

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 - General Requirements.
- .2 Section 21 05 01 - Common Work Results for Mechanical.
- .3 Section 23 05 53 - Mechanical Identification.
- .4 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.

**1.4 SUBMITTALS**

- .1 Submittals in accordance with Division 01 - General Requirements.
- .2 Submit WHMIS MSDS - Material Safety data sheets in accordance with Division 01 - General Requirements and Section 21 05 01 - Common Work Results for Mechanical. Indicate VOC's for all adhesives and solvents during application and curing.

**PART 2 PRODUCTS**

**2.1 NOT USED**

- .1 Not Used.

**PART 3 EXECUTION**

**3.1 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

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

### **3.2 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .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.

### **3.3 DRAINS**

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

### **3.4 AIR VENTS**

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

### **3.5 DIELECTRIC COUPLINGS**

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

### **3.6 PIPEWORK INSTALLATION**

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom and conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion.
- .14 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless otherwise indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.

- .6 Use gate or ball valves at branch take-offs for isolating purposes except where otherwise specified.
- .7 Install ball valves for glycol service.
- .15 Check Valves:
  - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
  - .2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

### **3.7 SLEEVES**

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
  - .2 Other floors: Terminate 25 mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
  - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

### **3.8 ESCUTCHEONS**

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

### **3.9 PREPARATION FOR FIRESTOPPING**

- .1 Fire stopping by General Contractor. Sub-Contractor shall provide required clearance between outside surface of piping and inside surface of sleeve or core drilled hole for installation of fire stopping assembly by General Contractor.
- .2 Un-insulated unheated pipes not subject to movement: No special preparation.
- .3 Un-insulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging fire stopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

### **3.10 FLUSHING OUT OF PIPING SYSTEMS**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Division 01 - General Requirements supplemented as specified in relevant sections of Mechanical Divisions.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### **3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Department Representative and Commissioning Agent 48 hours' minimum prior to performance of pressure tests.

- .2 Pipework: Test as specified in relevant sections of Mechanical Divisions.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Mechanical Divisions.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or test medium.
- .5 Conduct tests in presence of Department Representative and Commissioning Agent.
- .6 Pay costs for repairs or replacement, retesting and making good. Department Representative and Commissioning Agent to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Department Representative and Commissioning Agent.
- .8 Hydraulically test hydronic piping systems (glycol heating loop and refrigerant piping from condenser for AHU-1) at 1 ½ times system operating pressure or minimum 862 kPa, whichever is greater.
- .9 Test drainage, waste and vent piping to the National Building Code, the Canadian Plumbing Code and the Authorities Having Jurisdiction.
- .10 Test fire protection/sprinkler systems in accordance with NFPA 13, NFPA 20 and the Authorities Having Jurisdiction and as specified elsewhere.
- .11 Prior to start-up ensure all closed loop piping systems are thoroughly flushed and cleaned to remove any signs of debris in the systems.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and installation for thermometers and pressure gauges in piping systems.

**1.2 RELATED SECTIONS**

- .1 Division 01 - General Requirements.
- .2 Section 21 05 01 - Common Work Results for Mechanical.
- .3 Section 23 05 53 - Mechanical Identification.

**1.3 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B40.100-01, Pressure Gauges and Gauge Attachments.
  - .2 ASME B40.200-01, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

**1.4 SUBMITTALS**

- .1 Submittals in accordance with Division 01 - General Requirements.
- .2 Submit Manufacturer printed shop drawings and product data in accordance with Division 01 - General Requirements.
- .3 Submit manufacturer's product data for following items:
  - .1 Thermometers.
  - .2 Pressure gauges.
  - .3 Stop cocks.
  - .4 Wells.
- .4 Submit WHMIS MSDS - Material Safety data sheets in accordance with Division 01 - General Requirements and Division 20 - Common Work Results for Mechanical. Indicate VOC's for all adhesives and solvents during application and curing.

**1.5 HEALTH AND SAFETY**

- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

**1.6 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

**PART 2 PRODUCTS**

**2.1 GENERAL**

- .1 Design point to be at mid point of scale or range.
- .2 Ranges:
  - .1 Domestic Water: 0-80°C.
  - .2 Glycol Water: 0-115°C.
  - .3 Chilled Water: 0-30°C.

**2.2 DIRECT READING THERMOMETERS**

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length, dual scale: to CAN/CGSB14.4 and ASME B40.200.

**2.3 THERMOMETER WELLS**

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

**2.4 PRESSURE GAUGES**

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified, dual scale.

**PART 3 EXECUTION**

**3.1 GENERAL**

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



**3.2 THERMOMETERS**

- .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
  - .1 Entering and leaving heat exchangers.
  - .2 Entering and leaving air handler coils.
  - .3 Entering and leaving heat pumps and fan coils.
- .3 Install wells as indicated for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

**3.3 PRESSURE GAUGES**

- .1 Install in following locations:
  - .1 Suction and discharge of pumps.
  - .2 Upstream and downstream of PRV's.
  - .3 Upstream and downstream of control valves.
  - .4 Inlet and outlet of coils.
  - .5 Inlet and outlet of liquid side of heat exchangers.
  - .6 Inlet and outlet vacuum.
  - .7 Inlet and outlet of compressed air.
  - .8 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere.
- .3 Use extensions where pressure gauges are installed through insulation.

**3.4 NAMEPLATES**

- .1 Install engraved lamicaid nameplates as specified in Section 23 05 53 - Mechanical Identification, identifying medium.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Section 23 05 23 - Valves - Bronze and Cast Iron.
- .2 Related Sections:
  - .1 Division 01 - General Requirements.
  - .2 Section 23 05 05 - Installation of Pipework.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME):
  - .1 ANSI/ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose (Inch).
  - .2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 American Society for Testing and Materials International, (ASTM):
  - .1 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
  - .2 ASTM B283-99a, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  - .3 ASTM B505/B505M-02, Specification for Copper-Base Alloy Continuous Castings.
  - .4 ASTM A49-01, Specification for Heat-Treated Carbon Steel Joint Bars.
  - .5 ASTM A126-95 (2001), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .6 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
  - .7 ASTM B85-03, Specification for Aluminum-Alloy Die Castings.
  - .8 ASTM B209-04, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
  - .1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.

- .2 MSS-SP-80-2003, Bronze Gate Globe, Angle and Check Valves.
- .3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- .4 MSS SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .5 MSS SP-71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
- .6 MSS SP-82-1992, Valve Pressure Testing Methods.
- .7 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

### **1.3 SUBMITTALS**

- .1 Submittals in accordance with Division 01 - General Requirements.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Division 01 - General Requirements and Division 20 - Common Work Results for Mechanical.
  - .1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
  - .2 Submit data for valves specified in this section.
- .3 Closeout Submittals:
  - .1 Submit maintenance data for incorporation into manual in accordance with Division 01 - General Requirements.

### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

### **1.5 DELIVERY STORAGE AND DISPOSAL**

- .1 Waste Management and Disposal:
  - .1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.

### **1.6 MAINTENANCE**

- .1 Extra Materials:
  - .1 Furnish following spare parts:

- .1 Valve seats: one for every 10 valves each size, minimum 1.
- .2 Discs: one for every 10 valves, each size. Minimum 1.
- .3 Stem packing: one for every 10 valves, each size. Minimum 1.
- .4 Valve handles: 2 of each size.
- .5 Gaskets for flanges: one for every 10 flanged joints.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS - GENERAL**

- .1 Sustainable Requirements:
  - .1 Materials and resources in accordance with Division 01 - General Requirements.
- .2 Valves:
  - .1 Except for specialty valves, to be single manufacturer.
  - .2 All products to have CRN registration numbers.

### **2.2 VALVES - BRONZE**

- .1 End Connections:
  - .1 Connection into adjacent piping/tubing:
    - .1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.
    - .2 Copper tube systems: Solder ends to ANSI/ASME B16.18.
- .2 Gate Valves:
  - .1 Requirements common to gate valves, unless specified otherwise:
    - .1 Standard Specification: MSS SP-80.
    - .2 Bonnet: union with hexagonal shoulders.
    - .3 Connections: screwed with hexagonal shoulders.
    - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
    - .5 Packing: non-asbestos.
    - .6 Handwheel: non-ferrous.
    - .7 Handwheel Nut: bronze to ASTM B62.

- .2 NPS 2 and under, rising stem, solid wedge disc, Class 125:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Operator: Handwheel.
- .3 NPS 2 and under, rising stem, solid wedge disc, Class 150:
  - .1 Body: with long disc guides, screwed or union bonnet.
  - .2 Operator: Handwheel.
- .3 Globe Valves:
  - .1 Requirements common to globe valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Bonnet: union with hexagonal shoulders.
    - .3 Connections: screwed with hexagonal shoulders.
    - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
    - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
    - .6 Handwheel: non-ferrous.
    - .7 Handwheel Nut: bronze to ASTM B62.
  - .2 NPS 2 and under, composition disc, Class 125:
    - .1 Body and bonnet: screwed bonnet.
    - .2 Disc and seat: renewable rotating PTFE disc composition to suit service conditions, re-grindable bronze seat, loosely secured to bronze stem to ASTM B505.
    - .3 Operator: Handwheel.
  - .3 Angle valve, NPS 2 and under, composition disc, Class 150:
    - .1 Body and bonnet: union bonnet.
    - .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, re-grindable bronze seat, loosely secured to stem.
    - .3 Operator: Handwheel.
- .4 Check Valves:
  - .1 Requirements common to check valves, unless specified otherwise:

- .1 Standard specification: MSS SP-80.
  - .2 Connections: screwed with hexagonal shoulders.
- .2 NPS 2 and under, swing type, bronze disc, Class 125:
  - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
  - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: re-grindable.
- .3 NPS 2 and under, vertical lift type, bronze disc, Class 125:
  - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .5 Ball Valves:
  - .1 NPS 2 and under:
    - .1 Body and cap: cast high tensile bronze to ASTM B62.
    - .2 Pressure rating: Class125, 860 kPa steam.
    - .3 Connections: solder ends.
    - .4 Stem: tamperproof ball drive.
    - .5 Stem packing nut: external to body.
    - .6 Ball and seat: replaceable hard chrome solid ball and Teflon seats.
    - .7 Stem seal: TFE with external packing nut.
    - .8 Operator: removable lever handle.

## 2.3 VALVES - CAST IRON

- .1 Standard specifications:
  - .1 Gate valves: MSS SP-70.
  - .2 Globe valves: MSS SP-85.
  - .3 Check valves: MSS SP-71.
- .2 Requirements common to valves, unless specified otherwise:
  - .1 Body, bonnet: cast iron to ASTM B209 Class B.
  - .2 Connections: flanged ends plain face to ANSI B16.1.
  - .3 Inspection and pressure testing: to MSS SP-82.
  - .4 Bonnet gasket: non-asbestos.
  - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

- .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
  - .7 Gland packing: non-asbestos.
  - .8 Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
  - .9 Identification tag: with catalogue number, size and other pertinent data.
- .3 Gate Valves:
- .1 NPS 2 ½ -8, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:
    - .1 Body and multiple-bolted bonnet: with full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
    - .2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
    - .3 Seat rings: renewable bronze screwed into body.
    - .4 Stem: manganese-bronze.
    - .5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
    - .6 Seat rings: integral with body.
    - .7 Stem: nickel-plated steel.
    - .8 Pressure-lubricated operating mechanism.
    - .9 Operator: Handwheel.
- .4 Globe Valves:
- .1 NPS 2 ½ - 10, OSY:
    - .1 Body: with multiple-bolted bonnet.
    - .2 WP: 860 kPa steam, 1.4 MPa CWP.
    - .3 Bonnet-yoke gasket: non-asbestos.
    - .4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
    - .5 Seat ring: renewable, re-grindable and screwed into body.
    - .6 Stem: bronze to ASTM B62.

