (2") diam. 2.4m (8 ft.)
    - .2 65mm (2½”) to 100mm (4”) 3.0m (10ft.)
    - .3 125mm (5”) and larger 3.5m (12 ft.)
  - .4 Copper Tubing (Hard):
    - .1 Up to 25mm (1") diam. 1.8m (6 ft.)
    - .2 32mm (1¼”) and larger 2.4m (8 ft.)
  - .5 Cast Iron Pipe
    - .1 Maximum spacing – maximum 5 ft. (1.5m)
    - .2 Support M.J. pipe on both sides of joint. Provide with sway braces and anchors to Consultant’s approval. At multiple fittings, or short lengths, support every 300mm (12”).
  - .6 Plastic 1.2m (4 ft).

.8 Installation - Vertical Piping

.1 Support vertical pipes at each floor by Grinnell Fig. 261 riser clamps. Locate clamps immediately below coupling if possible. Support soil pipe at hub. Brace risers up to 50mm (2") size at intervals not over 2.25m (7 feet). Support base in approved manner.

.9 Structural Attachments

.1 To Concrete:

.1 Place inserts in structural floors for support of piping and equipment prior to pouring of concrete. Inserts in concrete slabs shall be Grinnell Fig. 285 Light Weight Concrete Insert for loads up to 182 Kg (400#) or Grinnell Fig. 281 Wedge type concrete insert for loads up to 544 Kg (1200#).

.2 Support hangers in corrugated steel deck by 50mm (2") piece of 3mm (1/8") thick steel plate placed across top of steel deck, secured to hanger rod by washer and nut; prior to pouring of concrete topping.

.3 Where inserts must be placed in existing concrete use Hilti H.K.D. steel anchors as recommended by Manufacturer, or if heavy weights must be supported, drill hole through slab and provide 50mm x 50mm (2" x 2") washer and nut above rough slab before floor finish is poured.

.2 To Steel Beams:

.1 Where pipe size is 50mm (2") or less, Grinnell Fig. 87 Malleable Iron C-Clamp and Retaining Clip, or equal.

.2 Where pipe size is over 50mm (2") use Grinnell Fig. 229 Malleable Beam Clamp or Fig. 228 Forged Steel Beam Clamp.

.10 Hangers and Supports

.1 Provide adjustable Clevis type equal to Grinnell Fig. 65 for pipe sizes up to and including 65mm (2½"). For pipe sizes 75mm (3") and over, provide adjustable Clevis type equal to Grinnell Fig. 260 size to suit O.D. of insulation.

.2 Provide Grinnell FM approved Fig. 104 split-swivel or Fig. 69 swivel-type hangers on fire protection piping. Pipe suspension systems for fire suppression systems shall be designed and installed in conformance with applicable sections of NFPA.

.3 Provide oversized hangers to pass over insulation on all cold and chilled water piping. Refer to Section 15180.

.4 Copper Tubing (Hard):

.1 Up to 50mm (2") - Grinnell CT65 copper plated clevis - size to suit O.D. of pipe. Fig. 65 may be used if piping is separated from hanger with an approved insulating tape or plastic coating.

.2 62mm (2½") and larger - Fig. 260 clevis - size to suit O.D. of insulation - on uninsulated pipe provide isolation as specified below.

.5 Cast Iron Pipe:

.1 All sizes - Fig. 260 clevis - size to suit O.D. of pipe.

.6 Plastic and Other Types of Piping: Support as recommended by Manufacturer.

.7 Provide fabricated steel supports as detailed on drawings or as required to adequately support piping and equipment. Details to be approved by Consultant.

.8 Pipes running on the roof surface (refrigeration, gas, etc.) shall be supported with factory produced supports Treated wood support blocking is not acceptable.

.9 For roof mounted piping, provide supports equal to Portable Pipe Hangers model PP 10 strut style with pipe clamp guides, Portable Pipe Hangers Model PSE-2-2 with clevis style hangers, or supports. Install to Manufacture’s specifications. Supports to be aluminium with stainless steel clamps and rollers. Membrane pads to be close-cell extruded polystyrene insulation equal to Dow Chemical Roofmate.

.10 Steam and hot water & cold water expansion in excess of 12mm (1/2") axially is anticipated, or where indicated, use Grinnell Fig. 171 Adjustable Pipe Roll or Grinnell Fig. 271 Pipe Roll Stand.

.11 For vertical piping support, use Grinnell Fig. 261 clamp. For vertical copper piping, use Fig. CT-121-C**.**

.12 Above indicates general requirements. Provide hangers and supports of equal quality to suit job requirements where not covered by the above.

.13 Support groups of horizontal pipes by angle iron trapeze hangers.

.14 Rollers and chairs shall not be installed on trapeze hangers.

.15 Several individual hanger rods may be supported from a trapeze or individual inserts in concrete slab.

.16 Hangers to be adjustable after pipe is in place. Parts must be of adequate strength for weight to be supported with safety factor of 5 to 1.

.17 Hanger Rod:

.1 Support hangers with mild steel rod. Load on hanger not to exceed capacity indicate in following table:

.2

| Rod Diam. | Max. Safe Load | Max Pipe Size |
|---|---|---|
| 9.5mm (3/8") | 277 Kg (610 lbs) | 100mm (4”) |
| 13mm (1/2") | 514 Kg (1130 lbs) | 200mm (8”) |
| 16mm (5/8") | 822 Kg (1818 lbs.) | 300mm (12”) |
| 19mm (3/4") | 1232 Kg (2710 lbs.) | Larger than 300mm |

.3 Rods to have sufficient threaded length to allow for vertical adjustment after pipe is in place. Use two nuts in each rod, one above clevis or angle iron, and one below.

.11 Isolation

.1 Copper piping isolated from steel supports by copper plated hangers, plastic coated hangers, or provision of suitable lead or copper isolators.

.12 Protection Saddles

.1 On piping 50mm (2") and smaller, carry insulation over pipe hangers. Canvas jacket shall be neatly cut and formed to fit over hangers. On chilled and cold water piping insert sections of insulation into space above pipe at each hanger. Seal saddle and pipe with insulation.

.2 On insulated steel pipe over 50mm (2") diam. use at each hanger or support, Grinnell Fig. 160 to 166 pipe saddles to suit pipe size and insulation thickness. Pack space between saddle and pipe with insulation.

.3 On copper piping over 50mm (2") diam. use at each hanger or support Grinnell Fig. 167 protection shield or equal.

.4 Shields shall have minimum length of 300mm (12") to spread weight.

## 2.16 IDENTIFICATION OF EQUIPMENT

.1 Provide each piece of equipment (including electric motors) with proper nameplates, showing the size, name of equipment, serial number and all information usually provided, which also includes voltage, cycle, phase and horsepower of motors and the name of the Manufacturer and his address.

.2 Give the equipment name and I.D. on each equipment label. Use the identifiers given in the contract drawings.

.3 Provide identification on each piece of equipment. Include registration plates (e.g. pressure vessel, Underwriters Laboratories and CSA approval plates) as required by respective agency and as specified.

.4 Identify as follows: equipment type and number (e.g. Pump P-2), service or areas or zone building served (e.g. South Zone Chilled Water Primary Pump).

.5 Minimum size 87mm x 32mm x 2.3mm (3½" x 1½" x 3/32") nominal thickness laminated phenolic plastic with black face and white centre. Engraved 6mm, (¼") high lettering. For motors and controls and for larger equipment such as chillers, tanks, 25mm (1") high lettering; for hot equipment such as boilers and exchangers, provide engraved brass or bronze plates with black paint filled identification.

.6 Identify controls and gauges by labels of 3mm (1/8") plastic engraving stock with white lettering on black background. Size to be 62mm x 25mm (2½" x 1") high.

.7 Prior to testing, adjusting and balancing, air terminal boxes shall be identified neatly with equipment labels. Air terminal box identification shall be readable from the floor.

## 2.17 IDENTIFICATION OF PIPING

.1 After all other specified work is performed on piping systems, provide identification of all exposed and concealed piping systems.

.2 Identify fluids in piping showing name and service, including temperature and pressure where relevant, and with arrows to indicate flow direction.

.3 Apply primary colours in exposed areas only on finished piping surfaces, including secondary colour bands, to indicate type and degree of hazard.

.4 For building additions and alterations, use existing coding system. For new buildings, and where no system presently exists, use CGSB 24-GP-3a and CSA and B53 colour codings and identification systems, using CGSB 1-GP-12c colour coding system schedule.

.5 Anchor piping labels at each end with adhesive arrow bands around the full circumference of the pipe and overlapping at the ends.

.6 Orient adhesive labels parallel to the pipe, and locate labels where view is unobstructed and they can be read from the floor or the most likely approach for access.

.7 Apply labels in strict accordance with Manufacturer's instructions.

.8 Where exposed pipes in occupied areas are to be painted, the Architect will specify the colour for aesthetic purposes. The term "exposed" in this context means unhidden by fixed architectural elements and does not mean uninsulated.

.9 Coordinate selection of piping labels with selection of insulation jackets for compatibility.

.10 Piping labels shall be made of rugged plastic with permanent adhesive.

.11 Use lettering large enough to be read from the floor (unless the pipe is too small to accommodate that size of lettering, in which case the size of the lettering will be the largest feasible for the pipe size.)

.12 Adhesive arrow bands shall have a background color that is coded in accordance with the following table. If the stated background color is not commercially available, incorporate arrows into the label and provide color-coded bands without arrows.

.13 For liquid piping systems, indicate on the labels whether they are supply or return pipes.

.14 Provide an arrow marker adjacent to each pipe marker with the arrow showing direction of flow and pointing away from pipe marker. Flow arrows shall be provided every 3m (10 feet) and at each change in the direction of the pipe and at take-offs. Use double-headed arrows or an arrow on either side of pipe marker if flow can be in both directions.

.15 Indicate pressures on labels for steam lines and on all gas lines (such as nitrogen, compressed air, etc.).

.16 Colour Codes

| Primary Classification | Secondary Classification | Legend and Direction Arrows |
|---|---|---|
| Yellow 505-101 | Orange 508-102 | Black 512-101 |
| Green 503-107 | Purple 511-101 | White 513-101 |
| Blue 202-101 | Black 512-101 | |
| Red 505-102 | Yellow 505-101 | |
| White 513-101 | | |

.17 Paint: For primary colour paint conform to Pipe Marker Legend below.

.18 Pipe Markers and Colour Bands

.1 Plastic coated cloth material with protective overcoating on outside and waterproof contact adhesive on underside, suitable for continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (400°F).

.2 For colour bands apply 50mm (2") wide tape single wrap around pipe or pipe covering with ends overlapping 25mm (1") minimum.

.3 Use direction arrows 150mm (6") long by 50mm (2") wide for piping of 75mm (3") or larger O.D. including insulation and 100mm (4") long by 18mm (¾") wide for smaller diameters. Use double head arrows where direction of flow is reversible.

.4 Use waterproof and heat resistant plastic marker tags for pipes and tubing of 18mm (3/4") and smaller O.D.

.5 Use black pipe marker letters and direction arrows except use white on red background for protection system piping.

.6 Standard of Acceptance: WH Brady identification tapes, bands, and markers.

.19 Letter Heights

.1 Identification letters and numbers to be the following heights:

| Outside Diameter of Pipe or Covering | Height of Letters & Numbers |
|---|---|
| 19mm (¾”) to 32mm (1¼”) | 13mm (½”) |
| 38mm (1½”) to 32mm (1¼”) | 19mm (¾”) |
| 64mm (2½”) to 150mm (6”) | 32mm (1¼”) |
| 200mm (8”) to 250mm (10”) | 64mm (2½”) |
| Over 250mm (10”) | 89mm (3½”) |

.20 Location of Identification

.1 Locate markers and classifying colours of piping systems, so that they can be seen from floor or platform and shall be positioned for easy viewing.

.2 Pipe labels shall be applied in the following locations.

.1 At changes in direction.

.2 At each valve.

.3 At each tee.

.4 At each point of exit and entry where pipe passes through walls, floors, partitions or ceilings.

.5 Every 5m (16 feet) on straight runs of pipe.

.3 Identify piping runs at least once in each room.

.4 Do not exceed 5m (16 feet) between identification in open areas, as well as at all branch take-offs.

.5 Identify on both sides where piping passes through walls, partitions and floors.

.6 Location schedules:

.1 Where piping is concealed in pipe chase or other confined space, identify at point of entry and leaving, and at each access opening.

.2 Identify piping at starting and ending points or runs and at each piece of equipment.

.3 Identify piping at major manual and automatic valves. Where this is not possible, place identification as close to valve as possible.

.7 Legends and colour classifications: Submit proposed material to Consultant for approval, where differing from following table, at least two weeks before ordering material.

.8 Legends and colour classifications: Submit to Consultant for approval, where differing from following table, at least two weeks before ordering material.

.9 Table: Pipe and valve identification. Note: Information in brackets under Pipe Marker Legend column is explanatory and need not be included as part of legend test.

.10

| PIPE MARKER LEGEND | PIPE LEGEND | PRIMARY COLOUR | SECONDARY COLOUR |
|---|---|---|---|
| Chilled Water Supply | CHS | Green | None |
| Chilled Water Return | CHR | Green | None |
| City Water | DOM COLD | Green | None |
| Comb San Storm Sewer | COMB SEWER | Blue | None |
| Compressed Air | COMP AIR (PSI) | Green | None |
| Condensate | COND | Yellow | Black |
| Condenser Water | CONDENSER S/R | Green | None |
| Deionized Water | DI | Green | None |
| Dom Hot Water | DOM HOT | Green | None |
| Dom Hot Water Recirc | DOM RECIRC | Green | None |
| Distilled water | DIST WATER | Green | None |
| Demineralized water | DEMIN WATER | Green | None |
| Engine exhaust | ENGINE EXHAUST None | | Yellow |
| Fire Protection Water | FIRE LINE | Red | White |
| Fuel Oil (show type no.) | OIL ( # ) | Yellow | Orange |
| Glycol Heating | | | |
| Supply | GLYS | Purple | White |
| Return | GLYR | Purple | White |
| Glycol Heat Recovery | | | |
| Supply | GHRS | Purple | White |
| Return | GHRR | Purple | White |
| Hot Water Heating Supply | HEAT S | Yellow | None |
| Hot Water Heating Return | HEAT R | Yellow | None |
| Isotope Drain | ISO DRAIN | Yellow | Purple |
| Lab Drain | LAB WASTE | Yellow | Black |
| Natural Gas | NAT GAS | Yellow | Orange |
| Nitrogen | NITROGEN | Yellow | None |
| Oxygen | OXYGEN | Yellow | None |
| Propane | PROPANE | Yellow | Orange |

| | | | | |
|---|---|---|---|---|
| Refrigeration suction | REF SUCTION | Yellow | None | |
| Refrigeration liquid | REF LIQUID | Yellow | None | |
| Refrigeration hot gas | REF HOT GAS | Yellow | None | |
| Reverse Osmosis Water | RO | Green | None | |
| Sanitary Sewer | SAN SEWER | Green | None | |
| Sprinkler Line | SPRINKLER | Red | | White |
| Steam (indicate pressure) | STEAM (PSI) | Yellow | Black | |
| Storm Sewer | STORM SEWER | Green | None | |
| Vacuum | VAC (PSI) | Green | None | |
| Vent (plumbing) | SAN VENT | Green | None | |
| Vent | VENT | Yellow | Black | |
| Waste water | WASTE WATER | Green | None | |

## 2.18 IDENTIFICATION OF VALVES

.1 Provide all manual and automatic valves with 38mm (1½") diameter round brass tags attached with brass chain. Brass tags shall be manufactured by W.H. Brady Co. or Manufacturer approved by Consultant.

.2 Emboss a 6mm (¼") high number on each tag, along with description of service controlled by valve. Also record in directory book along with location of valve. This directory shall also be mounted on a glazed directory board.

.3 On each valve tag, indicate the valve I.D. (as it is given in the contract drawings), and service of the fluid.

.4 Provide identification flow diagrams of approved size for each system with tag schedule, designating number, service, function, colour code, and location of each tagged item.

.5 Provide a valve chart and post it on the wall of the main mechanical room. For each valve on the chart, indicate the ID, service, temperature, pressure, and size. The ID on the chart shall match the ID on the valve tag.

.6 Identify controls and gauges by labels of 3mm (1/8") plastic engraving stock with white lettering on black background. Size to be 62mm x 25mm (2½" x 1") high.

.7 Submit one copy of flow diagram and schedule to the Consultant for review. Provide one reviewed copy mounted in glass frame. Secure frame to mechanical room wall where instructed. Place one copy in each maintenance instruction manual.

.8 Consecutively number valves in systems.

.9 Provide Consultant with typewritten lists of valve numbers giving description, type, duty, location and normal operating position of each valve.

.10 All valves with internal packing shall be tagged as non-asbestos.

## 2.19 INSERTS

.1 Use only factory made, threaded or toggle type inserts as required for supports, and anchors, properly sized for the load to be carried.

.2 Use factory made expansion shields where inserts cannot be placed, but only approved by the Consultant in writing and for light weights.

.3 Do not use power-activated tools except with written permission of the Consultant in writing.

## 2.20 MECHANICAL EQUIPMENT GUARDS

.1 Meet safety requirements of Provincial Department of Labour and local authorities having jurisdiction.

.2 Guards for drives shall have:
  .1 No. 2.5mm (12US std. ga.) galvanized 18mm (3/4") mesh wire screen welded to steel angle frame.
  .2 No. 1.2mm (18 US std. ga.) galvanized Sheet metal tops and bottoms.
  .3 Removable sides for servicing.
.3 For flexible couplings, provide removable, "U" shaped, 2.5mm (12 ga.) galvanized frame and 1.2mm (18 ga) expanded mesh face.
.4 Provide means to permit lubrication and use of test instruments with guards in place.
.5 Install belt guards to permit movement of motors for adjusting belt tension.
.6 Provide 18mm (¾") mesh wire screen on inlet or outlet of exposed fan blades.
.7 Provide 37mm (1½") diameter hole on shaft centre for insertion of tachometer.

## 2.21 METERS

.1 All meters are to be installed with isolation valves and full line size bypass valves.

## 2.22 MOTOR STARTERS

.1 Electric motor starters are specified in Division 16. Division 15 to provide motor starters only for equipment normally supplied with starters e.g. packaged air conditioning equipment, boilers and any equipment where specified.

## 2.23 PIPE AND FITTINGS

.1 Pipe and fittings shall be provided as listed below and to suit the application.
.2 All piping shall be installed to ensure proper flow, venting, and draining.
.3 Sewer pipe installations:
  .1 The maximum allowable drift from the proposed alignment is:
    .1 Horizontal alignment:
      .1 No section to be more than 30 minutes off straight line.
      .2 Installation to be no more than 150mm (6") off line at any point
      .3 End points to be as designed.
    .2 Vertical alignment:
      .1 No section to be more than 10% off slope.
      .2 End points to be to design elevations.
      .3 No ponding to occur at any point.

  .2 If the slope in the pipe is found to vary more than allowed limits, the Contractor shall relay the pipe. Pipe removed due to faulty grade shall be replaced with new pipe unless approved for reuse.
.4 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
.5 Locate groups of pipe parallel to each other, walls and ceilings to present a uniform appearance. Piping shall be spaced to permit applying insulation and servicing of valves. Install hot and cold water lines at least 6 inches apart. Install piping at least 3 inches clear of electrical conduit and avoid running pipe within 1M (40") of electrical equipment.
.6 Changes in direction and changes in pipe size shall be accomplished with manufactured pipe fittings.
.7 All pipe and fittings shall be manufactured in North America.

.8 Pipe extending into finished areas shall have chrome-plated escutcheons large enough to cover pipe sleeves and shall fit snugly over pipe or insulation.

.9 Anchor and support piping with allowance for free expansion and movement without causing damage to piping, equipment, or the building. Pipe expansion and contraction shall be controlled by expansion loops. No mechanical expansion joints will be allowed in any system.

.10 Calculations for expansion loops shall be documented and submitted for review prior to installation, as described in Section 15010.

.11 Use double swing joints when equipment mounted on vibration isolation and when piping is subject to movement.

.12 Use eccentric reducing fittings to increase or decrease pipe sizes. Bushings are not acceptable. Orient reducers to prevent trapping of water. Where changes in pipe sizes occur in horizontal straight lengths of pipe, install eccentric reducers with the straight side on top for water, and the straight side on the bottom for steam piping.

.13 All unions shall be extra heavy-duty pattern, having ground joints, brass seats and diagonal screws.

.14 Pipe nipples to be Schedule 80 or heavier on all piping systems.

.15 Use of space and close pipe nipples on steam system is prohibited.

.16 Use of bushing fittings on steam is prohibited.

.17 Gaskets shall be rated for individual application and shall be made with material suitable for each class of pipe. Submittals are required for all applications.

.18 Install piping to permit complete draining. Provide capped hose-end ball drain valves as specified at all low points.

.19 All connections between dissimilar metals shall be joined with bronze body ball valves, or other U of M approved method of separation, for prevention of galvanic corrosion. Couplings shall be compatible with piping materials and to suit pressure rating of system.

.20 Site fabricated weld fittings and take-offs are not acceptable.

.21 Welded pipe fittings shall be compatible with piping system being installed.

.22 <u>Compressed Air Piping:</u>

- .1 Pipe to be Schedule 40 carbon steel pipe to ASTM A120.
- .2 Systems operating up to 340 kPa (49 psig) to be threaded. Systems operating at 345 kPa (50 psig) and above to be welded. Socket weld up to 50mm (2") and butt weld 65mm (2½") and above.
- .3 Fittings to be 1035 kPa (150 psig) malleable iron.
- .4 Welding materials, fabrication standards and labour qualifications must conform to ANSI/ASME B31-1, ANSI B16.25, ASME Section 17C, and the Provincial Department of Labour regulations.
- .5 The Contractor shall have approval of the Department of Labour to work on high-pressure compressed air systems. The Contractor shall obtain all necessary Department of Labour permits and approval of the design of the compressed air system prior to construction.
- .6 All welds shall have 100% penetration to the root of the joints. Projection of metal into the pipe shall not exceed 1.5 mm. Welds having a lack of penetration or excessive projection shall be cut out and re-welded.
- .7 Ten welded joints are to be examined by radiography. The Consultant will select the joints and the Contractor will pay for the examination, which will be in accordance with ASME Section V, Article 2, and Section V111. Where defects are found, the Consultant will select an additional ten joints for every failed joint to be examined at the Contractor's expense.

.8 All branch piping shall be taken from the top of the main pipe. Bottom or side connections are not permitted.

.9 Compressed air piping shall be sloped down in the direction of flow a minimum of 1" per 40 feet.

.10 Provide 300mm (12") drip leg at end of run and at all low points with a pressure rated 20mm (¾") ball valve installed a maximum of 2m (6'-0") above the floor. Provide threaded end and cap on valve.

.11 For systems operating below 345 kPa (50 psig), copper piping may be used up to 100mm (4"). 4" and larger must be steel pipe. Copper piping to be Type L hard drawn, ASTM B 88 with wrought copper fittings to ANSI B16.22. Joints to be soldered through 50mm (2") and brazed for 65mm (2½") through 100mm (4").

.12 All piping in areas subjected to physical abuse shall be black steel.

.13 Site fabricated weld fittings and take-offs are not acceptable.

.23 Cooling Coil Condensate:

.1 Cooling coil condensate piping to be DWV copper drainage grade piping with copper/brass DWV fittings installed with lead-free solder.

.24 Domestic Hot, Cold, Recirc & Tempered Water:

.1 Domestic Water (Inside Buildings):

.1 Building water service up to 100mm (4"): Type L copper to ASTM B88 with wrought copper pressure solder fittings to ANSI B16.18. Joints to be soldered through 50mm (2") and brazed for 65mm (2½") through 100mm (4")

.2 Water services larger than 100mm (4"): Schedule 10, 316 stainless steel with welded joints.

.2 Building Water Service (Outside Buildings):

.1 Water service up to 50mm (2"): Type K soft temper copper to ASTM B88 with soldered pressure fittings to ANSI B22.18 or ANSI B16.18.

.2 Building water service 65mm (2½") and larger: C900 PVC with ring gasket joints class 150 to CSA B137.3.

.3 Where suspended between building entry point and water meter: Up to 100mm (4") to be Type L copper with wrought copper soldered fittings to ANSI B22.18. Joints to be soldered through 50mm (2") and brazed for 65mm (2½") through 100mm (4").

.4 Larger than 100mm (4"). Use seamless stainless steel 316 pipe and fittings welded and flanged.

.3 Use brass flanges, nuts and bolts at equipment connections.

.4 Soldered Fittings in Potable Water Systems: Provide lead, antimony, cadmium and zinc free solders composed of tin/copper/silver or nickel components that are acceptable to Authorities having jurisdiction.

.5 Where connecting to existing galvanized piping, use Type L hard drawn copper, wrought copper fittings, and bronze body ball valves where joining dissimilar metals.

