

**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 05.

**1.2 RELATED SECTIONS**

- .1 Section 01 74 21 – Construction/Demolition Waste Management And Disposal.
- .2 Section 01 74 11 - Cleaning.
- .3 Section 07 84 00 - Firestopping.
- .4 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.3 REFERENCES**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – 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 for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to approved metal recycling facility.

**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 automatic 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 in accordance with 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, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible 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 as indicated.
- .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 ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
  - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .8 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .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 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 – Fire stopping.
- .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 Section 01 74 11 - Cleaning supplemented as specified in relevant sections of Division 22, 23 and 25.
- .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 Engineer 48 hours' minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of this Division.
- .3 Maintain specified test pressure without loss for 12 hours minimum unless specified for longer period of time in relevant sections of this Division.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Engineer or his designate.
- .6 Pay costs for repairs or replacement, retesting, and making good. Engineer to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Engineer.

**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 19 01.

**1.2 SECTION INCLUDES**

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

**1.3 RELATED SECTIONS**

- .1 Division 01 – General Requirements.
- .2 Section 23 05 53.01 - Mechanical Identification.

**1.4 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.

**1.5 SUBMITTALS**

- .1 Submittals in accordance with Division 01 – General Requirements.
- .2 Submit Manufacturer printed shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.
- .3 Submit manufacturer's product data for following items:
  - .1 Thermometers.
  - .2 Pressure gauges.
  - .3 Stop cocks.
  - .4 Wells.
  - .5 Syphons.
- .4 Submit WHMIS MSDS – Material Safety data sheets in accordance with Division 01 – General Requirements.

**1.6 HEALTH AND SAFETY**

- .1 Do construction occupational health and safety in accordance with Section 01 35 29 06 – Health and Safety Requirements.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

## **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 Heating Water: 0-115°C.

### **2.2 DIRECT READING THERMOMETERS**

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB14.4 and ASME B40.200:
  - .1 Acceptable Material: Trerice, Winters, Weksler or approved equal.

### **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:
  - .1 Acceptable Material: Trerice, Winters, Weksler.

## **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 Heat exchangers.
  - .2 Water heating and cooling coils.
  - .3 Water boilers.
  - .4 DHW tanks.
  - .5 Fluid coolers.

- .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 Outlet of boilers.
  - .7 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 lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

**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 23.01.

**1.2 SUMMARY**

- .1 Section Includes:
  - .1 Bronze - valves.
- .2 Sustainable requirements for construction and verification. Refer to General Specs.
- .3 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 21 – Construction/Demolition Waste Management And Disposal.
  - .3 Section 01 47 15 – Sustainable Requirements: Construction.
  - .4 Section 01 35 29 06 - Health and Safety Requirements.
  - .5 Section 01 78 00 - Closeout Submittals.
  - .6 Section 23 05 05 - Installation of Pipework.

**1.3 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.
- .2 American Society for Testing and Materials International, (ASTM):
  - .1 ASTM A276-04, Specification for Stainless Steel Bars and Shapes.
  - .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
  - .3 ASTM B283-99a, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  - .4 ASTM B505/B505M-02, Specification for Copper-Base Alloy Continuous Castings.
- .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 ASTM B584-00, Specification for Copper Alloy Sand Castings for General Applications.

#### **1.4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets:
  - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Submit data for valves specified in this section.
- .3 Closeout Submittals:
  - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### **1.5 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Construction occupational health and safety in accordance with Section 01 35 29 06 - Health and Safety Requirements.
- .2 All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

#### **1.6 DELIVERY STORAGE AND DISPOSAL**

- .1 Waste Management and Disposal:
- .2 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .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.

#### **1.7 MAINTENANCE**

- .1 Provide Maintenance Data.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Sustainable Requirements:
  - .1 Materials and resources in accordance with Section 01 47 15 – Sustainable Requirements: Construction.
- .2 Valves:
  - .1 Except for specialty valves, to be single manufacturer.
  - .2 All products to have CRN registration numbers.

- .3 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.
      - .1 Grooved ends to copper tube dimensions and CSA B242.
      - .2 Push-to-connect ends to ANSI/ASME B16.22 and manufacturer's standards.
- .4 Lock shield Keys:
  - .1 Where lock shield valves are specified, provide 2 spare keys of each size to the City: malleable iron cadmium plated.
- .5 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: regrindable.
  - .3 NPS 2 and under, swing type, bronze disc:
    - .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.
  - .4 NPS 2 and under, swing type, composition disc, Class 200:
    - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
    - .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
  - .5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
    - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
    - .2 Disc: renewable PTFE rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.
  - .6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
    - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
  - .7 NPS 2 and under, vertical or horizontal, lift type, 1380-kPa (200 psig) CWP:
    - .1 Disc: 301 stainless steel, center guided.  
Victaulic PermaLynx PL-510.

- .6 Silent Check Valves:
  - .1 NPS 2 and under:
    - .1 Body: cast high tensile bronze to ASTM B62 with integral seat.
    - .2 Pressure rating: Class 125.
    - .3 Connections: screwed ends in accordance with ANSI B1.20.1 and with hex. shoulders.
    - .4 Disc and seat: renewable rotating disc.
    - .5 Stainless steel spring, heavy duty.
    - .6 Seat: re-grindable.
- .7 Ball Valves:
  - .1 NPS 2 and under:
    - .1 Body and cap: cast high tensile bronze in accordance with ASTM B62.
    - .2 Pressure rating: Class 125.
    - .3 Connections: Screwed ends in accordance with ANSI B1.20.1 and with hexagonal shoulders.
    - .4 Stem: tamperproof ball drive.
    - .5 Stem packing nut: external to body.
    - .6 Ball and seat: replaceable stainless steel solid ball and teflon seats.
    - .7 Stem seal: TFE with external packing nut.
    - .8 Operator: removable lever handle.

### **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 Section 01 47 15 Sustainable Requirements: Construction, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Local/regional materials.
  - .6 Low-emitting materials.

**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 29.

**1.2            SUMMARY**

- .1        Section Includes:
  - .1        Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.
  - .2        Sustainable requirements for construction and verification.

**1.3            REFERENCES**

- .1        American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
  - .1        ANSI/ASME B31.1-04, Power Piping.
- .2        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.
- .3        Factory Mutual (FM).
- .4        Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1        Material Safety Data Sheets (MSDS).
- .5        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.
- .6        Underwriter's Laboratories of Canada (ULC).

**1.4            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 or

- .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.

## **1.5 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .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 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 maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **1.6 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 06 - Health and Safety Requirements.

## **1.7 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 21 – Construction/Demolition Waste Management and Disposal.

## **Part 2        Products**

### **2.1            SUSTAINABLE REQUIREMENTS**

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

### **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 electro-plating galvanizing process.
  - .3        Ensure steel hangers in contact with copper piping are copper plated.
- .2        Upper attachment structural: suspension from lower flange of I-Beam:
  - .1        Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
    - .1        Rod: 9 mm UL listed.
  - .2        Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58 and MSS-SP69.
- .3        Upper attachment structural: suspension from upper flange of I-Beam:
  - .1        Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved to MSS SP69.
  - .2        Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4        Upper attachment to concrete:
  - .1        Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2        Concrete inserts: wedge shaped body with knockout protector plate UL listed in accordance with MSS SP69.
- .5        Shop and field-fabricated assemblies:
  - .1        Trapeze hanger assemblies.
  - .2        Steel brackets.
  - .3        Sway braces for seismic restraint systems.
  - .4        Pipe Racks.