- .7 Operator: Handwheel.
- .5 Check Valves:
  - .1 Swing check valves, Class 125:
    - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.
      - .1 Up to NPS 16: cast iron to ASTM A126 Class B.
    - .2 Disc: rotating for extended life.
      - .1 Up to NPS 6: bronze to ASTM B62.
    - .3 Seat rings: renewable bronze to ASTM B62 screwed into body.
    - .4 Hinge pin, bushings: renewable bronze to ASTM B62.
    - .5 Disc: A126 Class B, secured to stem, rotating for extended life.
    - .6 Seat: cast iron, integral with body.
    - .7 Hinge pin: exelloy; bushings; malleable iron.
    - .8 Identification tag: fastened to cover.
    - .9 Hinge: galvanized malleable iron.
  - .2 Swing check valves, NPS 2 ½ - 8 Class 250:
    - .1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
    - .2 Flanged ends: 2 mm raised face with serrated finish.
    - .3 Rating: 250 psi steam; 500 psi CWP.
    - .4 Disc: rotating for extended life.
      - .1 Up to NPS 3: bronze to ASTM B61.
    - .5 Seat rings: renewable bronze to ASTM B61, screwed into body.
    - .6 Hinge pin, bushings: renewable, bronze to ASTM B61.
    - .7 Hinge: galvanized malleable iron.
    - .8 Identification tag: fastened to cover.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Install rising stem valves in upright position with stem above horizontal.



- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

### **3.2 VERIFICATION**

- .1 Verification requirements in accordance with Division 01 - General Requirements.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.
- .2 Related Sections:
  - .1 Division 01 - General Requirements.
  - .2 Section 23 05 05 - Installation of Pipework.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM):
  - .1 ASTM A125-1996 (R2001), Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563-04a, Specification for Carbon and Alloy Steel Nuts.
- .2 Factory Mutual (FM).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
  - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC).

**1.3 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

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

#### **1.4 SUBMITTALS**

- .1 Submittals: in accordance with Division 01 - General Requirements.
- .2 Submit shop drawings and product data for following items:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.
- .3 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual Division 01 - General Requirements.

#### **1.5 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Division 01 - General Requirements and Section 21 05 01 - Common Work Results for Mechanical.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

**PART 2 PRODUCTS****2.1 SUSTAINABLE REQUIREMENTS**

- .1 Materials and products in accordance with Division 01 - General Requirements.

**2.2 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

**2.3 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized after manufacture.
  - .2 Use hot dipped galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
    - .1 Rod: 13 mm.

- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, to MSS SP69.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut.
- .4 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate to MSS SP69.
- .5 Shop and field-fabricated assemblies:
  - .1 Trapeze hanger assemblies.
  - .2 Steel brackets.
- .6 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .7 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis:
  - .1 Ensure "U" has hole in bottom for riveting to insulation shields.

- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563:
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated or epoxy coated.

#### **2.4 RISER CLAMPS**

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

#### **2.5 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

#### **2.6 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

#### **2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

#### **2.8 HOUSE-KEEPING PADS**

- .1 Provide templates to ensure accurate location and size of pads.

**PART 3 EXECUTION****3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .3 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .5 Use approved constant support type hangers where:
  - .1 Vertical movement of pipework is 13 mm or more,
  - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.

**3.3 HANGER SPACING**

- .1 Plumbing piping: to Canadian Plumbing Code and authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .5 Within 300 mm of each elbow.

<b>Maximum Pipe Size : NPS</b>	<b>Maximum Spacing Steel</b>	<b>Maximum Spacing Copper</b>
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m

### **3.4 HANGER INSTALLATION**

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### **3.5 HORIZONTAL MOVEMENT**

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### **3.6 FINAL ADJUSTMENT**

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.



- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

### **3.7 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Division 01 - General Requirements.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
  - .4 Applicable Systems: Vibration Isolation.
- .3 Verification requirements in accordance with Division 01 - General Requirements.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 GENERAL REQUIREMENTS**

- .1 The Contractor shall be responsible to carry out all the Work set out or referred to in this Section 23 05 53.

**1.2 SUMMARY**

- .1 Section Includes:
  - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
  - .2 Sustainable requirements for construction and verification.

**1.3 REFERENCES**

- .1 Canadian Gas Association (CGA):
  - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA):
  - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.

**1.4 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures
- .2 Product data to include paint colour chips, other products specified in this section.
- .3 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

**1.5 QUALITY ASSURANCE**

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
  - .1 Construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/ Demolition Waste Management and Disposal.
  - .2 Dispose of unused paint, coating material at official hazardous material collections site approved by Department Representative.
  - .3 Do not dispose of unused paint, coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

**PART 2 PRODUCTS**

**2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer. Metal plates shall be provided for all for equipment operating over 140°F.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.

- .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

## **2.2 SYSTEM NAMEPLATES**

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

Size	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20
  - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
  - .1 Terminal cabinets, control panels: use size #5.
  - .2 Equipment in Mechanical Rooms: use size #9.

## **2.3 EQUIPMENT CONCEALED BY CEILING**

- .1 At valves, balancing dampers air vents and drains, and other similar pieces of mechanical equipment located above T-bar ceilings or access doors, install circular  $\frac{3}{4}$ " diameter self-adhesive identification discs on the

underside of the ceiling, as close as possible to the location of the equipment.

- .2 Discs shall be coloured as scheduled in this section (see pipe primary and secondary colours table).
- .3 Where the item has a primary and secondary colour, provide a  $\frac{3}{4}$ " diameter primary colour disc with a  $\frac{3}{8}$ " diameter secondary colour disc centered on the primary disc.
- .4 For backflow preventers, fire dampers, air terminal units, exhaust fans, reheat coils and other similar pieces of equipment located above T-bar ceilings or access doors, provide laminated plastic plates as noted for System nameplates above (with plates for fire dampers to have red face and white lettering). A second identical plate shall be installed on the underside of the ceiling grid or access door opening frame, as close as possible to the location of the equipment.

## **2.4 PIPING SYSTEMS GOVERNED BY CODES**

- .1 Identification:
  - .1 Sprinklers: in accordance with NFPA 13.

## **2.5 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
  - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
  - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
  - .3 Use double-headed arrows where flow is reversible.

- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees Celsius.
- .7 Colours and Legends:
  - .1 Where not listed, obtain direction from Department Representative.
  - .2 Colours for legends, arrows: to following table:

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

Contents	Background colour marking	Legend
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Domestic hot water supply	Yellow	DOM. HW SUPPLY
Dom. HWS recirculation	Yellow	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS

Contents	Background colour marking	Legend
Chilled Water Loop Supply/ Return	Green	CHWS/CHUR
Storm water	Green	STORM
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

## **2.6 IDENTIFICATION DUCTWORK SYSTEMS**

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.
- .3 Identify Supply/Exhaust/Return System with labels as indicated on Mechanical Drawings prepared as part of Existing Design e.g. "AHU SG-1 Supply".
- .4 Identify "Supply/Return/Exhaust" systems with directional arrows as indicated e.g. "AHU SG1 Supply".

## **2.7 VALVES, CONTROLLERS**

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

## **2.8 CONTROLS COMPONENTS IDENTIFICATION**

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

## **2.9 LANGUAGE**

- .1 Identification in English.
- .2 Use one nameplate and label for each language.

**PART 3 EXECUTION**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 TIMING**

- .1 Provide identification only after painting specified Section 09 91 00 08 - Painting for Minor Works, has been completed.

**3.3 INSTALLATION**

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

**3.4 NAMEPLATES**

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

**3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.



- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points:
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.6 VALVES, CONTROLLERS**

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

### **3.7 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

**1.2 RELATED SECTIONS**

- .1 Division 01 - Commissioning Sections.
- .2 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

**1.3 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Submit names of personnel to perform TAB to Commissioning Agent and Department Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
  - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
  - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems - 1998.
  - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing - 2002
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract:
  - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
  - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

#### **1.4 PURPOSE OF TAB**

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

#### **1.5 EXCEPTIONS**

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

#### **1.6 CO-ORDINATION**

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

**1.7 PRE-TAB REVIEW**

- .1 Review contract documents before project construction is started and confirm in writing to Department Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Department Representative in writing proposed procedures, which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

**1.8 START-UP**

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

**1.9 OPERATION OF SYSTEMS DURING TAB**

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

**1.10 START OF TAB**

- .1 Notify Commissioning Agent and Department Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed.
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weather stripping, sealing, and caulking. Exterior envelope upgrade work must be complete.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.

- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 Filters in place, clean.
    - .2 Duct systems clean.
    - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
    - .4 Correct fan rotation.
    - .5 Fire, smoke, volume control dampers installed and open.
    - .6 Coil fins combed, clean.
    - .7 Access doors, installed, closed.
    - .8 Outlets installed, volume control dampers open.
  - .3 Liquid systems:
    - .1 Flushed, filled, vented.
    - .2 Correct pump rotation.
    - .3 Strainers in place, baskets clean.
    - .4 Isolating and balancing valves installed, open.
    - .5 Calibrated balancing valves installed, at factory settings.
    - .6 Chemical treatment systems complete, operational.

#### **1.11 APPLICATION TOLERANCES**

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

#### **1.12 ACCURACY TOLERANCES**

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

#### **1.13 INSTRUMENTS**

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

- .2 Calibrate within 3 months of TAB. Provide certificate of calibration to Commissioning Agent and Department Representative.

#### **1.14 SUBMITTALS**

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

#### **1.15 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of Department Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
  - .1 Details of instruments used.
  - .2 Details of TAB procedures employed.
  - .3 Calculations procedures.
  - .4 Summaries.

#### **1.16 TAB REPORT**

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit required copies of TAB Report to Department Representative for verification and approval, in English in D-ring binders, complete with index tabs.
- .4 **TAB Report must be accompanied by AutoCAD drawings complete with all actual measured readings entered on drawings for all associated equipment.**

#### **1.17 VERIFICATION**

- .1 Reported results subject to verification by Commissioning Agent and Department Representative.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results as directed by Commissioning Agent and Department Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Department Representative.

**1.18 SETTINGS**

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

**1.19 COMPLETION OF TAB**

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

**1.20 AIR SYSTEMS**

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.
- .2 Do TAB of following systems, equipment, components and controls:
  - .1 New air handlers.
  - .2 Vortex Exhaust Fans 1, 2, and 3.
  - .3 VAV terminals, laboratory Venturi air valves, grilles and diffusers.
  - .4 New fume hoods as per MD15128.
  - .5 Existing fume hoods as per MD15128.
  - .6 Fan coils.
  - .7 Dual duct boxes.
  - .8 Capture hoods.
  - .9 Extraction arms.
  - .10 ERV's.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC.
- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

- .6 Locations of equipment measurements: to include as appropriate:
  - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

#### **1.21 FUME HOOD BALANCING**

- .1 Contractor to provide tests as described by PWGSC MD15128. Refer to Appendix D for testing procedures and forms.

#### **1.22 LIQUID SYSTEMS**

- .1 Do TAB of the following systems, equipment and controls:
  - .1 Glycol heating loops (GH5/GHR).
  - .2 Glycol cooling loops (CHG5/CHGR).
  - .3 Chilled water loops (CHW5/CHWR).
  - .4 All pumps listed on drawings.
  - .5 All heating/cooling coils.
  - .6 All fan coils.

#### **1.23 OTHER TAB REQUIREMENTS**

- .1 General requirements applicable to work specified this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified this section.
  - .2 Quality assurance: as for air systems specified this section.

#### **1.24 POST-OCCUPANCY TAB**

- .1 As per Commissioning Plan; refer to Division 01 - General Requirements.

### **PART 2 PRODUCTS**

#### **2.1 NOT USED**

- .1 Not used.