.25 Fire Protection:

.1 Refer to Specification Section 15500 Fire Protection for information on piping.

.26 Gas Piping (Natural Gas):

.1 Piping

1. Piping: Schedule 40, ASTM-A-53 steel pipe and fittings, all to CAN1-B-149.1 M91 and Ontario Regulation 826-82.
2. Exposed Joints: Up to 50 mm (2) shall be screwed; 65 mm (2V2) and larger shall be welded.
3. Screwed Fittings: Malleable 1035 kPa (150 psig), unions malleable dart pattern.

.2 Pipe Grading

1. Heating water piping and domestic water piping is to grade to low points. Branch piping to heating units below the main shall be off the bottom, and off the top to units above.
2. Equipment drain piping to be graded down in the direction of flow 25 mm in 1200 mm (1 in 48 ).
3. Gas pipe shall be graded down to riser, 25 mm in 18.3 m (1 in 60). Dips at the bottom of the riser and at low points shall be complete with tee, nipple, and cap. Extend gas service from gas meter to mechanical room and rooftop unit, as indicated on the drawings.

.3 Piping Tests

1. Specify that tests be performed before application of pipe covering and before pipe is concealed in structure.
2. Specify testing of piping systems to the following pressures for four (4) hours without drop in pressure or as otherwise noted.
   - Heating water/glycol: 1035 kPa (150 psig) or 150% of working pressure, whichever is greater.
   - Domestic water: Hydrostatically to 1035 kPa (150 psig) for one (1) hour
     [OR] Air to 690 kPa (100 psig) for two (2) hours.

.4 Connections to equipment: provide extra heavy-duty pattern unions with ground joints, brass seats and threads to ANSI B1.20.1. Where flanges are required, provide standard weight type to ANSI B16.1 with neoprene gaskets.

.5 Provide cathodic protection at change from underground to building piping systems.

.6 Do not run gas piping through air plenums under any condition.

.27 <u>Heating Water:</u>

.1 **Service:** Hot water heating, glycol heating, vent, piping for mechanical devices such as pump gauges, pot feeder, chemical feed systems, etc., overflow relief and unburied drain piping from equipment. Maximum temperature 120°C (250°F) and 400 kPa (60 psig).

.2 **Piping:** Continuous-welded Schedule 40 ASTM A120 for screwed piping, and ASTM-A53 for welding.

.3 T drilling is not acceptable.

.28 <u>Sanitary Drainage - Internal:</u>

.1 Buried:

.1 Cast iron pipe and fittings to CSA B70.

.2 Suspended:

.1 Cast iron pipe and fittings to CSA B70.

.3 DWV copper to ASTM B306 with lead-free soldered cast brass drainage fittings to CSA B158.1 or wrought copper fittings to ANSI B16-29.

.3 Urinal drains from fixture outlet to branch main and vents from fixture outlet to branch vent shall be PVC. Pipe and fittings to CSA CAN 3-B181.2 (PVC) with solvent cement socket fittings.

.29 Sanitary Drainage - External:

.1 SDR35 PVC to CSA CAN B182.2 with ring gasket joints.

.30 Stand-by generator exhaust piping:

.1 Schedule 80 ASTM A53 wrought steel black pipe with black steel welding fittings.

.2 Schedule 10 304 Stainless Steel with butt welded joints.

.31 Sewage and Sump Pump Discharge Piping:

.1 Copper Type L to ASTM B88-83 with pressure fittings to ANSI B22.18-1973 or ANSI B16.18-73 with 50-50 solder. Where buried, use PVC class 150 to CSA B137.3.

.32 Storm Drainage Piping – Internal:

.1 Buried:

Cast iron pipe and fittings to CSA B70.

PVC/DWV pipe and fittings to CSA CAN3 B181.2 (PVC) with solvent welded socket fittings.

.2 Suspended:

Cast iron pipe and fittings to CSA B70.

DWV copper to ASTM B306 with 50-50 soldered cast brass drainage fittings to CSA B158.1 or wrought copper fittings to ANSI B16-29.

.33 Storm Drainage - External:

.1 SDR35 PVC with ring gasket joints.

.34 Vent Piping:

.1 Up to 50mm (2") use DWV Grade copper to ASTM B306 with lead-free soldered cast brass or wrought copper drainage fittings to CSA B158 and ANSI B16-29 respectively. For 75mm (3") and larger, use cast iron pipe and fittings to CSA B70.

.35 Weeping Tile Piping - High Temperature above 40°C (104°F):

.1 Where high temperature weeping tile is required, provide Fibreglass epoxy Red Thread II pipe for temperatures up to 99°C (210°F), and Fibreglass epoxy Green Thread for temperatures up to 107°C (225°F).

.2 Pipe shall be drilled to provide sufficient drainage openings for the application.

.3 Drainage piping shall be installed as regular weeping tile installation and be terminated in a sump pit or suitable collection point.

## 2.24 PRESSURE GAUGES

.1 Pressure gauge case size shall be based on pipe diameter size. Primary systems pipe diameters above 1½ " shall be fitted with gauges having a minimum 102mm (4") stainless steel case. Unless otherwise specified, the gauges shall have brass movement, phosphor bronze bourdon tube, brass socket and polycarbonate lens. Gauges are dry – no glycerin or

silicone fill. Connection is 1/4"npt bottom. Minimum accuracy is ANSI B40.1 grade "A" (1.5%).

.2 For Primary systems with pipe diameters below 1½ " and all other secondary system piping, the required gauges shall have a minimum 63.5mm (2½") dial. Unless otherwise specified, gauges shall have brass movement, phosphor bronze bourdon tube, brass socket and polycarbonate lens. Gauges are dry – no glycerin or silicone fill. Connection is 1/4"npt bottom. Minimum accuracy is ANSI B40.1 grade "A" (1.5%).

.3 Gauge ranges should be selected to show twice the normal operating pressure. Thus, the gauge pointer should ideally indicate a mid-scale reading during operation. Appropriate typical dual scale ranges are 0-30psi/kPa, 0-100psi/kPa and 160psi/kPa.

.4 For steam applications, pressure gauges shall have 304SS movement, 316SS bourdon tube, 316SS socket, safety glass lens. Gauges are dry – no glycerin or silicone fill. Connection is 1/4"npt bottom. Required accuracy is ANSI B40.1 grade "1A" (1.0%)

.5 Pressure gauges (including steam) mounted near pumps, compressors, motors, winches and large machinery are likely to be exposed to the damaging effects of pulsation & vibration. For these applications, the gauges should be supplied complete with a "Stabilizer" unit and a maximum adjustable pointer. The stabilizer unit comprises of a silicone-pot dampened bronze movement which reduces pointer fluctuation without the need for liquid filling the gauge. The maximum adjustable pointer is a second pointer, painted red, which records the peak pressure that the gauge is exposed to. This pointer is adjustable.

.6 Steam application gauges should be mounted on a 6mm (¼") stainless steel shut-off ball valve complete with a 1/4"npt stainless steel cooling siphon. The assembly is to be installed with 12mm (½") pipe. For high pressure steam installations, the ball valve, siphon and associated fittings should be minimum #300 rated. For low pressure installations,150# minimum rating is acceptable.

.7 Gauges located overhead shall be a minimum of 150mm (6") diameter and shall be positioned so that they are readable from floor level.

.8 On devices such as pumps, strainers, coils, etc., where the differential pressure is the desired information, install only one pressure gauge with valved connections to the upstream and downstream pressure taps. Include a pressure test port in addition to the pressure gauge. Provide a second set of isolating valves at the gauge if gauge location is not within reach of tap points.

.9 <u>Compressed Air Systems:</u>

63mm/102mm (2½"/4") stainless steel case, brass/bronze movement, phosphor bronze bourdon tube, brass socket, polycarbonate lens, Dry, 1/4"npt bottom connection, min1.5% accuracy. Dual scale ranges: 0-30psi/kPa, 0-100psi/kPa and 160psi/kPa. Stabilizer unit & maxipointer.

.10 <u>Domestic Hot, Cold, Recirculation & Tempered Water Systems:</u>

63mm/102mm (2½"/4") stainless steel case, brass/bronze movement, phosphor bronze bourdon tube, brass socket, polycarbonate lens, Dry, 1/4"npt bottom connection, min1.5% accuracy. Dual scale ranges: 0-30psi/kPa, 0-100psi/kPa and 160psi/kPa. Stabilizer unit & maxipointer.

.11 <u>Fire Protection System:</u>

63mm/102mm (2½"/4") stainless steel case, brass/bronze movement, phosphor bronze bourdon tube, brass socket, polycarbonate lens, Dry, 1/4"npt bottom connection, min1.5% accuracy. Dual scale ranges: 0-30psi/kPa, 0-100psi/kPa and 160psi/kPa. Stabilizer unit & maxipointer.

.12 Gas Systems (Natural Gas and Propane):

63mm/102mm (2½"/4") stainless steel case, brass/bronze movement, phosphor bronze bourdon tube, brass socket, polycarbonate lens, Dry, 1/4"npt bottom connection, min1.5% accuracy. Dual scale ranges: 0-30psi/kPa, 0-100psi/kPa and 160psi/kPa. Stabilizer unit & maxipointer.

.13 Heating Water System:

63mm/102mm (2½"/4") stainless steel case, brass/bronze movement, phosphor bronze bourdon tube, brass socket, polycarbonate lens, Dry, 1/4"npt bottom connection, min1.5% accuracy. Dual scale ranges : 0-30psi/kPa, 0-100psi/kPa and 160psi/kPa. Stabilizer unit & maxipointer.

## 2.25 PRESSURE PIPING QUALITY ASSURANCE MANUAL AND DOCUMENTATION

.1 Contractors working on pressure piping systems must be registered with the Ontario Department of Labour for work on Pressure Piping Systems and upon award of contract present a copy of their Quality Control Manual and Procedures for review by the client's Quality Control Manager.

.2 The Mechanical Contractor shall provide one copy of the Contractor's Certificate of Authorization issued by the Ontario Department of Labour, Mechanical & Engineering Branch (MLMEB).

.3 Provide a complete copy of the Quality Assurance Manual registered with and approved by the MLMEB.

.4 Provide all record information that is specified in the Quality Assurance Manual on pressure vessel and pressure piping systems under GSA - B51.

.5 Information shall include, but is not limited to:

- .1 Pipe and fitting mill certificates, metallurgy and heat numbers for traceability.
- .2 Valve and pressure vessel ORN numbers.
- .3 Fitting registrations where required.
- .4 Welding procedures, records and inspection reports.
- .5 MLMEB Inspection reports.
- .6 Quality control inspection reports.
- .7 Hydrostatic test reports on each system subject to GSA — B51.
- .8 Material acquisition data sheets

## 2.26 REUSE OF EXISTING EQUIPMENT

.1 Mechanical Contractor shall include costs for Manufacturer to pre-test all existing equipment which is to be re-used on this project. Pre-testing is to be complete and to establish that the equipment is fully operational, functioning and ready for re-use. Equipment to be tested in existing locations. Tests to be conducted at the beginning of the Mechanical Contract and results of equipment tests to be submitted within 10 working days of completion of testing. Any equipment deficiencies to be itemized and individually costed.

.2 The Mechanical Contractor shall provide a separate price for the replacement of each piece of existing equipment that is proposed to be re-used on this project. Provide an itemized list of all equipment and replacement costs.

## 2.27 SCREWS, BOLTS AND FASTENERS

.1 Use standard commercial sizes and patterns all nuts, bolts, and washers shall be cadmium plated Grade 5 quality.

.2 Use heavy hex heads, semi-finished unless otherwise specified. Use non-ferrous material throughout for plumbing services. Use 304 stainless steel for exterior areas.

.3 Bolts used on fan equipment for access to motors, bearings, filters and the like shall be heavy-duty.

.4 Bolts shall not project more than one diameter beyond nuts.

.5 Washers

.1 Use plain type washers on equipment, sheet metal and soft gaskets; lock type washers where vibration occurs, and stainless steel in humid and outdoor applications.

## 2.28 SLEEVES AND FLOOR PLATES

.1 Set sleeves in concrete forms for all pipes and ducts passing through concrete walls, beams and slabs.

.2 Pipe sleeves to extend above floor line as follow:

1. Unfinished areas - 25mm (1")
2. Finished areas - 6mm (¼")
3. Mechanical rooms, kitchens and washrooms - 100mm (4")
4. Caulk sleeves to provide watertight installation.
5. Through Equipment Room floors provide 100mm (4") high concrete curbs for ductwork and any piping where spaced so that sleeving is impractical.

.3 Where pipes pass through floors, walls, and ceilings in finished areas and where exposed to view, provide Crane #10 B.C. chrome-plated pressed floor plates.

.4 Install galvanized oversize pipe sleeves on passing through walls or partitions, for building into wall construction, by other trades.

.5 Sleeves and holes to be large enough to accommodate pipe insulation.

.6 Prior to installing sleeves in concrete beams, receive final jobsite approval by the Structural Consultant.

.7 Piping:

.1 Sleeves in load-bearing and masonry walls, floors, and partitions shall be machine-cut Schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel; finished with smooth edges.

.2 For other than masonry partitions, through suspended ceilings, and for concealed vertical piping, sleeves shall be No. 22 USG galvanized steel.

.3 Through interior walls, exterior walls above grade, interior non-waterproof floors: Machine cut Schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel.

.4 Through walls below grade, waterproof floors, floors in janitor's closets, equipment rooms, and kitchens: machine cut medium cast iron, DWV copper or copper sheet extended 100mm (4") above the floor and cut flush with the underside.

.8 Provide 100mm (4") concrete curbs around duct penetrations through Mechanical/ Equipment Room floors to reduce potential of water leakage to areas below. Concrete curbs to be arranged by, and paid for, the Mechanical Contractor.

.9 Sleeves through exterior walls below grade shall have the space between pipes and sleeves caulked watertight or fitted with a "link-seal."

.10 Where pipes pass through fire-rated partitions, the annular space around the pipes shall be sealed and/or filled with fireproofing sealers.

## 2.29 STRAINERS

.1 Provide strainer screens with a free area not less than three times the free area of the piping served.

.2 Provide where shown on the drawings, strainers rated at 1035 kPa (150 psi) at 500°F (260°C) for low pressure systems and be cast steel rated at 2070 kPa (300 psi) at 850°F (455°C) for high pressure systems.

.3 Strainer baskets: Type 304 stainless steel or Monel, 1.14 mm (.045") perforations for steam and 3 mm (0.125") perforations for water.

.4 Combination strainers and pump inlet diffusers with screens as specified above to be equal to S.A. Armstrong Ltd. suction guide.

.5 Construction startup strainers shall be fine mesh. After one month of operation, the strainer shall be changed to a larger mesh specified for normal use.

.6 All strainers shall be valved and capped to allow for blowdown of strainers.

.7 Strainers installed in steam systems to be installed horizontally with the screen mounted sideways so that condensate does not fill the screen basket and cause water hammer.

## 2.30 SUPPORTS, BASES, PADS, AND PITS

.1 Provide all special structural work required for installation of tanks, piping, pumps, fans, motors and other apparatus.

.2 Concrete pads, concrete for floating bases, curbs and pits to be supplied under Division 3 where shown on Architectural or Structural drawings. Where not shown on Architectural or Structural documents, required pads, bases, curbs, and pits are to be provided by Division 15.

.3 Supply all anchor bolts, fasteners and foundation drawings.

.4 Unless noted otherwise, provide housekeeping pads (equipment bases) at least 100mm (4") high under all floor-mounted equipment and as shown on the drawings. Provide minimum 150mm (6") high bases under equipment with cooling coils to provide sufficient clearance for deep seal condensate traps. Exact height to be determined by required condensate trap depth.

.5 Refer to standard details for method of forming pump bases, etc.

.6 Where not detailed elsewhere, mount equipment suspended above floor level on platform bracketed from wall. Where wall thickness is inadequate to permit such brackets, carry supports to either ceiling or floor, or both as required.

## 2.31 THERMOMETERS

.1 Thermometers shall be sized to read to twice the operating temperature.

.2 Provide thermometers on all air handlers to indicate discharge air, return air, outside air, and mixed air.

.3 Thermometers

.1 Regardless of whether the control system is pneumatic or DDC, thermometers shall be provided on all air handler system discharge, return, mixed air, and outside air ductwork, all inlet and outlet connections for heating and cooling equipment, and all building entrance service supply and return piping.

.2 Provide organic liquid-filled thermometers complete with separable wells where listed above and where shown on the drawings. Thermometers to be vari-angle with 230 mm (9") scale with locking adjustable angle body and a case of aluminum or non-metallic material. Thermometer shall be secured to well by tapered bushing and not by setscrews. Scale shall be selected to provide a mid-scale reading at normal operating temperatures.

.3 Required ranges are : -15°C to 50°C (0°F to 160°F) for chilled and condenser water and 0°C to 150°C (30°F to 300°F) for hot water . Ranges are Dual scale Celsius and Fahrenheit.

.4 Provide heat transfer grease in every thermowell.

.5 To attach, may use Style 923 Viclets/Style 924 Vic-Wells from Victaulic.

.6 Compressed Air Systems:
9" scale, variangle, -15°C to 50°C (0°F to 160°F) dual scale c/w brass thermowell.

.9 Condenser Water Systems:
9" scale, variangle, -15°C to 50°C (0°F to 160°F) dual scale c/w brass thermowell

.10 Domestic Hot, Cold, Recirculation & Tempered Water Systems:
HOT: 9" scale, variangle, 0°C to 150°C (30°F to 300°F) dual scale c/w brass thermowell
COLD: 9" scale, variangle, -15°C to 50°C (0°F to 160°F) dual scale c/w brass thermowell
RECIRC: 9" scale, variangle, -15°C to 50°C (0°F to 160°F) dual scale c/w brass thermowell
TEMPERED WATER: 9" scale, variangle, -15°C to 50°C (0°F to 160°F) dual scale c/w brass thermowell

.11 Fire Protection System:
9" scale, variangle, -15°C to 50°C (0°F to 160°F) dual scale c/w brass thermowell

.12 Gas Systems (Natural Gas and Propane):
9" scale, variangle, -15°C to 50°C (0°F to 160°F) dual scale c/w brass thermowell

.13 Heating Water System:

HOT: 9" scale, variangle, 0°C to 150°C (30°F to 300°F) dual scale c/w brass thermowell
COLD: 9" scale, variangle, -15°C to 50°C (0°F to 160°F) dual scale c/w brass thermowell

## 2.32 VALVES

.1 Where possible, valves shall be installed with the valve bonnet in an upright position to prevent deterioration or corrosion of the bonnet and packing. As a worst case, horizontal installations may be permitted with written acceptance by Physical Plant.

.1 Valve body materials shall be compatible with piping system materials. Valves shall meet all pressure, temperature, and fluid handling requirements of the system.

.2 A valve drain shall be provided at the base of each riser and at the low points of the system. Manual air vents shall be provided at the top of each riser and at the high points of the system.

.3 Ball valves and butterfly valves shall be used in place of gate valves providing they meet the pressure, temperature, and fluid handling requirements of the system.

.4 Isolation shutoff valves shall be installed at each piece of equipment, terminal unit, and each branch takeoff to facilitate shutdown for repair. Positive shutoff balancing valves with memory may satisfy this requirement at terminal units.

.5 For valves 150mm (6") and greater where mounted overhead, provide O. S. & Y. valves with chainwheel operation - length of chain to be determined on site to provide easy control.

.6 <u>Compressed Air</u>

.1 Up to 340kPa (49psig):

.1 Isolation valves to be forged brass ball valves, rated for 1035kPa (150psig) with 316 stainless steel ball and trim, of blowout proof construction and with threaded ends. Standard of acceptance: Crane CSC-9302-SS (iron pipe) or 9322-SS (solder ends).

.2 Over 345kPa (50psig):

.1 Class 800 full port, forged steel gate valves with bolted bonnet, outside screw & yoke, socket weld ends, furnished with ASTM A105 carbon seat. Standard of acceptance: Crane No.B3604XU-W.

.3 Check Valves

50mm (2") and smaller, spring loaded with screwed ends, Kitz 36, Apollo 61-100.
65mm (2½") and larger, wafer type, spring loaded, Crane Uni-check 125# bronze, Moygro W12A-16V-CW c/w outside lever and weight.

.7 <u>Domestic Hot, Cold, Recirc & Tempered Water:</u>

.1 Up to 50mm (2"): Forged brass ball valves, rated for 1035kPa (150psig) with 316 stainless steel ball and trim, threaded ends. Valve to be equal to Crane CSC-9302-SS (iron pipe) or 9322-SS (solder ends).

.2 2½ and 3" gate valve (Sil-Fos connections)

.3 4" and over: Outside screw and yoke, rising stem, flanged gate valves with bronze trim, rated for 1380kPa (200psig) with tapered solid wedge disc, renewable bronze seat rings, bronze stem, flanged ends. Valve to be equal to Crane 465½.

.4 Drain valves to be forged brass ball valves, rated for 1035kPa (150psig) with 316 stainless steel ball and trim, threaded ends, cap & chain. Valve to be equal to Crane CSC-9302-SS (iron pipe) or 9322-SS (solder ends) complete with adaptor, cap & chain.

.8 Drain Down Valves:

.1 All piping shall be arranged to completely drain the system.

.2 Install piping with grade in direction of flow except as indicated or specified otherwise.

.3 Provide drain valves at low points in piping systems, at equipment and at section isolating valves to allow complete draining of all systems.

.4 Where sectionalizing valves are installed, a drain shall be installed on the downstream side of the valve to drain that section of the system.

.5 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible. In the case of glycol systems, drains to be taken to suitable glycol receptacles to allow reuse of fluid.

.6 All system and equipment drains and air vents shall be piped to a floor drain.

.7 All cooling tower drains and overflows shall be piped to a sanitary system (not onto the roof). All system and equipment drains and air vents shall be piped to a floor drain.

.8 Drain down valves shall have rating to match service valves and shall be provided with hose end, cap and chain.

.9 20mm (¾") to 50mm (2"): Brass construction ball action valve complete with hose end, cap and chain rated 150 psi steam 600 w.o.g. Valves to be equal to Crane CSC-9302-SS (iron pipe) or 9322-SS (solder ends)-SD.

.9 Fire Protection:

.1 100 mm (4") and larger above ground: iron body, bronze trim O S & Y, flanged 200 psi, U.L.C./FM approved. McAvity 10269, Nibco F6070TS ULC.

.2 100 mm (4”) and larger buried: non-rising stem, iron body bronze trim, SS bolts, integral bonnet, ULC/FM approved, McAvity series 616 or Nibco F609/M609 ULC to suit pipe connections.

.3 Indicator post to be cast iron body ULC/FM approved. McAvity 6225, Nibco NIPIAJ ULC.

.4 Hydrants: Cast iron construction ULC/FM approved for 9'-0" bury with 1-100 mm (4”) pump and 65mm (2½”) hose connections, compression valve, SS bolting for 150 mm (6") line connection, constructed to AWWA C502 standard: McAvity M-67.

.10 Gas Systems (Natural Gas and Propane):

.1 Gas Service Plug Cocks: Class 125, cast iron body and plug with parallel valve, CGA approved.

.1 12mm (1/2“) to 50 mm (2”): Newman Hattersley 170M.

.2 65 mm (2½“) and greater, flanged: Newman Hattersley #171M.

.2 Ball Valves (Gas Service)

.1 50mm (2”) and smaller, Class 125, non-lubricated type with brass body and stainless steel trim, CGA approved with screwed connections. Standard of Acceptance: Crane CSC 9302-SS (iron pipe) or 9322-SS (solder ends).

.11 Heating Water:

.1 Up to 50mm (2”): Forged brass ball valves, rated for 1035kPa (150psig) with 316 stainless steel ball and trim, threaded ends. Valve to be equal to Crane CSC-9302-SS (iron pipe) or 9322-SS (solder ends).

.2 65mm (2½”) and over: Cast iron lug-type butterfly valves, rated for 1035kPa (150psig) with 316 stainless steel disc and stem, EPDM food grade valve seat, polyester upper stem bushing, NBR stem packing, 316 stainless steel torque plug and disc screws, 17-4PH stainless steel taper pins. Valve to be equal to Keystone Fig AR2. Handles and operators: 65mm (2½") to 150mm (6") use lever with multi-position adjustment. For 8” and over use wheel operated worm gear actuator.

.3 Drain valves to be forged brass ball valves, rated for 1035kPa (150psig) with 316 stainless steel ball and trim, threaded ends, cap & chain. Valve to be equal to Crane CSC-9302-SS (iron pipe) or 9322-SS (solder ends) complete with adaptor, cap, & chain.

.4 Check Valves:

.1 Where check valves are required, they shall be installed on the equipment side of all shutoff valves to facilitate servicing of the check valve.