- .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.
  - .3 Do not use 22mm or 28 mm rod.
- .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 in accordance with MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .10 U-bolts: carbon steel in accordance with MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## **2.4 RISER CLAMPS**

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

## **2.5 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield in accordance with MSS SP69, galvanized sheet steel. Length designed for maximum 3 m span, min. 300 mm long.
- .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 meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

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

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

## **2.8 HOUSE-KEEPING PADS**

- .1 Contractor shall provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

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

- .7 Use variable support spring hangers where:
  - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 Variation in supporting effect does not exceed 25 % of total load.

### 3.3 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
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
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

- .7 Pipework greater than NPS 12: in accordance with MSS SP69.

### 3.4 HANGER INSTALLATION

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

### 3.5 HORIZONTAL MOVEMENT

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

### **3.6 FINAL ADJUSTMENT**

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

### **3.7 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report.
- .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 in accordance with Section 01 33 00 – Submittal Procedures..
  - .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 Verification requirements in accordance with Section 01 47 15 – Sustainable Requirements: Construction, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.

**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 53.01.

**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 06 - 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 21 – Construction/Demolition Waste Management and Disposal.
  - .2 Dispose of unused paint, coating material at official hazardous material collections site approved by Engineer.
  - .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 SUSTAINABLE REQUIREMENTS**

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

### **2.2 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.

### **2.3 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.

## 2.4 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new Work.

.2 Where existing identification system does not cover for new work, use identification system specified this Section.

.3 Before starting work, obtain written approval of identification system from Engineer.

## 2.5 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Propane gas: in accordance with CSA/CGA B149.1 authority having jurisdiction.

.2 Sprinklers: in accordance with NFPA 13.

## 2.6 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 Engineer.
  - .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
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Propane Gas regulator vents	to Codes to Codes	

## **2.7 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".

## **2.8 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.

## **2.9 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.

## **2.10 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 - Painting has been completed.

### **3.3 INSTALLATION**

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



### **3.4 NAMEPLATES**

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

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

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

### **3.6 VALVES, CONTROLLERS**

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

- .3 Number valves in each system consecutively.

### **3.7 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Section 01 47 15 - Sustainable Requirements: Construction, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.

### **3.8 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 GENERAL REQUIREMENTS**

- .1 The Contractor shall be responsible to carry out all the Work set out or referred to in this Section 23 05 93.

**1.2 SUMMARY**

- .1 "TAB" is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

**1.3 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Submit names of personnel to perform TAB to Engineer within 90 days of Execution Date.
- .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 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.
- .4 Advise Engineer and if additional sheaves required to meet balance point.

#### **1.5 EXCEPTIONS**

- .1 TAB of systems and equipment regulated by Governmental Authorities shall be to satisfaction of such Governmental Authorities.

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

- .1 Schedule time required for TAB (including repairs, re-testing) into Project Schedule to ensure completion.
- .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 Construction Work is started and confirm in writing to Architect of Record adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Architect of Record in writing proposed procedures which vary from this Section.
- .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 Engineer for verification of TAB reports.

## **1.10 START OF TAB**

- .1 Notify Engineer 14 days prior to start of TAB.
- .2 Start TAB when Construction is Substantially Complete. TAB shall include, without limitation:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weather stripping, sealing, and caulking.
  - .3 Pressure, leakage, other tests specified elsewhere Division 23.
  - .4 Provisions for TAB installed and operational.
- .3 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 Water 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 Perform TAB to following tolerances of design values:
  - .1 HVAC systems: plus 5%, minus 5%.
  - .2 Hydronic systems: plus or minus 5%.

## **1.12 ACCURACY TOLERANCES**

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

## **1.13 INSTRUMENTS**

- .1 Prior to TAB, submit to Engineer list of instruments used together with serial numbers.

- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 28 days of TAB. Provide certificate of calibration to Engineer.
- .4 Calibrate every 6 months thereafter.

#### **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 Engineer, 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 Submit format for approval with referenced standard.
- .2 TAB report to show results in English units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit 4 bound copies of TAB Report in English to Engineer for verification and approval.

#### **1.17 VERIFICATION**

- .1 Reported results subject to verification by Engineer.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results as directed by Engineer.
- .4 Repeat TAB as required to satisfaction of Engineer.

#### **1.18 SETTINGS**

- .1 After TAB is completed to satisfaction of Engineer, replace drive guards, close access doors, lock devices in set positions and 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 Engineer.

**1.20 AIR SYSTEMS**

- .1 Standard: TAB to AABC, SMACNA and ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified Division 23 following systems, equipment, components, controls:
  - .1 All air handling units and exhaust fans.
- .3 Qualifications: personnel performing TAB/current member in good standing of AABC qualified to standards 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 OTHER TAB REQUIREMENTS**

- .1 General requirements applicable to work specified this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified this section.
  - .2 Quality assurance: as for air systems specified this section.
- .2 Building pressure conditions:
  - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.
- .3 Liquid Systems: Balance in-floor heating manifold on specified flows.

**1.22 POST-OCCUPANCY TAB**

- .1 Measure air velocity, NC levels, in occupied zone of following areas: 4 rooms in Administration Wing, two in Maintenance and one in Storage Garage.
- .2 Emergency evacuation: participate in full scale emergency evacuation exercises.

- .3 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period. Allow for traverses of all AHU main branches and all VAV boxes.

**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 Division 01 – General Requirements.
- .2 Division 20 – Common Work Results for Mechanical.
- .3 Related Sections:
  - .1 Section 23 31 13 01 – Metal Ducts – Low Pressure to 500 Pa.
  - .2 Section 23 31 13 02 – Metal Ducts – High Pressure to 2500 Pa.

**1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
  - .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

**1.3 SUBMITTALS**

- .1 Make submittals in accordance with Division 01 – General Requirements.
- .2 Co-ordinate submittal requirements and provide submittals in accordance with Division 01 – General Requirements.
- .3 Test Reports: submit certified test reports from approved testing agency indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
  - .1 Submit proposed report form and test report format to Engineer and Commissioning Agent for approval at least one month before proposed date of first series of tests. Do not start tests until approval received in writing from Engineer and Commissioning Agent.
  - .2 Prepare report of results and submit to Engineer within 24 hours of completion of tests. Include:
    - .1 Schematic of entire system.
    - .2 Schematic of section under test showing test site.
    - .3 Required and achieved static pressures.
    - .4 Orifice differential pressure at test sites.
    - .5 Permissible and actual leakage flow rate (L/s) for test sites.
    - .6 Witnessed certification of results.
  - .3 Include test reports in final TAB report.

**1.4 QUALITY ASSURANCE**

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting one week prior to beginning on-site installations in accordance with Division 01 – General Requirements.

- .1 Verify project requirements.
- .2 Review installation and substrate 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 Division 01 – General Requirements.
- .3 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 TESTING AGENCY**

- .1 TAB Contractor on this project.

## **Part 2 Products**

### **2.1 TEST INSTRUMENTS**

- .1 Test apparatus to include:
  - .1 Fan capable of producing required static pressure.
  - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
  - .3 Flow measuring instrument compatible with the orifice plate.
  - .4 Calibration curves for orifice plates used.
  - .5 Flexible duct for connecting to ductwork under test.
  - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- 3% of flow rate and pressure.
- .3 Submit details of test instruments to be used to Engineer at least one month before anticipated start date.
- .4 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative and Engineer no more than 28 days before start of tests.