2021-02-18

Project No. R.110935.001

SECTION 23 05 93  
TESTING, ADJUSTING AND BALANCING FOR HVAC

Page 8 of 8

**PART 3      EXECUTION**

**3.1          NOT USED**

.1      Not used.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Division 01 - General Requirements.
- .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .3 Section 23 31 13 - Metal Ducts - Low Pressure to 500 Pa.

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
  - .1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM):
  - .1 ASTM B209M-02, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
  - .2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .4 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
  - .5 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .6 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
- .3 Canadian General Standards Board (CGSB):
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .5 Underwriters Laboratories of Canada (ULC):
  - .1 CAN/ULC-S102-M88 (R2000), Surface Burning Characteristics of Building Materials and Assemblies.

- .2 CAN/ULC-S701-01, Thermal Insulation Polyotrene, Boards and Pipe Covering.

### **1.3 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as defined herein.
  - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
  - .1 CRD: Code Round Ductwork,
  - .2 CRF: Code Rectangular Finish.

### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Division 01 - General Requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.
- .3 Indicate VOC's for adhesives and solvents during application and curing.

### **1.5 MANUFACTURERS' INSTRUCTIONS**

- .1 Submit manufacturer's installation instructions in accordance with Division 01 - General Requirements.
- .2 Installation instructions to include procedures used, and installation standards achieved.

### **1.6 QUALIFICATIONS**

- .1 Installer: specialist in performing work of this section.

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

- 1.7 .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions recommended by manufacturer.

## **1.8 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.

## **PART 2 PRODUCTS**

### **2.1 FIRE AND SMOKE RATING**

- .1 In accordance with CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### **2.2 INSULATION**

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

### **2.3 JACKETS**

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: Compatible with insulation.

### **2.4 ACCESSORIES**

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.

- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.
- .6 Contact adhesive: quick-setting.
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm stainless steel.
- .9 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .10 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

## **2.5 VOC LIMITS**

- .1 Refer to Section 21 05 01 - Common Work Results for Mechanical.

## **PART 3 EXECUTION**

### **3.1 PRE-INSTALLATION REQUIREMENTS**

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

### **3.2 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes:
  - .1 Hangers, supports to be outside vapour retarder jacket.

- .5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

- .6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

### 3.3 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
. 1 Rectangular and round hot deck and cold deck supply air duct and outdoor air ductwork. All supply and outdoor air ductwork to be insulated. Supply air ductwork includes hot deck and cold deck ductwork (cold deck and outdoor air).	C-1	Yes	25
. 2 Exhaust air/return air ductwork within 10' of exterior envelope that pass through envelope	C-1	No	25
. 3 All exterior ductwork (provide aluminum jacket)	C-1	Yes	50

- .2 Apply in accordance with manufacturer's instructions.

### 3.4 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Division 01 - General Requirements.

### 3.5 CLEANING

- .1 Proceed in accordance with Division 01 - General Requirements.

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

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Related Sections:
  - .1 Division 01 - Commissioning Sections.
  - .2 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM):
  - .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

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

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

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

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
  - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    - .1 Pump operation.
    - .2 Heating converter operation.
    - .3 Pressure bypass open/closed.
    - .4 Control pressure failure.
    - .5 Maximum heating demand.
    - .6 Converter failure.
    - .7 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.



**1.5 HYDRONIC SYSTEM CAPACITY TEST**

- .1 Perform hydronic system capacity tests after:
  - .1 TAB has been completed
  - .2 Verification of operating, limit, safety controls.
  - .3 Verification of primary and secondary pump flow rates.
  - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger and radiation control valves.
    - .2 With hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

**1.6 REPORTS**

- .1 In accordance with Division 01 - Commissioning Sections: Reports, supplemented as specified herein.

**1.7 TRAINING**

- .1 In accordance with Division 01 - Commissioning Sections.

2021-02-18

Project No. R.110935.001

SECTION 23 08 01

PERFORMANCE VERIFICATION MECHANICAL PIPING SYSTEMS

Page 3 of 3

**PART 2 PRODUCTS**

**2.1 NOT USED**

.1 Not Used.

**PART 3 EXECUTION**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.
- .2 Related Sections:
  - .1 Division 01 - Commissioning Sections.

**1.2 REFERENCES**

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

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements:
  - .1 Instructions: submit manufacturer's installation instructions.

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Division 01 - General Requirements.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

**PART 2 PRODUCTS****2.1 SUSTAINABLE REQUIREMENTS**

- .1 Materials and products in accordance with Division 01 - General Requirements.

**2.2 CLEANING SOLUTIONS**

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

**PART 3 EXECUTION****3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 CLEANING HYDRONIC AND STEAM SYSTEMS**

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
  - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4 Cleaning procedures:
  - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
    - .1 Cleaning procedures, flow rates, elapsed time.
    - .2 Chemicals and concentrations used.
    - .3 Inhibitors and concentrations.

- .4 Specific requirements for completion of work.
  - .5 Special precautions for protecting piping system materials and components.
  - .6 Complete analysis of water used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning of systems:
- .1 Systems: free from construction debris, dirt and other foreign material.
  - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
  - .3 Strainers: clean prior to initial fill.
  - .4 Install temporary filters on pumps not equipped with permanent filters.
  - .5 Install pressure gauges on strainers to detect plugging.
- .6 Report on Completion of Cleaning:
- .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
- .1 Fill system with water, ensure air is vented from system.
  - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
  - .3 Use water metre to record volume of water in system to +/- 0.5%.
  - .4 Add chemicals under direct supervision of chemical treatment supplier.
  - .5 Closed loop systems: circulate system cleaner at 60°C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
  - .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
  - .7 Add chemical solution to system.

- .8 Establish circulation, raise temperature slowly to maximum operating temperature. Circulate for 12 h, ensuring flow in all circuits. Remove heat continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

### 3.3 **START-UP OF HYDRONIC SYSTEMS**

- .1 After cleaning is completed and system is filled:
  - .1 Establish circulation and expansion tank level, set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
  - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
  - .5 Clean out strainers repeatedly until system is clean.
  - .6 Commission water treatment systems as specified.
  - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
  - .8 Repeat with water at design temperature.
  - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
  - .10 Bring system up to design temperature and pressure slowly over a 48 hour period.
  - .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .12 Adjust pipe supports, hangers and springs as necessary.
  - .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
  - .14 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
  - .15 Check operation of drain valves.

- .16 Adjust valve stem packings as systems settle down.
- .17 Fully open balancing valves (except those that are factory-set).
- .18 Check operation of over-temperature protection devices on circulating pumps.
- .19 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

### **3.4 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Division 01 - General Requirements.

### **3.5 CLEANING**

- .1 Proceed in accordance with Division 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for steel piping, valves and fittings for hydronic systems in building services piping.
- .2 Related Sections:
  - .1 Division 01 - General Requirements.
  - .2 Section 23 05 05 - Installation of Pipework.
  - .3 Section 23 05 23 - Valves - Bronze and Cast Iron.
  - .4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .5 Section 23 08 01 - Performance Verification Mechanical Piping Systems.
  - .6 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.3-98, Malleable Iron Threaded Fittings.
  - .3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  - .4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.
  - .5 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
  - .6 ASME B18.2.2-87 (R1999), Square and Hex Nuts (Inch Series).
- .2 American Society for Testing and Materials International, (ASTM):
  - .1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - .3 ASTM A536-84 (1999) e1, Standard Specification for Ductile Iron Castings.
  - .4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.



- .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .3 American Water Works Association (AWWA):
  - .1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International):
  - .1 CSA B242-M1980 (R1998), Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS):
  - .1 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .2 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.
  - .3 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
  - .4 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

### **1.3 SUBMITTALS**

- .1 Submit shop drawings in accordance with Division 01 - General Requirements.
- .2 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual in accordance with Division 01 - General Requirements.
- .3 Submit required copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements. Indicate VOC's for adhesives and solvents during application and curing.

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

**1.6 MAINTENANCE**

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

**PART 2 PRODUCTS**

**2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 Up to NPS6: Scheduled 40.

**2.2 PIPE JOINTS**

- .1 Under NPS2: screwed fittings with lead-free pipe dope.
- .2 NPS2 and over: Roll grooved: standard coupling to CSA B242.
- .3 Pipe thread: taper.
- .4 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
- .5 Roll grooved coupling gaskets: type EPDM or suitable gasket for propylene glycol acceptable to Victaulic.

- .6 Acceptable Roll Grooved System: Victaulic style 07  
"Zero-Flex" or approved equal.

## **2.3 FITTINGS**

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
  - .1 Cast iron: to ASME B16.1, Class 125.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.
- .5 Fittings for roll grooved piping: ductile iron to ASTM A536.

## **2.4 VALVES**

- .1 Connections:
  - .1 Under NPS2.
  - .2 NPS2 and larger: grooved ends.
- .2 Gate valves: Application: Isolating equipment, control valves, pipelines:
  - .1 NPS2 and under:
    - .1 Mechanical Rooms: Class 125, rising stem, solid wedge disc as specified Section 23 05 23 - Valves - Bronze and Cast Iron.
    - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23 - Valves - Bronze and Cast Iron.
  - .2 NPS2 1/2 and over:
    - .1 Mechanical Rooms: rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23 - Valves - Bronze and Cast Iron.
      - .1 Operators: Handwheel.
    - .2 Elsewhere: Non-rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23 - Valves - Bronze and Cast Iron.
      - .1 Operators: Handwheel.
- .3 Globe valves: to Application: Throttling, flow control, emergency bypass:
  - .1 NPS2 and under:

- .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23 - Valves - Bronze and Cast Iron.
- .2 Elsewhere: Globe, with composition disc, as specified Section 23 05 23 - Valves - Bronze and Cast Iron.
- .4 Balancing, for TAB:
  - .1 Sizes: Calibrated balancing valves, as indicated on drawings.
- .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23 - Valves - Bronze and Cast Iron.
- .6 Swing check valves: to MSS-SP-71.
  - .1 NPS2 and under:
    - .1 Class 125, swing, with composition disc, as specified Section 23 05 23 - Valves - Bronze and Cast Iron.
  - .2 NPS2 1/2 and over:
    - .1 Grooved ends: as specified Section 23 05 23 - Valves - Bronze and Cast Iron.
- .7 Ball valves:
  - .1 NPS2 and under: as specified Section 23 05 23 - Valves - Bronze and Cast Iron.

### **PART 3 EXECUTION**

#### **3.1 PIPING INSTALLATION**

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

#### **3.2 CLEANING, FLUSHING AND START-UP**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

#### **3.3 TESTING**

- .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.
- .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

**3.4 BALANCING**

- .1 Balance water systems to within 10% of design output.
- .2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 The supply and installation of Hydronic Specialties Equipment.
- .2 Related Sections:
  - .1 Division 01 - General Requirements.
  - .2 Section 23 08 01 - Performance Verification Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME-04, Boiler and Pressure Vessel Code.
- .2 American Society for Testing and Materials, (ASTM):
  - .1 ASTM A47/A47M-99, Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A278M-01, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 345°C.
  - .3 ASTM A516/A516M-96 (e1), Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  - .4 ASTM A536-84 (1999) e1, Specification for Ductile Iron Castings.
  - .5 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International):
  - .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Division 01 - General Requirements.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Division 01 - General Requirements:
  - .1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.

- .2 Indicate on product data expansion tanks, air vents, separators, valves, strainers, heat exchanger and low loss header.
- .3 Indicate VOC's for all adhesives and solvents during application and curing.
- .3 Closeout Submittals:
  - .1 Submit maintenance data in accordance with Division 01 - General Requirements.

#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

#### **1.5 DELIVERY STORAGE AND DISPOSAL**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

### **PART 2 PRODUCTS**

#### **2.1 MATERIAL**

- .1 Sustainable Requirements:
  - .1 Materials and resources in accordance with Division 01 - General Requirements.