.2 50mm (2”) and smaller, ASTM B62 bronze body with replaceable disc, Y-pattern body with integral seat, easy access cap to permit quick regrinding, 45° seat angle, 2-piece hinged disc construction and threaded ends. Standard of acceptance Crane 37.

.3 65mm (2½”) and larger, Class 125 cast iron body with replaceable bronze seat rings, bronze hinges in 150mm (6”) and smaller; ductile iron in larger sizes, bolted cover, solid bronze disc in 150mm (6”); bronze-faced cast iron in larger sizes, and seating ring, replaceable brass hinge pins, flanged ends. Standard of acceptance Crane 373.

.12 Radiation Valves

.1 32 mm (1¼”) and smaller, bronze body, Teflon disc, threaded ends, Toyo 252, Dahl 11040.

## 2.33 V-BELT DRIVES

.1 Fit reinforced belts in sheave grooves matched to drive.

.2 For 0.25 KW (1/3 hp) to 5.5 kW (7½ hp) motors use standard adjustable pitch drive sheaves, having plus/minus 10% range. Use mid-position of range for specified rpm.

.3 For over 7.5 KW (10hp) motors, use sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Refer to Section 15600 and 15800 for fan requirements relating to V-belt, vari-pitch drives. Provide sheave of correct size as approved by Consultant to suit balancing.

.4 Use minimum drive rating of two times nameplate rating on motor. Keep overhung loads under Manufacturer’s requirements on all prime mover shafts.

.5 With belt drive, provide motor slide rail adjustment plates, allowing for 150mm (6") minimum centre line adjustment.

.6 Obtain approval to use cast iron or steel sheaves secured to shafts with removable keys.

## 2.34 WELDING

.1 Do not weld when temperature of base metal is lower than -18°C (0°F) except with consent of Consultant. At temperatures below 0°C (32°F), surface of all areas within 75mm (3") of point where weld is to be started to be heated to temperature at least warm to hand before welding is commenced. At all temperatures below +4°C (40°F), operator and work to be protected against direct effect of wind and snow.

.2 Welding performed by welder holding current welder's certificate from Provincial Department of Labour.

.3 Comply with fire protection standard #302 latest revision, for welding and cutting operations, issued by Dominion Fire Commissioner.

### 2.35 WIRING

.1 Electric power wiring for equipment (connection of motors through starters and disconnects) provided by mechanical trades is specified in Division 16. Electrically operated equipment: to CSA Standard and bear Certification label.

.2 Provide motor control wiring (at any required voltage) between starter panels and control components to all requirements specified in Division 16.

.3 Provide wiring of items supplied by equipment Manufacturers such as filter advance motors and control, high level alarms, low water cut-offs, anti vibration lock-outs, flow switches, remote and local thermostats for all equipment, sump pump alternators, level controllers, water treatment equipment, and oil/grease interceptor alarms, and control wiring between starters and control panels (e.g. air cooled condensers, cooling towers and condensing units). Also provide wiring for communications interface panels, sensors, oil pumps, purge pumps and oil heaters supplied with water chillers. Refer also to Section 15900.

## PART 3 EXECUTION

### 3.1 GENERAL

.1 Install equipment, ductwork, wiring, conduit, piping, and all other portions of the work in a workmanlike manner to present a neat appearance and to function properly to the acceptance of the Consultant. Install ducts, wiring, equipment, and piping parallel and perpendicular to building planes. Install exposed system neatly and group to present a neat appearance. Comply with Manufacturer's installation instructions.

.2 Install gauges, meters, thermometers, and other equipment that needs to be observed in a manner that permits easy observance.

.3 Install all equipment and apparatus with adequate space allowance and with regard to wiring, maintenance, adjustment or eventual replacement with due allowances therefore.

.4 Install control devices to guarantee proper sensing. Shield elements from direct radiation and avoid placing them behind obstructions.

.5 Include all Manufacturers' requirements.

.6 Replace all work unsatisfactory to the Consultant without extra cost.

.7 Install all ceiling mounted components (Diffusers, Grilles, and Sprinklers) in accordance with reflected ceiling drawings, accepted by the Architect.

.8 Leave space clear and install all work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or materials supplied by other trades. Verify spaces in which work is to be installed. Install pipe runs etc., to maintain maximum headroom and clearances and to conserve space in shaft and ceiling spaces.

.9 Miscellaneous metals provided by the Mechanical Contractor shall be primed and ready for painting prior to installation.

.10 Provide hose end blowdown valves complete with caps and chains on all strainers.

## 3.2 AIR VENTS

.1 Provide air vents at all high points in piping systems and at each piece of equipment. Provide shut off valves to all vents.

.2 Provide automatic air vents on piping mains except where a possibility from water damage would occur, in which case, use manual vents.

.3 Provide manual air vents at each piece of equipment.

## 3.3 ACCESS PANELS AND DOORS

.1 Install all concealed mechanical equipment requiring adjustment or maintenance in locations easily accessible through access panels and doors. Install systems and components to result in a minimum number of access panels.

.2 Access doors are required for the following:

- .1 Fire dampers and motorized dampers (for inspection, repair and resetting). Provide access doors on both upstream and downstream sides of automatic dampers.
- .2 Duct mounted coils (duct access upstream and downstream sides for cleaning).
- .3 Fan inlets and outlets (for inspection of impellers and vanes).
- .4 At VAV terminal inlets for access to airflow measurement devices and for cleaning and servicing.
- .5 Duct mounted smoke detectors (for inspection of in-duct sensors).
- .6 Control valves and temperature control components.
- .7 All other equipment or fittings that require access.

.3 Indicate access panels on "As built" drawings and at each location note the items (i.e. equipment or valve no.) for which access is being provided.

.4 Supply Division 9 Subtrade with panels, doors or frames, complete with all pertinent information and pay that trade for installation.

.5 Prepare detail drawings showing location and type of all access doors in co-ordination with other trades before proceeding with installation and submit for review.

.6 Size access doors to provide adequate access and be commensurate with type of structure and architectural finish.

.7 Ensure proper rating of doors in fire separations.

## 3.4 CLEANING AND FLUSHING OF PIPING SYSTEMS

.1 Construction startup strainers shall be fine mesh. After one month of operation, the strainer shall be changed to a larger mesh specified for normal use.

.2 All strainers shall be valved and capped for blowdown.

.3 On completion, each piping system shall be flushed out before installation of equipment, fixtures, etc. in order to remove any foreign material in piping.

.4 Flush with water, unless noted otherwise in individual mechanical sections of specifications.

.5 All plumbing fixtures and all equipment shall be thoroughly cleaned and left in first class operating condition.

## 3.5 CONCRETE

.1 Except as specifically indicated on the Mechanical Drawings or where indicated on the Architectural or Structural Drawings as provided by other Sections, provide all concrete work required for mechanical work (bases, curbs, anchors, thrust blocks, manholes, catch basins) in accordance with requirements of Division 3.

.2 Concrete work required for mechanical work and not shown on Architectural of Structural drawings - to be provided by Division 15.

.3 Provide reinforcing steel in all housekeeping pads and other concrete construction work required for the mechanical installation.

.4 Provide in good time, all inserts, sump frames, anchors, etc., required to be built into forming for mechanical services.

## 3.6 CONTROL COMPONENTS

.1 Install all pipeline devices required by the Section 15900 sub-contractor such as flow switches, valves and separable wells for temperature controllers and sensors.

## 3.7 CUTTING AND PATCHING

.1 Give timely notice concerning required openings. In work already finished the Contractor will perform all cutting and patching at the expense of Division 15.

.2 Obtain the approval of the Consultant before doing any cutting.

.3 Seal around services passing through cut openings with materials commensurate with the fire rating of the wall, floor or roof. Ensure sealing is weatherproof for openings through exterior surfaces. Before sealing, provide prime coat of paint on all repaired surfaces.

## 3.8 DIRT ACCUMULATION UNDER CONTROL VALVES

.1 If dirt accumulates under the seats of automatic control valves, this Sub-Contractor is responsible, during the first two year's operation, to remove the collected materials under the valve seats and if the seat is damaged, replace it at no cost to the Owner.

## 3.9 EXCAVATION AND BACKFILL

.1 Perform all excavation, bedding, backfill and related work required for mechanical Work in accordance with requirements of Division 2 except as supplemented by this Article. Ensure all services are buried a minimum of 2.5m (8 feet) where piping is located outside the building perimeter walls.

.2 Where excavation and backfill is required outside perimeter foundation walls, provide all required layout of mechanical services trenches.

.3 Provide all required information to Section 02200 Subtrade during excavation.

.4 Perform carving and trimming of final 150 mm (6”) of trench bottom excavation.

.5 Perform bedding, installation of services, backfilling and testing to 300 mm (12”) above uppermost buried service.

.6 The balance of backfilling to be performed by Division 2 Subtrade after receiving clearance from Division 15.

.7 Grade the bottom of the pipe trench excavation as required.

.8 In firm undisturbed soil, lay pipes directly on the soil and shape soil to fit the lower □ segment of all pipes and pipe bells. Ensure even bearing along the barrels.

.9 In rock and shale excavate to 150mm (6") below and a minimum of 200mm (8") to either side of the pipe. Fill back with a bedding of 12mm (½") crushed stone or granular 'A' gravel.

.10 Prepare new bedding under pipe in unstable soil, in fill, and in all cases where pipe bedding has been removed in earlier excavation, particularly near perimeter walls of buildings, at manholes and catch basins. Compact to maximum possible density and support the pipe by 200mm (8") thick concrete cradle, spanning full length between firm supports. Install reinforcing steel in cradle and construct piers every 2400mm (8 ft.) or closer, down to solid load bearing strata. Provide a minimum of one pier per length of pipe. Use the same method where pipes cross.

.11 Where excavation is necessary in proximity to and below the level of any footing, bed with 14,000 kPa (2000 psi) concrete to the level of the highest adjacent footing. Proximity is determined by the angle of repose as established by the Consultant.

.12 Provide support over at least the bottom one-third segment of the pipe in all bedding methods.

.13 Do not open trench ahead of pipe laying and bedding more than weather will permit. Break up rocks and boulders and remove by drilling and wedging. Do not use blasting unless specifically approved by the Consultant.

.14 Perform all, or required portions of backfilling as specified in150mm (6") layers with clean selected materials acceptable to the Consultant.

.15 At a point where backfilling has been completed to 600 mm (24") above the top of the pipe, lay in three strips of 75mm (3") wide yellow polyethylene or copolymer tape with repeating black letters every 600mm (24") “Caution – Fire Main” or similar notification acceptable to the Consultant.

.16 Replace all paving removed for the installation of buried fire mains, post indicator valves and hydrants as specified.

.17 Backfill and compact to the following standard Proctor percentages:

| | |
|---|---|
| Sodded area | 85% |
| Under paving | 95% |
| Under Floor slabs | 100% |

.18 Dispose of excavated material as directed by the Contractor.

## 3.10 EXPANSION LOOPS

.1 Install expansion loops, joints and compensators in accordance with the drawings and as required to manage pipe expansion.

.2 Follow Manufacturer’s instructions, in regard to proper length, anchoring and guiding, pre-compression, removal of spacers and testing.

## 3.11 EXPOSED WORK

.1 Wherever any work (plumbing, heating, sprinkler, wiring, piping, ductwork, and associated thermal insulation) is exposed in finished areas, co-ordinate the work with the Consultant prior to installation. If unsatisfactory installation results due to not following this procedure, perform remedial work to the Consultant's acceptance.

## 3.12 FLASHING

.1 Flash all mechanical parts passing through or built into an outside wall, roof, floor, or waterproof assembly.

.2 Provide copper flashing for sleeves passing through exterior surfaces or waterproof assemblies.

.3 Provide counter flashing on stacks, ducts and pipes passing through roofs to fit over flashing or curb. Supply flashing for roof drains, vents, piping, or other penetrating materials to Division 7 Subcontractor for installation.

## 3.13 HANGERS

.1 Hanger rods may be attached to beam or joist clamps, brackets, or concrete inserts. Explosive actuated tools are not permitted. Do not weld to structural steel unless Consultant's approval is given.

## 3.14 IDENTIFICATION

.1 Identify all automatic control devices, pumps, fans etc., with 3mm ($^1/_8$") thick Lamacoid plastic plates of approved size with bevelled edges having engraved white letter on black background giving the name of the equipment or equipment service and its number, i.e. "Washroom Exhaust E-1", "Condenser Pump P-1", etc. Fix to equipment using pop rivets or sheet metal screws.

.2 Also provide: 50mm (2") lettering for motor starters and 75mm (3") lettering for equipment.

.3 Where equipment is locally switched (e.g. Room exhaust fans) provide identification plate at switch.

.4 Co-ordinate with Section 15900 subcontractor and obtain list of automatically operated equipment and provide warning identification on Lamacoid plate for each item as follows:

"Warning: This equipment may start at any time.
Do not service without disconnecting power."

## 3.15 INSERTS, SLEEVES AND ESCUTCHEONS

.1 Provide all sleeves required for ductwork, piping and access openings unless they are specifically shown on Architectural and Structural drawings.

.2 Place inserts only in portion of the main structure and not in any finishing material.

.3 Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected.

.4 Provide the following for pipe sleeves:

- .1 Through interior walls, exterior walls above grade, interior non-waterproof floors: Machine cut Schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel.
- .2 Through walls below grade, waterproof floors, floors in janitor's closets, equipment rooms, and kitchens: machine cut medium cast iron, DWV copper or copper sheet extended 100mm (4") above the floor and cut flush with the underside.

.5 Provide the following for ductwork:

- .1 Where fire dampers are not required in poured walls; removable wood box out of required size. In block or brick walls; masonry to be built around ducting.
- .2 Where fire dampers are required; 18 gauge galvanized steel or heavier sleeves complete with steel angle framing both sides installed in accordance with requirements of Authorities. See also detail drawings.

.3 Through Equipment Room floors provide 100mm (4") high concrete curbs for ductwork and any piping where spaced so that sleeving is impractical.

.6 Seal all sleeves as follows:

.1 Through fire rated walls and floors and within mechanical assemblies (ducts): Stop insulation flush with all wall and floor surfaces and seal space between duct or pipe and sleeve with ULC approved and listed fire stopping material.

.2 Through all non-fire rated walls and floors stop insulation, where applicable, at wall and floor surfaces. Ram-pack fibreglass materials around piping and ductwork. Apply an approved caulking compound over the ram packed material on both sides.

.3 Through foundation walls: Use either of the two following methods:

.1 Co-operate with the Waterproofing trade and apply an approved caulking compound over ram-packed mineral wool on both sides. Over this, on both sides, apply a layer of glassfab tape embedded in two coats of an approved mastic compound.

.2 Provide Link-Seal Model S mechanical seal mechanism with stainless steel bolting, EPDM seal element and composite pressure plates as supplied by Power Plant Supply Company (905) 845-7951. Follow Manufacturer's instructions in all aspects of installation procedure.

.7 Cover sleeves and openings around exposed piping in all finished areas with chrome plated escutcheons. Cover exposed duct sleeves in finished areas with an 18 gauge galvanized steel collar fixed to wall or floor.

## 3.16 INSTALLATION OF ROOF MOUNTED EQUIPMENT

.1 Flashing of equipment bases and curbed openings for ductwork or roof mounted fans and flashing of roof drains and plumbing vents is specified in Section 07555. Equipment bases and curbs for openings to be supplied and set in place by Division 15.

## 3.17 LINTELS

.1 Lintels for openings in masonry to conform to requirements given on structural drawings and as required by By-laws.

.2 Pay all costs for lintels over openings required solely by the mechanical trades.

## 3.18 METALS

.1 Steel construction required solely for the work of Mechanical Trades and not shown on Architectural or Structural drawings: Provided by this Sub-contractor to the acceptance of the Consultant.

.2 These metals shall be primed and ready for finish painting prior to installation.

## 3.19 MISCELLANEOUS DRAINS

.1 Pipe all discharge from relief valves and drains from equipment, chemical pot feeders and tanks to nearest floor drain or suitable receptacle.

.2 All system and equipment drains, blowdown lines, and similar items shall be piped to a floor drain with an approved air gap.

.3 Provide 20mm (3/4") ball valves with hose ends, caps and chains at strainers, all piping system low points, pumps, coils and at each piece of equipment.

.4 Provide deep seal traps on all air handling equipment condensate drains and on floor drains located within air handling unit plenums. Depth of trap to suit operating equipment static pressure conditions. Submit calculations for review prior to installation.

.5 Provide trap seal primers on all floor drain traps and gang traps.

## 3.20 PAINTING

.1 Provide all exposed ferrous metal work and equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all metal before painting. Finish painting is specified in Section 09900. This Division is not required to prime coat or paint ductwork or piping.

.2 Coordinate with Division 9 Subcontractor and provide all required assistance in identifying all piping circuits requiring colour coding in addition to natural gas, propane and fire protection piping.

.3 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

.4 Co-operate with Section 09900 in identifying equipment and piping where required for colour coding, pipe stenciling and the like.

## 3.21 PIPING SYSTEM INSTALLATION

.1 Mechanical room equipment shall be laid out and installed to provide adequate maintenance clearances for all equipment (such as tube and coil pull spaces). Adequate means of access shall be provided for replacement of the largest piece of equipment without removing walls or other systems.

.2 Clearance shall be adequate to allow maintenance activity without disassembly of any fixed piping, supports, or devices.

.3 Clearance shall be provided around boilers and pressure vessels in accordance with Ontario Department of Labor requirements and Manufacturer’s recommendations.

.4 Install all piping in accordance with the best practices of the trade.

.5 The piping shown on the drawings is diagrammatic indicating general runs and connections. Take responsibility for the proper erection of systems of piping in every respect suitable for the intended functions and as described herein.

.6 Keep all openings in pipe and fittings plugged or capped during installation.

.7 Install piping to avoid any interference with the installation or removal of equipment, other piping and ducts.

.8 Install all valves, strainers and specialities to permit easy operation and access. On horizontal piping, install valves in an upright position. Where there are space constraints mount valves at a maximum of 45° off vertical. Install strainers to provide easy strainer basket removal.

.9 Install systems to provide thorough drainage and air elimination.

.10 Follow safe work procedures for all aspects of this project. During welding or soldering procedures, provide a fire retardant cloth, mat or blanket to protect the structure, and adequate fire protection equipment at all locations where work is being done. Close off shafts or confined areas with a fire retardant mat or cloth to prevent sparks or pieces of hot metal from falling down the shaft or areaway.

.11 Provide long turn pipe fittings having not less than pipe wall thickness. Provide line size tees. Where branch lines are less than one-half the size of the main, weldolets may be used.

.12 Where steel piping is required to be buried, apply two coats of Densopaste (Denso of Canada Ltd.) primer to all buried surfaces after assembly and testing. Hot or cold applied tape as manufactured by Tapecoat, selected for the application and applied to Manufacturer's instructions, is also acceptable. Optional installation requirement, apply two coats of flint-guard or equal 410-02 bituminous paint to all buried surfaces after assembly and testing.

.13 Where it is necessary to offset piping to avoid obstructions, use 45° rather than 90° elbows.

.14 Provide suitable cleanouts on every other change in direction and slope all condensate drip drains.

.15 Make all threaded pipe joints on piping systems using a thread paste or Teflon tape suitable for the service for which the pipe is to be used. Use of hemp or similar materials on threaded joints is not acceptable.

.16 Gas Piping: Install in accordance to relevant Codes. Provide vents to atmosphere for all safety switches and regulators as required by Code. Provide manufactured gas pipe supports for all roof-mounted piping.

.17 Steam and Condensate Piping: Grade in the direction of flow. On branch lines from mains feeding risers, pitch branch lines towards the horizontal mains to prevent water hammer. Grade all condensate piping in direction of flow.

.18 Install all piping requiring insulation with sufficient clearance to apply, seal and finish the insulation.

.19 Provide sufficient space between piping to install valves arranged in straight rows or equally spaced steps. Valve wheels, handles and operators to be easily accessible and operable.

.20 Do not install horizontal piping within masonry walls. Any piping installed in this manner will not be accepted.

.21 Use only non-ferrous metals in high humidity areas.

.22 Do not suspend any equipment, piping, ducting or any other mechanical components from formed hollow steel decking.

.23 Lab waste and vents: Vents to be taken directly to roof vents and installed separately from non-acid waste systems. Vents to be cast iron where they pass through roof. Provide fibreglass protective packing at sleeves. Provide rigid fibreglass pads (sections of pipe covering) at all support points in accordance with Manufacturer's instructions.

.24 Stainless steel piping is to be completely cleaned of all foreign material and be passivated.

## 3.22 PIPING SYSTEM TESTS

.1 Do not insulate piping systems until completed, perfected, and proven tight.

.2 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings and equipment.

.3 Test piping system in sections as required by the progress of work.

.4 Test all heating and chilled water [condenser water] and domestic water piping hydraulically to a minimum pressure of 1100 kPag (150 psig) or 1.5 times the normal working pressure, whichever is the greater, and prove tight for a period of 8 hours. Testing with nitrogen is also acceptable provided a pressure of 1.25 times values specified previously is used. Test natural gas piping as required by codes and authorities.

.5 All tests must be recorded. Submit recorded data to the Consultant.

## 3.23 PROTECTION

.1 Cover all openings in equipment and cover equipment where damage may occur from weather. Cover temporary openings in ducts and pipes with polyethylene sheets, until final connection is made. Cover all items cast into concrete floors or walls such as floor drains and cleanouts prior to pour, with heavy plastic tape or duct tape.

.2 Cover and seal, with polyethylene sheeting, all equipment, coils and motors in place during construction to prevent entry of dust, paint and debris.

## 3.24 PUMP AND EQUIPMENT CONNECTIONS

.1 Install piping connections to pumps, coils, and all other equipment without strain at the pipe connections. Remove, where requested by the Consultant, bolts in flanged connections or disconnect piping after the installation is complete to demonstrate that the piping has been so connected.

.2 Provide shut-off valves on supply and return piping connections on all items of equipment.

.3 Corrosion Prevention: Install bronze body ball valves at:

- .1 Connections to copper/aluminium perimeter convectors, radiant ceiling panels and coils with copper connections in steel piping systems.
- .2 Connections between copper and steel pipe.
- .3 Connections to cooling coil condensate drains.
- .4 Steel Valves used in a copper or copper alloy piping system. In this case, use brass or bronze valves whenever possible.
- .5 Connections to expansion tanks and domestic hot water tanks to be complete with minimum 150mm (6") brass nipples.
- .6 In either steel or copper piping systems, do not put short black steel nipples and individual black steel fittings between brass or bronze components such as valves - use only copper, brass or bronze components.
- .7 Do not use copper alloy (brass and bronze) fittings and valves in place of specified dielectric couplings.

.4 Stand-by generator: Install and connect the flexible piping and muffler supplied by Division 16. Make installation in accordance with detail drawings.

## 3.25 RELIEF VALVES

.1 Terminate vent lines from relief valves outdoors at a safe location.

.2 Provide drip-pan elbow with drain connection to nearest floor drain.

.3 When several relief-valve vents connect to one vent header, size header cross-sectional area to equal the sum of individual vent-outlet areas.

## 3.26 RIGGING OF EQUIPMENT

.1 Provide all rigging, hoisting and handling of equipment as necessary in order to place the equipment in designated area in the building.

.2 Direct this work by qualified people normally engaged in rigging, hoisting and handling of equipment.

## 3.27 VIBRATION ISOLATION

.1 Provide Vibration Isolators as manufactured by Vibro-Acoustics, Vibron or Air Master.

.2 Mechanical equipment shall be installed so that the average noise criteria curves as outlined in the latest edition of the ASHRAE guide for this type of project are not exceeded. Where

objectionable noise or vibration is encountered due to faulty equipment or inefficient noise and vibration reduction devices, as determined by the Consultant, make necessary tests, change and provide additional equipment as may be required and approved, without extra charge.

.3 Provide all sound and vibration elimination materials by one supplier unless otherwise specified. Provide shop drawings showing isolator location, load forces, anchor positions etc., and installation instructions.

.4 Provide vibration isolators for all mechanical motor driven equipment throughout the project, unless specifically noted otherwise.

.5 Support all piping connected to isolated equipment by spring hangers on the first three support points. Bolt all anchors and guides on elastorib pads with neoprene washers on each side of the fastening. Use of 3 Style 77 Victaulic flexible couplings to absorb noise/vibration is acceptable alternative.

.6 Give consideration to side loading of equipment and inertia pads when calculating maximum loads on isolators; provide pairs of side snubbers and/or restraining springs where side torque or thrust may develop. When properly adjusted, the equipment shall be level when operating.

.7 Provide all spring isolators with height and levelling adjustment and set on neoprene antisound pads 6mm (¼") or thicker. Do not use sponge rubber for side snubbers.

.8 Provide spring isolation for ceiling mounted equipment with box-frames and anti-sound spring seats. All hardware: corrosion resistant.

## 3.28 WELDING

.1 Only persons who have passed welding tests to the satisfaction of the authorities having jurisdiction and who are certified by them to be qualified welders, shall be permitted to do any welding on this contract.