## **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 TEST PROCEDURES**

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
  - .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

### **3.3 SITE TOLERANCES**

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates:
  - .1 Small duct systems up to 250 Pa: leakage 2%.
  - .2 Large low pressure duct systems up to 500 Pa: leakage 2%.
  - .3 High pressure duct systems up to 2500 pa: leakage 2%.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

### **3.4 TESTING**

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

### **3.5 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Division 01 – General Requirements.
- .2 Performance Verification:
  - .1 Engineer to witness tests and to verify reported results.
  - .2 To be certified by same TAB agency on this project.

### **3.6 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL REQUIREMENTS**

- .1 The Contractor shall be responsible to carry out all the Work set out or referred to in this Section 23 07 13.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management And Disposal.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

**1.3 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 C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fibre-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795-92, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  - .9 ASTM C921-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .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.

#### **1.4 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.

#### **1.5 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

#### **1.6 SAMPLES**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

#### **1.7 MANUFACTURERS' INSTRUCTIONS**

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used and installation standards achieved.

#### **1.8 QUALIFICATIONS**

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

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

- .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.

#### **1.10 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – 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 for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Engineer.
- .5 Divert unused adhesive material from landfill to official hazardous material collections site approved by Engineer.
- .6 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

### **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 reinforced foil faced vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this Section.
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied reinforced foil faced vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this section:
  - .1 Mineral fibre: to ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: in accordance with ASTM C553.

## 2.3 JACKETS

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: Compatible with insulation.
- .3 Aluminum:
  - .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this Section.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: Smooth.
  - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
    - .1 Stainless steel:
  - .5 Type: 304.
  - .6 Thickness: 0.50 mm sheet.
  - .7 Finish: Smooth.

## 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, in accordance with ASTM C449.
- .4 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5mm thick stainless steel.

- .11 Facing: 25mm galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .12 Fasteners: 2mm diameter pins with 35mm diameter or square clips, length to suit thickness of insulation.

### **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 HVAC 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)
Supply and exhaust plenums	C-1	yes	50
Supply and exhaust ducts between ERV's and louvers	C-2	yes	50

**Note:** exposed foil face is acceptable in Attic Mechanical Room. Tape all joints with foil tape.

#### **3.4 JACKETS**

- .1 Use jacket in all Mechanical Rooms.

**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 08 02.

**1.2 SUMMARY**

- .1 Section includes:
  - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.
- .2 Sustainable requirements for construction and verification.
- .3 Related Sections:
  - .1 All heating water systems.

**1.3 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM):
  - .1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).

**1.4 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures:
  - .1 Instructions: submit manufacturer's installation instructions.

**1.5 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 06 - Health and Safety Requirements.

**1.6 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 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 SUSTAINABLE REQUIREMENTS**

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

### **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 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 Visit site one week in advance of planned cleaning start date to ensure following 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 Within 10 working day of cleaning completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
  - .1 Fill system with water and 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 degrees 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 design. 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 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

- .7 Repeat with water at design temperature.
- .8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
- .9 Bring system up to design temperature and pressure slowly over a 48 hour period.
- .10 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .11 Adjust pipe supports, hangers, springs as necessary.
- .12 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .13 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .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 Section 01 47 15 - Sustainable Requirements: Construction, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.

### **3.5 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 REFERENCES**

- .1 ANSI/ASME B16.5-1996, Pipe Flanges and Flanged Fittings
- .2 ANSI B16.18-84 (R1994), Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ASTM A 53/A53M-01, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .4 CAN/CGA B149.1-00, Natural Gas and Propane Installation Code.

**1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 11 00.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Provide Maintenance data for incorporation into manual as specified in Section 01 11 00.

**Part 2 Products**

**2.1 PIPE**

- .1 Steel pipe: to ASTM A 53, Schedule 40, seamless as follows:
  - .1 NPS 1/2 to 2, screwed.
  - .2 NPS 2½ and over, plain end, welded.

**2.2 JOINTING MATERIALS**

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.

**2.3 FITTINGS**

- .1 Steel pipe fittings, screwed, flanged or welded:
  - .1 Malleable iron: screwed, banded, Class 150.
  - .2 Steel pipe flanges and flanged fittings: to ANSI/ASME B16.5.
  - .3 Welding: butt-welding fittings.
  - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A47M.
  - .5 Bolts and nuts: to ASME B18.2.1.
  - .6 Nipples: schedule 40, to ASTM A 53/A53M.

**2.4 VALVES**

- .1 Provincial Code approved, lubricated ball type.

## **2.5 CONNECTORS**

- .1 Quick connect and flexible connectors for each appliance being served by the gas system.
- .2 Plastic coated stainless steel safety cables to secure each appliance mounted on castors, or on counters.
- .3 Standard of Acceptance:  
Fairview QD-GMC  
Fairview ACM-50  
Fairview ACM-GAS-RCP

## **PART 3 Execution**

### **3.1 PIPING**

- .1 Install in accordance with applicable Provincial Codes.
- .2 Install in accordance with CAN/CSA B149.1-00.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .5 Slope piping down in direction of flow to low points.
- .6 Install drip points:
  - .1 At low points in piping system.
  - .2 At each connection to equipment.
- .7 Use eccentric reducers at pipe size change installed to provide positive drainage.
- .8 Provide clearance for access and for maintenance.
- .9 Ream pipes, clean scale and dirt, inside and out.
- .10 Install piping to minimize pipe dismantling for equipment removal.

### **3.2 VALVES**

- .1 Install valves with stems upright or horizontal unless otherwise approved by Engineer, or authority having jurisdiction.
- .2 Install valves at branch take-offs to isolate each piece of equipment, and as indicated.

**3.3 FIELD QUALITY CONTROL**

- .1 Test system in accordance with CAN/CGA B149.1 and requirements of authorities having jurisdiction.

**3.4 PURGING**

- .1 Purge after pressure test in accordance with CAN/CGA B149.1-00.

**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 21 13 02.

**1.2 SUMMARY**

- .1 Section includes:
  - .1 Materials and installation for steel piping, valves and fittings for hydronic systems.
  - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 21 – Construction/Demolition Waste Management And Disposal.
  - .3 Section 01 35 29 06 - Health and Safety Requirements.
  - .4 Section 01 78 00 - Closeout Submittals.
  - .5 Section 21 05 01 - Common Work Results.
  - .6 Section 23 05 17 - Pipe Welding.
  - .7 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
  - .8 Section 23 05 05 - Installation of Pipework.
  - .9 Section 23 05 23.01 - Valves - Bronze.
  - .10 Section 23 05 23.02 - Valves - Iron.
  - .11 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

**1.3 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.3-98, Malleable Iron Threaded Fittings.
  - .3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  - .4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.
  - .5 ASME 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-67-025, Butterfly Valves.
  - .2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.
  - .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS-SP-85-02, Iron Globe and Angle Valves, Flanged and Threaded Ends.

#### **1.4 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:
  - .2 Contractor to submit grooved product submittals. Grooved product to be of one manufacture, and must have current CRN #'s
  - .3 Grooved product Manufacture to supply on site tool and products installation training.

#### **1.5 QUALITY ASSURANCE**

- .1 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 Waste Management and Disposal.
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – 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.
- .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## **1.7 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: in accordance with ASTM A53/A53M, Grade B, as follows:
  - .1 To NPS2: Schedule 40, unless otherwise noted.