#### **2.2 AUTOMATIC AIR VENT**

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 310 kPa working pressure.
- .2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.
- .3 Float: solid material suitable for 115°C working temperature.

#### **2.3 CIRCUIT BALANCING VALVE**

- .1 NPS 2 and Under:
  - .1 A metal (pressure die cast, nonporous copper alloy body).
  - .2 Max Working Pressure: 1207 kPa (175 psig).

- .3 Max Working Temperature: 121°C (250°F).
- .2 NPS 2 ½ and Over:
  - .1 ANSI flanged connections (64mm) or roll grooved ends (64 mm).
  - .2 Ductile Iron body, ASTM A536, epoxy resin coated.
  - .3 Max Working Pressure: 1207 kPa (175 psig).
  - .4 Max Working Temperature: 121°C (250°F).
- .3 Circuit balancing valves are to be sized based on the required flow rate as outlined in the table below. Reduce pipe sizes as required.

#### **2.4 PIPE LINE STRAINER**

- .1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.
- .2 NPS 2 1/2 to 12: cast iron body to ASTM, Class 30 flanged connections.
- .3 Blowdown connection: NPS 1.
- .4 Screen: stainless steel with 1.19 mm perforations.
- .5 Working pressure: 860 kPa.

#### **2.5 WATER PRESSURE RELIEF**

- .1 Pressure setting: 415 kPa.
- .2 Kw Relief Capacity: Refer to Heat Exchanger Schedules.
- .3 ASME Certified.

#### **2.6 SUCTION DIFFUSER**

- .1 Body: cast iron with flanged connections complete with guide vanes, strainer, and start-up fine strainer.
- .2 Strainer: with built-in, disposable 1.19mm mesh, low pressure drop screen and NPS 1 blowdown connection.
- .3 Permanent magnet particle trap.
- .4 Full length straightening vanes.
- .5 Pressure gauge tappings.
- .6 Adjustable support leg.



**2.7 AIR SEPARATOR**

- .1 Fabricated Steel, flanged body with flanged inlet and outlet, NPS 2-1/2 and above, ASME Section VIII, Division I, rated for 160 psig. @ 350°F, blow down tapping, steel strainer.

**2.8 TRIPLE FUNCTION VALVE**

- .1 Valve installed at discharge of each base - mount pump, performs tight shut-off, non- slam spring-closure silent check valve, flow measurement and throttling.
- .2 Ductile iron body, grooved or flanged ends with lugs, bronze plug disc, stainless steel valve stem, 125/150 design, gaskets. Max temperature 93°F.
- .3 Pre-formed removable PVC jacketed thermal insulation.

**2.9 CONTROL VALVES**

- .1 Refer to Drawing Schedule for details.
- .2 Install as per Manufacturer's recommendations.

**2.10 GLYCOL TANK**

- .1 Fused power supply adapter with LED indicator, 115V to 24V VDC, 50 watts.
- .2 125 mm (5") fill opening and cover.
- .3 Pump suction hose with inlet strainer and check valve.
- .4 Fuse protection for pressure pump.
- .5 Low fluid level pump cut out.
- .6 Manual diverter valve for air purge.
- .7 Two sets of SPST dry contract, each adjustable to 69-172 kPa cut-out pressure.
- .8 Liquid filled pressure gauge.
- .9 Refer to drawings for quantities.

**2.11 EXPANSION TANK**

- .1 Replaceable bladder design.
- .2 ASME construction.

- .3 862 kPa working pressure.
- .4 116°C maximum working temperature.
- .5 83 psi. factory pre-charge.
- .6 Refer to drawings for quantities.

## **2.12 FAN COIL PIPING PACKAGE**

- .1 Provide one per fan coil.
- .2 Fan coil piping package to include:
  - .1 Isolation valves on supply and return.
  - .2 Supply side strainer.
  - .3 Pressure independent control valve (Belimo PIQCV or equal)
  - .4 600mm hose extensions.
- .3 Size as per fan coil flow requirement.

## **2.13 BUFFER TANK (BT-1)**

- .1 The **BUFFER TANK/HYDRAULIC SEPARATOR** shall be constructed in accordance with ASME Boiler and Pressure Vessel Code Section VIII Div. 1, Part U requirements, stamped and registered with the National Board of Boiler and Pressure Vessel Inspectors. The tank shall be furnished with NPS 3 (Flanged, NPT) connections for system supply and return and NPS 3 (Flanged) connections for chiller supply and return. One 25mm relief valve tapping; and one 25mm drain pipe shall be supplied. The tank shall be constructed with a built in air separator with automatic air vent.
- .2 The **BUFFER TANK/HYDRAULIC SEPARATOR** shall have a working pressure of 862 kPa PSI and shall be channel iron skid mounted with lifting lugs. The **BUFFER TANK/HYDRAULIC SEPARATOR** shall carry a five year limited warranty against tank failure resulting from defects in materials or workmanship.
- .3 The **BUFFER TANK/HYDRAULIC SEPARATOR** shall be constructed with a heavy gauge galvanized steel jacket assembly, primed and pre-painted on both sides with a minimum dry film thickness of 0.70 mills.

The **BUFFER TANK/HYDRAULIC SEPARATOR** shall be completely encased in a minimum of 50mm thick, high density, HCFC free, polyurethane foam insulation to meet the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard.

- .4 The jacket dimensions shall be 813 diameter and 2273 tall. Tank shall have 757 L capacity.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- .1 Install as indicated and to manufacturer's recommendations.
- .2 Run drain lines and blow off connections to terminate above nearest drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

#### **3.2 VERIFICATION**

- .1 Verification requirements in accordance with Division 01 - General Requirements.

#### **3.3 PRESSURE SAFETY RELIEF VALVES**

- .1 Run discharge pipe to terminate in glycol tank.

#### **3.4 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems, supplemented as specified herein.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials, equipment selection, installation and start up for hydronic system pumps.

**1.2 RELATED SECTIONS**

- .1 Division 01 - General Requirements.
- .2 Division 21 - Common Work Results for Mechanical.

**1.3 REFERENCES**

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE):
  - .1 Standard 90.1-2001 Energy Standard for Buildings except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .3 Canadian Standards Association (CSA International):
  - .1 CAN/CSA-B214-01, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA MG 1-2003, Motors and Generators.

**1.4 HEALTH AND SAFETY**

- .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

**PART 2 PRODUCTS**

**2.1 HEATING AND COOLING CIRCULATORS**

- .1 Performance:
  - .1 Refer to Plans.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Do Work in accordance with CAN/CSA-B214.
- .2 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.
- .3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
- .4 Pipe drain tapping to floor drain, if required.
- .5 Install volute venting pet cock in accessible location.
- .6 Check rotation prior to start-up.
- .7 Install pressure gauge test cocks.

**3.2 START-UP**

- .1 General:
  - .1 In accordance with Division 01 - Commissioning Sections; supplemented as specified herein.
  - .2 In accordance with Manufacturer's recommendations.
- .2 Procedures:
  - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
  - .2 After starting pump, check for proper, safe operation.
  - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  - .4 Check base for free-floating, no obstructions under base.
  - .5 Run-in pumps for 12 continuous hours.
  - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
  - .7 Eliminate air from scroll casing.
  - .8 Adjust water flow rate through water-cooled bearings.

- .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
- .10 Adjust alignment of piping and conduit to ensure true flexibility at all times.
- .11 Eliminate cavitation, flashing and air entrainment.
- .12 Adjust pump shaft seals, stuffing boxes, glands.
- .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .15 Verify lubricating oil levels.
- .3 General:
  - .1 In accordance with Division 01 - Commissioning Sections: General Requirements, supplemented as specified herein.
  - .2 In accordance with Division 01 - General Requirements.
  - .3 In accordance with manufacturer's recommendations.
- .4 Exclusions:
  - .1 This paragraph does not apply to small in-line circulators.
- .5 Assumptions: these PV procedures assume that:
  - .1 Manufacturer's performance curves are accurate.
  - .2 Valves on pump suction and discharge provide tight shut-off.
- .6 Multiple Pump Installations - Series and Parallel:
  - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .7 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .8 Commissioning Reports:
  - .1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

**3.3 OPERATION REQUIREMENTS**

- .1 Operational requirements in accordance with Division 01  
- General Requirements.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials, components, equipment, and chemicals for installation of complete HVAC water treatment system.
- .2 Related Sections:
  - .1 Division 01 - Commissioning Sections.
  - .2 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME Boiler and Pressure Vessel Code, Section VII-2004.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
    - .1 Submit required copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements. Indicate VOC's for adhesives and solvents during application and curing.
- .2 Shop Drawings:
  - .1 Submit Manufacturer printed shop drawings in accordance with Division 01 - General Requirements.
- .3 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements.



- .4 Closeout Submittals:
  - .1 Submit operation and maintenance data for incorporation into manual in accordance with Division 01 - General Requirements.

#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.

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

- .1 Packing, shipping, handling, and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Division 21 - Common Work Results for Mechanical.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

### **PART 2 PRODUCTS**

#### **2.1 SUSTAINABLE REQUIREMENTS**

- .1 Materials and products in accordance with Division 01 - General Requirements.

#### **2.2 MANUFACTURER**

- .1 Equipment, chemicals, service provided by one supplier.

#### **2.3 POT FEEDER**

- .1 Welded steel, pressure rating 860 kPa. Temperature rating: 90°C.

#### **2.4 CHEMICAL FEED PIPING**

- .1 Resistant to chemicals employed. Pressure rating: 860 kPa.

#### **2.5 WATER TREATMENT FOR HYDRONIC SYSTEMS**

- .1 Hot water heating system: pot feeder, 25 L, operating pressure 860 kPa.
- .2 Glycol system: fill tank, operating pressure 860 kPa.

- .3 Micron filter for each pot feeder:
  - .1 Capacity 2% of pump recirculating rate at operating pressure.
  - .2 Six (6) sets of filter cartridges for each type, size of micron filter.

## **2.6 CHEMICALS**

- .1 Provide 1 years supply.

## **2.7 TEST EQUIPMENT**

- .1 Provide one set of test equipment for each system to verify performance.
- .2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

## **2.8 GLYCOL THERMOFLUID**

- .1 Provide propylene glycol thermofluid at 40% concentration.
- .2 Test water before mixing and use only deionised filtered water.
- .3 Co-ordinate with thermofluid supplier/subcontractor to determine the system volume.
- .4 Install all system appurtenances, tanks and fill points as required for a fully functional and operations system.
- .5 Supply and install any other catalogue listed standard accessories required to complete the system.

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

### **3.3 CHEMICAL FEED PIPING**

- .1 Install crosses at changes in direction. Install plugs in unused connections.

### **3.4 CLEANING OF MECHANICAL SYSTEM**

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by Department Representative.
- .2 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.
- .3 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.
- .4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .5 Disposal of cleaning solutions approved by authority having jurisdiction.

### **3.5 WATER TREATMENT SERVICES**

- .1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:
  - .1 Initial water analysis and treatment recommendations.
  - .2 System start-up assistance.
  - .3 Operating staff training.
  - .4 Visit plant every 5 days during period of operation and as required until system stabilizes, and advise on treatment system performance.
  - .5 Provide necessary recording charts and log sheets for one year operation.
  - .6 Provide necessary laboratory and technical assistance.

- .7 Provide clear, concise, written instructions and advice to operating staff.

### **3.6 FIELD QUALITY CONTROL**

- .1 Start-up:
  - .1 Start up water treatment systems in accordance with manufacturer's instructions.
- .2 Commissioning:
  - .1 Commissioning Agency: to be installing water treatment sub-contractor.
  - .2 Timing:
    - .1 After start-up deficiencies rectified.
    - .2 After start-up and before TAB of connected systems.
  - .3 Pre-commissioning Inspections: verify:
    - .1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.
    - .2 Suitability of log book.
    - .3 Currency and accuracy of initial water analysis.
    - .4 Required quality of treated water.
  - .4 Commissioning procedures - applicable to Water Treatment Systems:
    - .1 Establish, adjust as necessary and record automatic controls and chemical feed rates.
    - .2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
    - .3 Establish test intervals, regeneration intervals.
    - .4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
    - .5 Establish, monitor, and adjust automatic controls and chemical feed rates as necessary.