## 3.29 DETAIL DRAWINGS, [LEGENDS[ [AND EQUIPMENT SCHEDULES]

.1 Refer to legends, detail drawings and equipment schedules on the drawings. Comply with requirements of the detail drawings on drawings. Refer also to the appropriate Sections of this Division for additional information and requirements on scheduled equipment.

**END OF SECTION**

# PART 1 GENERAL

## 1.1 GENERAL

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 15010, Mechanical General Requirements, as applicable.

## 1.2 RELATED SECTIONS

.1 Conform to Section 16010 - Electrical General Requirements.

.2 Installation of inserts, sleeves and anchors supplied by this Section: Section 04200, Masonry.

## 1.3 REFERENCES

| | |
|---|---|
| ANSI B31.1 to B31.9 (inclusive) | Piping |
| CAN/CGSB-1.40-97 | Primer, Structural Steel, Oil Alkyd Type |
| CSA B51-03 | Boiler, Pressure Vessel, and Pressure Piping Code |
| CSA B52-99 | Mechanical Refrigeration Code |
| CAN/CSA-G40.20/G40.21-98 | General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel |
| CAN/CSA-S16-01 | Limit States Design of Steel Structures |
| CSA W47.1-92(R2001) | Certification of Companies for Fusion Welding of Steel Structures |
| CAN/CSA W48-01 | Filler Metals and Allied Materials for Metal Arc Welding. |
| CSA W59-M1989 (R2001) | Welded Steel Construction (Metal Arc Welding) |
| CAN/CSA W117.2-01 | Safety in Welding, Cutting and Allied Processes |

## 1.4 SUBMITTALS

.1 **Shop Drawings:** Prepare and submit shop drawings for equipment covered by this Section including upper, middle and pipe attachments, riser clamps, shields and saddles, and sway braces.

# PART 2 PRODUCTS

## 2.1 MATERIALS

.1 **Welding Studs:**

1. Graham
2. Omark
3. Nelson

.2 **Concrete Inserts and Anchors:**

1. Readhead by ITW
2. SSS by Star
3. Parabolt by USM
4. Kwik-Bolt by Hilti

.3 **Beam Clamps:**

1. Grinnell
2. Myatt
3. Hilti

.4 **Concrete Grout:**

1. Sikagrout 212 by Sika Canada Inc.
2. Embeco 636 Grout by Master Builders
3. Sealtight V-3 Grout by W.R. Meadows

.5 **Pipe Hangers:**

1. Grinnell
2. Myatt
3. Hilti

.6 **Zinc-Rich Paint:**

1. Galvafroid by W.R. Meadows

.7 **Primer:**

1. CAN/CGSB-1.40-M

## PART 3 EXECUTION

### 3.1 GENERAL CONSTRUCTION REQUIREMENTS

.1 Attachment to Building Construction

1. Use welding studs of size not larger than 10 mm (3/8") for attaching miscellaneous materials and equipment to building steel. If weight of materials or equipment require bolts or studs larger than 10 mm (3/8") diameter use steel clips or brackets, secured to building steel by welding or bolting method of attachment as approved by Consultant.

2. Use self-drilling expansion type concrete inserts for securing miscellaneous equipment and materials to masonry or concrete construction already in place, of sufficient number and size to prevent concrete from breaking away. Use of powder or power actuated fasteners will not be allowed unless prior written approval is obtained from Consultant.

3. Support rods for any suspended item must not be attached to or extended through steel

pan type roofs or through concrete slab roofs.

4. Provide beam clamps of 2-bolt design and of such type that rod load is transmitted only concentrically to beam web centreline. Use of "C" and "I" beam side clamps and other similar items will not be allowed without written consent of Consultant.

5. Where roof or floor framing consists of open web or long span steel joists, ensure that hangers are located at or within 150 mm (6") of joist top or bottom chord panel points, otherwise provide additional structural steel as required where hanger spacing does not coincide with joist spacing. Design suspension assembly such that hanger load is transmitted only concentrically to supporting joist. Do not use "C" and "I" beam side clamps, brackets and other similar, without written consent of Consultant.

6. Locate secondary structural steel members between joists at or within 150 mm (6") of top or bottom chord panel points. Where secondary structural steel member cannot be located at or near joist panel point, provide additional diagonal structural steel web member(s) designed for applicable load to nearest panel point in opposite chord member. This condition may be waived if load to be suspended between panel points is not in excess of 45 kg (100 lbs). Diagonal hangers which will induce lateral stresses in chord member of joist will not be permitted. Submit shop drawings of suspension assembly indicating location of suspension or support points, max load at each suspension point, location and size of hangers, brackets and intermediate framing members when required, and also details of connection to building structure.

## 3.2 PIPING CONSTRUCTION METHODS

.1 Unless specified otherwise herein, construct and install piping in accordance with ANSI Sections B31.1 to B31.9 as applicable to service, except that soldered joints will not be permitted in compressed air piping.

.2 To avoid unnecessary cutting of masonry, provide inserts, sleeves and anchors to other trades for building in as Work proceeds. Arrange with other trades to leave openings, slots and chases to accommodate later installation of mechanical work.

## 3.3 PIPE HANGERS AND SUPPORTS

.1 General

1. Support or suspend piping with necessary hangers, structural supports and/or brackets as indicated on Drawings and/or as required, to prevent sagging, warping and vibration and to allow for movement due to expansion and contraction. Place hangers and supports close to fittings, valves and/or other heavy parts.

2. Do not allow loads of any nature to be transmitted through piping connections to equipment not specifically designed for such loads. Where flexible connections are not called for at connections to equipment, support pipe by stands attached to both pipe and supporting structure so that force in any direction is not transmitted to equipment.

3. Provide suitably dampened spring hangers for first 3 supports from equipment connection on piping subject to excessive movement or shock from any source, thermal expansion and contraction, selected in accordance with ANSI B31.1. Where it is

evident that no undue loads will be transmitted to equipment by system concerned, i.e. small bore connections to comparatively large equipment, cold service piping not subject to shock, etc., then spring hangers may be omitted and standard hangers used.

4. Use trapeze type hangers where pipes are grouped together, unless specifically indicated otherwise on Drawings. Suspend horizontal member by adjustable rods with locking feature for maintaining level and slope. Space trapeze type hangers based on closest interval required by any pipe supported thereon. Provide any auxiliary steel required to support trapeze between building steel.

5. Do not hang any pipe from another pipe unless specifically indicated on Drawings.

.2 Saddles and Roller Supports

1. Provide saddles at roller supports for piping carrying liquids at 10.5°C (51°F) or higher. Weld saddles to black or galvanized steel piping. Refinish galvanized surfaces destroyed by welding with zinc rich paint.

.3 Hangers

1. For insulated piping up to NPS 4 carrying liquids at temperatures 10.5°C (51°F) and higher, use standard weight clevis hangers with level adjustment and locknut.

2. For insulated lines of NPS 4 diameter and larger carrying liquids at temperatures 10.5°C (51°F) or higher, use adjustable roller type hangers with locknuts, and rollers of sufficient width to clear outside diameter of insulation on piping. Support rollers at both ends, either by yoke, swivel type hanger or by 2 adjustable rods with locknuts.

3. For insulated piping carrying liquids at temperature of 10°C (50°F) or less, use elongated clevis type hangers, with clevis of sufficient width to fit over insulation bearing plate.

4. Provide insulation protection bearing plates at hangers and supports for piping carrying liquids at temperature of 10°C (50°F) or less. Install temporary spacers between plate and pipe equal to thickness of insulation specified. (Refer to Section 15081, Piping Insulation).

5. Bearing plates may be either shop fabricated, or manufactured plates of size required to properly fit outside diameter of pipe insulation.

6. Fabricate bearing plates conforming to following table for various pipe sizes:

| | **Length of Thickness of:** | |
|---|---|---|
| **Pipe Size (NPS)** | **Plate - mm (in)** | **Plate - mm (ga)** |
| 1/2 thr. 1-1/2 | 130 (5) | 1.2 (18) |
| 2 | 150 (6) | 0.52 (16) |
| 2-1/2 | 200 (8) | 1.52 (16) |
| 3 | 230 (9) | 1.52 (16) |
| 4 and up | 250 (10) | 1.52 (16) |

7. Form bearing plates to outside diameter of adjoining pipe insulation and extend plate up to horizontal centre line of pipe.

8. For non-insulated piping use clevis type of wrought steel construction with adjustable rod, level locking feature and backnuts.

9. For copper tubing provide copper coated hangers. Regulations of some municipalities require that copper tubing be taped with plastic tape at hanger location, or hanger be provided with plastic insert. Meet these requirements when required, in which case copper coating may be omitted on hanger.

10. Attach hanger rods to building structure by means of malleable iron beam clamps, concrete inserts, and/or approved anchors as hereinbefore specified.

.4 Hanger Spacing

1. For horizontal runs of plumbing and drainage piping comply with hanger spacing requirements of OBC.

2. For horizontal runs of black or galvanized steel pipe, other than for plumbing service, do not exceed max distances between supports and with minimum diameter rods as follows:

| Pipe Size (NPS) | Distance - m (ft) | Diameter of Rod - mm (in) |
|---|---|---|
| Up thru 1-1/4 | 1.8 (6) | 10 (3/8) |
| 1-1/2 | 1.8 (6) | 10 (3/8) |
| 2 | 3.05 (10) | 10 (3/8) |
| 2-1/2 & 3 | 3.66 (12) | 12 (1/2) |
| 4 | 4.27 (14) | 16 (5/8) |
| 6 | 5.18 (17) | 19 (3/4) |
| 8 | 5.79 (19) | 22 (7/8) |
| 10 & 12 | 6.71 (22) | 22 (7/8) |

3. Provide additional hangers in locations where there are concentrated loads such as valves, specialties and other such items.

4. For horizontal runs of copper tubing for services other than plumbing, do not exceed 1.8 m (6 ft) between hangers for lines up to and including NPS 3/4 and 2.4 m (8 ft) for lines of NPS 1 and larger.

5. For horizontal runs of piping fabricated of PVC, use hanger spacing as recommended by the manufacturer.

.5 Vertical Piping Supports

1. Support vertical plumbing and drainage piping as required by OBC, unless more stringent requirements are specified herein.

2. Support cast iron soil pipe at every floor and other piping at every other floor unless otherwise required by expansion conditions or otherwise specified.

3. Support bottom of riser with base fitting set on concrete pier or by hanger located at top of riser pipe as close to riser as possible.

4. For supports at intermediate floors, use Grinnell Fig. 261 or approved equal steel extension pipe clamp, bolted securely to pipe. Rest ends of clamp on pipe sleeve or on floor.

5. Provide lateral stability of vertical piping by fabricated brackets or malleable iron, extension type split hangers. Run vertical piping at columns in column webs, on either or both sides of column, unless otherwise directed.

.6 Anchors and Guides

1. Supply and install anchors where indicated on Drawings and/or as required to maintain permanent location of pipe lines. Construct anchors for steel or galvanized pipe of approved steel straps and/or rods and for anchoring copper lines use copper plated anchors or provide insulation bands between tubing and clamps if steel straps or rods are used. Install anchors and guides in approved manner.

2. Acceptable Materials: Grinnell #256 or Myatt.

## 3.4 MISCELLANEOUS STEEL

.1 General

1. Supply and install miscellaneous structural supports, platforms and braces as may be required to hang or support piping unless Drawings or other Sections of Specifications state otherwise.

2. Submit detailed shop drawings to structural engineer for review before commencing fabrication.

.2 Materials and Fabrication

1. Conform to CAN/CSA-S16 for materials, design of details, and execution of work.

2. Conform to CAN/CSA-G40.20/G40.21, grade 300W for structural shapes, plates, and other similar items.

3. Use welded construction wherever practicable, with bolted joints allowed for field assembly using high strength steel bolts. Chip welds to remove slag, and grind smooth.

4. Conform to the latest issue of the following CSA Specifications:

a. CSA W47.1, for qualification of welders
b. CSA W48.1-M, for electrodes (only coated rods allowed)
c. CSA W59-M, for design of connections and workmanship
d. CSA W117.2, for safety

.3 Painting & Cleaning

1. Touch up minor damage to finish on equipment with standard factory applied baked enamel finish. If, in Consultant's opinion, damage is too extensive to be remedied by touch up, replace damaged equipment.

2. Clean steel by scraping, wire brushing or other effective means to remove base scale, rust, oil, dirt or other foreign matter.

3. Apply one coat of zinc chromate iron oxide primer, conforming to CAN/CGSB-1.40-M to miscellaneous steel.

4. In field, touch up bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as herein before specified.

5. Give two coats of primer to surfaces which will be inaccessible after erection.

6. Remove foreign matter from steelwork on completion of installation.

7. With exception of prime painting of miscellaneous steel or any other specific requirements as specified above or under respective Sections of Division 15, or equipment otherwise factory painted, painting will be provided under Division 9, Finishes.

## 3.5 CONCRETE INSERTS

.1 Install inserts required for attachment of hangers, either for suspension of piping or equipment.

.2 For masonry or poured concrete construction use expansion type units. Insert into concrete after concrete has cured. Anchors or inserts installed by explosive means shall not be used.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 GENERAL

.1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 15010 – Mechanical General Requirements.

### 1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 15010 – Mechanical General Requirements.

.2 Submit for approval, manufacturer's catalogue literature related to installation and fabrication.

## PART 2 PRODUCTS

### 2.1 GENERAL

.1 Supply access doors to the relevant building trade to provide access in furred ceilings for the following:

1. Servicing equipment.
2. Access to plumbing cleanouts.
3. Access to shut-off valves.
4. Inspection of life safety equipment.
5. Service of operating devices.
6. All locations where periodic maintenance is required.

.2 Access door sizes shall be as follows:

1. Body Entry: 24” x 24” (600 x 600 mm)
2. For Hand Entry: 18” x 18” (450 x 450 mm)
3. For Viewing Only: 12” x 12” (300 x 300 mm)

.3 All doors shall open 180 degrees and have rounded safety corners.

.4 For fire rated ceilings or wall provide a fire rated access door that will match the fire rating of the wall that the access door is installed in. The Division 15 Contractor shall be responsible for reviewing the drawings and providing fire rated access doors where they are required.

.5 Where body access is possible the access doors shall be provided with a releasing mechanism on both sides of the door.

.6 Refer to Section 08310 of the specification.

### 2.2 RECESSED ACCESS DOOR FOR DRYWALL APPLICATIONS

.1 Door shall be 16 gauge steel. Mounting frame shall be 14 gauge galvanized steel.

.2 Door shall be provided with a 25 mm (1") recess or 14 mm (5/8") to suit the thickness of the drywall ceiling.

.3 The frame shall be provided with a galvanized steel drywall taping bead on all sides.

.4 The hinge shall be a concealed pivoting rod.

.5 The latch shall be a flush to the surface, screwdriver operated cam latch.

.6 The steel finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.

.7 Standard of Acceptance: Acudor DW-5015, Mifab, Zurn, Watrous, Williams Brothers.

## 2.3 RECESSED ACCESS DOOR FOR PLASTER APPLICATIONS

.1 Door shall be 16 gauge steel. Mounting frame shall be 14 gauge galvanized steel.

.2 Door shall be provided with a 14 mm (5/8") recess and shall be lined with self-furring galvanized lath.

.3 The frame shall be provided an expansion casing bead with 75 mm (3") wide galvanized lath, recessed 20 mm (3/4") to receive plaster.

.4 The hinge shall be a concealed pivoting rod.

.5 The latch shall be a flush to the surface, screwdriver operated cam latch.

.6 The steel finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.

.7 Standard of Acceptance: Acudor AP-5010, Mifab, Zurn, Watrous, Williams Brothers.

## 2.4 FLUSH ACCESS DOORS FOR TILED WALL APPLICATIONS

.1 For doors 400 x 400 mm (16" x 16") and smaller the door shall be 16 gauge with 18 gauge mounting frame.

.2 For doors over 400 x 400 mm (16" x 16") the door shall be 14 gauge with 16 gauge mounting frame.

.3 Door shall be flush to frame with rounded safety corners.

.4 The frame shall be one piece welded to the mounting frame.

.5 The hinge shall be a continuous concealed hinge.

.6 The latch shall be a stainless steel screwdriver cam latch.

.7 The finish shall be type 304 #4 satin polish stainless steel.

.8 Standard of Acceptance: Acudor UF-5000, Mifab, Zurn, Watrous, Williams Brothers.

**2.5 FIRE RATED ACCESS DOORS**

.1 Door shall be constructed of 20 gauge steel with a 16 gauge mounting frame.

.2 Door shall be filled with 50 mm (2") thick fire rated insulation.

.3 The door frame shall be provided with a 25 mm (1") wide flange and mounting frame to have anchor straps.

.4 The hinge shall be concealed and shall be provided with a spring closer.

.5 Door shall be UL/ULC rated for 1 ½ hour "B" label with 250 degree F temp rise in 30 minutes.

.6 The latch shall be a universal self-latching bolt, operated by either a knurled knob.

.7 The steel finish shall be 5 stage iron phosphate prepared with a prime coat of grey baked enamel.

.8 Door shall be provided with an interior latch release.

.9 For drywall applications, provide a galvanized steel drywall taping bead flange.

.10 Standard of Acceptance: Acudor FB-5060, Mifab, Zurn, Watrous, Williams Brothers.

**2.6 FIRE RATED ACCESS DOOR WITH INSIDE LATCH RELEASE**

.1 Door shall be constructed of 16 gauge steel with a 16 gauge mounting frame.

.2 Door shall be flush to frame with reinforced edges.

.3 The door frame shall be provided with a 25 mm (1") wide flange and shall be provided with anchor straps.

.4 The hinge shall be concealed and shall be provided with a spring closer.

.5 The door shall be UL/ULC rated for 1 ½ hour "B" label or 2 hour "B" label as required where temperature rise is not a factor.

.6 The latch shall be a universal self-latching bolt, operated by either a knurled knob.

.7 The steel finish shall be 5 stage iron phosphate prepared with a prime coat of grey baked enamel.

.8 Door shall be provided with an interior latch release.

.9 For drywall applications provide a galvanized steel drywall taping bead flange.

.10 Standard of Acceptance: Acudor FB-5060, Mifab, Zurn, Watrous, Williams Brothers.

**2.7 VALVE BOX – SURFACE MOUNT**

.1 Door shall be stainless steel in public areas and steel in mechanical rooms and service areas.

.2 Door and box shall be 16 gauge steel.

.3 The door shall overlap the box, providing a tight and secure fit.

.4 The box shall be fully enclosed, attached to the door.

.5 The hinge shall be a continuous piano hinge.

.6 The door shall be provided with a cylinder lock and key.

.7 For steel doors the finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.

.8 Stainless steel doors shall be #4 satin finish.

.9 Standard of Acceptance: Acudor ASVB, Mifab, Zurn, Watrous, Williams Brothers.

**2.8 VALVE BOX – RECESSED**

.1 Door shall be stainless steel in public areas and steel in mechanical rooms and service areas.

.2 Door and box shall be 16 gauge steel.

.3 The door shall be flush to the frame with rounded safety corners.

.4 The box shall be fully enclosed, completely attached to the frame.

.5 The hinge shall be a continuous concealed hinge.

.6 The door shall be provided with a cylinder lock and key.

.7 For steel doors the finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.

.8 Stainless steel doors shall be #4 satin finish.

.9 Standard of Acceptance: Acudor ARVB, Mifab, Zurn, Watrous, Williams Brothers.

## PART 3 EXECUTION

### 3.1 INSTALLATION

.1 On some drawings, access door locations have been indicated for coordination. The drawings do not show all access doors required.

.2 The Division 15 Contractor shall provide a set of drawings showing locations and types of all access doors located in public areas to the Consultant for approval, prior to commencing the installation of any piping or ductwork within these areas.

.3 Access doors shall be turned over to the building trade that is responsible for finishing the wall or ceiling where the access door is required.

.4 The Division 15 Contractor shall be responsible for providing the access doors required to be installed in ductwork. Refer to section 15820 for requirements.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 GENERAL

.1 This section includes:

1. Valve tags.
2. Pipe Markers/Arrow Tape above ground.
3. Underground Piping Warning Tape.
4. Mechanical Equipment and HVAC Controls Identification.
5. Safety Signs.
6. Isolation Valves Numbering.

### 1.2 DEFINITIONS

.1 Exposed Areas

1. Finished areas and other areas used by personnel in normal use of building, such as equipment rooms and storage rooms.

.2 Concealed Areas

1. Duct or pipe tunnels, duct or pipe chases, spaces above accessible ceilings, and crawl spaces.

## PART 2 PRODUCTS

### 2.1 STANDARD OF ACCEPTANCE

.1 W. H. Brady Co. catalogue numbers are used as a basis of identification.

.2 Stock catalogue numbers are listed in these specifications. Subcontractor is responsible to review schedules and provide required markers. In some instances, "non-stock" markers (special) may be required.

### 2.2 MANUFACTURER'S NAMEPLATES

.1 Manufacturer's nameplates:

1. Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.

2. Provide Underwriters' Laboratories or CSA registration plates, as required by respective agency.

3. Manufacturers nameplate to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

4. Locate nameplates so that they are easily read. Do not insulate or paint over plates.

## 2.3 VALVE TAGS

.1 Metal Tags: Brass or aluminium with stamped or engraved letters; tag sizes minimum 2" (round, square, or rectangle) with smooth edges. Thickness 19 gauge (0.040") minimum.

.2 Beaded Chain: Size 6, brass or aluminium, 4-1/2" long with locking link.

## 2.4 PIPE MARKERS/ARROW TAPE ABOVE GROUND

.1 Colour: Conform to ANSI A13.1.

.2 Self-Sticking Pipe Markers/Arrow Tape: Material B-946, flexible, vinyl film tape with pressure sensitive permanent adhesive backing and printed markings.

.3 Suitable for indoor/outdoor application.

.4 Temperature range: Minus 40 degrees to 180 degrees F.

## 2.5 UNDERGROUND PIPING WARNING TAPE

.1 Tracer wire and test station(s) required when burying cast iron, ductile iron, or non-metallic piping.

.2 Tracer Wire: #10AWG THHN/THWN, yellow, solid copper.

.3 Tracer Wire Test Station: C.P. Test Services. Test Station: Plastic Pipe, cast iron cover, 2-point terminal box.

## 2.6 CONTROLS IDENTIFICATION

.1 Refer to Section 15900.

## 2.7 EQUIPMENT IDENTIFICATION

.1 Labelling shall be furnished and installed by the contractor.

.2 Engraved signs shall be dark letters on light background.

.3 Identify mechanical equipment and HVAC controls, e.g., air handling units, pumps, heat transfer equipment, water treatment devices, controls instruments, stationary tanks/containers, and similar items, with nameplates or tags.

.4 Provide engraved nameplates made of rigid plastic laminate in which coloured top and bottom layers of the material are thermoset with a contrasting colour core. Minimum thickness 0.062".

.5 Size: Minimum 1" x 3".

.6 Material Colour: White background/black lettering.

.7 Manufacturer: Brady, No. B-1.

.8 Provide lettering as follows:

1. Size: 10 point minimum.
2. Spacing: 1/4” from top, 1/8” from bottom, 1/16” between lines.
3. Provide nameplate with component nomenclature as noted in the Equipment Schedules. Coordinate with the controls sub-contractor.

.9 As a minimum, identify the system, e.g., HVAC (heating, ventilating, and air conditioning), the component, e.g., FGF (furnace, gas fired), and the sequence number.

### 2.8 SAFETY SIGNS

.1 Colours associated with specific words such as "Danger," "Warning," "Caution," or "Notice" shall conform to ANSI Z35.1.

## PART 3 EXECUTION

### 3.1 PREPARATION

.1 Degrease and clean surfaces to receive adhesive for identification materials .

### 3.2 INSTALLATION

.1 Valve Tags:

1. Install with brass beaded chain.
2. Steel stamp or engrave valve tag in accordance with schedule herein.
3. Letter style block, 1/4" height minimum.
4. Tag all valves in concealed or exposed areas except isolation and by-pass valves installed adjacent to the equipment they serve.
5. Provide typewritten letter size list of applied tags and location. Frame under glass and hang where directed.

.2 Pipe Markers above Ground:

1. Install in accordance with manufacturer's instructions.
2. Seal markers with clear lacquer.
3. Identify piping in exposed or concealed areas in accordance with schedule herein.
4. Pipe marker consists of pipe contents identification with flow direction arrow tape. Provide consistent colour scheme, unless otherwise noted.
5. Wrap arrow tape completely around pipe at both ends of pipe markers.
6. Install in clear view and align with axis of piping.

7. Label piping at intervals of not more than 20 feet on horizontal and vertical runs, at each branch connection, and where pipe penetrates walls, ceilings and floors (both sides).
8. Size of label depends on outside diameter (OD) of pipe. Pipe OD includes insulation

or protective coating.