### **2.2 PIPE JOINTS**

- .1 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope.  
Roll grooved: standard rigid coupling to CSA B242: (Proprietary grooved joint systems acceptable provided specifications are met, Architect of Record Approved):
  - .1 Roll grooved: standard coupling to CSA B242. Victaulic # 107 Quick Vic couplings 2" to 6" / Victaulic # 07 Couplings 2" and above.
  - .2 Flexible Victaulic Couplings to CSA B242 to be used where noted on drawings prepared as part of Existing Design titled "Victaulic # 77 Flexible Couplings".
- .2 Flanges: raised face, weld neck in accordance with AWWA C111.
- .3 Orifice flanges: slip-on raised face, 2100 kPa.
- .4 Flange gaskets: in accordance with AWWA C111.
- .5 Pipe thread: taper.
- .6 Bolts and nuts: in accordance with ASME B18.2.1 and ASME B18.2.2.
- .7 Roll grooved coupling gaskets: type EPDM. (-30\* C To + 110\*C for continuous operation). Acceptable on hot water in all areas.

## **2.3 FITTINGS**

- .1 Screwed fittings: malleable iron, in accordance with ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
  - .1 Cast iron: in accordance with ASME B16.1, Class 125.
  - .2 Steel: in accordance with ASME B16.5.
- .3 Unions: malleable iron, in accordance with ASTM A47/A47M and ASME B16.3.
- .4 Fittings for roll grooved piping: malleable iron in accordance with ASTM A47/A47M. Victaulic Grooved Fittings.

## **2.4 VALVES**

- .1 Connections:
  - .1 NPS2 and smaller: screwed ends.
- .2 Balancing, for TAB:
  - .1 Sizes: Calibrated balancing valves, as specified this section.
  - .2 NPS2 and under:
    - .1 Mechanical Rooms: Globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze. Tour & Anderson 787.
    - .2 Elsewhere: Globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
    - .3 The Contractor may install in lieu of standard malleable iron or copper fittings, the following component system: Victaulic Koil Kits.
- .3 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .4 Swing check valves: to MSS-SP-71.
  - .1 NPS2 and under:
    - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .5 Silent check valves:
  - .1 NPS2 and under:
    - .1 As specified Section 23 05 23.01 - Valves - Bronze.
- .6 Ball valves:
  - .1 NPS2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

## **Part 3 Execution**

### **3.1 PIPING INSTALLATION**

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

**3.2 CIRCUIT BALANCING VALVES**

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

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

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

**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 21 14.

**1.2 SUMMARY**

- .1 Section includes:
  - .1 The supply and installation of hydronic specialties equipment.
  - .2 Materials, equipment selection, installation and start-up for hydronic system pumps.
- .2 Sustainable requirements for construction and verification.
- .3 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
  - .3 Section 01 47 15 - Sustainable Requirements: Construction.
  - .4 Section 01 35 29 06 - Health and Safety Requirements.
  - .5 Section 01 78 00 - Closeout Submittals.

**1.3 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 650°F (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.
  - .2 CAN/CSA-B214-01, Installation Code for Hydronic Heating Systems.
- .4 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE):
  - .1 Standard 90.1-2001 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .5 Electrical Equipment Manufacturers Advisory Council (EEMAC).

- .6 National Electrical Manufacturers Association (NEMA):
  - .1 NEMA MG 1-2003, Motors and Generators.

#### **1.4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 30 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets:
  - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate on product data expansion tanks, air vents, separators, valves, strainers.
- .3 Closeout Submittals:
  - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.

#### **1.5 QUALITY ASSURANCE**

- .1 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 DISPOSAL**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management And Disposal.
  - .2 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.

#### **1.7 EXTRA MATERIAL**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish following spare parts: seals, gaskets.

### **Part 2 Products**

#### **2.1 MATERIAL**

- .1 Sustainable Requirements:
  - .1 Materials and resources in accordance with Section 01 47 15 – Sustainable Requirements: Construction.
  - .2 Do component selection and siting to: CAN/CSA-B214.

## **2.2 DIAPHRAGM TYPE EXPANSION TANK – EXP-1**

- .1 Vertical galvanized steel pressurized diaphragm type expansion tank.
- .2 Capacity: sized per system requirements.
- .3 Diaphragm sealed in EPDM suitable for 115°C operating temperature.
- .4 Working pressure: 860 kPa with ASME stamp and certification.
- .5 Air pre-charged to initial fill pressure of system.
- .6 Base mount for vertical installation.
- .7 Renewable diaphragm.
- .8 Supply and install tanks for all systems indicated on drawings.
- .9 Size: Tank Volume: 8.0 gal, Acceptance Volume: 2.4 gal.
- .10 Acceptable Material: Amtrol AX-15V.

## **2.3 AUTOMATIC AIR VENT**

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 1034 kPa working pressure. Standard of Acceptance: Watts FV-4M1.

## **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 (or grooved type).
- .3 NPS 2 to 12: T type with ductile iron body to ASTM A536 malleable iron body to ASTM A47M, grooved ends.
- .4 Blowdown connection: NPS 1.
- .5 Screen: brass with 1.19 mm perforations.
- .6 Working pressure: 860 kPa.

## **2.5 LOW LOSS HEADER LLH-1**

- .1 Combination hydraulic separator, air and dirt separator with magnetic separator.
- .2 Epoxy resin coated steel body, MWP: 150 psi.
- .3 NPT 1" threaded connections with unions.
- .4 Thermo-well port.
- .5 Automatic air vent (brass) with PP float.

- .6 Drain valve.
- .7 Manufacturer's insulation kit.
- .8 Acceptable Material: Caleffi SEP4.

**2.6 GLYCOL FILL TANK GFT-1**

- .1 65 litre capacity.
- .2 Built-in pressure pump with gauge, setpoint adjust.
- .3 120V/1Ø, plug and cord.
- .4 Acceptable Material: Axiom Industries MF300.

**2.7 CONDENSATE NEUTRALIZATION TANK**

- .1 Capacity: 400 MBH of condensate.
- .2 Includes Media.
- .3 3/4" NPT connections.
- .4 Complete with stand.
- .5 Acceptable Material: Axiom Industries NC-1.

**2.8 BALANCING VALVE BV-2 (AT CP-1)**

- .1 CV: 12.01.
- .2 Size: VN 25 (1").
- .3 Brass Construction, threaded connections.
- .4 Acceptable Material: Armstrong CBV100 Series.

**Part 3 Execution**

**3.1 GENERAL**

- .1 Install as indicated on drawings 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 Engineer's directive.
- .5 Check shop drawings for conformance of all tapings for ancillaries and for equipment operating weights.



### **3.2 STRAINERS**

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

### **3.3 AIR VENTS**

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet.

### **3.4 EXPANSION TANKS**

- .1 Adjust expansion tank pressure to suit design criteria.
- .2 Install Lockshield type valve at inlet to tank.

### **3.5 VERIFICATION**

- .1 Verification requirements in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

### **3.6 PRESSURE SAFETY RELIEF VALVES**

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

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Division 01 – General Requirements.
- .2 Division 20 – Common Work Results for Mechanical.
- .3 Section 23 05 48 – Vibration Controls for HVAC Piping and Equipment.

**1.2 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.

**1.3 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 detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- .4 Submit product data of pump curves for review showing point of operation.
- .5 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.
- .6 Provide maintenance data for incorporation into manual in accordance with Division 01 – General Requirements.