- .6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
- .7 Advise Department Representative in writing on matters regarding installed water treatment systems.
- .5 Commissioning procedures - Closed Circuit Hydronic Systems:
  - .1 Analyze water in system.
  - .2 Based upon an assumed rate of loss approved by Department Representative, establish rate of chemical feed.
  - .3 Record types, quantities of chemicals applied.
- .6 Training:
  - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
  - .2 Train O&M personnel in softener regeneration procedures.
- .7 Certificates:
  - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .8 Commissioning Reports:
  - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Department Representative.
- .9 Commissioning activities during Warranty Period:
  - .1 Check out water treatment systems on regular basis and submit written report to Department Representative.
- .3 Verification requirements in accordance with Division 01 - General Requirements.

### **3.7 CLEANING**

- .1 Proceed in accordance with Division 01 - General Requirements.

2021-02-18

Project No. R.110935.001

SECTION 23 25 00  
HVAC WATER TREATMENT SYSTEMS

Page 7 of 7

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

**END OF SECTION**

**PART 1 GENERAL****1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.
- .2 Related Sections:
  - .1 Division 01 - General Requirements.
  - .2 Section 07 84 00 - Firestopping.
  - .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .4 Section 23 05 94 - Pressure Testing of Ducted Air Systems.
  - .5 Section 23 07 13 - Duct Insulation.

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM):
  - .1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus):
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Association (NFPA):
  - .1 NFPA 90A-07, Standard for the Installation of Air-Conditioning and Ventilating Systems.

- .2 NFPA 90B-07, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 NFPA 96-07, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.
- .7 Transport Canada (TC):
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

### **1.3 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Division 01 - General Requirements.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Division 01 - General Requirements for the following:
  - .1 Sealants.
  - .2 Tape.
  - .3 Proprietary Joints.
- .3 Co-ordinate submittal requirements and provide submittals required in accordance with Division 01 - General Requirements.
- .4 Submit Indoor Air Quality (IAQ) Management Plan in accordance with Division 01 - General Requirements.
- .5 Indicate VOC's for adhesives and solvents during application and curing.

### **1.4 QUALITY ASSURANCE**

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



- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Division 01 - General Requirements.
- .3 Indoor Air Quality (IAQ) Management Plan:
  - .1 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01 - General Requirements for construction and preoccupancy phases of building.
  - .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .4 Sustainable Requirements:
  - .1 Construction requirements: in accordance with Division 01 - General Requirements.
  - .2 Verification: contractor's verification in accordance with Division 01 - General Requirements.

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

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Store and manage hazardous materials in accordance with Division 20 - Common Work Results for Mechanical and Manufacturer's Written Instructions.
- .3 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

#### **PART 2 PRODUCTS**

##### **2.1 SUSTAINABLE REQUIREMENTS**

- .1 Materials and resources in accordance with Division 01 - General Requirements

##### **2.2 SEAL CLASSIFICATION**

- .1 Classification as follows:

Maximum Pressure	SMACNA Seal Class
Pa	
500	C

- .2 Seal classification:
  - .1 Class C: transverse joints and connections made air tight with gaskets, sealant or combination thereof. Longitudinal seams unsealed.

### **2.3 SEALANT**

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.
- .2 Indicate VOC's during application and curing.

### **2.4 TAPE**

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

### **2.5 DUCT LEAKAGE**

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

### **2.6 FITTINGS**

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
  - .1 Rectangular: standard radius.
  - .2 Round: five piece.
- .3 Mitred elbows, rectangular:
  - .1 To 400 mm: with double thickness turning vanes.
  - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
  - .1 Rectangular main and branch: 45 degrees entry on branch.
  - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
  - .3 Provide volume control damper in branch duct near connection to main duct.
  - .4 Main duct branches: with splitter damper.
- .5 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.

- .6 Offsets:
  - .1 Full radiused elbows or as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area:
  - .1 Maximum included angles: as for transitions.

## 2.7 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping, Fire Damper Manufacturer's written instructions and local authority having jurisdiction.
- .2 Fire stopping material and installation must not distort duct.

## 2.8 GALVANIZED STEEL

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

## 2.9 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment and Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
  - .1 Hanger configuration: to ASHRAE and SMACNA.
  - .2 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .3 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.
  - .2 For steel joist: manufactured joist clamp.
  - .3 For steel beams: manufactured beam clamps.

**2.10 VOC LIMITS**

- .1 Refer to Division 20 - Common Work Results for Mechanical.

**PART 3 EXECUTION****3.1 GENERAL**

- .1 Do not break continuity of insulation vapour barrier with hangers or rods:
  - .1 Insulate strap hangers 100 mm beyond insulated duct and Ensure diffuser is fully seated.
- .2 Support risers in accordance with ASHRAE and SMACNA.
- .3 Install breakaway joints in ductwork on sides of fire separation.
- .4 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .5 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining (clear inside dimensions shown on drawings).

**3.2 HANGERS**

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

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

**3.3 SEALING AND TAPING**

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

**3.4 LEAKAGE TESTS**

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section as identified in Section 23 05 94 - Pressure Testing of Ducted Systems.
- .7 Complete test before performance insulation or concealment Work.

**3.5 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Division 01 - General Requirements.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes, collars, balance dampers, motorized dampers, and flexible ductwork.
- .2 Related Sections:
  - .1 Division 01 - General Requirements.
  - .2 Section 21 05 01 - Common Work Results for Mechanical.
  - .3 Section 23 73 10 - Air Handling Built-up.
  - .4 Division 25 - Integrated Automation.

**1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .4 National Fire Protection Association (NFPA):
  - .1 NFPA 90A-07, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B-07, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .5 Underwriters' Laboratories Inc. (UL):
  - .1 UL 181-96, Standard for Factory-Made Air Ducts and Air Connectors.
- .6 Underwriters' Laboratories of Canada (ULC):
  - .1 CAN/ULC-S110-1986(R2001), Fire Tests for Air Ducts.

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Division 01-General Requirements.

- .2 Product Data:
  - .1 Submit manufacturers' printed shop drawings, product literature, specifications and data sheet. Indicate the following:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.
    - .5 Balance Dampers.
    - .6 Motorized Dampers.
    - .7 Flexible Ductwork.
  - .2 Indicate Following:
    - .1 Thermal properties.
    - .2 Friction loss.
    - .3 Acoustical loss.
    - .4 Leakage.
    - .5 Fire rating.
  - .3 Submit WHMIS MSDS in accordance with Division 01-General Requirements. Indicate VOC's for adhesive and solvents during application and curing.
  - .4 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
  - .5 Closeout submittals: submit maintenance and engineering data for incorporation into manual in accordance with Division 01- General Requirements.

#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Division 01- General Requirements.
- .2 Construction requirements: in accordance Division 01-General Requirements.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Division 20- Common Work Results Mechanical.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01- General Requirements.

## **1.6 INDOOR AIR QUALITY (IAQ) MANAGEMENT**

- .1 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01 - General Requirements.
- .2 During construction meet or exceed the requirements of SMACNA IAQ Guidelines for Occupied Building under Construction in accordance with Division 01 - General Requirements.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Materials and resources in accordance with Division 01- General Requirements.

### **2.2 GENERAL**

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

### **2.3 FLEXIBLE CONNECTIONS**

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

### **2.4 ACCESS DOORS IN DUCTS**

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.



- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .2 Doors over 1000 mm: piano hinge and two handles operable from both sides.
  - .3 Hold open devices.

## **2.5 TURNING VANES**

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

## **2.6 INSTRUMENT TEST PORTS**

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

## **2.7 SPIN-IN COLLARS**

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

## **2.8 BALANCE DAMPERS (GENERAL USE)**

- .1 Single Blade Dampers:
  - .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
  - .2 Size and configuration to recommendations of SMACNA, except maximum height 250mm.
  - .3 Locking quadrant.
  - .4 Inside and outside end bearings.

- .2 Multi-Bladed Dampers:
  - .1 Factory manufactured of material compatible with duct.
  - .2 Opposed blade: configuration to recommendations of SMACNA.
  - .3 Maximum blade height: 100mm.
  - .4 Bearings: pin in bronze bushings.
  - .5 Linkage: shaft extension with locking quadrant.
  - .6 Channel frame of same material as adjacent duct, complete with angle stop.

## **2.9 BALANCING DAMPERS (FUME HEAD AND CANOPY)**

- .1 Single Blade Dampers:
  - .1 Damper frame to be 316 stainless steel complete with welded flange connections.
  - .2 Round damper blade to be 316 stainless steel.
  - .3 Axle to be 316 stainless steel with bearings in a stainless steel sleeve.
  - .4 Designed for 3000 fpm velocities and 6 inches static pressure.

## **2.10 FLEXIBLE DUCT**

- .1 General:
  - .1 Factory fabricated to CAN/ULC-S110
  - .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
  - .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.
- .2 Non-Metallic - Insulated Acoustic:
  - .1 Spiral would flexible perforated aluminum with factory applied flexible glass fibre thermal insulation with vapour barrier and vinyl jacket.
  - .2 Performance:
    - .1 Minimum working pressure: 2.5 kPa.

## **2.11 EXHAUSTS EXTRACTION ARM**

- .1 Fume Arms:
  - .1 Arm sections are to be 1.6 mm (0.063 in.) wall, corrosion resistant, aluminum coated inside and out with an HM white finish, 100 mm diameter.
  - .2 The mounting swivel assembly shall be high-grade cast aluminum with 360 degree rotation.

- .3 Jointed elbows shall be 3.8 mm (0.15 in.) thick polypropylene with glass fiber reinforcement. The elbows shall be radiused 90 degree ells to minimize pressure drop and reduce noise. Knurled adjusting knobs supported by ball bearings are to be utilized at each friction joint. Certain arm sizes shall incorporate an internal stainless steel support spring.
  - .4 The two outermost joints of the arm shall rotate and swivel through 360 degrees. This feature is to provide unique directional flexibility and makes it possible to position the hood exactly where required. Adjustable external locking rings shall be incorporated to lock each respective joint in position. The external locking rings and locking knobs shall be glass fiber reinforced polypropylene.
  - .5 A duct mounting transition shall be included to ease the coupling of external ductwork to the arm. The duct transition shall be fabricated of 22 gauge plated steel and include a sealing O-ring.
  - .6 The fume arms shall incorporate a factory mounted integral damper. The damper blade shall be thermo plastic elastomer and the damper adjustment handle shall be anodized aluminum.
- .2 Mounting Brackets:
- .1 A multi-purpose mounting system shall be included with each arm. The mounting system will allow for the arm to be ceiling mounted with the hardware. The mounting system shall consist of a base bracket, for securing to the wall, ceiling or floor, and an extension tube, which is used to set the distance between the base bracket and the arm swivel.
  - .2 The base bracket is to be constructed of hi-grade cast aluminum.
  - .3 The extension profile, available in 25.4 mm 111.8 mm (10 in. and 44 in.) lengths, is to be constructed of 3.17 mm (0.125 in.) thick anodized structural extruded aluminum. The extension profile can be field cut to length as required.
- .3 Hoods:
- .1 Provide chemical resistant, double anodized aluminum metal hood. Hood to have an O.D. of 27.9 mm (11 in.). Plated steel hardware to be included for metal hood mounting.

- .4 General:
  - .1 Install as per manufacturer's written instructions.
  - .2 Provide 3 year warranty.

## **2.12 VOC LIMITS**

- .1 Refer to Division 21 - Common Work Results for Mechanical.