9. Minimum length of marker, including arrows:

| | |
|---|---|
| a. 2” diameter pipe or smaller: | 8” |
| b. 2” to 8”: | 12” |
| c. 8” to 10” | 24” |
| d. Over 10” | 32” |

.3 Safety Signs

1. Install in clear view.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 DESCRIPTION

.1 Comply with requirements of Mechanical General Provisions Section 15010 and Basic Materials and Methods Section 15050.

.2 Work performed by this Section: Provision of all required equipment, piping, and chemicals, for scale, corrosion, algae, and bacteriological control of chilled, heating, condenser and sprayed coil piping circuits.

### 1.2 WORK PERFORMED BY THIS SECTION

.1 Provide all required equipment, piping, wiring, and chemicals for scale, corrosion, algae, and bacteriological control of heating, and glycol piping circuits.

.2 Provision of degreasing chemicals for degreasing of all heating, and glycol system piping and equipment.

.3 Conduct water treatment analysis; supervise installation of equipment and initial start-up of treatment procedures. If, from analysis, other treatment is required, provide same but submit proposed treatment to Consultant for approval prior to start-up of any system.

.4 Supplier to provide training in use of test equipment, establish treatment ranges, and provide log sheets with training in their use.

.5 Supplier to make regular callbacks to check on procedures being followed and report each call in writing to the Consultant and City during first two year's operation. Call-backs to be in accordance with the following:

.1 Heating systems - at the beginning, mid-point and end of the heating season.

.6 Supplier to guarantee all chemical treatment equipment provided to be free of defects for two years from date of start-up.

.7 Provide operating manual indicating all phases of conditioning programs. Include detailed schematic drawings showing all special fittings, timers, controllers, etc. for each system. Six hard cover binders to be submitted to Consultant for approval.

.8 Supplier to witness cleaning of all strainers.

.9 If system is used for temporary heat, clean it as outlined below prior to use for temporary heat and then clean it again before takeover by City. During temporary heat period chemically treat system under Supplier supervision and logs maintained on chemical balances. Chemicals required during temporary heat period are to be in addition to quantities listed below.

.10 Supervision of all degreasing procedures, initial fill/start-up, commissioning and monitoring of treated systems and training of City staff in operating and maintenance procedures.

.11 Submission of a report, on completion of the Work specified in this Section of the Specifications, for the following:

.1 Results of degreasing and initial fill of treated systems.

.2 Results of treatment procedures for each system treated.

.3 Details of instructions given to the City staff and names of persons receiving instructions.

### 1.3 QUALITY ASSURANCE

.1 Qualifications: Execute work of this section only by skilled tradesmen, technicians, and manufacturers regularly employed in the administration of water piping systems chemical treatment.

.2 Acceptable manufacturers or suppliers: Dearborn, Perolin-Bird Archer, Mogul and Drew Chemical.

.3 Coordinate with City for existing chemical treatment services are in place for existing systems, all chemicals supplied under this contract shall be consistent with present chemicals and supplied by present chemical supplier.

### 1.04 SUBMITTALS

.1 Submit shop drawings on all equipment and piping arrangements and provide Material Safety Data Sheets on chemicals and degreasing compounds.

## PART 2 PRODUCTS

### 2.1 BYPASS CHEMICAL FEEDER (POT FEEDER)

.1 Provide a Neptune Model DBF-2 bypass feeder. Capacity to be 7.6 litres (2 gal.) and be rated for 1380 kPa (200 psig)

### 2.2 SIDE ARM FILTER

.1 Provide a Filterrite Model LMO B sidearm filter water on each circulation loop.
.2 Unit to be provided with cast iron head and carbon steel shell. Unit to be rated for 1200 kPa (175 psig) and 95°C (200°F).
.3 Provide new filter at system turnover as well as 12 spare 30 - 30 micron cotton filters.
.4 Unit to be provided with 316 stainless steel T-handle cover nut and 14mm (1/16") brass petcock drain.

### 2.3 FLOW INDICATOR

.1 Provide a 20mm (3/4") Filter-Mate flow indicator on each sidearm filter. Unit to have 304 stainless steel body and be equipped with metric and imperial flow scales.
.2 Unit to be rated for 1100 kPa (150 psig) and 100°C (212°F).

### 2.4 WATER TREATMENT

.1 Provide a water conditioning system to control corrosion, scaling, algae and bacteria in heating and glycol piping systems.
.2 Provide thermofluid to prevent freeze-up of piping circuits.
.3 Provide a water conditioning program complete with all required chemicals for a period of one year commencing with the start-up of the equipment and systems.
.4 Provide welding sockets where required or shown on the drawings and all piping to equipment required for water treatment such as pumps, chemical storage tanks, and include all necessary piping, valves and accessories and control wiring.
.5 Provide pot feeders on all closed piping systems for administration of chemical treatment.
.6 Use only chemicals and methods complying with local health codes that do not have a detrimental effect on non-metallic materials such as rubber, neoprene and plastic used in the piping systems. Provide nitrite/borate type inhibitors.

.7 Provide suitable corrosion test coupons installed in appropriate piping arrangements for each treated closed loop system representing the metals in the circuit. Control corrosion rates in steel piping at maximum depth of pitting of 0.127mm (0.005") of penetration per year and a maximum corrosion rate for copper tubing of 0.025mm (0.001") per year.

.8 Provide a low-flow micron sidearm pipeline filter assembly and flow indicator on the leaving side of each pot feeder.

.9 Provide a system of automatic blow-down and injection of chemicals for treatment of the condenser water circuit through a system of measuring water consumption with a contact meter to initiate an interval timer with adjustable on-off cycle time periods to control purging and chemical injection in sequence with chemical feeding by means of a diaphragm pump connected to a 170 l (45 gal.) polyethylene mixing tank. For algae control, provide a pot feeder located within the equipment room on the condenser water circuit.

.10 Do not use chemical treatment containing tin or tin compounds in any cooling tower or any other evaporative process circuits.

.11 All cleaning and flushing shall be carried out at a minimum flow rate of 80% of design. Pump on each system may be used to circulate cleaning solution. Balancing valves on pump discharges to be regulated to ensure against operating pumps out of their normal operating range.

.12 Flush each system until conductivity of water in system is back to conductivity of make-up water. If gland packed or mechanical seal pumps of permanent system are used during cleaning period, replace packing and mechanical seals with new material.

.13 All strainers to be cleaned.

.14 System to be refilled and required amount of chemical treatment added to provide immediate protection against corrosion.

.15 Supplier to conduct conductivity tests before, during, and after cleaning each system, and report procedures followed and conductivity readings to Consultant and Contractor in writing.

.16 System not to be used until cleaning procedure has been carried out and supervised by Supplier.

## 2.5 SAMPLING CONNECTIONS

.1 Provide 19mm (3/4") valved sampling connections where instructed by the City in all systems including the following:

- .1 Heating water
- .2 Boilers
- .3 Feedwater
- .4 Glycol heating

## 2.6 HOT WATER HEATING SYSTEMS

.1 Chemical Treatment

- .1 Mechanical Contractor to engage services of Water Treatment Contractor (referred to below as WTS) to conduct water treatment analysis and supervise installation of equipment and initial start-up of treatment procedures. If, from analysis, other treatment is required, provide same but submit proposed treatment to Consultant for approval prior to start-up of any system.
- .2 WTS to submit required number of shop drawings.
- .3 WTS to provide training in use of test equipment, establish treatment ranges, and provide log sheets with training in their use.

.4 WTS to make regular call-backs (every 3 months) to check on procedures being followed and report each call in writing to Consultant, Contractor and City during first two year's operation.

.5 WTS to guarantee all mechanical equipment supplied by him to be free of defects for one year from date of start-up.

.6 A complete operating manual to be provided indicating all phases of water conditioning program. Manual to include detailed schematic drawings showing all special fittings, timers, controllers, etc. for each system. Manuals to be included in Mechanical O & M Manuals.

.7 WTS to witness cleaning of all strainers.

.8 If any system is to be used for temporary heat, it is to be cleaned as outlined below prior to use for temporary heat and then cleaned again before take-over by the City. During temporary heat period system to be chemically treated under WTS supervision and logs maintained on the chemical balances. Chemicals required during temporary heat period are to be in addition to the quantities listed below.

.2 Hot Water Heating System Clean Out

.1 Each system to be flushed until conductivity of water in system is back to conductivity of make-up water.

.2 All strainers to be cleaned by the Mechanical Contractor.

.3 System to be returned to normal operation and required amount of chemical treatment added to provide immediate protection against corrosion.

.4 System not to be used until cleaning procedure has been carried out and supervised by WTS.

.5 Systems to be cleaned and flushed. A permanent system pump may be used to circulate cleaning solution.

.6 Balancing valves on pump discharges to be regulated to ensure against operating pumps out of their normal operating range.

.7 Cleaner to be introduced and circulated from 48 to 72 hours and removed from system by Contractor by dumping and flushing system. Chemicals to be recovered and disposed of in accordance with provincial regulations.

.8 Each system to be flushed until conductivity of water in system is back to conductivity of make-up water.

.9 System to be returned to normal operation and required amount of chemical treatment added to provide immediate protection against corrosion.

.10 System not to be used until cleaning procedure has been carried out and supervised by WTS.

.11 Provide 45.5 litres (10 gallons) of FERROQUEST FQ7103 Pre-operational Cleaner per 4,546 litres (1,000 gallons) of water in system.

.12 WTS is to monitor system Ph and add FERROQUEST FQ7102 neutralizer as required, to bring Ph into the 6.5 - 7.0 range.

.3 Chemical Treatment for Hot Water Heating Systems

.1 CORRSHIELD MD4102 corrosion inhibitor is to be introduced into the system through the pot feeder and left to circulate. Sufficient corrosion inhibitor is to be added to the system to bring treatment residual into recommended range. Also leave on site 20 litres (5 gallons) of CORRSHIELD MD4102 corrosion inhibitor.

.4 Chemical Feed Equipment for Hot Water Heating Systems

.1 Provide a pot feeder, sidearm filter, sight flow indicator and 1 carton of 12, 30 - 30 micron cotton filter cartridges to be installed on each system by the Mechanical Contractor under the supervision of and according to the drawings submitted by WTS.

.5 Test Equipment for Hot Water Heating Systems

.1 Provide a Molybdate test kit and log book for measuring and recording treatment residuals.

## 2.7 HOT WATER SYSTEMS

.1 General

.1 Mechanical Contractor to engage services of a Water Treatment Specialist (WTS) to conduct water treatment analysis and supervise installation of equipment and initial start-up of treatment procedures. If, from analysis other treatment is required, provide same but submit proposed treatment to Consultant for approval prior to start-up of any system.

.2 WTS to provide required number of shop drawings.

.3 WTS to provide training in use of test equipment, establish treatment ranges, and provide log sheets with training in their use.

.4 WTS to make regular callbacks every 3 months to check on procedures being followed and report each call in writing to Consultant, Contractor and City during first two year's operation.

.5 WTS to guarantee all mechanical equipment supplied will be free of defects for one year from date of start-up.

.6 A complete operating manual to be provided indicating all phases of water conditioning program. Manual to include detailed schematic drawings showing all special fittings, timers, controllers, etc. for each system. Manuals to be included in Mechanical O & M Manuals.

.7 WTS to witness cleaning of all strainers.

.8 If any system is to be used for temporary heat, it is to be cleaned as outlined below prior to use for temporary heat and then cleaned again before take-over by the City. During temporary heat period system to be chemically treated under WTS supervision and logs maintained on the chemical balances. Chemicals required during temporary heat period are to be in addition to the quantities listed below.

## 2.8 GLYCOL FEEDER SYSTEM

Hydronic system feeder shall be AXIOM INDUSTRIES LTD. Model SF100 or equal. System shall include 208-liter (55 gallon) storage/mixing tank with cover; pump suction hose with inlet strainer; pressure pump with thermal cut-out; integral pressure switch; integral check valve, cord and plug. per-charged accumulator tank with EPDM diaphragm; manual diverter valve for purging air and agitating contents of storage tank; pressure regulating valve adjustable (30-380 Kpa; 5-55 psig) complete with pressure gauge; built in check valve; union connection;12 mm (1/2") X 900 mm (36") long flexible connection hose with check valve; low level pump cut out. Pressure pump shall be capable of running dry without damage. Power supply 115/60/1 0.7 A. Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No 68.

# PART 3 EXECUTION

## 3.1 WATER TREATMENT

.1 Install test equipment cabinet as directed by the Consultant or as shown on the drawings.

.2 Install electrostatic conditioning equipment, wiring and accessories in compliance with manufacturer's instructions.

.3 Thoroughly flush and clean all water circulating systems and clean strainer baskets as often as necessary to ensure that scale, metal particles, etc. have been completely removed.

.4 As directed by the City's chemical treatment supplier, refill all systems and inject degreasants and circulate at temperatures and for periods as required to ensure that the systems are thoroughly cleaned. Flush systems and refill in preparation for administration of chemical treatment.

## 3.2 THERMOFLUID SYSTEM

.1 Locate thermofluid storage feed pump system in the mechanical room with ground loop pumps.

.2 Fill the entire heat pump piping system (inside pipe loops, storage tanks, expansion tank, and outside ground loops) with thermofluid.

## 3.3 MONITORING AND INSTRUCTIONS

.1 Advise Subtrades where drains and fill points are required in the piping systems to facilitate proper drainage and fill/injection of fluids.

.2 Carefully monitor the condition of all systems from initial fill to the point at which the systems are considered under stable operating conditions.

.3 Provide oral and written instructions to operating personnel for the maintenance and control of the water conditioning program.

.4 Submit a written report of system start-up showing water analysis and corrosion check test as part of documentation at the completion of the work.

.5 For the first two years of operation provide service calls once every thirty days and provide written reports to operating personnel showing details of each service call.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 GENERAL

.1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 15010.

### 1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 15010.

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

.3 Submit type of isolator, size, and height when uncompressed and maximum allowable static deflection weight of all isolated equipment, loads on each isolator, and static deflection of each isolator under the specific design load.

.4 Submit marked up plans indicating all locations where pipes are to be isolated in mechanical rooms and as specified.

## PART 2 PRODUCTS

### 2.1 GENERAL

.1 Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.

.2 Elastomeric elements that will be exposed to temperatures below freezing shall be fabricated from natural rubber instead of neoprene.

.3 All isolators to be installed outdoors or exposed to weather shall be hot dipped galvanized and shall be furnished with neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.

.4 Standard of Acceptance: Kinetics Noise Control, Vibro-Acoustics.

### 2.2 FLEIBLE PIPE CONNECTORS

.1 Flexible pipe connectors shall be used on all piping connected to rotating equipment (chiller, pumps, air handling equipment) to reduce the transmission of noise and Vibration, and to eliminate stresses in piping systems due to misalignment and thermal movement of the piping.

.2 Flexible connectors shall be of the single- or double-sphere molded joint configuration and shall meet or exceed specifications of the Rubber Expansion Joint Division, Fluid Sealing Association.

.3 Connectors shall be made of molded neoprene reinforced with nylon tire cord and shall have mild steel floating flanges or female union ends.

.4 Control rods shall be used with unanchored systems or with spring-mounted equipment where the pressures and movements exceed those connectors are designed to withstand.

.5 Standard of acceptance: Kinetics model Kinflex.

## 2.3 FLEXIBLE DUCT CONNECTORS

.1 Flexible Connections

1. Where duct connections are made to fans and air handling units (not internally isolated), install a non-combustible flexible connection of 822 g (29 ounce) neoprene coated fiberglass fabric approximately 150 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50 mm (2 inches) on center. Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack during operation to insure that no vibration is transmitted.

.2 Length of connection: 6".

.3 Minimum distance between metal parts when system in operation: 3".

.4 Install in accordance with recommendations of SMACNA.

## 2.4 ELASTOMERIC PADS

.1 Neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa. Mason type W.

.2 Application: between all floor-mounted pumps supports and the house-keeping pads.

## 2.5 ELASTOMETRIC MOUNTS

.1 Neoprene, moulded from oil-resistant compounds, with a cast-in-top steel load transfer plate for bolting to supported equipment and a bolt-down plate with holes provided for anchoring to the supporting structure. Isolator shall provide lateral load resistance for loads applied parallel to mounting surface. Neoprene vibration isolators shall be Mode lRQ, by Kinetics Noise Control, Inc.

.2 Application: between boilers support frames and house-keeping pads.

## 2.6 PIPE HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Swivel arrangement to permit hanger box or rod to move through a 30 deg. arc without metal to metal contact. Unless specified otherwise, the static deflection shall be 9mm, with a strain not exceeding 15%, and spring hangers to have minimum static deflection of 2". A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box such that the

hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 19mm larger than the diameter of the hanger rod.

.2 Standard of acceptance: Kinetics model SRH.

## PART 3 EXECUTION

### 3.1 INSTALLATION

.1 Provide vibration isolation for new equipment as noted in the specification, listed in the schedule and shown on the drawings.

.2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.

.3 Ensure piping and electrical connections to isolated equipment do not reduce system flexibility.

.4 All suction and discharge from the pumps shall be provided with flexible pipe connections.

.5 Unless indicated otherwise, support all piping connected to the pumps and boilers with spring equipped hangers as described in these specifications, as follows:

1. First 3 points of support.

2. First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 2".

.6 Unless specified otherwise, all pump supports will be mounted on elastomeric pads.

.7 Unless specified otherwise, the boilers, indoor air handlers, indoor chillers will be mounted on elastomeric mounts.

.8 All wiring connections to the pumps shall be made in a 360 degree loop; Minimum conduit length: 3 ft.; cut any ties used to install this loop prior to adjusting the isolators.

.9 Provide suitable supports for all equipment which does not have a frame with adequate rigidity.

.10 There shall be a minimum of 4" clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

.11 Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes or ductwork installed on vibration isolators. Such elements shall be supported on or suspended from building structure.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 GENERAL

.1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 15010.

### 1.2 QUALITY ASSURANCE

.1 Comply with OBC and NFPA 90A requirements, particularly paragraphs pertaining to the maximum flame spread index (currently set at 25) and maximum smoke development index (currently set at 50).

.2 All materials shall be compatible and suitable for service temperature and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

.3 Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

### 1.3 SUBMITTALS

.1 Submit Shop Drawings and Product Data in accordance with Section 15010.

.2 Provide the following:

1. Insulation materials: Specify each type used and state surface burning characteristics.

2. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.

3. Insulation accessory materials: Each type used.

4. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.

### 1.4 STORAGE AND HANDLING OF MATERIAL

.1 Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

### 1.5 STANDARDS OF ACCEPTANCE

.1 Knauf Fiber Glass
.2 Owens/Corning Fiberglass
.3 Armstrong
.4 Johns Manville

.5 Rockwool Manufacturing

## PART 2 PRODUCTS

### 2.1 GENERAL

.1 K-factors (thermal conductivity) shown are expressed in BTU•in/hr•ft$^2$•F.

### 2.2 FIBERGLASS PIPE INSULATION

.1 Insulation

1. Rigid molded in compliance with ASTM C547, Class 1, minimum density 3.5 pounds/cubic foot, K-factor of approximately 0.24 at 75°F, suitable for temperatures from -20°F to 450°F.

.2 Vapor Barrier

1. Factory applied vapor barrier all-service type with self-sealing lap and butt strips.

.3 Valves and Fitting Covers

1. Pre-molded PVC covers with fiber glass insert. Manufacturers: Proto Corp., Ceelco.

.4 Applications

1. All domestic cold water piping.
2. All hot water heating piping.
3. All DHW and recirculation piping.

### 2.3 INSULATION THICKNESS

| PIPE INSULATION THICKNESS | | | | | |
|---|---|---|---|---|---|
| **Service** | **Fluid Design Operating Temperature Range (°F)** | **Nominal Pipe Size Insulation Thickness** | | | |
| | | **Runouts Up To 2** | **1 & Less** | **1-3/4 To 2** | **2-1/2 To 4** |
| Dom. Hot Water & Recirc. Piping & Tempered Water | Up to 140°F (60°C) | 1” (25mm) | 1” (25mm) | 1” (25mm) | 1.5” (40mm) |
| Hot Water Heating | | 1” (25mm) | 1” (25mm) | 1” (25mm) | 1” (25mm) |
| Domestic Cold Water | 40°F to 50°F | 1” (25mm) | 1” (25mm) | 1” (25mm) | 1” (25mm) |

## 2.4 ADHESIVE, MASTIC, CEMENT

.1 ASTM C449: Mineral fiber hydraulic setting thermal insulating and finishing cement.

.2 Other: Insulation manufacturers' published recommendations.

## 2.5 MECHANICAL FASTENERS

.1 Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.

.2 Bands: 20 mm (3/4 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

## 2.6 CANVAS JACKETING

.1 Apply in concealed areas, compact, firm ULC listed heavy plain weave, cotton fabric at 220 g/m sq.

## 2.7 PVC JACKETING

.1 Apply in exposed areas on piping with operating temperatures less than 180°F (80°C).

.2 Piping: ULC listed PVC moulded type jacketing material, gloss white complying with 25 Flame Spread and 50 Smoke Developed ratings.

.3 Fittings: ULC listed PVC, gloss white, 1-piece, pre-moulded fittings complying with 25 Flame Spread and 50 Smoke Developed ratings.

.4 PVC Application: strictly in accordance with the requirements of Authorities having jurisdiction.

.5 Ultraviolet resistant.

.6 Fastenings: To manufacturer’s standard(s).

## 2.8 METAL JACKETING

.1 At all locations where the pipe is located outdoors or in heavy abuse areas, use metal jacketing to protect piping or ductwork insulation.

.2 Jacketing: Aluminum, 0.016” thick, embossed surface with factory bonded moisture barrier.

.3 Valve and Fitting Insulation Covers: Fabricate from same material as jacketing or use prefabricated insulation covers made in two matching halves.

.4 Metal Jacketing Bands: 0.5” wide, aluminum or stainless.

### 2.9 PROTECTION SADDLES AND SHIELDS

.1 Provide factory engineered galvanized steel hanger shields on horizontal insulated pipe complying with MSS SP-58 and MSS SP-59 standards for gauge and length of saddle.

### 2.10 SADDLES (PIPING/TUBING UP TO 2 INCHES)

.1 Use 180 degree saddle on systems utilizing teardrop type hangers.

.2 Use 360 degree saddle on systems utilizing trapeze hangers or clamps.

### 2.11 INSERTS AND SHIELDS (PIPING/TUBING OVER 2 INCHES)

.1 Use 360 degree calcium silicate insert with a 180 degree shield on systems utilizing clevis or teardrop type hangers.

.2 Use 360 degree calcium silicate with a 360 degree shield on systems utilizing trapeze hangers or clamps.

.3 The unit shall have an integral moisture barrier consisting of a tri-laminate All-Service Jacket equal and similar to the jacketing on the adjoining insulation.

.4 Insert: Calcium silicate, minimum density 9 psi.

## PART 3 EXECUTION

### 3.1 EXAMINATION

.1 Verify that items to be insulated have been pressure tested and approved before applying insulation material.

.2 Verify that surfaces are clean, foreign material removed, and dry.

### 3.2 INSTALLATION – GENERAL

.1 Install materials in accordance with manufacturer's instructions.

.2 Required pressure tests of piping joints and connections shall be completed and the work approved by the Consultant for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.

.3 Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories). Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.

.4 Insulation materials shall be installed with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating

temperature 16°C (60°F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6”).

.5 Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.

.6 Insulation on hot piping and equipment shall be terminated square at items not to be insulated, such as access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.

.7 Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.

.8 Piping work not to be insulated:

1. In hot piping: Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.

.9 Plumbing work not to be insulated:

1. Piping and valves of fire protection system.
2. Chromium plated brass piping.
3. Piping in pipe basement serving wall hydrants.
4. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).

.10 Work shall be performed by qualified insulation journeymen.

.11 Apply insulation and coverings on hot piping while surface is between 50 to 60°C.

.12 Vapor barriers and insulation to be complete over full length of pipe or surface, without penetration for hangers, and without interruption at sleeves, pipe and fittings.

.13 Do not insulate factory-insulated equipment.

.14 Do not insulate nameplates.

.15 Fit insulation tightly against surface to which it is applied.

.16 For non-fire rated barriers (e.g., wall, floor, ceiling, or roof) continue insulation and vapor barrier through penetrations. For fire rated barriers, provide ULC/FM approved through penetration stop systems.

.17 Weatherproof outdoor installations of piping or ductwork covered with aluminum jacket.

Provide watershed lap joints and seal with mastic as required.

.18 Do not install metal jacketing with raw edges; provide a safety edge.

## 3.3 INSTALLATION – PIPING

.1 On exposed piping located in finished areas, locate cover seams in least visible area.

.2 Provide continuous insulation through pipe hangers or supports. Do not notch insulation. Provide shields or saddles to prevent crushing insulation.

.3 Where insulation terminates, taper to pipe and finish with insulating cement or acrylic mastic.