**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.

**1.6 EXTRA MATERIALS**

- .1 Provide maintenance materials 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 EQUIPMENT**

- .1 Do component selection and sizing to: CAN/CSA-B214.

**2.3 IN-LINE CIRCULATORS**

- .1 Boiler Circulation Pump CP-1:
  - .1 Constant speed, wet rotor circulation.
  - .2 120V/1Ø (powered by boiler).
  - .3 5 gpm @ 5' head.
  - .4 Acceptable Material: Grundfos UPS 15-58FC (1).
- .2 System Circulation Pump CP-2:
  - .1 Variable speed smart pump.
  - .2 240V/1Ø.
  - .3 6 gpm @ 25' head.
  - .4 Acceptable Material: Wilo Stratos 1.25 x 3-30.

**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.

### **3.3 PERFORMANCE VERIFICATION (PV)**

- .1 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.
- .2 Exclusions:
  - .1 This paragraph does not apply to small in-line circulators.
- .3 Assumptions: these PV procedures assume that:
  - .1 Manufacturer's performance curves are accurate.
  - .2 Valves on pump suction and discharge provide tight shut-off.

- .4 Multiple Pump Installations - Series and Parallel:
  - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .6 Commissioning Reports: In accordance with Division 01 – Commissioning Sections. Reports supplemented as specified herein. Reports to include:
  - .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.
  - .2 Report forms Division 01 – Commissioning Sections: Report Forms and Schematics.
  - .3 Pump performance curves (family of curves).

### **3.4 OPERATION REQUIREMENTS**

- .1 Operational 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 31 13.01.

**1.2 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.
  - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 35 29 06 - Health and Safety Requirements.
  - .3 Section 01 47 15 - Sustainable Requirements: Construction.
  - .4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
  - .5 Section 07 84 00 - Firestopping.
  - .6 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

**1.3 REFERENCES**

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

- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.

#### **1.4 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 01 30 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 47 15 - Sustainable Requirements: Construction for the following:
  - .1 Sealants.
  - .2 Tape.
  - .3 Proprietary joints.
- .3 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.
- .4 Submit Indoor Air Quality (IAQ) Management Plan in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

#### **1.5 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 Construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- .3 Indoor Air Quality (IAQ) Management Plan:
  - .1 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
- .4 Sustainable Requirements:
  - .1 Construction requirements: in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
  - .2 Verification: Contractor's verification in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

## **1.6 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 Section 01 47 15 - Sustainable Requirements: Construction.
- .3 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
  - .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.
  - .4 Separate for reuse and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
  - .5 Place materials defined as hazardous or toxic in designated containers.
  - .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA and Applicable Laws.
  - .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## **Part 2 Products**

### **2.1 SUSTAINABLE REQUIREMENTS**

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

### **2.2 SEAL CLASSIFICATION**

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	A – All HVAC supply and return duct unless noted
250	B – All exhaust Ducts
- .2 Seal classification:
  - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
  - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape or combination thereof.

### **2.3 SEALANT**

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.



## **2.4 TAPE**

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

## **2.5 FITTINGS**

- .1 Fabrication: in accordance with SMACNA.
- .2 Radiused elbows:
  - .1 Rectangular: standard radius Centreline radius: 1.5 times width of duct.
  - .2 Round: five piece. Centreline radius: 1.5 times diameter.
- .3 Branches:
  - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45° entry on branch.
  - .2 Round main and branch: enter main duct at 45° with concentric conical connection.
  - .3 Provide volume control damper in branch duct near connection to main duct unless otherwise noted.
  - .4 Main duct branches: with splitter damper.
- .4 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .5 Offsets:
  - .1 Full radiused elbows.

## **2.6 FIRE STOPPING**

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.
- .2 Fire stopping material and installation must not distort duct.

## **2.7 GALVANIZED STEEL**

- .1 Lock forming quality: in accordance with ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: in accordance with SMACNA.
- .3 Joints: in accordance with SMACNA proprietary manufactured duct joint.
- .4 Round Duct: Spiral wound locked seam; made for high static ventilation system.

## **2.8 HANGERS AND SUPPORTS**

- .1 Hangers and Supports: Refer to 23 05 29 – Hangers and Supports for HVAC Piping and Equipment for General Requirements:
  - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

- .1 Maximum size duct supported by strap hanger: 500mm round or single side.
- .2 Hanger configuration: in accordance with ASHRAE and SMACNA.
- .3 Hangers: galvanized steel angle with galvanized steel rods shall be in accordance with the following table:

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

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

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods:
  - .1 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
- .3 Support risers in accordance with ASHRAE, SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

### **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 ASHRAE, SMACNA as follows:

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

### **3.3 WATERTIGHT DUCT**

- .1 Provide watertight duct for:
- .1 All AHU plenums (under main supply and return ducts).
  - .2 Fresh air intakes – Intake to AHU.
- .2 Form bottom of horizontal duct without longitudinal seams:
- .1 Solder or weld joints of bottom and side sheets.
  - .2 Seal other joints with duct sealer.
- .3 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and valve and discharging to open funnel drain.

### **3.4 SEALING AND TAPING**

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

### **3.5 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Section 01 47 15 – Sustainable Requirements: Construction, 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.

**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 33 00.

**1.2 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.
  - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 35 29 06 - Health and Safety Requirements.
  - .3 Section 01 45 00 - Quality Control.
  - .4 Section 01 47 15 - Sustainable Requirements: Construction.
  - .5 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .6 Section 01 78 00 - Closeout Submittals.

**1.3 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.

**1.4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.
  - .2 Submit WHMIS MSDS in accordance with Section 01 47 15 - Sustainable Requirements: Construction. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

- .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout submittals: submit maintenance and operations data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **Part 2 Products**

### **2.1 GENERAL**

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

### **2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: galvanized sheet metal frame 18 ga. 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>.

### **2.3 ACCESS DOORS IN DUCTS**

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene or foam rubber.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2 301 to 450 mm: four sash locks complete with safety chain.
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
  - .5 Hold open devices.
  - .6 300 x 300 mm glass viewing panels.

## **2.4 TURNING VANES**

- .1 Factory or shop fabricated double thickness without trailing edge, in accordance with recommendations of SMACNA and as indicated.

## **2.5 INSTRUMENT TEST**

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

## **2.6 TAKE-OFFS ON BRANCH DUCTS**

- .1 Prefabricated eccentric conical branch takeoff with flange to main duct.
- .2 Spin-in collars not permitted.

## **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 on the drawings.
  - .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:
    - .1 600 x 600 mm for person size entry.
    - .2 300 x 300 mm for servicing entry, viewing.
    - .3 As indicated on the drawings.

- .2 Locations:
  - .1 Fire dampers (both sides).
  - .2 Control dampers (both sides).
  - .3 Devices requiring maintenance.
  - .4 Reheat coils (both sides).
  - .5 Elsewhere as required by Engineer for inspections.
  - .6 All access as required for duct cleaning. Cooperate with duct cleaner and make duct cleaning complete.
- .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 on the drawings.
    - .2 For temperature readings:
      - .1 At outside air intakes.
      - .2 In mixed air applications in locations as approved by Engineer.
      - .3 At inlet and outlet of coils.
      - .4 Downstream of junctions of two converging air streams of different temperatures.
      - .5 And as indicated on the drawings.
- .4 Turning vanes:
  - .1 Install in accordance with recommendations of SMACNA and as indicated.