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

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

- .5 Reheat coils.
- .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  - .2 Locate to permit easy manipulation of instruments.
  - .3 Install insulation port extensions as required.
  - .4 Locations:
    - .1 For traverse readings:
      - .1 Ducted inlets to roof and wall exhausters.
      - .2 Inlets and outlets of other fan systems.
      - .3 Main and sub-main ducts.
      - .4 And as indicated.
    - .2 For temperature readings:
      - .1 At outside air intakes.
      - .2 In mixed air applications in locations as approved by Department Representative.
      - .3 Downstream of junctions of two converging air streams of different temperatures.
      - .4 And as indicated.
- .4 Turning vanes:
  - .1 Install in accordance with recommendations of SMACNA and as indicated.
- .5 Balance Dampers:
  - .1 Install where indicated.
  - .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  - .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
  - .4 Run outs to registers and diffusers: install single blade damper located as close as possible to main ducts.
  - .5 Dampers: vibration free.
  - .6 Ensure damper operators are observable and accessible.

- .6 Flexible Ductwork:
  - .1 Install in accordance with: CAN/ULC-S110, UL-181, NFPA 90A, NFPA 90B, SMACNA.
  - .2 Maximum allowable length 3 feet.
- .7 Extraction Arms:
  - .1 Install where indicated.
  - .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  - .3 Install as per manufacturer requirements.

### **3.3 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Division 01- General Requirements:

### **3.4 CLEANING**

- .1 Perform cleaning operations in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Fire and smoke dampers and fire stop flaps.

**1.2 REFERENCES**

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA):
  - .1 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories of Canada (ULC):
  - .1 CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.
  - .2 CAN4-S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
  - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed Shop Drawings, Product Literature, Specifications and Datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
    - .1 Submit required copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01- General Requirements. Indicate VOC's for adhesives and solvents during application and curing.
  - .2 Indicate the following:
    - .1 Fire dampers.
    - .2 Smoke dampers.
    - .3 Fire stop flaps.
    - .4 Operators.
    - .5 Fusible links.
    - .6 Design details of break-away joints.

- .2 Quality assurance submittals: submit following in accordance with Division 01- General Requirements:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual in accordance with Division 01- General Requirements.

#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - General Requirements.
- .2 Certificates:
  - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

#### **1.5 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Division 01 - General Requirements.
  - .2 Provide following:
    - .1 6 fusible links of each type.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Division 01- General Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01- General Requirements.



**PART 2 PRODUCTS**

**2.1 SUSTAINABLE REQUIREMENTS**

- .1 Materials and products in accordance with Division 01 - General Requirements and Division 21 - Common Work Results for Mechanical.

**2.2 FIRE DAMPERS**

- .1 Fire dampers: listed and bear label of ULC meet requirements of provincial fire authority Fire Commissioner of Canada (FCC) ANSI/NFPA 90A and authorities having jurisdiction. Fire damper assemblies' fire tested in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation:
  - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
  - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; sized to maintain full duct cross section as indicated.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

### **PART 3 EXECUTION**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.2 INSTALLATION**

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

#### **3.3 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Division 01- General Requirements.

#### **3.4 CLEANING**

- .1 Proceed in accordance with Division 01- General Requirements.

2021-02-18

Project No. R.110935.001

SECTION 23 33 16  
DAMPERS - FIRE AND SMOKE

Page 5 of 5

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

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

**1.2 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
    - .1 Submit required copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements. Indicate VOC's for all adhesives and solvents during application and curing.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.
- .2 Quality assurance submittals: submit following in accordance with Division 01 - General Requirements

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - General Requirements.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Division 01 - General Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

**1.6 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Division 01 - General Requirements.
  - .2 Include:
    - .1 Keys for volume control adjustment.
    - .2 Keys for air flow pattern adjustment.

**PART 2 PRODUCTS****2.1 GENERAL**

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as specified.
- .2 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board.
  - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as specified on drawing schedules.

**2.2 MANUFACTURED UNITS**

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

**PART 3 EXECUTION**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install in accordance with manufacturers instructions.
- .2 Install with screws in countersunk holes where fastenings are visible.

**3.3 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Division 01 - General Requirements.

**3.4 CLEANING**

- .1 Proceed in accordance with Division 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Division 01 - General Requirements.
- .2 Division 21 - Common Work Results for Mechanical.
- .3 Related Sections:
  - .1 Section 23 72 00 - Air to Air Energy Recovery Equipment.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

**1.3 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

**1.4 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed shop drawings, product literature, specifications and datasheet in accordance with Division 01 - General Requirements. Include product characteristics, performance criteria, and limitations.
    - .1 Submit required copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 - General Requirements. Indicate VOC's for adhesives and solvents during application and curing.

- .2 Indicate following:
  - .1 Pressure drop.
  - .2 Face area.
  - .3 Free area.
  - .4 Beginning point of water penetration.
- .2 Quality assurance submittals: submit in accordance with Division 01 - General Requirements.

## **1.5 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - General Requirements.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Division 21 - Common Work Results for Mechanical.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

## **PART 2 PRODUCTS**

### **2.1 SUSTAINABLE REQUIREMENTS**

- .1 Materials and products in accordance with Division 01 - General Requirements and Division 21 - Common Work Results for Mechanical.

### **2.2 FIXED LOUVRES - ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
  - .1 Material: extruded aluminum alloy 6063-T5.
  - .2 Blade: stormproof pattern drainage blade.
  - .3 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot; integral to unit.



- .4 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .5 Screen: 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .6 Finish: anodized. Colour: by Departmental Representative at Shop Drawing submission for approval.
- .7 Free Area: 53%.
- .8 Free Area velocity at beginning point of water penetration: 381 m/sec.
- .9 Pressure drop at beginning point of water penetration: 45 Pa.
- .10 Acceptable Manufacturers: Price, Ventex, Greenheck provided technical specifications are satisfied.
- .2 ERV-1 Intake and Exhaust Louvers:
  - .1 Manufacturer: Price Industries.
  - .2 Model: DE635
  - .3 Size: 900 W x 350 H.

## **2.3 VOC LIMITS**

- .1 Refer to Division 21 - Common Work Results for Mechanical.

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated, refer to structural.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

**3.3 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Division 01 - General Requirements.

**3.4 CLEANING**

- .1 Proceed in accordance with Division 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Division 01 - General Requirements.
- .2 Division 21 - Common Work Results for Mechanical.

**1.2 REFERENCES**

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA):
  - .1 ANSI/NFPA 96-2011, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
  - .1 ASHRAE 52.1-1992, Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).
- .3 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.
  - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.
  - .4 CAN/CGSB-115.13-85, Filter Media, Automatic Roll.
  - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
  - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
  - .8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
  - .9 CAN/CGSB-115.20-95, Polarized Media Air Filter.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

- .5 Underwriters' Laboratories of Canada ULC -S111-95,  
Standard Method of Fire Tests for Air Filter Units:
  - .1 ULC-S649-1993, Exhaust Hoods and Related Controls  
for Commercial and Institutional Kitchens.

### **1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature,  
specifications and datasheet in accordance with  
Section 01 33 00 - Submittal Procedures. Include  
product characteristics, performance criteria, and  
limitations.
    - .1 Submit two copies of Workplace Hazardous  
Materials Information System (WHMIS) Material  
Safety Data Sheets (MSDS) in accordance with  
Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section  
01 33 00 - Submittal Procedures.
- .3 Quality assurance submittals: submit following in  
accordance with Section 01 33 00 - Submittal  
Procedures.
- .4 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into  
manual specified in Section 01 78 00 - Closeout  
Submittals.

### **1.4 QUALITY ASSURANCE**

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

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

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

**1.6 MAINTENANCE**

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

**PART 2 PRODUCTS**

**2.1 GENERAL**

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50°C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

**2.2 ACCESSORIES**

- .1 Holding frames: permanent "T" section or channel section construction of galvanized steel or extruded aluminum same material as casing/hood, 1.6 mm thick, except where specified.
- .2 Seals: to ensure leak proof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side.

**2.3 FIBROUS GLASS PANEL FILTERS**

- .1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.
- .2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.
- .3 Performance: minimum average synthetic dust weight arrestance 70% to ASHRAE 52.1.
- .4 Fire rated: to ULC -S111.

**2.4 FILTER GAUGES - DIAL TYPE**

- .1 Diaphragm actuated, direct reading.

- .2 Range: 0 to 2 times initial pressure 0 to 250 Pa.

## **2.5 FILTER GAUGES - MANOMETER TYPE**

- .1 Inclined acrylic tube.
- .2 Complete with levelling screws.
- .3 Range: 0 to 2 times initial pressure 0 to 250 Pa.

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION GENERAL**

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

### **3.3 REPLACEMENT MEDIA**

- .1 Replace media with new upon acceptance.
- .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

### **3.4 FILTER GAUGES**

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

### **3.5 FIELD QUALITY CONTROL**

- .1 Contractor's Verification, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.

- .5 Recycled content.
- .6 Local/regional materials.
- .7 Low-emitting materials.

**3.6 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 The work to be performed consists of providing all labor, equipment, materials, etc. to furnish and commission new factory assembled hot water boilers as described in the specifications herein.

**1.2 REFERENCES**

- .1 American Boiler Manufacturer's Association (ABMA).
- .2 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME):
  - .1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.
- .3 Canadian Standards Association (CSA International):
  - .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.
- .4 Electrical and Electronic Manufacturer's Association of Canada (EEMAC).
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate the following:
    - .1 General arrangement showing terminal points, instrumentation test connections.



- .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
  - .3 Foundations with loadings, anchor bolt arrangements.
  - .4 Piping hook-ups.
  - .5 Equipment electrical drawings.
  - .6 Burners and controls.
  - .7 All miscellaneous equipment.
  - .8 Flame safety control system.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures:
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

#### **1.5 MAINTENANCE**

- .1 Extra materials:
- .1 Special tools for manholes, handholes and Operation and Maintenance.
  - .2 Spare parts for 1 year of operation.
  - .3 Spare gaskets.
  - .4 Spare gauge glass inserts.
  - .5 Probes and sealants for electronic indication.
  - .6 Safety valve test gauge.

**Part 2 Products**

**2.1 HEATING BOILERS: B-1**

- .1 The electric hot water boiler shall be rated at 27 kW, for a balanced 3-phase, 3-wire delta load at 600 volts, 3-phase, 60 Hertz. The Boiler shall be designed for a 0.6 L/s flow with a water temperature rise of 11°C. The hot water boiler shall be designed for a low-pressure heating system with an operating pressure at 310 kilopascals.
- .2 The boiler vessel shall be constructed in accordance with Section IV of the ASME Boiler and Pressure Vessel Code requirements, "H" stamped and registered with the National Board of Boiler and Pressure Vessels. The vessel shall be equipped with a threaded 32 mm inlet, a threaded 32 mm outlet, safety valve and drain nozzle connections as required.
- .3 The vessel shall be enclosed in a rectangular 16-gauge jacket and be completely insulated with a 4" blanket of fiberglass insulation. The assembled electric boiler jacket shall have an acrylic enamel finish. Jacket shall have a full-length hinged access door with key lock for access to heating elements and controls. The assembled boiler shall be capable of wall mounting.
- .4 All field electrical wiring connections to the boiler shall be made to a main terminal block. All internal wiring shall be made to solderless terminal lug wiring connections. Wiring to be color coded or numbered for ease of servicing. All power circuits to heating elements shall be fused with cartridge type fuses having a minimum 100,000 amp interrupting capacity. Operation of the heating elements shall be switched by a three pole magnetic contactors operated by a 120 volt control circuit. The control circuit shall use a built-in transformer to reduce line voltage to 120 volts for operation of the control circuit components. The control circuit shall be fused on the primary side as well as fused and grounded on the secondary side.
- .5 Temperature control shall be with DDC enable and disable wired to a terminal strip. A proportional solid state step control shall be provided to balance heat input to demand on boilers with multiple stages of control.