.4 Cover insulated pipes located outdoors or in utility tunnels with aluminum jacket. Secure with aluminum bands and screws as required.

.5 Tape circumferential joints of pipe insulation with 3” wide white vinyl tape.

.6 Insulate fitting and valves where required with same material thickness as specified for adjacent pipe.

.7 Insulate potable and non-potable cold water piping within walls, chases, or ceiling plenums where return air is present.

.8 Insulate potable and non-potable cold water piping in equipment rooms.

.9 Do not insulate unions, flanges and valves in potable or non-potable piping systems of 140°F or less, except for chilled water.

.10 Vertical pipe over 3" diameter: use insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter locate on 12 feet centers and at each valve and flange.

.11 Expansion joints: Terminate single layer and each layer of multiple layers in straight cut. Leave space of 1" between terminations. Pack void tightly with glass wool. Protect joints with aluminum sleeves.

.12 Use factory fabricated, easily disassembled insulation, for valves, fittings and process equipment requiring periodic maintenance of parts and sub-assemblies listed or indicated.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 GENERAL

.1 This section of the specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 15010.
.2 Conform to Sections of Division 1 as applicable.
.3 All valves must have a valid CRN Number. Statutory declaration must be provided on request.

### 1.2 REFERENCE STANDARDS

.1 Do the work in accordance with the Ontario Building Code Plumbing Code and local authority having jurisdiction.
.2 ASTM B32 – 2008 - Specifications for Solder Metal.
.3 ASTM B306 – 2009 - Specifications for Copper Drainage Tube (DWV).
.4 ASTM B62-09 - Specifications for Composition Bronze or Ounce Metal Castings.
.5 ASTM B88, ASTM B88M – 2003 - Specifications for Seamless Copper Water Tube.
.6 ASTM A74 – 2009 - Specification for Cast Iron Soil Pipe and Fittings.
.7 ASTM C564 – 2009 - Specification for Rubber Gasket for Cast Iron Soil Pipe and Fittings.
.8 ANSI/ASME B16.5-2005 - Pipe Flanges and Flanged Fittings.
.9 ANSI/ASME B16.11-2009 - Forged Fittings, Socket Welding.
.10 ANSI B16.29.
.11 CAN3-B79-94 - Floor Drains and Trench Drains.
.12 CAN/CSA-B45 Series-02 - CSA Standards on Plumbing Fixtures.
.13 CSA B70 – 2006 - Specifications for Cast Iron Soil Pipe Fittings and Means of Joining.
.14 CSA B125 – 2005 - Specifications for Plumbing Fittings.
.15 CSA B242-M80 - Groove and Shoulder Type Mechanical Pipe Couplings.
.16 MSS SP 67-2002 - Butterfly Valves.
.17 MSS SP 70-2006 - Cast Iron Gate, Globe, Angle and Check Valves.
.18 MSS SP 71-2005 - Cast Iron Swing Check Valves Flanged and Threaded Ends.
.19 MSS SP 80-2003 - Bronze Gate, Globe, Angle and Check Valves.
.20 PDI-G101 - Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
.21 PDI-WH201 - Water Hammer Arrestors.

### 1.3 SUBMITALS

.1 Product Data / Shop Drawings:

.1 Submit product data in accordance with Section 15010 - Mechanical General Requirements.
.2 Indicate dimensions, construction details and roughing-in dimensions for the following: all fixtures and trim, floor drains, cleanouts, water hammer arrestors, strainers, traps, trap seal primers, valves.

.1 Provide shop drawings for all grooved end components.
.2 All grooved end components shall be provided by one manufacturer.

.2 Maintenance Data:

.1 Provide maintenance data for incorporation into manual specified in Section 01300 - Administrative Requirements.
.2 Data to include:

1. Description of plumbing fixtures and trim giving manufacturers name, type, model, year capacity and flow.
2. Details of operation, servicing and maintenance.
3. Recommended spare parts list.

# PART 2 PRODUCTS

## 2.1 EMERGENCY EYEWASH:

.1 Haws Model 7360BTWC eye/face wash with 280 (11") diameter stainless steel bowl, twin plastic wash heads with flip covers and push handle, anodized aluminum mounting bracket and trap, and a fully serviceable in-line strainer
.2 Supply: 12mm (½").
.3 32mm (1¼") tailpiece and trap assembly.

## 2.2 PLUMBING FIXTURES AND TRIM

.1 GENERAL

.1 Manufacture plumbing fixtures in accordance with CAN/CSA-B45 Series. Conform to latest code requirements for water saving features noted in the Ontario Building Code.
.2 Manufacture plumbing fittings in accordance with CAN/CSA-B125.
.3 Architectural drawings to govern in determination of number and location of fixtures.
.4 Trim in any one washroom or location to be product of one manufacturer and of same type, unless otherwise noted.
.5 Exposed plumbing to be chrome plated.
.6 The type number and letter allocated to each style of fixture identifies that particular fixture on Mechanical Drawings.
.7 Under this Contract, supply and install all plumbing fixtures denoted under Section 2 – Products.

## 2.3 DRAINAGE PIPING AND VENT

.1 COPPER TUBE AND FITTINGS

.1 For all above grade vent, sanitary, and storm piping, Type DWV to:

1. ASTM B306 - Specification for Copper Drainage Tube (DWV).
2. CSA B158 for cast brass fittings.
3. ANSI B16.29 for wrought copper fittings.
4. Solder: tin-lead, 50:50, to ASTM B32, type 50A - Specification for solder metal.
5. ASTM B88.
6. ASTM C564.

.2 CAST IRON PIPING AND FITTINGS

.1 For above grade storm, sanitary and vent piping, minimum NPS 3, to CSA B70, ASTM A74 with heavy bituminous coating.

.2 For above grade storm, sanitary and vent piping 4" (100 mm) size and larger: Cast iron.

.3 For storm, sanitary and vent piping joints.

1. Mechanical Joints:
   a. Neoprene of butyl rubber compression gaskets for all pipe connections: to ASTM C564-2009.
   b. SS Clamps.

.3 PUMPED DRAINAGE

.1 Pumped drains shall be galvanized steel

.4 SANITARY DRAINAGE AND VENTS

.1 Piping and fittings.

.2 For buried sanitary, storm, and vent piping:

1. ASTM D2665, ASTM D2949, ASTM B251.
2. ASTM D3034, ASTM F891.
3. CAN/CSA- B181.2 for PVC DWV or
4. CAN/CSA B182.1- for plastic DWV.

.3 Joints

1. Solvent weld for PVC: to ASTM D2564.
2. Solvent weld for ABS: to ASTM D2235.
3. For sizes above 4” (100 mm), provide Ring-Tite joints Canron Ring-Tite joints PVC DR35 gravity sewer pipe, with locked in rubber ring sealing feature providing tight flexible seal. Spigot ends to be supplied complete with bevel.

.4 All PVC piping below grade shall be a minimum of SDR 35.

## 2.4 PLUMBING SPECIALTIES AND ACCESSORIES

.1 GENERAL

.1 Furnish plumbing and drainage specialties. Ancon catalogue numbers are specified to indicate quality and features required. Furnish sizes as shown on Drawings.
.2 Acceptable Manufacturers: Ancron, Zurn, Empoco.

.2 FLOOR DRAINS

.1 New floor drain shall be Zurn Z 400H – 6/9H or Wade 110 – FC6/9. Seal around pipe with Astromastic 100. Complete installation shall be in accordance with flooring manufacturer's instructions.

.3 FLOOR DRAIN TRAPS AND PRIMERS

.1 Furnish each floor drain installation with a deep seal "P" trap unless otherwise shown.
.2 Furnish trap seal primer valves Ancon No. M3-810 with cast brass body, vacuum breaker and NPS 1/2 sweat connections.
.3 Where a floor drain trap is not within a reasonable distance from a plumbing fixture, furnish an automatic flush tank for priming of trap, Crane No. 7-170 1/2 L, or American Standard No. AF-4104L, complete with automatic syphon, tank liner, concealed top cover, bottom supply and screw driver stop.
.4 As an alternative to automatic flush tanks for remote floor drains, furnish ZURN Model Z1022 trap primers and distribution units, as supplied by S-M-S Ltd.

.4 DRAINAGE CLEANOUTS

.1 Furnish drainage cleanout fittings in drainage piping at locations indicated on the Drawings, at base of each vertical stack or rainwater leader, and as required to comply with applicable plumbing code.
.2 For buried piping furnish flush floor type cast iron ferrule cleanout with push-on, MJ, inside caulked or spigot connection outlet, closure plug and nickel brass frame and cover suitable for type of floor in which it is to be installed, e.g. tile, terrazzo, carpet, concrete, etc.

.5 SHOCK ABSORBERS

.1 Size shock absorbers in accordance with P.D.I.-WH201:
Ancon "Shok-Gard"
Zurn Z-1700
Enpoco HT Series

## 2.5 DOMESTIC WATER PIPING

.1 PIPING

.1 Domestic hot, cold and recirculating tubing, within building:

1. Above ground: Copper tube, hard drawn, Type L: to ASTM B88M.
2. Buried: Copper tube, soft annealed, Type K: to ASTM B88M.

.2 All piping shall have certification markings for compliance with ASTM B88.

.2 FITTINGS

.1 Brass or bronze flanges and flanged fittings: to ANSI B16.24.
.2 Brass or bronze threaded fittings: to ANSI B16.15.
.3 Cast bronze to ANSI B16.18- 1984 or wrought copper and bronze to ANSI B16.22.

.3 JOINTS

.1 Rubber gaskets, 0.063" (1.6 mm) thick: to AWWA C111-95.
.2 Bolts, nuts, hex head and washers: to ASTM A307-92a-07b, heavy series.
.3 For installation of the potable water system only lead free solder shall be used in accordance with Ontario Building Code Standards.
.4 Solder, tin antimony, 95:5: to ASTM B32.

.4 GROOVED COPPER METHOD

.1 Application

1. Grooved piping system may be used in lieu of flanged or sweated copper in size 2" (50 mm) and larger. Couplings shall be designed with angle bolt pads to provide a rigid joint, complete with EPDM flush seal gasket suitable for temperatures from -30°F to 230°F (-34°C to 110°C).

.2 Fittings

1. Housing: ductile iron conforming to ASTM-A536, Grade 65-45-12.
2. Coating: rust inhibiting lead free paint.
3. Bolts and nuts: heat treated, zinc electroplated carbon steel oval-neck track bolts conforming to ASTM A-183 and zinc electroplated carbon steel heavy hex nuts conforming to ASTM A-563.
4. Hinge Pin: carbon steel.
5. Gaskets: in accordance with ASTM D-2000. Grade E: EPDM rated for service between -30°F and 230°F (-34°C to 110°C).
6. Copper Fittings: Copper per ASTM B-75 and ASTM B-584.
7. When connecting dissimilar metals in liquid systems from grooved end steel (IPS) to Copper (CTS) provide a dielectric waterway between the two materials.

.3 Standard of Acceptance: Victaulic, Anvil.

.5 GROOVED END BUTTERFLY VALVES

.1 NPS 2 1/2 and over, grooved ends:

1. Class 300, bubble tight shut off to 300 psi (2065 kPa) bronze body.
2. Operators:

a. NPS 4 and under, lever handle.
b. NPS 6 and over, gear operated.

3. Standard of Acceptance: Victaulic Series 608, Grinnell. Mueller.

.6 GATE VALVES

.1 Gate valves shall only be utilized where specifically noted on the drawings. For all other shut off valve applications utilize ball valves for 2" (50 mm) or smaller and butterfly valves for 2.6" (65 mm) and larger.

.2 NPS 2 and under, soldered:

1. Non-rising stem to MSS SP-80, Class 125, 860 kPa, bronze body, screw-in or bolted bonnet.
2. Standard of Acceptance: Jenkins, Crane, Toyo 281, Kitz 41, Grinnell.

.3 NPS 2 and under, screwed:

1. Rising stem: to MSS SP-80, class 125, 860 kPa, bronze body, solid wedge disc.
2. Standard of Acceptance: Jenkins, Crane, Toyo 293, Kitz 24, Grinnell.

.4 NPS 2-1/2 and over, in mechanical rooms, flanged:

1. Rising stem: to MSS SP-70, class 125, 860 kPa, FF flange, cast-iron body, OS&Y bronze trim.
2. Standard of Acceptance: Jenkins, Crane, Toyo 421, Kitz 72, Grinnell.

.5 NPS 2-1/2 and over, other than mechanical rooms, flanged:

1. Non-rising stem: to MSS SP-70, class 125, 860 kPa, FF flange, cast-iron body, bronze trim, bolted bonnet.
2. Standard of Acceptance: Jenkins, Crane, Toyo 415, Kitz 75, Grinnell.

.7 GLOBE VALVES

.1 NPS 2 and under, balancing, soldered:

1. To MSS SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet.
2. Lockshield handles: as indicated.

3. Standard of Acceptance: Jenkins, Crane, Toyo 222, Kitz 10, Grinnell.

.2 NPS 2 and under, balancing, screwed:

1. To MSS SP-80, class 125, 860 kPa, bronze body, screwed over bonnet, renewable composition disc.
2. Lockshield handles: as indicated.
3. Standard of Acceptance: Jenkins, Crane, Toyo 220, Kitz 09, Grinnell.

.8 SWING CHECK VALVES

.1 NPS 2 and under, soldered:

1. To MSS SP-80, class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
2. Standard of Acceptance: Jenkins, Crane, Toyo 237, Kitz 23, Grinnell.

.2 NPS 2 and under, screwed:

1. To MSS SP-80, class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
2. Standard of Acceptance: Jenkins, Crane, Toyo 236, Kitz 22, Grinnell.

.3 NPS 2-1/2 and over, flanged:

1. To MSS SP-70, class 125, 860 kPa, cast iron body, FF flange, regrind renewable seat, bronze disc, bolted cap.
2. Standard of Acceptance: Jenkins, Crane, Toyo 435, Kitz 78, Grinnell.

.9 BALL VALVES

.1 NPS 2 and under, branch isolators, screwed:

1. 600 WOG, bronze body, solid chrome plated bronze ball, with Teflon seal.
2. Ball valves shall have full port opening.
3. Standard of Acceptance: Jenkins, Crane, Toyo 5044A, Kitz 58, Grinnell, Apollo.

.10 AUTOMATIC CIRCUIT BALANCING VALVES

.1 Circuit balancing valves shall be of the automatic variety. Manual circuit balancing valves will not be accepted.
.2 Circuit Balancing Valves are required on the domestic hot water recirculation system.
.3 Provide the following sizes:

1. Provide 0.032 l/s (0.5 gpm) for 12 mm pipe size.
2. Provide 0.063 l/s (1.0 gpm) for 20 mm pipe size.

.4 Product Warranty and Performance Guarantee

1. Valves shall be warranted by the manufacturer to be free of defects in material and workmanship for a period of five years.
2. Valves shall control flow to within plus/minus 5 percent of design over an operating differential range of at least 14 times the minimum required for control. Four operating pressure ranges shall be available with the minimum range requiring less than 3 psid to actuate the mechanism.
3. The valve flow curve shall be smooth over its entire nominal control range. Gaps, bumps and dips in flow curves shall not be acceptable.

.5 Shop Drawing Submission

1. The Balancing Valve Manufacturer shall submit a complete list of balancing valves, their location and their performance.
2. The Balancing Valve Manufacturer shall mark up a set of full size plans showing the location of each balancing valve and assign an appropriate identification tag for the balancing valve.
3. The Balancing Valve Manufacturer shall submit these drawings for the Consultant to review, incorporate any comments from the Consultant and then submit copies of this drawing to the Mechanical Contractor, Mechanical Consultant, Architect and Construction Manager.
4. All balancing valves shall be shipped to site with this tag number firmly attached to the valve and the full size drawings shall be utilized to identify the location where they are to be installed.

.6 Valve Flow Control Cartridge (typical for all valves)

1. The non-adjustable flow control cartridge shall be 100% stainless steel. Parts made of soft metals such as brass with only a coating of hard metal such as nickel shall not be allowed. Rubber based materials whose properties change with temperature and pressure shall not be allowed.
2. The cartridges shall have segmented ports through which water can pass, rather than a continuous large port, to eliminate noise and full travel linear coil spring.
3. The cartridge movement shall result in a shearing action that will dislodge or shear any particle that may tend to get stuck in a port.
4. Cartridge shall be removable from the housing and shall be held in place in the housing without adhesive.
5. All flow control cartridges shall be warranted by the manufacturer for five years from the date of sale.

.7 Sizes 40 mm and smaller:

1. Valves shall have forged brass bodies and stainless steel cartridge assembly rated for a minimum of 230 psi/250°F.

.8 Valve end connections shall be either female sweat or FPT.
.9 Valves shall be provided with two pressure/temperature taps.
.10 Valves shall be provided with a union tailpiece and built in isolation valve.

.11 The body design shall allow for inspection or removal of the cartridge without disturbing piping connections.
.12 The valve shall come fully assembled and shall be permanently marked to show direction of flow and shall have a body tag to indicated flow rate and model number.
.13 Provide a shut off valve upstream of the valve to allow the system to be shut off and the balancing valve to be removed without shutting down the entire heating system.
.14 Standard of Acceptance: Griswold Isolator R valve.

# PART 3 EXECUTION

## 3.1 DRAINAGE PIPING AND VENT

.1 INSTALLATION

.1 Install piping parallel and close to walls to conserve space, and to grade indicated, and to suit installation of related work.
.2 Apply two coats of asphalt paint to pipe laid in, or passing through concrete.
.3 Where piping passes through floor or wall below grade pack and seal in concrete complete with Link Seal in accordance with Section 15010.
.4 PVC piping shall not be utilized above grade. The PVC piping shall convert to cast iron/copper prior to the point where it penetrates the floor slab.
.5 Provide venting to plumbing fixtures and fixture groups in accordance with the Ontario Building Code - Plumbing Code and local authorities having jurisdiction.
.6 Install buried pipe on 6" (150 mm) bed of clean sand, shaped to accommodate hubs and fittings, to line and grade as indicated. Backfill with clean sand.
.7 Install piping parallel and close to walls to conserve space and to grade indicated, and to suit the installation of related work.
.8 Apply solvent to male end of joints only.
.9 Pipe installation: Pipe shall be installed as specified and indicated on the drawings.
.10 The piping system shall be installed in accordance with the manufacturer's current published installation procedures.
.11 Where piping passes through floor or wall below grade pack and seal in concrete in accordance with Section 15010.
.12 Provide venting to all plumbing fixtures and fixture groups in accordance to the Ontario Building Code - Plumbing Code and local authorities having jurisdiction.
.13 If tests are required by an authority having jurisdiction, perform tests in presence of each governing authority and obtain certification. Repeat tests as often as necessary to obtain certification.
.14 Test pressure shall not exceed 1-1/2 times the maximum rated pressure of the lowest related element in the system.
.15 Remove all fittings which do not withstand test pressure, replace and retest.
.16 Eliminate leaks, or remove and refit defective parts.

.2 TESTING

.1 The drainage and vent system shall be tested in accordance with the Ontario Building Code - Plumbing Code and tested in accordance with the requirements of the authority having jurisdiction, perform tests in the presence of each governing authority and obtain certification. Repeat tests as often as necessary to obtain certification.
.2 Perform tests before piping is covered or concealed.
.3 Remove all fittings which will not withstand test pressure, and replace after test.
.4 Eliminate leaks, or remove and refit defective parts.

## 3.2 PLUMBING SPECIALTIES AND ACCESSORIES

.1 INSTALLATION

.1 Install in accordance with Canadian Plumbing Code, provincial codes and local authority having jurisdiction except where specified otherwise.
.2 Install in accordance with manufacturer's instructions and as specified.

.2 CLEANOUTS

.1 In addition to those required by code, and as indicated, install at base of all soil and waste stacks and rainwater leaders and where 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.

.1

.3 TRAP SEAL PRIMERS

.1 Install trap seal primer valve in cold water supply line to nearest plumbing fixture (preferably a water closet) and run NPS 1/2 Type K copper piping to primer connection on floor drain body. Obtain Minister's Designee's approval for location of primer valves prior to installation.
.2 Install trap primer tank in truss space or other suitable location as directed by ORC Designee, or as shown on Drawings.
.3 (Install in access pit as indicated).

.4 COMMISSIONING

.1 After start-up, test, adjust and prove operation as indicated, to suit conditions.
.2 Clean out strainers periodically until clear.
.3 Clean out and prime all floor drain traps using trap seal primers or other means

acceptable to the Canadian Plumbing Code.

.4 Prove freedom of movement of cleanouts.

## 3.3 DOMESTIC WATER PIPING

.1 INSTALLATION

.1 Connect to fixtures and equipment in accordance with manufacturer's instructions.

.2 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.

.3 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.

.4 Lay buried tubing in accordance with AWWA Class "B" bedding.

.5 Isolate equipment, fixtures and branches with ball valves.

.6 New or repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority having jurisdiction or in the absence of a prescribed method as follows:

1. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.
2. The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million (200mg/l) of chlorine and allowed to stand for three (3) hours.
3. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.
4. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

.7 Compression fittings are not acceptable.

.8 All valves packing shall be asbestos free.

.9 Provide isolation valves on all main branch feeds to each washroom group.

.10 Install all grooved end components as per manufacturer's latest recommendation.

**END OF**

- **PART 1 GENERAL**

**1.1 GENERAL**

.1 Conform to the General Provisions For Mechanical Section 15010 and Basic Materials and Methods Section 15050.

.2 Furnish and install base bid Electrical Precision Boiler, expansion tank, unit heaters, hydronic pumps, pipes and tubing, etc. as per listed specifications.

**1.2 SUBMITTALS**

.1 Submit shop drawings and product data in accordance with Section 15010 for the following:
- .1 Catalogue cuts / Diagrams / Descriptions
- .2 Sizing calculations
- .3 Equipment, capacity, piping, and connections
- .4 Installation Instructions
- .5 Installation Drawings
- .6 Copy of product warranties
- .7 Pipe and equipment supports
- .8 Pipe and tubing, with specification, class or type, and schedule
- .9 Pipe fittings, including miscellaneous adapters and special fittings
- .10 Flanges, gaskets and bolting
- .11 Valves of all types
- .12 Strainers
- .13 Flexible connectors for water service
- .14 Pipe alignment guides
- .15 Expansion joints
- .16 Expansion compensators
- .17 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes
- .18 Shop drawings shall indicate location of supply and return hook-ups in addition to interconnection details for each zone

.2 Maintenance Data:
- .1 Provide maintenance data for incorporation into maintenance manual specified in Section 15010.

**1.3 CODES AND APPLICABLE STANDARDS**

.1 All products furnished under this Section shall conform to the requirements of The National Fuel Gas Code, ANSI Z223.1 / NFPA-54 where applicable and shall comply with and be listed to UL 1738, the U.S. Standard for Venting Systems for Gas –Burning Appliances, Category II, III and IV and ULC-S636-95, the Canadian Standard for Type BH gas vent systems. Components coming in direct contact with products of combustion shall carry the appropriate UL or cUL.

**1.4 WARRANTIES**

.1 The Manufacturer shall warrant the Positive Pressure Vent System against defects in material and workmanship for a period of 15 years from the date of original installation. Any portion of the vent repaired or replaced under the warranty shall be warranted for the remainder of the original warranty

period.

## PART 2 PRODUCTS

### 2.1 BOILERS (DOMESTIC HOT WATER HEATING SYSTEM)

Tag(s): BLR1, BLR2

.1 GENERAL

.1 GENERAL

A. Conform to General Provisions for Mechanical Divisions and Basic Materials and Methods Section.

.2 SUBMITTALS

A. Submit shop drawings and product data in accordance with City requirement.

B. Indicate the following: complete specifications; wiring diagrams (showing all interconnections); weight; performance details.

C. Provide data for inclusion in the Operating and Maintenance manuals in accordance with City requirements.

.2 PRODUCTS

.1 GENERAL

A. Furnish where shown on the plans gas fired hot water condensing boilers manufactured by Viessmann. Acceptable equals shall be DeDietrich or Raypak.
B. Boiler shall be CSA approved and shall be built in compliance with ASME Section IV, carrying the "H" stamp. All individual components shall be accepted as part of the system under the governing body having jurisdiction. Field approval shall not be required for any component.
C. The boiler vent system shall meet Category IV venting requirements. The vent material shall be UL/ULC/CSA listed for Category IV, made of either stainless steel or polypropylene (PPs), and be water and gas tight. Sidewall venting applications shall be acceptable.
D. The boiler shall have the following approvals and listings, or be in compliance with CSA, CRN, ASME, and AHRI

.2 CONSTRUCTION

A. The boiler shall include a single compact heat exchanger made of high-alloy stainless steel, designed based on the laminar heat transfer principle for high operational reliability and a long service life. A radial design shall be used to obtain maximum heat transfer performance in a single pass. Rectangular design of the coil is required to maximize the coil gap length and ensure maximum utilization of the heat exchanger surface. Defined gaps (0.8 mm) between coil passes sized to promote laminar flue gas flow for efficient heat transfer. The heat exchanger design shall allow for self-cleaning functionality.