### 3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review Work involved in the handling, installation/application, protection and cleaning of its products and submit written reports in format acceptable to the Engineer.
  - .2 Manufacturer's Field Services: 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 by manufacturer to review Work at a minimum at the stages listed:
  - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of the Work, after cleaning is carried out.
- .2 Verification requirements in accordance with Section 01 47 15 - Sustainable Requirements: Construction, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified Wood.
  - .8 Low-emitting materials.

### **3.4 CLEANING**

- .1 Perform cleaning operations as specified and 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 GENERAL REQUIREMENTS**

- .1 The Contractor shall be responsible to carry out all the Work set out or referred to in this Section 23 33 14.

**1.2 SUMMARY**

- .1 Section Includes:
  - .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.
- .2 Operating dampers for mechanical forced air ventilation and air conditioning systems.

**1.3 REFERENCES**

- .1 Sheet Metal and Air Conditioning National Association (SMACNA):
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible - (1985).
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .3 American Society for Testing and Materials International (ASTM):
  - .1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

**1.4 SUBMITTALS**

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

**Part 2 Products**

**2.1 GENERAL**

- .1 Manufacture to SMACNA standards.
- .2 Materials and products in accordance with Section 01 47 15 – Sustainable Requirements: Construction.

**2.2 SINGLE BLADE DAMPERS**

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA.

- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

## **2.3 MULTI-BLADED DAMPERS**

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

## **2.4 BACK DRAFT DAMPERS**

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted or counterweighted, as required.

## **2.5 OPERATING DAMPERS**

- .1 Insulated Opposed and Parallel Blade Dampers:
  - .1 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, extruded aluminum frame.
  - .2 Pressure-fit self-lubricated bronze bearings.
  - .3 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
  - .4 Performance Characteristics:
    - .1 Leakage: in closed position to be less than 2% of rated air flow at 1.0 kPa differential across damper.
    - .2 Pressure drop: at full open position to be less than 8.0 Pa differential across damper at 5.08 m/s.
  - .5 Opposed blade damper for all modulating services unless otherwise indicated.
  - .6 Parallel blade dampers for all two position services unless otherwise indicated.
  - .7 Frames: insulated with extruded polystyrene foam with R factor of 5.0.
  - .8 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 5.0 parallel or opposed as indicated on schematics.
  - .9 Acceptable Material: TA Morrison (TAMCO Series 1000 and 9000) AutoDamp Series 01 and 02.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.
- .7 Corrections and adjustments conducted by Engineer.
- .8 Seal multiple damper modules with silicon sealant.
- .9 Install access door adjacent to each damper.

**3.3 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 GENERAL REQUIREMENTS**

- .1 The Contractor shall be responsible to carry out all the Work set out or referred to in this Section 23 37 13.

**1.2 SUMMARY**

- .1 Section Includes:
  - .1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.
  - .2 Sustainable requirements for construction and verification.

**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 product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.
  - .3 Instructions: submit manufacturer's installation instructions to Architect of Record.

**1.5 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 06 - 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 21 – Construction/Demolition Waste Management and Disposal.

## **1.7 MAINTENANCE**

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

## **Part 2 Products**

### **2.1 SUSTAINABLE REQUIREMENTS**

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

### **2.2 GENERAL**

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board and as specified.
  - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: standard off white unless otherwise noted on drawings prepared as part of Existing Design.

### **2.3 MANUFACTURED UNITS**

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.
- .2 Standard of Acceptance for this section shall be "E.H. Price" with pertinent models noted on drawings. Others, including Titus, Nailor, Anemostat will be considered equivalent, provided the specifications are met.

### **2.4 SUPPLY GRILLES AND REGISTERS**

- .1 General: Grilles and registers shall have opposed blade dampers where indicated.
- .2 Refer to schedule on drawings.

## **2.5 RETURN AND EXHAUST GRILLES AND REGISTERS**

- .1 General: Return and exhaust grilles and registers shall have opposed blade dampers unless noted otherwise.
- .2 Refer to schedule on drawings.

## **2.6 DIFFUSERS**

- .1 General: Diffusers shall have volume control dampers with flow straightening devices and gaskets where no duct damper provided.
- .2 Refer to schedule on drawings.

## **2.7 EQUIVALENT MANUFACTURERS**

- .1 E. H. Price, Nailor, Tuttle & Bailey, Titus.

## **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 oval head cadmium plated screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
- .4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere as indicated.

### **3.3 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Section 01 47 15 - Sustainable Requirements: Construction, 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.

**3.4 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 Section Includes:
  - .1 Materials, accessories and installation for breechings, chimneys and stacks.

**1.2 REFERENCES**

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- .2 Underwriters' Laboratories of Canada (ULC).
- .3 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.
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of New Brunswick, Canada.
  - .2 Indicate following:
    - .1 Methods of sealing sections.
    - .2 Methods of expansion.
    - .3 Details of thimbles.
    - .4 Bases/Foundations.
    - .5 Supports.
    - .6 Guy details.
    - .7 Rain caps.
- .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.
- .4 Closeout Submittals:
  - .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.



#### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 06 - Health and Safety Requirements.
- .2 Certificates:
  - .1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

#### **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 Section 01 61 00 - Common Product Requirements.

### **Part 2 Products**

#### **2.1 SOLID FUEL BURNING CHIMNEY AND BREECHING**

- .1 ULC labelled, complete certified packages in solid fuel burning application.
- .2 Indoor Sections:
  - .1 Double wall, stainless steel inner liner, aluminized steel outer liner (black enamel painted), 12mm air space.
  - .2 Size: 150mm Ø inside diameter.
  - .3 Complete with 45° elbows as indicated.
  - .4 Acceptable Material: Selkirk Model DSP stove pipe.
- .3 Outdoor Sections:
  - .1 Double wall insulated with 50mm mineral fibre insulation, polished stainless steel outer liner, stainless steel inner liner.
  - .2 Size: 150mm Ø inside diameter.
  - .3 Including: Cathedral ceiling support box, roof thimble, storm collar (coordinate roof pitch), rain cap, all other roof supports and accessories as required.
  - .4 Acceptable Material: Selkirk Model Sentinel CF.

#### **2.2 ACCESSORIES**

- .1 Cleanouts: bolted, gasketed type, full size of breeching, as indicated.
- .2 Hangers and supports: in accordance with manufacturer's instructions.
- .3 Rain cap.
- .4 Expansion sleeves with heat resistant caulking, held in place as indicated.

**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        Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.
- .2        Suspend breeching at 1.5 m centres and at each joint.
- .3        Support chimneys at bottom, roof and intermediate levels as indicated.
- .4        Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.
- .5        Install flashings on chimneys penetrating roofs, as indicated.
- .6        Install rain caps and cleanouts, as indicated.

**3.3                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    Section Includes:
  - .1    Heating boiler units:
    - .1    Gas burners.
    - .2    Installation.
    - .3    Commissioning.
- .2    Related Sections:
  - .1    Division 01 – General Requirements.
  - .2    23 51 00 – Breeching, Chimney and Stacks.