The hot water boiler shall be provided with an adjustable auto reset high limit control and an additional manual reset high limit control (on units with more than two stages of control).

- .6 The immersion heating elements shall be low watt density with an incoloy outer sheath material for long life.
- .7 The electric hot water boiler shall be a complete factory package with the following trim furnished as standard: On-Off pilot switch with pilot light to manually operate the 120 volt control circuit, status pilot light for each stage of operation, probe type electronic low water cut-off, pressure gauge with cock, temperature indicator, drain valve and an ASME rated pressure relief valve(s). The boiler shall be factory assembled, wired and tested. The entire hot water boiler shall be U.L. Listed and provide a 10 year limited warranty on the vessel and a 1 year limited warranty on parts.
- .8 The following options shall be included:
  - .1 Ground Fault Detector, Low Temperature Switch, Flow Switch, Safety Door Interlock, Dial Temperature Gauge, Dial Pressure Gauge, Manual Reset Low Water Cut-off, Auto Air Vent Installed and Vacuum Breaker Installed.
    - BMS Alarm.
    - BMS Remote Setpoint.
- .9 Approved Product: Allied Engineering Mini-Star 27MSE or approved alternate.

### **Part 3 Execution**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.2 INSTALLATION**

- .1 Boiler to be shipped to site by others. Unloading, storage on-site and final locating by this Contractor.

- .2 Install in accordance with ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .3 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .4 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .5 Mount unit level using specified vibration and seismic isolation in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .6 Pipe hot water relief valves full size to nearest drain.
- .7 Pipe blow down/drain to blow down tank/floor drain.

### **3.3 MOUNTINGS AND ACCESSORIES**

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

### **3.4 FIELD QUALITY CONTROL**

- .1 Commissioning:
  - .1 Manufacturer to:
    - .1 Certify installation.
    - .2 Start up and commission installation.
    - .3 Carry out on-site performance verification tests.
    - .4 Demonstrate operation and maintenance.
    - .5 Assist Commission Agent in building Commissioning in accordance with Division 01 - General Requirements.

- .2 Provide Consultant and Commissioning Agent at least 24 hours' notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.
- .2 Verification requirements in accordance with Division 01 - General Requirements.

### **3.5 CLEANING**

- .1 Proceed in accordance with Division 01 - General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

### **3.6 MANUFACTURER'S FIELD SERVICES**

- .1 General: The boiler supplier's factory authorized service organization shall be responsible for performance of inspections, start up and testing of the package boiler, and accessory equipment and materials furnished under this Section. A detailed written record of the start up performance, including burner setting data over the entire load range shall be furnished to the Consultant before final acceptance. All labour, equipment and test apparatus shall be furnished by the authorized service organization. All equipment defects discovered by the tests shall be rectified either by the service organization or boiler manufacturer.
- .2 Equipment inspection and pre-start walk through services are as identified in specification sections.
- .3 Start-up shall be conducted by experienced and factory authorized technician in the regular employment of the authorized service organization and shall include:
  - .1 Demonstrate that boiler, burner, controls and accessories comply with requirements of this Section as proposed by the boiler and accessories supplier. Pre-test all items prior to the scheduling the final testing that will be witnessed by the test Consultant.
  - .2 Readings at different firing rates 20, 50, 75 and 100% of load for the modulating burner shall be taken with a written report of the tests submitted to the Consultant.

- .3 Auxiliary Equipment and Accessories: Observe and check all valves, draft fans, electric motors and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctioning, defects and non-compliance with referenced standards or overloading as applicable.
- .4 Commissioning Requirements:
  - .1 Fireside inspection.
  - .2 Set up operating set points.
  - .3 Check all safeties, including LWCO and High limits.
  - .4 Set up and verify efficiencies at 25%, 50%, 75% and 100%.
- .4 Training to include all safety procedures, maintenance procedures, control operations and diagnostic procedures.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Division 01 - General Requirements.
- .2 Division 21 - Common Work Results for Mechanical.

**1.2 SCOPE**

- .1 Furnish and install radiant floor heating system tubing, distribution manifolds with venting/air purge valve, manifold to tubing fittings, embeddable compression sleeve tubing repair couplings, circuit isolation and balancing valves, installation specialties, strainer, supervision and field engineering required for complete and proper function of the system.

**1.3 REGULATORY REQUIREMENTS**

- .1 Tubing shall conform to CAN/CSA B-137.5.
- .2 Installer's qualification: Installer's shall be qualified in writing as either being certified or certifiable prior to the commencement of the installation.

**1.4 REFERENCES**

- .1 ASTM F876 Standard Specification for Cross linked Polyethylene (PEX) Tubing.
- .2 ASTM F877 Cross linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution System.
- .3 CAN/CSA-B137.5 Cross linked Polyethylene (PEX) Tubing Systems for Pressure Applications.
- .4 DIN 4726 German Standard for Plastic Piping used in Warm Water Floor Heating Systems.

**1.5 SUBMITTALS**

- .1 Provide submittals and shop drawings in accordance with Section 01 33 00 - General Requirements and as specified herein. Submit shop drawings indicating schematic layout of system, including equipment, critical dimensions and tubing/slab penetration details and details for protected exposed PEX tubing.

- .2 Submit manufacturer's technical instructions.
- .3 Submit installer's certifications of training for installation of PEX floor heating systems.
- .4 Submit data indicating tube sizing and panel performance at tube spacing and warm water temperatures selected.
- .5 Submit independent certification results for the tubing systems from a recognized testing laboratory.
- .6 Submit catalog data on all supports, tube guides, spacers and associated items necessary for the installation to the tubing and manifolds.
- .7 Submit approved Design Calculation Record forms.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **1.7 WARRANTY**

- .1 The radiant floor system component manufacturer shall warranty the cross linked, polyethylene tubing and all related water distribution components, except controls to be free from defects in material and workmanship for a period of twenty five (25) years. Warranty shall be issued upon presentation of design calculation record forms and approved site inspection reports. The design shall be approved either by submittal by a registered Departmental Representative as being complete and accurate. Any warranty repairs will include costs associated with cutting and patching concrete floor and flooring materials.



**PART 2 PRODUCTS****2.1 TUBING**

- .1 Material: All radiant floor heating tubing shall be high density cross linked polyethylene to CAN/CSA B-137.5. All tubing shall be fully cross linked to the specified standard prior to shipment from the manufacturing facility. All tubing shall be 5/8" i.d. unless noted.
- .2 Temperature and Pressure Rating: Tubing shall be rated for not less than 82°C working temperature and 690 kPa working pressure. Oxygen Diffusion Barrier: Tubing shall have a co-extruded oxygen diffusion barrier capable of limiting oxygen diffusion through the tube at no greater than 0.10/g/m<sup>3</sup>/day at 40°C water temperature.
- .3 Bend Radius: The minimum bend radius for cold bending of the tube shall not be less than five (5) times the outside diameter. Bends with a radius less than stated shall require the use of a bending template as supplied by the tube manufacturer.

**2.2 FITTINGS**

- .1 Fittings shall be manufactured of brass and shall be supplied by the tubing manufacturer as part of a proven catalogued system.
- .2 Tube couplings embedded within the thermal mass shall be brass compression type with ribbed insert and compression sleeve.

**2.3 RADIANT HEATING MANIFOLDS**

- .1 Material: Distribution manifolds shall be manufactured of brass and be supplied by the piping manufacturer as a proven catalogued part of the manufacturer's system.
- .2 Brass manifolds shall be produced from extruded brass round pipe with tapped holes for connections, be pre-assembled and 100% air tested by the manufacturer.
- .3 Provide complete system for each zone as follows:
  - .1 Capable of 2-12 loops, as per In-Floor Heating Manifold Schedule.

- .2 Supply manifold with circuit balancing valve and integral visual flow gauges that read to 0.12 l/s (2 USGPM) for each circuit.
- .3 Return manifolds with 24V modulating temperature control valves for analog output signal from EMCS.
- .4 Each circuit valve shall be supplied with a manual actuating handle for filling/purging operation.
- .5 Drain valve.
- .6 Isolation valve with integral thermometer housings.
- .7 Air vent/fill ports.
- .8 Pipe fittings.
- .9 Steel Cabinet, insulated, with locking door.
- .10 Temperature gauge.
- .11 Pressure gauge.
- .12 Schedule: Rehau Pro-Balance Manifold.

#### **2.4 CAPACITY**

- .1 As indicated on drawings.

#### **2.5 ACCEPTABLE MANUFACTURERS**

- .1 Rehau.
- .2 Wirsbo
- .3 Approved Equal.
- .4 All equals are to be approved prior to tender closing (See Instructions to Bidders, Prior Approval of Products).

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- .1 Concrete Slab on Grade: Subsoil should be compacted, flat and smooth to prevent damage to tube or insulation.
- .2 Preparing the wall cavity for manifold installation. See drawings to determine the width of the wall cabinet and required wall opening dimensions. Mount the manifold cabinet allowing space for the screed to fill up the front of the tube opening.

**3.2        INSTALLATION**

- .1    Install in accordance with manufacturer's published technical manual.
- .2    Route tubing in orderly manner, according to layout and spacing shown in approved submittal drawings. All notes on drawings shall be followed.
- .3    At joints and fittings, square and clean end of tube, using a plastic tube cutter and join immediately or cap with tape to seal from contaminants. Where fittings are installed within the thermal mass they shall be wrapped in chloride-free tape.
- .4    Remove all twists prior to securing tube. Fasten tubing at no more than 914 mm intervals, being careful not to twist the tube. In thin concrete slabs, it may be necessary to secure tubing every 610 mm.
- .5    Tubing that must pass through expansion joints shall be sleeved 254 mm on each side of the joint.
- .6    Where tubing exits the floor, a sleeve shall be placed around the tube, with the sleeve extending a minimum of 254 mm into the floor and exiting by a minimum of 254 mm.
- .7    After laying each circuit, cap the end of the tube with tape and label the tube's circuit numbers (supply and return) or connect to associated manifold and label tube length for balancing.
- .8    The following precautions shall be taken in areas intended for carpet:
  - .1    Notify carpet layer that hydronic floor heating has been installed.
  - .2    Install metal guards where carpet tack strips will be installed.
- .9    The heating system should be put into operation after the poured concrete thermal mass has cured a minimum of 28 days. If it is necessary to operate the heating system to prevent freezing, a maximum flow temperature of 15°C must not be exceeded while the thermal mass is curing. Gradually increase the flow temperature by 5°C each day until it reaches the maximum operating temperature.

### **3.3 FIELD QUALITY CONTROL**

- .1 Filling, testing and balancing:
  - .1 Tests of hydronic heating systems shall comply with local codes and where required, should be witnessed by the building official.
  - .2 Pressure gauges used must show pressure increments of 7 kPa and should be located at or near the lowest points in the distribution system.
  - .3 Charge the complete, yet unconcealed tubes with water. Purge all air from tubes. Check the system for leakage, especially at all tube joints. Take necessary precautions to prevent water from freezing.
  - .4 Perform a preliminary pressure test pressurizing the system to 1.5 times the maximum operating pressure or 690 kPa whichever is greater for 30 minutes. As the tubing expands, restore pressure, first at 10 minutes into the test and again at 20 minutes. At the end of the 30 minute preliminary test, pressure must not fall by more than 55 kPa from the maximum and there shall be no leakage.
  - .5 After the performing the preliminary test, perform the main pressure test immediately. The main pressure test shall last 2 hours. The test pressure should be restored and must not fall more than 20 kPa (3 psig) after 2 hours. No leakage should be detected.
  - .6 Pressure shall be maintained during installation of the thermal mass.
  - .7 Complete all inspection and test reports as supplied by the manufacturer of the system.