B. The burner shall be constructed from high-grade stainless steel for universal use with natural gas or propane gas. Burner ignition shall be by a direct spark ignition system. The boiler shall be equipped with a digital boiler control unit interface.

C. The burner shall be capable of operating at altitudes of up to 10,000 ft. (3,000 m) without change of orifices, but through the adjustment of a coding address.

D. Wire and cable entry to boiler shall be facilitated by strain reliefs to protect electrical wires. All controls, relays, transformers, ignition module, wiring, and redundant seat combination gas valve shall be installed behind the boiler enclosure.

E. The boiler shall be rated for zero (0") clearance to combustibles, including its vent system.

F. The burner shall be capable of operating at natural gas pressures from 4 up to 14" W.C., and propane gas pressure of 10 up to 14" W.C.

G. Burner safeties shall include a manual reset fixed high limit and low water cut-off.

H. Provide a refillable neutralization kit with granular pellets designed to neutralize condensate. Treated condensate shall be non-corrosive with a PH of 6.5 or higher.

I. Each boiler shall be provided with circulator pumps.

.3 DESIGN PERFORMANCE

A. Boiler performance shall be as scheduled with capacity and efficiency ratings based on actual operating conditions.

B. Turn-down ratio shall be 4:1.

C. Combustion efficiency shall not be below 95.0% and thermal efficiency shall not be below 95.0% as tested to U.S. Standard ANSI Z21.13/CSA 4.9.

D. ASME maximum allowable working pressure (MAWP) shall be 60 psig.

E. ASME maximum water temperature (Fixed High Limit): 210°F (99°C).

F. Maximum boiler operating temperature (Adjustable High Limit): 185°F (85°C).

G. Provide a bronze safety pressure relief valve sized for maximum set pressure of 30 psig.

H. Boilers to be complete with multiple boiler low loss distribution manifold that allows two to eight Vitodens 200-W B2HA/B2HB boilers to be fully assembled, wired and piped prior to the installation. The distribution manifolds are free standing and shall be mounted to a floor capable of handling the weight of a fully assembled operational unit.

.4 CONTROLS AND OPERATION

A. The standard control options shall be able to operate independently, or integrate with building management system protocols as referenced in this control section.

B. Boiler control module shall include of a 5 inch color touch screen monitor with the following features:

- EPROM memory shall be maintained during loss of main power
- PID based control algorithms
- LON ready with integrated Viessmann LON communication module
- Quick connect plug & play system for low voltage controls
- Supports the following output devices: (1) domestic hot water pump; (1) domestic hot water recirc pump; (2) low temperature heating loop circulation pumps in conjunction with mixing valves; (2) heating loop modulating mixing valves

C. The control interface shall be a digital display capable of displaying temperatures as °C or °F, with menu driven selection functions, and access to the following operating points:

- All system temperatures and set points
- Alarm fault messages with failure alarm contact closure
- Domestic hot water temperature set point adjustment
- Boiler operating hours
- Scheduling and multi boiler run time sharing functions
- Number of burner starts
- Operating status check
- Emission/service test switch (TUV)
- Slope and shift adjustment for heating curve
- Operating condition scans
- Maintenance requirement status
- Integrated boiler flue gas temperature sensor
- Quick heat up and quick set-back functions
- Start-up and shut-down optimization functions

D. The following dry contact inputs shall be available to be wired to each boiler to control the following functions (functionality dependent on operating mode):
- Boiler disable
- Change between modulating to staged burner control
- External heat demand
- Boiler sequencing
- External enable
- External blocking
- Heating program changeover

E. Boiler control system shall include both outdoor reset capabilities and cascadable capabilities as part of a multi boiler system (up to a maximum of 8 boilers using the Viessmann LON protocol).

F. For standalone operation the control unit shall provide control for a boiler with one high temperature circuit and two mixing valve circuits with the integrated mixing valve module, using a digital weather responsive reset. System components shall use the Viessmann LON communication protocol. Outside temperature, room set point temperature and boiler operating mode functions shall be used to calculate outdoor reset temperatures.

G. In cascade operation each boiler is supplied with an integrated LON card for communication between boilers, via the Viessmann LON Protocol. In cascaded operation one boiler will be selected and programmed as the 'Lead Boiler' (primary) with the remaining boilers being programmed as 'Lag Boilers' (secondary). The boilers shall be controlled by a set point temperature generated through the 'Lead Boiler' (primary) and delivered to the cascade system via the Viessmann LON protocol. The 'Lead' (primary) control unit shall provide control for a heating

system with one high temperature circuit and two mixing valve circuits with the integrated mixing valve module, using digital weather responsive reset.

H. Boiler System Supply Water Temperature Control

- Each controlled zone shall have a calculated heating curve which describes the required supply water temperature at different outside air temperatures. The slope and shift of each heating curve shall be adjusted to fit any type of building or system. The highest required temperature of all zones shall be used in conjunction with an optional room temperature sensor to determine the common boiler supply temperature set-point.
- In the unoccupied mode, the supply water temperature set-point shall be reduced by a pre-determined amount. A call for domestic hot water or an external demand signal shall override this set-point to pre-determined values.
- Control logic shall be equipped to protect the heating system from freeze-up if left powered during the off season.

.5 WARRANTIES

A. The boiler manufacturer shall warrant each boiler for a period of eighteen (18) months from date of shipment or twelve (12) months from date of start-up, whichever occurs first. All defective items shall be replaced with no charge for the one (1) year period. This warranty shall cover both parts and labor on all components assembled and furnished by the boiler manufacturer.

.6 START-UP, INSTRUCTION AND WARRANTY SERVICE

B. The boiler manufacturer or their representative shall provide start-up, instruction and warranty service of each new boiler, including burner and boiler control system. Start-up, instruction and warranty service shall cover all components assembled and furnished by the manufacturer.

C. The boiler manufacturer or their representative shall provide the complete commissioning of equipment as well as instructions to the owner's personnel concerning operation and maintenance. Provide a written start-up report on the following items:

- Indoor ambient air temperature
- Flue gas temperatures at both high and low fire conditions
- Stack draft
- Amount of carbon monoxide (smoke), carbon dioxide and oxygen in the flue gas at both high and low fire conditions
- Entering and leaving water and steam temperatures and pressures
- Record of all control settings

.3 EXECUTION

.1 INSTALLATION

A. Install units on a flat surface.

B. Coordinate all power requirements with equipment supplier for boiler(s) and any special remote mounted control expansion modules (install by contractor). Control expansion modules require a 120 volt / 60Hz power supply which can be connected to power terminal on boiler or they can be fed from a separate 120 volt power supply (install and power wiring by installing contractor).

C. Provide components furnished as per manufacturer's literature.

D. Provide all water piping so boilers and water circuits are serviceable, without having to dismantle excessive lengths of pipe.

E. Provide valves in water piping upstream and downstream of the boilers for maintenance and to balance and trim the system.

F. Provide drain valves and vent cocks to each water connection.

G. Provide strainers ahead of all pumps and automatic modulating valves.

H. Provide certified wiring schematics to the electrical division for the chiller, associated equipment and controls.

I. Provide all necessary control wiring as recommended by the manufacturer.

**Approved Manufacturer:**

A. **Viessmann Vitocrossal 200 CI2-500**

B. **De Dietrich**

## 2.2 HYDRONIC PUMPS – VERTICAL IN LINE

Tag(s): Primary: BLR1_PMP, BLR2_PMP
Secondary: HTGP_PMP1, HTGP_PMP2, HTGP_PMP3
Recirculation domestic hot water pump: DHW_RPMP
Heat recovery pump: HPL_PMP4

.1 GENERAL DESCRIPTION

.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

.2 SUMMARY

A. This Section includes the following:

- Rigidly coupled, vertical in-line centrifugal pumps.
- Closed coupled, vertical in line centrifugal pumps.

.3 DEFINITIONS

A. CSC: Carbon vs. Silicon Carbide

B. STC: Solid Tungsten Carbide

.4 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves. Pumps shall be non-overloading thru out the operating curve.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

- Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system Requirements.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Pump Manufacture shall be ISO certified, and Six Sigma rated.

.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion solution after assembly and testing. Protect flanges, pipe openings, and nozzles with plastic cover over entire pump.

B. Store pumps in dry location. Rotate Motor & Impeller routinely for long storage periods.

C. Retain protective covers for flanges and protective wood crate and plastic wrap during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements.

.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- Mechanical Seals: One mechanical seal and volute gasket for each pump.

.2 PRODUCTS

.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

- Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include but are not limited to, manufacturers specified.

- Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

.2 CLOSED COUPLED, Vertical, IN-LINE CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close coupled, in-line pump as defined in Hi 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for 170-psig maximum working pressure and a continuous water temperature of 225 F.

B. Pump Construction:

- Casing: Back Pull-Out design, cast iron, with threaded gage tappings at inlet and outlet, and flange connections. ASTM A48-CL30. Provide case wear rings per ASTM B505-932. Bottom of casing to be drilled and tapped to accommodate a pipe flange for floor supports. Provide stamped pump serial number in casing, so as to identify pump if tag is removed.

- Impeller: ASTM B584-875, precision cast bronze; statically and dynamically balanced, and keyed to shaft with Stainless Steel Key. Trim impeller to match specified performance. Impeller to be balanced and trimmed by the Pump Manufacture.

- Mechanical Seal: Carbon rotating ring against a Silicon Carbide seat held by a 416 stainless- steel spring, and Buna-N bellows and gasket. Copper flush seal line shall be installed from discharge of pump to seal gland.

- Pump Bearings: Permanently lubricated ball bearings.

C. Motor: JM Frame, Single speed, with permanently lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division __ Section "Common Motor Requirements for HVAC Equipment." Motor shall be a JM Frame Motor.

D. Capacities and Characteristics.

- Refer to schedule on drawings.

.3 RIGIDLY COUPLED, VERTICAL IN-LINE CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in Hi 1.1-1.2 and Hi 1.3; designed for base mounting, with pump

and motor shafts horizontal. Rate pump for 170-psig maximum working pressure and a continuous water temperature of 225 deg F.

B. Pump Construction:

- Casing: Back Pull-out design, cast iron, with threaded gage tapings at inlet and outlet, drain plug at bottom, flanged connections. ASTM A48-CL30. Bottom of casing to be drilled and tapped to accommodate a pipe flange for floor supports. Provide stamped pump serial number in casing, so as to identify pump if tag is removed.

- Impeller: ASTM B584-875, precision cast bronze; statically and dynamically balanced, keyed to shaft, secured with a locking stainless steel cap screw. Trim impeller to match specified performance. Impeller to be balanced and trimmed by the Pump Manufacture.

- Pump Shaft: 416 Stainless Steel, with Graph alloy GM 205.3 throttle bushing.

- Mechanical Seal: Carbon rotating ring against a Silicon Carbide seat held by a 416 stainless-steel spring, and Buna-N bellows and gasket. Copper flush seal line shall be installed from discharge of pump to seal gland.

C. Rigid Shaft Coupling: High Tensile Aluminum, two-piece design. Coupling key to be Steel-ASTM A 108-1018.

D. Motor: VP Frame Single speed, with permanently lubricated ball bearings, unless otherwise indicated; secured to motor mounting frame, with adjustable alignment: Cast Iron ASTM A48-CL30, allowing the removal of Motor without disturbing wet end of pump. Comply with requirements in Common Motor Requirements for HVAC Equipment.

E. Capacities and Characteristics:

- Refer to schedule on drawings.

.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; straightening vanes; drain plug; and factory-fabricated support boss. The diffuser shall accommodate a fully opened Butterfly Valve on the vertical inlet side. Manufactured by Pump Manufacture.

.3 EXECUTION

.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

.2 PUMP INSTALLATION

A. Comply with HI 14.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Section "Vibration and Seismic Controls for HVAC Piping and Equipment. Fabricate brackets or supports as required. Hanger and support materials are specified in Hangers and Supports for HVAC Piping and Equipment.

E. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until the alignment procedure is complete.

- Support pump base plate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting

- Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in Hi 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill Base plate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

.4 CONNECTIONS

A. Piping installation requirements are specified in specification general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install triple-duty valve on discharge side of pumps.

F. Install Y-Strainer or Suction Diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves with control rods.

H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

I. Install check valve and gate or ball valve on each condensate pump unit discharge.

J. Install electrical connections for power, controls, and devices.

K. Ground equipment according to Electrical Specification Section.

L. Connect wiring according to Electrical Specification Section.

.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

- Complete installation and startup check according to manufacturer's written instructions.
- Check piping connections for tightness.
- Clean strainers on suction piping.
- Perform the following startup checks for each pump before starting:

  i. Verify bearing lubrication.

  ii. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If the pump is bound or drags, do not operate until the cause of trouble is determined and corrected.

  iii. Verify that pump is rotating in the correct direction.

- Prime pump by opening suction valves and closing drains and preparing pump for operation.
- Start motor.
- Open discharge valve slowly.

.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

**Approved Manufacturer:**

A. **Bell & Gossett**

B. **Taco**

C. **Armstrong**

## 2.3 Heat Pump

TAG:HP1 (Nyle C-Series 270)

### 1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Divisions 1 Specification Sections, apply to this section.

### 1.2 REFERENCES

A. ASME Boiler and Pressure vessel code

A. UL 60335-2-40 HVACR Equipment

### 1.3 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties and accessories for each model indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, components, and size of each field connection

C. Wiring Diagrams: Detail for wiring power signal, differentiate between manufacture- installed and field-installed wiring

D. Maintenance Data: Include in the maintenance manuals specified in Division 1. Include maintenance guide and wiring diagrams

### 1.4 REGULATORY REQUIREMENTS

A. Conform to applicable code for internal wiring of factory wired equipment

B. Conform to ASME Section VIII for heat exchanger construction

C. Water heater shall have UL-60335-2-40 certification for all operating modules.

### 1.5 COORDINATION

Coordinate size and location of concrete bases

### 1.6 WARRANTY

A. Equipment shall include parts warranty for 12 months from startup or 18 months from shipment.

B. Compressors shall include a 5 year parts warranty.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Nyle is the basis of design. Acceptable manufacturers shall be subject to compliance with the requirements and shall be submitted for consultant approval.

### 2.2 GENERAL

A. Heat pump water heater shall be packaged water source equipment, factory assembled, charged, and tested. The heat pump shall be suitable for heating potable water and have the capability of producing no less than 160°F potable water, with published heating capacity and C.O.P. based on project specifications.

B. Heat Pump unit shall consist of compressor, condenser, evaporator, and hot water circulating pump, piping, and controls, factory assembled, charged, and tested.

C. All components, including assemblies, sub-assemblies and the materials that go into constructing the heat pump water heater's potable water system must be certified for coming in direct contact with potable water, including but not limited to: piping, brazing, soldering or welding materials, circulator pump, flow sensor, temperature sensors, thread sealant, flow control valves and flat plate heat exchanger.

D. The heat pump water heater shall have an SCCR rating of not less than 100 kA.

E. Maximum waterside working pressure on the potable water side of the unit shall be 150 PSIG. Maximum waterside working pressure on the source side of the unit shall be 300 PSIG.

### 2.3 CABINET

A. Shall be corrosion resistant epoxy coated aluminum. Supports, channels and beams shall also be constructed of the like. Compartments shall have large access doors for servicing. Cabinet shall be insulated to prevent condensation from forming on exterior surfaces.

### 2.4 COMPRESSOR & REFRIGERATION

A. Compressor: Suitable for high temperature operation with R-513A refrigerant. Compressor shall be furnished with service ports for suction and discharge connections

B. Anti-Short Cycle Control: Units shall be factory wired to allow a maximum of twelve compressor starts per hour to prevent compressor short cycling and allow time for suction and discharge pressures to equalize permitting the compressor to start in an unloaded condition.

C. Compressor Controls: Compressor controls/accessories must include the following:
   a. High Pressure Safety monitoring

b. Low Pressure Safety monitoring
c. Incoming power Phase Monitoring
d. Compressor manufacturer-recommended motor protection module

D. Refrigerant Accessories:
a. Filter-Drier: Sweat connection type.
b. Site Glass: Moisture indicating type.
c. Liquid Line Service Valves: Bronze quarter turn type.
d. Discharge Check Valve: Copper magnetic in-line type.
e. Liquid Line Solenoid Valve: Electrically actuated.
f. Compressor Crankcase Heater
g. Suction accumulator
h. Liquid receiver

## 2.5 CONDENSER

A. 316L Stainless steel copper brazed plate vented double wall type, standard on all units. Single wall condenser construction shall not be allowed. UL Listed, and suitable for up to 450°F (232°C) high temperature operation with domestic hot water. Unit shall be operational pressure rated to no less than 435 PSI (30 Bar).

## 2.6 EVAPORATOR

A. 316L Stainless steel copper brazed plate vented single wall type, standard on all units. UL Listing is required. Unit shall be operational pressure rated to no less than 435 PSI (30 Bar).

## 2.7 EXPANSION VALVE

A. Heat pump shall be provided with a thermal expansion valve shall be specifically designed for heat pump use with field adjustable superheat feature, or an electronically controlled valve shall be used.

## 2.8 POTABLE WATER CIRCULATING PUMPS

A. Provide factory installed and wired in-line circulators with lead-free bronze or stainless-steel body, and able to deliver the rated flow against the external head listed in the performance specifications.

## 2.9 CONTROLS:

A. Provide factory mounted controls for each heat pump module along with a centralized controller responsible for module staging.

B. Each heat pump shall be provided with:

**a.** PLC Controls
**b.** Timed Short Cycle Control
**c.** Panel Mount Control Touch Screen
**d.** Access Level Control
**e.** Internal or External Aquastat Controls
**f.** Resettable Compressor Run Times

**g.** Low Temperature Freeze Monitoring
**h.** Flow Meter for Potable Water
i. Flow Meter for Source Water
**j.** 100 Fault Memory
**k.** Systems Performance Monitoring
**l.** Anti-Short Cycle Control

C. Heat pump shall be factory equipped with electronic temperature control valve which automatically maintains constant leaving potable water temperature regardless of entering water temperature. Leaving water temperature is set by the heat pump operator/user via the field adjustable touch screen interface.

D. Each heat pump shall have a contact to control its source pump or control valve.

E. Heat pump shall be factory equipped with water temperature detection indicating a freeze risk is present on both DHW and source loop sides. Heat pump shall open valves and transmit a run signal to trigger attached valves or pumps, and suspend compressor operation during a freeze protection event. Freeze protection settings shall be adjustable to accommodate use with glycol source loops.

**PART 3 – EXECUTION**

**3.1 INSTALLATION**

Install water heaters level and plumb in accordance with manufacturer's written instructions and referenced standards.
Coordinate size and location of concrete bases.
Provide all power and control wiring between individual heat pump modules, main control panel and ancillary sensors and pumps.

**3.2 START-UP**

Start up on the unit will be performed by factory trained and authorized personnel. A copy of the startup report will be provided to the owner and factory.

## 2.4 HEAT EXCHANGER

Tag(s): HX-1, HX-2, HX-3

.1 PRODUCTS

.1 All connections shall be located on the fixed head frame plate, allowing the movable head pressure plate, to slide back. Assembly shall permit plates to be added, removed, or replaced from the plate pack without disturbing the connections or associated piping.

.2 The unit shall be provided with an aluminum or stainless-steel OSHA splash shield.

.3 The frame plate and pressure plate shall be carbon steel SA 516 grade 70 with sufficient thickness to meet the ASME design pressure. Stiffeners or support brackets are not allowed.

.4 Carbon steel frame components shall be painted with grey epoxy paint.

.5 Units with 3-inch or greater connections shall be unlined or alloy lined studded ports to mate with raised face or flat faced ANSI flanges. Rubber liners will not be permitted. Units with smaller than 3-inch connections shall have carbon steel female tapped NPT or male NPT connections.

.6 Units with connections greater than 2-inch require that the thermal plates be supported by the carry bar, top bar. The carry and guide bar plate contact surfaces shall be stainless steel. Units with connections smaller than 2-inch shall allow the plates to be supported by the guide bar, bottom bar. Carry and guide bars are to be steel with a zinc chromate coating.

.7 Tightening bolts shall be zinc plated carbon steel SA193 B7 with captive working nuts at the pressure plate, and rear head such that the unit can be opened and closed with one wrench from the front of the unit.

.8 Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate, carry bar and guide bar. Welded hanging brackets or stiffeners are not acceptable.

.9 The plate pack shall use a positive plate to plate alignment system to ensure proper plate to gasket seals throughout the plate pack. The positive alignment system shall be a gasket lug which fits within a plate recess on the proceeding plate (tongue in groove) to align successive plates, or an extended rolled edge hanger which nests successive plates through direct contact around the entire plate hanger. Plate designs which only offer alignment through contact with the carry and guide bar are unacceptable.

.10 Gaskets shall be a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination. All gaskets except the gasket on the first plate shall be identical.

**Approved Manufacturer:**

A. **Bell & Gossett**

B. **PVI**

C. **Armstrong**

## 2.5 VENTS

.1 SUBMITTALS

.1 Submit the following:

A. Catalogue cuts / Diagrams / Descriptions

B. Sizing calculations

C. Installation Instructions

D. Installation Drawings

E. Copy of product warranties

.2 CODES AND APPLICABLE STANDARDS

.1 All products furnished under this Section shall conform to the requirements of The National Fuel Gas Code, ANSI Z223.1 / NFPA-54 where applicable and shall comply with and be listed to UL 1738, the U.S. Standard for Venting Systems for Gas –Burning Appliances, Category II, III and IV and ULC-S636-95, the Canadian Standard for Type BH gas vent systems. Components coming in direct contact with products of combustion shall carry the appropriate UL or cUL.

.3 WARRANTIES

.1 The Manufacturer shall warrant the Positive Pressure Vent System against defects in material and workmanship for a period of 15 years from the date of original installation. Any portion of the vent repaired or replaced under the warranty shall be warranted for the remainder of the original warranty period.

.4 POSITIVE PRESSURE VENT

.1 The vent shall be of the double wall, factory-built type, designed for use in conjunction with Category I, III or IV condensing or non-condensing gas fired appliances or as specified by the heating equipment manufacturer.

.2 Maximum continuous flue gas temperature shall not exceed 550 degree F (288 degree C).

.3 Vent shall be listed for a maximum positive pressure rating of 6” w.c. and shall have passed at 15” w.c.

.4 The vent system shall be continuous from the appliance’s flue outlet to the vent termination outside the building. All system components shall be UL / cUL listed and supplied from the same manufacturer.

.5 The vent shall be constructed with an inner and outer tube, where the annular air space between the tubes is 0.5 inches.

A. The inner tube (flue gas conduit) shall be constructed from AL29-4C® or UNS S44735 stainless steel, with a minimum wall thickness of .016” for 3” through 7” diameter vents, .019” for 8” through 12” diameter vents and .024” for 14” and 16” diameter vents.

B. The outer tube (jacket) shall be constructed from 304 or 430 stainless steel, with a minimum wall thickness of .016” for 3” through 6” diameter vents and .024” for 7” through 16” diameter vents.

.6 All system components such as vent supports, roof or wall penetrations, terminations, appliance connectors and drain fittings require to install the vent system shall be UL listed and provided by the vent manufacturer.

.7 All system components shall include a factory – installed gasket in their female – end to render the vent air and watertight when the male / female ends are pushed together as per manufacturer’s instructions. Vent systems requiring field installed sealants or compounds shall not be acceptable.

.8 All system components shall include a factory – installed internal mechanical locking band for fastening and securing all vent components against each other.

.9 Vent layout shall be designed and installed in compliance with manufacturer's installation instructions and all applicable local codes.

.10 Venting supplier shall make prevision for barometric dampers for boilers if required at the time of startup

.11 Contractor is responsible for inspecting the chimney prior to tender to assure proper venting installation inside existing chimney.

.12 Venting supplier shall include venting calculation and venting layout in shop drawing package for review and approval.

.5 EXECUTION

.1 VENT SYSTEM LAYOUT

A. The vent system shall be routed to maintain minimum clearance to combustibles as specified by the manufacturer.

B. Vent installation shall conform to the manufacturer's installation instructions, its UL listing and state / local codes.

C. The vent system and breechings shall be inspected and cleaned before the final connection to the appliances.

**Approved Manufacturer:**

A. **APPLIED ENERGY SYSTEM**

B. **ENVOIRON**

## 2.6 NATURAL GAS PIPIG

.1 MATERIAL

.1 Steel pipe for natural gas

.2 ABOVE GROUND PIPING

NPS 2 AND UNDER:

.1 ASTM A106 GR B, Schedule 40 seamless, for design pressures less than 860 KPA (125 Psig)

.2 ASTM A106 GR B, Schedule 80 seamless, for design pressure 590 KPA (125 Psig) and higher NPS 2-1/2 to 10:

.3 ASTM A53 GR B, Schedule 40 electric resistance weld (ERW)

.3 BELOW GROUND PIPING

.1 Same as above ground piping, with factory applied polyethylene jacker (*yellowjacket), with field applied coating at welded joints.