**1.2        REFERENCES**

- .1    Canadian Standards Association (CSA):
  - .1    CSA B51- M1991, Boiler, Pressure Vessel, and Pressure Piping Code.
- .2    American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME):
  - .1    ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 1992.
- .3    American Boiler Manufacturer's Association (ABMA).
- .4    American National Standards Institute (ANSI):
  - .1    ANSI Z21.13 2004/CSA 4.9 2004, Gas Fired Low Pressure Steam and Hot Water Boilers.
- .5    American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME):
  - .1    ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.
- .6    Canadian Gas Association (CGA):
  - .1    CAN/CSA B149.1 05, Natural Gas and Propane Installation Code.
- .7    Canadian Standards Association (CSA International):
  - .1    CSA B51 03, Boiler, Pressure Vessel, and Pressure Piping Code.
- .8    Electrical and Electronic Manufacturer's Association of Canada (EEMAC).
- .9    Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1    Material Safety Data Sheets (MSDS).

### **1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 11 00.
- .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.
  - .9 Breeching and stack configuration.
  - .10 Stack emission continuous monitoring system to measure CO, O<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, stack temperature and smoke density of flue gases.
- .3 Engineering data to include:
  - .1 Boiler efficiency at 25%, 50%, 75%, 100%, and 110% of design capacity.
  - .2 Radiant heat loss at 100% design capacity.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 11 00.

### **1.5 MAINTENANCE MATERIALS, SPECIAL TOOLS AND SPARE PARTS**

- .1 Maintenance materials to include:
  - .1 Special tools for burners, 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 Spare burner tips.
  - .7 Spare burner gun.
  - .8 Safety valve test gauge.

### **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations and authority.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions, Division 01 – General Requirements and Division 20 – 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 HEATING BOILER HB-1**

- .1 The BOILER shall have a modulating input rating of 55,000 Btu/Hr, an output of 51,000 Btu/Hr and shall be operated on L.P. Gas. The BOILER shall be capable of full modulation, firing down to 20% of rated input with a turndown ratio of 5:1.
- .2 The BOILER shall be of a fire tube design and shall be vertically down fired. The BOILER shall bear the ASME "H" stamp for 80 psi working pressure and shall be National Board listed. The heat exchanger assembly shall be fully welded through an automated process to ensure weld integrity. The 439 stainless steel combustion chamber and tubes shall be self-cleaning and designed to drain condensation to the bottom of the heat exchanger assembly. A built-in stainless steel flue collector shall allow condensation to drain from the heat exchanger assembly and into the external condensate trap. The complete heat exchanger assembly shall carry a twelve (12) year limited warranty.
- .3 The BOILER shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 /CSA4.9 test standard for the U.S. and Canada. The BOILER shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard and the minimum efficiency requirements of the latest edition of the ASHRAE 103 Standard. The BOILER shall meet U.S. Environmental Protection Agency and Department of Energy guidelines for "Energy Star" efficiency. The BOILER shall be certified for indoor installation. The BOILER's efficiency ratings shall be verified through third party testing by the Hydronics Institute Division of AHRI and listed in the AHRI Certification Directory.

- .4 The BOILER shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fibre outer covering to provide modulating firing rates. The BOILER shall be supplied with a gas valve designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The BOILER shall operate in a safe condition at a de-rated output with gas supply pressures as low as 4 inches of water column.
- .5 The BOILER shall utilize a 24 VAC control circuit and components. The control system shall have an electronic display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The BOILER shall be equipped with; a temperature/pressure gauge, high limit temperature control certified to UL353, ASME certified pressure relief valve, outlet water temperature sensor, return water temperature sensor, a UL 353 certified flue temperature sensor, outdoor air sensor, low water flow protection and built-in adjustable freeze protection.
- .6 The BOILER shall feature the "Smart System" control with a Multi-Colored Graphic LCD display with Navigation Dial and Soft Keys for, password security, three loop temperature setpoints with individual outdoor air reset curves, pump delay with adjustable freeze protection, pump exercise, domestic hot water prioritization with DHW modulation limiting and USB PC port connection. The BOILER shall be capable of controlling a variable speed boiler pump to keep a constant Delta T at all modulation rates. The BOILER shall have the capability to accept a 0-10 VDC input connection for BMS control of modulation or setpoint, enable/disable of the boiler, variable system pump signal and a 0-10VDC output of boiler modulation rate. The Boiler shall have a built-in "Cascade" with sequencing options for "lead lag" or "efficiency optimized" modulation logic, with both capable of rotation while maintaining modulation of up to eight boilers without utilization of an external controller. Supply voltage shall be 120 volt / 60 hertz / single phase.
- .7 The BOILER shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 42 data points for safety and operating controls, i.e., Auxiliary Relay, Auxiliary Proving Switch, Alarm Contacts, Runtime Contacts, Manual Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure Switches, Tank Thermostat, Three Wall Thermostat/Zone Controls, System Supply Sensor, Outdoor Sensor, Building Management System Signal, Modbus
- .8 Control Contacts and Cascade Control Circuit. A high voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump, the Boiler pump and the Domestic Hot Water pump.

- .9 The BOILER shall be installed and vented with:
  - .1 Direct Vent Sidewall system with a horizontal sidewall termination of both the vent and combustion air. The flue shall be CPVC sealed vent material terminating at the sidewall with the manufacturers specified vent termination. A separate pipe shall supply combustion air directly to the BOILER from the outside. The air inlet pipe may be CPVC sealed pipe. The air inlet must terminate on the same sidewall with the manufacturer's specified air inlet cap. The BOILER's total combined air intake length shall not exceed 100 equivalent feet. The BOILER's total combined exhaust venting length shall not exceed 100 equivalent feet.
  - .2 The BOILER shall have an independent laboratory rating for Oxides of Nitrogen (NOx) of 20 ppm or less corrected to 3% O<sub>2</sub>. The manufacturer shall verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping.
  - .3 The BOILER shall operate at altitudes up to 4,500 feet above sea level without additional parts or adjustments.
  - .4 The BOILER shall be suitable for use with polypropylene glycol, up to 50% concentration without contingencies.
  - .5 The Firing Control System shall be Direct Spark Ignition with Electronic Supervision.
- .14 Acceptable Material: Lochinvar Knight WHN055, direct vent capability, include 2" (50mm) sidewall vent termination kit.

### **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/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make all required piping connections to all inlets and outlets recommended by boiler manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 Pipe hot water relief valves full size to nearest drain.
- .5 Natural gas fired installations - in accordance with CAN/CGA-B149.1.

### **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 Blowdown valves:
  - .1 Run discharge to terminate as indicated.

### **3.4 COMMISSIONING**

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

### **3.5 FIELD QUALITY CONTROL**

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

### **3.6 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 GENERAL REQUIREMENTS**

- .1 The Contractor shall be responsible to carry out all the Work set out or referred to in this Section 23 52 02.

**1.2 WORK INCLUDED**

- .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, 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: Subcontractor responsible for installation of the radiant floor heating system 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 Division 01 – 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 The tender documentation indicates the required zoning, manifold locations and heating requirements. The in-floor heating equipment supplier shall prepare a detailed design layout with all piping layout, capacities, manifold details and other installation requirements and submit to the Engineer for approval prior to installation.
- .3 The detailed layout shall indicate pipe sizes, manifold details, zone flow requirements and temperature controls.
- .4 Submit installer's certifications of training for installation of PEX floor heating systems.

- .5 Submit data indicating tube sizing and panel performance at tube spacing and warm water temperatures selected.
- .6 Submit independent certification results for the tubing systems from a recognized testing laboratory.
- .7 Submit catalogue data on all supports, tube guides, spacers and associated items necessary for the installation to the tubing and manifolds.
- .8 Submit approved design calculation record forms to Architect of Record.