**END OF SECTION**

**PART 1 GENERAL****1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for piping and fittings used in HVAC heat exchangers.
- .2 Related Sections:
  - .1 Section 01 32 16 07 - Construction Progress Schedules - Bar (GANTT) Chart.
  - .2 Section 01 33 00 - Submittal Procedures.
  - .3 Section 01 35 29 - Health and Safety Requirements.
  - .4 Section 01 45 00 - Quality Control.
  - .5 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
  - .6 Section 01 78 00 - Closeout Submittals.
  - .7 Section 01 91 13 - General Commissioning (Cx) Requirements.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME Boiler and Pressure Vessel Code.
    - .1 BPVC-VIII B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.
    - .2 BPVC-VIII-2 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.
    - .3 BPVC-VIII-3 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.
- .2 Canadian Standards Association (CSA International):
  - .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for heat exchangers.
- .3 Shop Drawings:
  - .1 Submit shop drawings to indicate project layout including layout, dimensions of heat exchangers and system. Indicate following information:
    - .1 Manufacturers recommended clearances for tube withdrawal and manipulation of tube cleaning tools.
    - .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
    - .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .4 Instructions: submit manufacturer's installation instructions.
    - .5 Manufacturer's Field Reports: manufacturer's field reports specified.
    - .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.4 QUALITY ASSURANCE**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
    - .1 Verify project requirements.
    - .2 Review installation conditions.

- .3 Co-ordination with other building sub-trades.
- .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

#### **1.5 MAINTENANCE**

- .1 Maintenance Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Supply following spare parts:
  - .1 Head gaskets.

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

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 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 (WMP).
  - .4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan (WMP).
  - .5 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

**PART 2 PRODUCTS**

**2.1 PLATE HEAT EXCHANGER**

- .1 General:
  - .1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code, Section VIII, CSA B51 and provincial pressure vessel regulations.
- .2 Frames: carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.
- .3 Gaskets: as recommended by manufacturer to suit fluid temperature.
- .4 Supports: as indicated on drawings.
- .5 Piping connections: as indicated on drawings.
- .6 Capacity: per drawing schedule.

**PART 3 EXECUTION**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.
- .2 Tube in shell heat exchangers: arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.

**3.3 APPURTENANCES**

- .1 Install with safety relief valve piped to drain, vacuum breaker, steam trap and hose bib drain valve.
- .2 Install thermometer wells with thermometers on inlet and outlet of secondary side.



- .3 Install pressure gauge on steam inlet.

### **3.4 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product(s), and submit written reports, in acceptable format, to verify compliance of work with Contract.
  - .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
  - .3 Schedule site visits to review work at stages listed:
    - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
    - .2 Twice during progress of work at 25% and 60% complete.
- .2 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within 3 days of review and submit immediately to Departmental Representative.
- .4 Start-up:
  - .1 General: perform start-up operations as specified herein.
  - .2 Check heater for cleanliness on primary and secondary sides.
  - .3 Check water treatment system is complete, operational and correct treatment is being applied.
  - .4 Check installation, settings, operation of relief valves and safety valves.
  - .5 Check installation, location, settings and operation of operating, limit and safety controls.
  - .6 Check supports, seismic restraint systems.

- .5 Performance Verification:
  - .1 General: perform performance verification as specified.
  - .2 Timing: only after TAB of hydronic systems have been successfully completed.
  - .3 Primary side:
    - .1 Measure flow rate, pressure drop, and either one steam pressure and temperature at heater inlet or two water temperature at heater inlet and outlet.
    - .2 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.
  - .4 Control valve: verify proper operation without binding, slack in components. Measure steam pressure and temperature at control valve inlet.
  - .5 Secondary side:
    - .1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.
    - .2 Verify installation and operation of air elimination devices.
  - .6 Calculate heat transfer from primary and secondary sides.
  - .7 Simulate heating water temperature schedule and repeat above procedures.
  - .8 Verify settings, operation, safe discharge from safety valves and relief valves.
  - .9 Verify settings, operation of operating, limit and safety controls and alarms.
  - .10 Reports: Provide start-up reports.

### **3.5 CLEANING**

- .1 Perform cleaning operations in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1 GENERAL****1.1 SUMMARY**

- .1 Division 01 - General Requirements.
- .2 Division 21 - Common Work Results for Mechanical.

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
  - .1 ASHRAE 84-1991, Method of Testing Air-to-Air Heat Exchangers (ANSI approved).
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

**1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

- .5 Certificates:
  - .1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
  - .2 Provide confirmation of testing.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

#### **1.5 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Furnish list of individual manufacturer's recommended spare parts for equipment include:
    - .1 Bearings and seals.
    - .2 Addresses of suppliers.
    - .3 List of specialized tools necessary for adjusting, repairing or replacing.

### **PART 2 PRODUCTS**

#### **2.1 GENERAL**

- .1 Comply with ASHRAE Standard 84-2020.

#### **2.2 INDOOR ENERGY RECOVERY VENTILATOR ERV-1**

- .1 Outdoor Air Performance:
  - .1 Capacity: 1047 lps @ 0.31 kPa ESP.
  - .2 Motor: 2.2 kW.
  - .3 Fan RPM: 1496.

- .2 Exhaust Air Performance:
  - .1 Capacity: 1047 lps @ 0.31 kPa ESP.
  - .2 Motor: 2.2 kW.
  - .3 Fan RPM: 1496.

- .3 Arrangement:
  - .1 OA Intake Position: SIDE.
  - .2 OA Discharge Position: SIDE.
  - .3 EA Intake Position: SIDE.
  - .4 EA Discharge Position: SIDE.

- .4 Electrics: 575/3/60, MCA: 8.2, MOP: 15.

- .5 Energy Recovery Performance:

- .1 Winter Conditions
  - .1 Outdoor Air:

Entering	Leaving
Dry Bulb: -18 °C	7.5 °C
Wet Bulb: -19 °C	3.5 °C
Specific Humidity: 6.6 gr/kg.	51.7 gr/kg.
Enthalpy: 0.465 kJ/kg.	33.7 kJ/kg.

- .2 Exhaust Air:

Entering
Dry Bulb: 21 °C
Wet Bulb: 12 °C
Specific Humidity: 85.1 gr/kg.
Enthalpy: 53.0 kJ/kg.

- .3 Sensible effectiveness: 65.5 %.
- .4 Total effectiveness: 63.4 %.

- .6 Features:
  - .1 Exterior Housing, Galvanized Steel.
  - .2 Energy Recovery core.
  - .3 Two blower and motor assemblies, belt driven.
  - .4 Forward curved steel wheels.
  - .5 Ball bearing motors.
  - .6 Fan shafts in permanently lubricated rubber mounted ball bearings.
  - .7 Mounted on unit base w/neoprene isolators.
  - .8 Corrosion resistant fasteners.
  - .9 Housing lined w/25 mm 3# density foil faced insulation.
  - .10 Single point wiring.
  - .11 Complete with unit mounted disconnect, motor starters, 24 VAC control transformer, control circuit fusing.
  - .12 Motors mounted on adjustable plate.
  - .13 Adjustable motor pulleys.
  - .14 Static-free belts.
  - .15 ARI performance certified.
  - .16 AMCA certified ratings.
  - .17 Listed to UL-1995.
  - .18 OA Filter - 50 mm MERV 8.
  - .19 EA Filters - 50 mm MERV 8.
  - .20 Painted Exterior -Gray.
  - .21 Frost Control: Timed Exhaust.
  - .22 Internal Panel.
  - .23 Spare Belts.
  - .24 Spare Energy Wheel Belt.
  - .25 Internal Panel - ON/OFF Switch.
  - .26 Spare Filter Set (2) Supply (2) Exhaust.
  - .27 Integral variable frequency drive fan speed control.
  - .28 Enhanced controls with BACnet interface
  - .29 Hinged Access Doors.
  - .30 Double Wall Construction - 24 ga. Galv. Int. liner.
  - .31 Approximate Weight: 400 kg.
- .7 Acceptable Material: Renewaire Model HE-3XJINH.

**PART 3 EXECUTION**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of adjacent ductwork with flexible connections.
- .3 Install access doors in accordance with Section 23 33 00 - Air Duct Accessories for access to coils, dampers.

**3.3 FIELD QUALITY CONTROL**

- .1 Tests:
  - .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

**3.4 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- .1 Division 01 - General Requirements.
- .2 Division 21 - Common Work Results for Mechanical.
- .3 Related Sections
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

**1.2 REFERENCES**

- .1 Air-Conditioning and Refrigeration Institute (ARI):
  - .1 ARI 210/240-1994, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- .2 American National Standards Institute/National Fire Protection Association (ANSI/NFPA):
  - .1 ANSI/NFPA 90A-1999, Installation of Air Conditioning and Ventilating Systems.
- .3 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
  - .1 ASHRAE Standard 15-2001, Safety Standard for Refrigeration Systems.
- .4 Canadian Standards Association (CSA International):
  - .1 CAN/CSA-C656-M92(R1998), Performance Standard for Single Package Central Air Conditioners and Heat Pumps.
- .5 Environment Canada, (EC)/Environmental Protection Services (EPS) :
  - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
  - .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Sections 01 33 00 - Submittal Procedures.
- .2 Indicate:
  - .1 Capacities.



- .2 ARI Ratings.
- .3 Sound Power levels.
- .4 Installation instructions.
- .5 Start-up Instructions.
- .6 O&M, Instructions.

#### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

#### **1.5 WARRANTY**

- .1 For heat pumps, warranty period is extended to 5 years.
- .2 Contractor hereby warrants heat pumps for 5 years.

### **PART 2 PRODUCTS**

#### **2.1 GENERAL**

- .1 Heat pumps: EPS 1/RA/2, CSA approved and carry ARI or CSA certification seal.

#### **2.2 REFRIGERANTS**

- .1 Type of Refrigerant: R-410A.

#### **2.3 AIR TO WATER HEAT PUMP**

- .1 General:
  - .1 To consist of air-to-water outdoor heat pump unit, for use with R-410a.
- .2 Performance data: as indicated:
  - .1 Electrical: 220V, 1 pH, 60 Hz, 30.4 MCA, 50 MOP
  - .2 Heating:
    - .1 Capacity: 10.4 kW.
    - .2 Total unit power input: 4.1 kW maximum.
    - .3 Ratings: in accordance with ARI 210/240.

- .4 Water flow rate in heating mode 0.67 L/s.
- .3 Outdoor unit:
  - .1 Scroll compressor on anti vibration mounts with crankcase heater, internal and external current sensitive overload and over-temperature protection.
  - .2 Outdoor air fan: propeller type with horizontal discharge, direct-driven from permanently lubricated motor.
  - .3 Coil: aluminum plate fins mechanically bonded to copper tubing with joints brazed.
  - .4 Mounted legs to elevate unit.
  - .5 Finish: primer and corrosion restraint coatings.
- .4 Acceptable materials: Aermec ANK-H-050.
- .5 Controls and protective devices to include:
  - .1 High-pressure stat, loss-of-charge pressure stat.
  - .2 Crankcase heater.
  - .3 Suction line accumulator.
  - .4 Pressure relief device.
  - .5 Short-cycle protection of compressor.
  - .6 Demand defrost.
  - .7 Defrost interlock relay to ensure only one heat pump can defrost.
- .6 Accessories:
  - .1 Refrigerant head pressure controls.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install where indicated and in accordance with manufacturer's instructions.
- .2 Install outdoor units at ground level on RC housekeeping pad.
- .3 Secure with hold-down bolts.
- .4 Level unit with fans running. Align pipework and use flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.

- .5 Make piping connections.
- .6 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

**3.2 START-UP AND COMMISSIONING**

- .1 Manufacturer to certify installation.
- .2 Manufacturer to test and start up units and certify performance.
- .3 Manufacturer to provide verbal and written instructions to operating personnel.
- .4 Submit written report to Departmental Representative.

**END OF SECTION**