.2 Pipe jointing

.4 WELFING FITTINGS

.1 Wall thickness to match pipe

.2 Butt weld type to ANSI 16.9 or socker weld type to ANSI 16.11

.5 THEREDED FITTING

.1 Threaded malleable iron fitting, class 150 # to ANSI B16.3

.2 1030 KPA (150#) black malleable iron, bronze dace, ground joint unions.

Standard of acceptance: Fitting Limited 165

.6 FLANG

.1 Cast iron class 150 to ANSI B16.1.

.2 Forged steel, 1035 KPA (150#) to ANSI B16.5, weld neck with wall thickness to match pipe or slip on type

.3 Gasket to ANSI B16.21, ANSI B16.20 or ANSI A21.11 of heavy duty graphite impregnated compressed sheet 1.6mm (1/16 inch) thick

Standard of acceptance: Chesterton 195

.4 Studs, bolts and nuts to ANSI B18.2.1, ANI 18.2.2 and ASTM A194. ‘High Strength’ type

.7 JOING MATERIAL

.1 Joining compounded for screwed pipe: Pulverized lead paste.

.8 EXCUTION

.1 GAS SERVICE

A. Meter and service regulator installation to be in accordance with TSSA directors order FS-053-05.

B. Presence of gas service to be clearly indicated with permanent marking at or on outside of building.

.2 BUILDING SERVICE PIPING

A. Extend service piping from meter installation into building. Use steel piping for pipe riser up through grade, and for final 3 meters (10 ft) at building wall.

.3 PIPING AND JOINT FITTING

A. Exposed piping:

- NPS 2 and smaller: threaded fitting and joints,
- NPS 2 ½ and larger: welded with butt welded fitting or flanged.

B. Condensing piping:

- NPS 2 and smaller: socket welded fitting
- NPS 2 ½ and larger : butt welded fitting

.4 CONNENTION TO APPLIANCES

A. Connect to appliances with screwed unions up to NPS and Flanged NPS 2 ½ and above.

B. Provide dirt traps and service valve at each appliance.

.5 PIPING INSTALLATION

A. Provide clearance and access for maintenance of appliances, valve, and fittings.

B. Ream pipe after cutting to lengthen and clearance of scale and dirt both inside and outside before assembly.

C. Cap ends during construction to prevent entry of foreign matter.

D. Make up threaded pipe with;

- Coupling
- Caps and plugs
- 90 and 45 degrees elbows
- Tee fitting
- Make welded pipe with:
  - Long radius elbow

- Tee fitting where branch connection are same size as main
- Tee fitting or welded outlet fitting where branch connections are smaller than main and where main is NPS 2 to NPS 5 size, and Saddles where mains and branches are NPS 6 or over but of different sizes.
- Branches may be welded directly into main provided main is more than NPS 4 and branch is at least 2 pipe size smaller than main
- Where branch fitting is welded into main:
    - Cut opening in main true and beveled
    - Hole saw or drill and ream main to maintain full inside diameter of branch line
    - Opening to be sized to prevent branch pipe from projecting inside main and
    - To inhibit entry of welding metal and slag into pipes.

.6 HANGER INSTALLATION

A. Install hangers for steel pipes with spacing and hanger rod diameter

.7 VALVES

A. Install valves with steams upright o horizontal.

B. Install valves at branch takes-off and to isolate each piece of appliances

.8 COORDINATION OF INSPECTION/SERVICE CONNECTION

A. Submit, to gas supply authority, list of natural gas appliances being installed showing type, quantity and rating.

## 2.7 PIPE AND TUBING

.1 Heating Hot Water:

.1 Steel: ASTM A53 Grade B, seamless or ERW, Schedule 40.

.2 Copper water tube option: ASTM B88, Type K or L, hard drawn. Soft drawn tubing, 20 mm (3/4 inch) and larger, may be used for runouts to floor mounted fan coil units or perimeter convectors

## 2.8 FITTINGS FOR STEEL PIPE

.1 65 mm (2½ inches) and Larger: Welded or flanged joints.

.1 Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be

long radius type, unless otherwise noted.

.2 Welding flanges and bolting: ASME B16.5:

.3 Weld neck or slip on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).

.4 Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

.2 50 mm (2 inches) and Smaller: Screwed or welded.

.1 Butt welding: ASME B16.9 with same wall thickness as connecting piping.

.2 Forged steel, socket welding or threaded: ASME B16.11.

.3 Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.

.4 Unions: ASME B16.39.

.5 Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half couplings, ASME B16.11 may be used for drain, vent and gage connections.

## 2.9 FITTINGS FOR COPPER TUBING

.1 Solder Joint:

.1 Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.

.2 Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.

.3 Bronze Flanges and Flanged Fittings: ASME B16.24.

## 2.10 DIELECTRIC FITTINGS

.1 Provide where copper tubing and ferrous metal pipe are joined.

.1 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.

.2 65 mm (2½ inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.

.3 Temperature Rating, 99 degrees C (210 degrees F).

## 2.11 SCREWED JOINTS

.1 Pipe Thread: ANSI B1.20.

.2 Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

## 2.12 VALVES

.1 Asbestos packing is not acceptable.

.2 All valves of the same type shall be products of a single manufacturer. Provide gate and globe valves with packing that can be replaced with the valve under full working pressure.

.3 Provide chain operators for valves 100 mm (4 inches) and larger when the centerline is located 2400

mm (8 feet) or more above the floor or operating platform.

.4 Standard of Acceptance: Crane, Jenkins, Toyo, Kitz.

.5 Gate Valves:

.1 50 mm (2 inches) and smaller: MSS SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.

.2 65 mm (2½ inches) and larger: Flanged, outside screw and yoke.

.3 MSS SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.

.6 Globe, Angle and Swing Check Valves:

.1 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.) Globe and angle valves shall be union bonnet with metal plug type disc.

.2 65 mm (2½ inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 85 for globe valves and MSS SP 71 for check valves.

.3 Non Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut off. Provide where check valves are shown in chilled water and hot water piping.

a. Body: Cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, or wafer type.

b. Seat, disc and spring: 18 8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.

.7 Butterfly Valves:

.1 May be used in lieu of gate valves. Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation.

.2 MSS SP 67, flange lug type (for end of line service) working pressure at 93 degrees C (200 degrees F).

.3 Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65 45 12 electro-plated.

.4 Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.

.5 Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.

.6 Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.

.7 Valves 200 mm (8 inches) and larger: Enclosed worm gear with hand wheel, and where required, chain wheel operator.

.8 Ball Valves:

.1 Brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig) working pressure rating. Screwed or solder connections. Provide stem extension to allow operation without interfering with pipe insulation.

.9 Water Flow Balancing Valves

.1 For flow regulation and shut off. Valves shall be line size rather than reduced to control valve size and be one of the following types.

.2 Butterfly valve as specified herein with memory stop.

.3 Eccentric plug valve: Iron body, bronze or nickel plated iron plug, bronze bearings, adjustable memory stop, operating lever, rated 861 kPa (125 psig) and 121 degrees C (250 degrees F).

.10 Circuit Setter Valve

.1 A dual purpose flow balancing valve and adjustable flow meter, with bronze or cast iron body,

calibrated position pointer, valve pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

.11 Automatic Balancing Control Valves

.1 Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:

a. Gray iron (ASTM A126) or brass body rated 1205 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless steel piston and spring.

b. Brass or ferrous body designed for 2067 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.

c. Combination assemblies containing ball type shut off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.

.2 Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.

.12 Manual Radiator/Convector Valves

.1 Brass, packless, with position indicator.

## 2.13 STRAINERS

.1 Basket or Y Type. Tee type is acceptable for water service.

.2 Screens: Bronze, monel metal or 18 8 stainless steel, free area not less than 2 1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations.

.3 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.

.4 Suction Diffusers: Specified in the HYDRONIC PUMPS section.

## 2.14 NEUTALIZER KIT

Condensing Boilers, Flue Drains

.1 Application Restriction:

.1 Do not exhaust flue gases through neutralizer, they are not rate for boiler or furnace flue gases. Operating neutralizer as exhaust vents can cause injury or death from carbon monoxide.

.2 Gas traps must be installed between the boiler, flue drains, and furnace condensate outlet and the inlet of all neutralizers. Consider using the next larger size neutralizing tube for boiler systems with domestic hot water heating.

.3 Neutralizer must be installed below system P-traps, boiler, furnace, and breaching condensate drains. Before operating the boiler or hot water heater, fill the neutralizer tube and traps whit tap water.

.2 Combined Piping Options (Flue pipe condensate drains):

.1 Boiler condensate drain, and flue condensate drain can be commonly piped to a neutralizer tube. Also, the flue pipe must be terminated so rainwater cannot enter the flue pipe.

.2 Connect PVC piping from appliance or breaching drains to P-traps and then P-trap outlets to either one of the two neutralizer tube inlets. (Use Teflon tap on all threaded plastic fittings.)

.3 Recharge tubes regularly:

.1 Neutralizer tubes should be recharged when the pH level moves below 5.0. The pH should be checked regularly (at least twice during the first year of operation) to determine the required recharging schedule.
.2 This may require recharging as often as twice per year for high-usage systems, such as boiler systems equipped with indirect water heaters.
.3 Boiler applications for space heating only or when PH falls below5.0.

.4 Supplier

.1 Neutralizer kit must be sized and supplied by the boiler manufacturer.

## 2.15 GAGES, PRESSURE AND COMPOUND

.1 ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4 1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
.2 Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.
.3 Range of Gages: Provide range equal to at least 130 percent of normal operating range.

## 2.16 PRESSURE/TEMPERATURE TEST PROVISIONS

.1 Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.
.2 Provide one each of the following test items to the Owner:
.1 6 mm (1/4 inch) FPT by 3 mm (1/8 inch) diameter stainless steel pressure gage adapter probe for extra-long test plug. PETE'S 500 XL is an example.
.2 90 mm (3 1/2 inch) diameter, one percent accuracy, compound gage, , ——100 kPa (30 inches) Hg to 700 kPa (100 psig) range.
.3 0 - 104 degrees C (220 degrees F) pocket thermometer one half degree accuracy, 25 mm (one inch) dial, 125 mm (5 inch) long stainless steel stem, plastic case.

## 2.17 THERMOMETERS

.1 Mercury or organic liquid filled type, red or blue column, clear plastic window, with 150 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.
.2 Case: Chrome plated brass or aluminum with enamel finish.
.3 Scale: Not less than 225 mm (9 inches), range as described below, two degree graduations.
.4 Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
.5 Scale ranges may be slightly greater than shown to meet manufacturer's standard. Required ranges in degrees C (F):

## 2.18 VACUUM AND AIR RELIEF VALVES

.1 Vacuum and air relief valves shall be iron body with bronze trim, and stainless steel floats.

## 2.19 EXPANSION TANK

TAG: **EXPTNK1, EXPTNK2, EXPTNK3, EXPTNK4**

**Closed expansion tank**

1 Construction:

.1 welded construction conforming to ASME Section VIII for unfired Pressure Vessels, CSA B-51, and provincial regulations,

.2 material: manufactured from ASTM A516 pressure vessel carbon steel plate with dished eds,

.3 ASME code rated for 860 kPa (125 psi) test pressure with ASME stamp and certification,

.4 water services: hot dip galvanized after fabrication,

.5 glycol service: black steel for glycol service primed on exterior surface only.

.2 Nozzles and couplings:

.1 NPS 1 expansion pipe connection at bottom,

.2 NPS 1 make-up connection at bottom,

.3 NPS 1 drain connection at bottom,

.4 NPS 1 vent connection at top,

.5 relief valve connection near bottom.

.6 Schrader valve connection for compressed air at top.

.3 Accessories:

.1 manhole 275 mm x 375 mm (11 in x 15 in)

.2 structural steel saddles for horizontal tanks,

.3 three structural steel legs for vertical tanks so that bottom of tank is 300 mm (12 in) off floor [,]

SPEC NOTE: THE FOLLOWING IS REQUIRED FOR VERTICAL TANKS FOR SEISMIC DESIGN PROJECTS.

.1 support legs and hold-down bolt-holes designed for a horizontal seismic cycle load equal to 50% of tank and contents weight in shear, and each leg designed for 100% of the resulting bending moment, and

.2 safety factor of 4:1

.4 sight glasses, with shut-off valves and protection rods, to cover 75% of tank volume, with individual units not more than 450 mm (18 in) long.

## 2.20 Bladder type expansion tanks

.1 Construction:

.1 cylindrical, pressurized type with elastomer bladder, suitable for 115°C (240°F) operating temperature,

.2 welded construction conforming to ASME Section VIII for unfired Pressure Vessels, CSA B-51, and provincial regulations,

.3 manufactured from ASTM A516 pressure vessel carbon steel plate with dished ends,

.4 finishes: primed on outside,

.5 ASME code rated for 860 kPa (125 psi) working pressure with ASME stamp and certification,

.6 annular base mount for vertical installation.

.1 support base and hold-down bolt-holes designed for a horizontal seismic cycle load equal to 50% of tank and contents weight in shear, and each leg designed for 100% of the resulting bending moment, and

.2 safety factor of 4:1

.2 Nozzles and couplings:
.1 NPS 1 expansion line fitting at/near bottom.
.3 Accessories:
.1 Schrader tank valve for compressed air located above bladder,
.2 air pre charged to 84 kPa (12 psi) (initial fill pressure of system).

## 2.21 Louver

.1 GENERAL

.1 Section includes:

A. Stationary Louvers.

.2 Reference Standards

A. All referenced standards and recommended practices in this section pertain to the most recent publication thereof, including all addenda and errata.

B. AAMA 611 – Voluntary Specification for Anodized Architectural Aluminum

C. AAMA 2603 – Voluntary Specification, Performance Requirements and Test Procedures For Pigmented Organic Coatings on Aluminum Extrusions and Panels

D. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures For Superior Performing Pigmented Organic Coatings on Aluminum Extrusions and Panels

E. AMCA 500L – Laboratory Methods for Testing Louvers for Rating

F. ASTM D7091 (formerly ASTM D1400) – Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals

.3 Submittals

A. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings.

B. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication.

C. Project Record Documents: Record actual locations of units and control components.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions (if applicable), and maintenance and repair data (if applicable).

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

.4 Quality Assurance

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.

.5 Warranty

A. See SeCloseout Submittals, for additional warranty requirements.

B. Provide 12 month manufacturer warranty from date of shipment of louvers.

.2 PRODUCTS

.1 Stationary Louver

A. Basis of Design: Price Industries, Inc.

- Drainable Louver

B. Description:

- Furnish and install Price Model DE635 Drainable Louver of size and shape indicated on the plans and/or as described in schedules.
- Louver performance shall be based on tests and procedures in accordance with AMCA publication 500-L.

C. Construction:

- Louvers shall be constructed of 6063-T5 alloy extruded aluminum.
- Louver blades and frames shall be minimum 0.081 inch wall thickness. Louver assemblies shall be 6 inches deep with 35-degree stationary drainable blades. Louvers shall be welded construction.
- Louvers shall be designed to withstand a 25 pound per square foot wind load.
- Louvers shall be fitted with 1/2 inch x 0.051 inch flattened expanded aluminum bird screen. Bird screen shall be mounted on interior louver face.
- Louvers shall be supplied with a standard mill finish.

D. Accessories

- Louvers shall be fitted with 1/2 inch x 0.051 inch flattened expanded aluminum bird screen. Bird screen shall be permanently secured to a formed aluminum frame and mounted on interior louver face.
- Louvers shall be supplied with a 1.5 inch [0.5 inch, 1.0 inch, 2.0 inch, 2.5 inch, 3.0 inch, 3.5 inch, 4.0 inch] flanged frame.

- Louvers shall be supplied with a continuous blade appearance and concealed mullions.
- Each louver shall be fitted with [1 inch, 2 inch, 3 inch, 4 inch insulated] or [a non-insulated] aluminum blank-off panel.
- Thermosetting acrylic based resin coating for standard duty architectural applications:
- Louvers shall be factory finished-after-assembly with a thermosetting acrylic based resin coating. Resin coating shall be oven cured in accordance with the coating manufacturer's instructions.
- The coating system shall have a minimum dry film thickness of 0.8 mil in accordance with ASTM D7091.
- The coating system product shall meet salt spray and hardness specifications of AAMA 2603.
- Cured fluoropolymer based resin coating for weather protection in architectural applications:
- Louvers shall be factory primed and finished-after-assembly with a fluoropolymer based resin coating. Primer and resin coating shall be oven cured in accordance with the coating manufacturer's instructions.
- The coating system shall have a minimum dry film thickness of 0.25 mil primer and 1.0 mil color coat in accordance with ASTM D7091.
- The coating system product shall meet salt spray and hardness specifications of AAMA 2605.
- Cured fluoropolymer based resin coating (Kynar 500) for corrosive architectural applications:
- Louvers shall be factory primed and finished-after-assembly with a fluoropolymer based resin coating and clear topcoat. Primer, resin and topcoat coating shall be oven cured in accordance with the coating manufacturer's instructions.
- The coating system shall have a minimum dry film thickness of 0.25 mil primer, 1.0 mil color coat and 0.6 mil clear topcoat in accordance with ASTM D7091.
- The coating system product shall meet salt spray and hardness specifications of AAMA 2605.
- Color Anodized Coating – Anodized finish type 1:
- Louvers shall receive an anodized color finish [Light Bronze, Medium Bronze, Dark Bronze, Black] in accordance with AAMA 611. The finish shall be applied to chemically etched and pretreated aluminum with a minimum thickness of 0.4 – 0.7 mils.
- Clear Anodized Coating – Anodized finish type 2:

- Louvers shall receive a clear anodized finish in accordance with AAMA 611. The finish shall be applied to chemically etched and pretreated aluminum with a minimum thickness of 0.4 - 0.7 mils.

.3 EXECUTION

.1 Examination

- Verify that conditions are suitable for installation.
- Verify that field measurements are as shown on the drawings.

.2 Installation

- Install in accordance with manufacturer's instructions.
- See drawings for the size(s) and locations of louvers.

## 2.22 Unit Heater

REFERENCES

Air Movement and Control Association (AMCA).
AMCA 210. Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
Natural Electrical Manufacturers Association (NEMA).
NEMA MG-1 Motors and Generators
Canadian Standards Association (CSA).

PRODUCT DATA

- Submit product data in accordance with Section Submittal Procedures.
- Submit WHMIS MSDS – Safety Data Sheets in accordance with- Submittal Procedures. WHMIS acceptable to Labor Canada, and Health Canada.
- Submit product data sheets for unit heaters. Include:

Product characteristics.
Performance criteria.
Mounting methods.
Physical size.
kW rating, voltage, phase.
Cabinet material thicknesses.
Limitations.
Colour and finish.

- Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

.1 SHOP DRAWINGS

- Submit shop drawings in accordance with - Submittal Procedures.
- Indicate:

Equipment, capacity and piping connections.

Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

CLOSEOUT SUBMITTALS

- Provide operation and maintenance data for unit heaters for incorporation into manual specified in Closeout Submittals.

WASTE MANAGEMENT AND DISPOSAL

- Separate and recycle waste materials in accordance with Section Construction/Demolition Waste Management and Disposal, and with Waste Reduction Work plan.
- Remove from site and dispose of packaging materials at appropriate recycling facilities.
- Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- Divert unused metal and wiring materials from landfill to metal recycling facility approved by Owner.
- Fold up metal banding, flatten and place in designated area for recycling.
- Collect, package and store existing unit heaters for either reuse, recycling or rebuilding and return to recycler in accordance with Waste Management Plan.

CABINET UNIT HEATERS

- Cabinet type: surface semi-recessed or recessed as indicated, 1.6 mm thick steel with rounded exposed corners and edges, removable panels, glass fiber insulation and integral air outlet and inlet.
- Finish with factory applied primer coat.
- Special cabinets or front panels: as indicated.
- Coils: aluminum fins mechanically bonded to copper tubes as indicated. Hydrostatically tested to 1 MPa.
- Electric coils as indicated: nickel-chrome resistance coils embedded in refractory material and enclosed in steel sheathing with low or high watt density extended fins.

Two stage heating with magnetic contactors, high temperature limit switch, and fan override switch.

Control heating elements in conjunction with fan by common control switch.

- Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted.
- Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.
- Filters: removable 25 mm thick fibrous glass throwaway or permanent washable type.
- Capacity: as indicated.
- Control:

3 speed on-off switch with integral overloads in cabinet or wall mounted as indicated.

Low limit aquastat strapped on to steam or hot water heating supply set to prevent fan operating below 27 °C.

HORIZONTAL UNIT HEATERS

- Casing: 1.6 mm thick cold rolled steel, gloss enamel finish, with threaded connections for hanger rods.
- Coils: seamless copper tubing, silver brazed to steel headers with evenly spaced aluminum fins mechanically bonded to tubing. Hydrostatically test to 1 MPa.
- Fan: direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard.
- Motor: speed as indicated continuous duty, built-in overload protection, and resilient motor supports.
- Air outlet: two-way adjustable louvres.
- Capacity as indicated, base steam capacity on 14 kPa, base hot water heating capacity on 8 °C E.W.T. and 11° C temperature drop, 15° C - E.A.T.
- Control:

3 speed on-off switch with integral overloads in cabinet or wall mounted as indicated.

Low limit aquastat strapped on to steam or hot water heating supply set to prevent fan operating below 27 °C.

VERTICAL UNIT HEATERS

- Casing: 1.6 mm thick cold rolled steel, glossed enamel finish, with threaded connections for hanger rods.
- Coils: seamless copper tubing, silver brazed to steel headers and with evenly spaced aluminum fins mechanically bonded to tubing. Hydrostatically test to 1 MPa.
- Fan: direct drive propeller type, factory balanced, with anti-corrosive finish.
- Motor: speed as indicated, continuous duty, ball bearing motor with built-in overload protection, and resilient motor supports.
- Air outlet: adjustable multi-vane diffuser with finish to match casing, as indicated.
- Capacity: as indicated, base steam capacity on 14 kPa, base hot water heating capacity on 88° C E.W.T. and 11° C temperature drop, 15 °C - E.A.T.
- Control:

3 speed on-off switch with integral overloads in cabinet or wall mounted as indicated.

Low limit aquastat strapped on to steam or hot water heating supply set to prevent fan operating below 27° C.

Execution

INSTALLATION

- Install in accordance with manufacturer's instructions.
- Provide double swing pipe joints as indicated.
- Check final location with Owner if different from that indicated prior to installation.

Should deviations beyond allowable clearances arise, request and follow Owner's directive.

- Hot water units: for each unit, install gate or ball valve on inlet as indicated and calibrated balancing valve on outlet of each unit. Install drain valve at low point.

Install manual or automatic air vent at high point as indicated.

- Steam units: for each unit, install gate valve on inlet, steam trap assembly as indicated on outlet.
- Clean finned tubes and comb straight.
- Provide supplementary suspension steel as required.
- Install thermostats in locations indicated.
- Before acceptance, set discharge patterns and fan speeds to suit requirements.

**PART 3 EXECUTION**

**INSTALLATION**

A. Install in accordance with manufacturer's instructions.
B. Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of one eight-hour day per tower.
C. Install tower on structural steel beams as instructed by manufacturer.
D. Connect condenser water piping to tower. Pitch condenser water supply to tower and condenser water suction away from tower.
E. Connect make-up water piping to tower. Pitch to tower.
F. Connect overflow and drain to acceptable discharge point as required by jurisdiction.

**FIELD QUALITY CONTROL**

A. See Section Quality Requirements, for additional requirements.
B. Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

**SYSTEM START-UP**

A. Start-up tower in presence of and instruct Owner's operating personnel.

**GENERAL**

.1 The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid.

Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

.2 Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.

.3 Support piping securely.

.4 Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.

.5 Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

.6 Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take offs with 3 elbow swing joints where noted on the drawings.

.7 Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.

.8 Provide manual air vent at all piping system high points and drain valves at all low points.

.9 Connect piping to equipment as shown on the drawings. Install components furnished by others such as:

.1 Water treatment pot feeders and condenser water treatment systems.

.2 Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.

.10 Thermometer Wells: In pipes 65 mm (2 1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.

.11 Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material.

.12 Where copper piping is connected to steel piping, provide dielectric connections.

**FLUSHING AND CLEANING PIPING SYSTEMS**

.1 Water Piping: Clean systems as recommended by the suppliers of chemicals specified.

.2 Initial flushing:

.1 Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect downstream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the Consultant.

.3 Cleaning

.1 Using products supplied by the chemical treatment manufacturer circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/S (6 feet per second). Circulate each section for not less than four hours. Blow down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.

.4 Final Flushing

.1 Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

**END OF SECTION**