## **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 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 calculation record shall be approved by submittal by an engineer registered or licensed to practice in New Brunswick confirming that such design calculation record is 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 in accordance with 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" ID (minimum) unless otherwise 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 or stainless steel 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 0.13 l/s (2 USGPM) for each circuit.
  - .3 Return manifolds with 24V modulating temperature control valves for analog output signal to 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.

## **2.4 CAPACITY**

- .1 As indicated on drawings.

## **2.5 ACCEPTABLE MANUFACTURERS**

- .1 UPUNOR - PexA.
- .2 Rehau – PexA.
- .3 Heat Link – PexA.

## **Part 3       Execution**

### **3.1       PREPARATION**

- .1       Concrete Slab on Grade: Subsoil shall 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 (except in thin concrete slabs), being careful not to twist the tube.
- .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.
  - .8 Engineer to be notified 48 hours in advance of installation completion to visit and perform inspection prior to concrete slab pour.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Division 01 – General Requirements.
- .2 Division 20 – 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 84.

### **2.2 INDOOR ENERGY RECOVERY VENTILATORS ERV-1 AND ERV-2 (IDENTICAL)**

- .1 Horizontal airflow aluminum core type with recirculating defrost cycle.
- .2 Supply Airflow: 283 l/s (600 cfm) @ 175 Pa (0.7" wc).
- .3 Exhaust Airflow: 283 l/s (600 cfm) @ 175 Pa (0.7" wc).
- .4 Set on high speed (fan setting).
- .5 Energy performance (sensible effectiveness): Heating mode – 58%.
- .6 120V/1Ø, 5.5A.
- .7 Complete with reversible electrical box (reversible unit orientation), electrostatic filters, full length drain pan.
- .8 Acceptable Material: Fantech SHR 6905R.

**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 Section Includes:
  - .1 Vacuum, condensing, non-condensing, pressure or gravity vented or unvented, high intensity or low intensity infrared heating systems compatible with either natural gas or propane fuel.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI):
  - .1 ANSI Z83.19-2001/CSA 2.35-2001, Gas-Fired High-Intensity Infrared Heaters.
- .2 Canadian Gas Association (CGA):
  - .1 CSA-B149.1-10, Natural Gas and Propane Installation Code.
- .3 Canadian Standards Association (CSA International):
  - .1 CSA C22.1-02, General Requirements, Canadian Electrical Code, Part II.
- .4 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.
    - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province New Brunswick, Canada.
- .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 maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **1.4 QUALITY ASSURANCE**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 06 - Health and Safety Requirements.

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

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

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Provide CSA and CGA approved, packaged factory assembled components consisting of heat exchangers, burners, controls, air filters, vacuum generators, reflectors, fans.

### **2.2 CAPACITY**

- .1 Refer to schedule on drawings.

### **2.3 RADIANT HEATING UNITS IRH-1 AND IRH-2 (IDENTICAL)**

- .1 Low intensity propane fired radiant tube type heaters, sealed combustion.

### **2.4 BURNERS**

- .1 Burners to include following features:
  - .1 Manufactured to ANSI Z83.19 (vented infrared heater standards) and CSA 2.35.
  - .2 CGA and CSA certified for use with propane.
  - .3 Air-fuel mixture controlled combustion system designed for compatibility with remote-generated and controlled vacuum.
  - .4 Fail-safe design to shut off supply of fuel in following situations:
    - .1 Power failure.
    - .2 Inadequate pilot flame.
    - .3 Inadequate vacuum in combustion chamber.
    - .4 Failure of main fuel valve in open position.
  - .5 Combustion air terminal compatible with connect of filter and outside air duct.
  - .6 Electrical control system isolated from combustion air system.
  - .7 Combustion process operational status indicator lights or observation windows.
  - .8 Pre-wired burner control system with electric ignition.
  - .9 Suitable for operation with 115VAC, single phase, 60 Hz electrical service.
  - .10 Enamel-finished steel enclosure complete with removable access panels.

- .11 Heating output capacity compatible with associated downstream radiant tube.

## **2.5 HEAT EXCHANGER**

- .1 Heat exchanger to consist of radiant piping with following features:
  - .1 Nominal 102 mm O.D., 1.519 mm thick, steel tubing.
  - .2 Removable, heat and corrosion-resistant joint connections designed to accommodate system expansion/contraction.
  - .3 Length compatible with upstream burner output capacity.

## **2.6 REFLECTORS**

- .1 Reflectors to include following features:
  - .1 Polished aluminum construction complete with corrugations and configuration to maximize radiant heat directed toward floor.
  - .2 Standard lengths to facilitate installation complete with overlaps at joints to accommodate expansion and contraction.
  - .3 Hangers/supports at spacing recommended by system manufacturer to maintain maximum reflector efficiency.
  - .4 Side extension reflector complete with supports, retainers, and brackets, to prevent radiant heat from striking adjacent surfaces.
  - .5 Barrier reflector shield complete with supports, retainers, and brackets, to prevent radiant heat from striking objects beneath radiant piping.
  - .6 Factory fabricated corners, joints, tees, end caps, and related accessories.
  - .7 Egg-crate style aluminum grille beneath reflectors complete with supports, shields, as required, to improve aesthetics of radiant heating system and complement reflector design efficiency.

## **2.7 OUTSIDE AIR SUPPLY**

- .1 Outside air supply to include following features:
  - .1 Ducted outside air supply to each burner to provide sealed-combustion system.
  - .2 Insulation and vapour retarder on duct to prevent condensation.
  - .3 Duct size to ensure adequate air supply to each burner.
  - .4 Exterior air inlet terminal complete with bird screen and weatherproof hood.
  - .5 Flexible duct connector adjacent to burner complete with removable joint clamp at burner.
  - .6 Sidewall air intake termination (stainless steel), complete with bug screen, wall plate.

## **2.8 CONTROLS**

- .1 System controls to include following features:
  - .1 Pre-wired control panel complete with transformers, relays, terminal blocks, wiring, circuits, hinged door, visible door-mounted system status lights, steel cabinet complete with baked enamel finish and keyed access.
  - .2 24V heating radiant (bubble type) thermostat control of burners.
  - .3 Integral pre-purge and post-purge cycles for heat exchanger pipes.
  - .4 Thermostat radiant heat reflector shields, if exposed to radiant heat.
  - .5 Vacuum switch interlock with vacuum generator.

## **2.9 VENTING**

- .1 Vent material to be 100mm Ø 24 gauge galvanized spiral vent, complete with sealed joints.
- .2 Include manufacturer approved sidewall vent termination and s.s. wall thimble/plate as required.

## **2.10 ACCEPTABLE MATERIAL**

- .1 SCHWANK STS-JZ 45 (30' length), 120V/1Ø, complete with mounting hardware, suitable for 45° reflector installation.

## **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 infrared radiant system in accordance with CSA-B149.1, as recommended by manufacturer and as indicated.
- .2 Provide grading of radiant pipe as required.
- .3 Make provision for pipe movement caused by normal operation and expansion.
- .4 Maintain required clearances from combustibles.
- .5 Follow manufacturer's detailed installation, testing, operation and maintenance instructions.
- .6 Install thermostats where indicated. Supply heat shields where recommended by manufacturer.
- .7 Test radiant system as recommended by manufacturer and required by authorities having jurisdiction. Air test piping for leaks. Check burner safety controls.

- .8 Arrange equipment, including burners, vacuum generators, to facilitate removal without dismantling pipe, reflectors, or associated apparatus.

### **3.3 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Low-emitting materials.

### **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**