

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes regulations and circumstances where mechanical systems may be used during construction.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Shop drawings: submit drawings stamped where required, and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
  - .3 Shop drawings to show:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .4 Shop drawings and product data accompanied by:
    - .1 Detailed drawings of bases, supports, and anchor bolts.
    - .2 Acoustical sound power data, where applicable.
    - .3 Points of operation on performance curves.
    - .4 Manufacturer to certify current model production.
    - .5 Certification of compliance to applicable codes.
  - .5 Closeout Submittals:
    - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
    - .2 Operation and maintenance manual approved by, and final copies deposited with, PWGSC Representative before final inspection.
    - .3 Operation data to include:
      - .1 Control schematics for systems including environmental controls.
      - .2 Description of systems and their controls.
      - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
      - .4 Operation instruction for systems and component.
      - .5 Description of actions to be taken in event of equipment failure.
    - .4 Maintenance data to include:
      - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
      - .2 Data to include schedules of tasks, frequency, tools required and task time.
    - .5 Performance data to include:
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- .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
- .2 Equipment performance verification test results.
- .3 Special performance data as specified.
- .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless directed by Engineer.
  - .2 Make changes as required and re-submit as directed by Engineer.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 PWGSC Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Engineer for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
  - .6 Submit copies of as-built drawings for inclusion in final TAB report.

#### 1.4 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 – Quality Management System.

#### 1.5 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One filter cartridge or set of filter media for each filter or filter bank in addition

- to final operating set.
- .2 One set of fan belts for each belt driven equipment.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

#### 1.6 DELIVERY, STORAGE AND HANDLING

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

### PART 2 - PRODUCTS

#### NOT USED

### PART 3 - EXECUTION

#### 3.1 PAINTING, REPAIRS AND RESTORATION

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

#### 3.2 CLEANING

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

#### 3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 – Quality Management System.
  - .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.
    - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
    - .3 Schedule site visits, to review Work, as directed in QUALITY ASSURANCE.
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3.4 DEMONSTRATION

- .1 PWGSC Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.

3.5 PROTECTION

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

3.6 HALOCARBONS

- .1 All activities involving work with equipment or systems including halocarbon refrigeration, air conditioning, fire extinguishing and/ or solvent cleaning systems shall be completed in accordance with the Federal Halocarbon Regulations, including completing and maintaining on-site ozone depleting substance (ODS) documents for the removal and/ or addition of refrigerants.

END

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for pipe installation.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 22 07 20 - Thermal Insulation for Piping.
- .3 Section 23 05 00 - Common Work Results for Mechanical.
- .4 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .5 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 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.
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### 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, 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 vent.
- .3 Install drain piping to approved location and terminate where discharge is visible.

#### 3.5 DIELECTRIC COUPLINGS

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

### 3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
  - .2 Protect openings against entry of foreign material.
  - .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
  - .4 Assemble piping using fittings manufactured to ANSI standards.
  - .5 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
  - .6 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
  - .7 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
  - .8 Install, except where indicated, to permit separate thermal insulation of each pipe.
  - .9 Group piping wherever possible and as indicated.
  - .10 Ream pipes, remove scale and other foreign material before assembly.
  - .11 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
  - .12 Provide for thermal expansion as indicated.
  - .13 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.
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- .6 Use ball valves at branch take-offs for isolating purposes except where otherwise specified.
- .7 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
  
- .14 Check Valves:
  - .1 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 uninsulated pipe or between sleeve and insulation.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm above finished floor.
- .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.
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### 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 - Firestopping.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

### 3.10 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 15.
- .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 PWGSC Representative 5 work days minimum prior to performance of pressure tests.
  - .2 Pipework: test as specified in relevant sections of Divisions 22 and 23.
  - .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Divisions 22 and 23.
  - .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 PWGSC Representative.
  - .6 Pay costs for repairs or replacement, retesting, and making good. PWGSC Representative to determine whether repair or replacement is appropriate.
  - .7 Insulate or conceal work only after approval and certification of tests by PWGSC Representative.
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END

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications regarding electrical motors for HVAC equipment.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
  - .1 ANSI/ASHRAE 90.1-2013 (SI), Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings, SI Edition.
- .2 Electrical Equipment Manufacturer's Association Council (EEMAC).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

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 datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Management System.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Closeout Submittals:
  - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.
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- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

#### 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.

#### 1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- .1 Motors: high efficiency, in accordance with NSPI standards and to ASHRAE 90.1.

#### 2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified. Motors to be suitable for variable speed operation, where required.
- .2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, unless otherwise indicated.

#### 2.3 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by PWGSC Representative for temporary use. Work will only be accepted when specified motor is installed.

#### 2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
  - .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise
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- indicated.
- .3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
  - .4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
  - .5 Correct size of sheave determined during commissioning.
  - .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
  - .7 Motor slide rail adjustment plates to allow for centre line adjustment.
  - .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

## 2.5 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives:
  - .1 Expanded metal screen welded to steel frame.
  - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
  - .3 38 mm dia. holes on both shaft centres for insertion of tachometer.
  - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
  - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
  - .2 Securely fasten in place.
  - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
  - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
  - .2 Net free area of guard: not less than 80% of fan openings.
  - .3 Securely fasten in place.
  - .4 Removable for servicing.

## PART 3 - EXECUTION

### 3.1 MANUFACTURERS' INSTRUCTIONS

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

3.2            INSTALLATION

- .1      Fasten securely in place.
- .2      Make removable for servicing, easily returned into, and positively in position.

3.3            CLEANING

- .1      Proceed in accordance with Section 01 71 11    - Cleaning.
- .2      Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for thermometers and pressure gauges to mechanical systems.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.

1.3 REFERENCES

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

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
  - .1 Thermometers.
  - .2 Pressure gauges.
  - .3 Stop cocks.
  - .4 Syphons.
  - .5 Wells.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

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- .1 Design point to be at midpoint of scale or range.
- .2 Ranges: as indicated.

## 2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB 14.4.
  - .1 Acceptable material: Trerice 8X9, Weksler EG Series, Winters 91T.

## 2.3 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: stainless steel.
- .3 Adjustable type 9" graduated scale, metal casing calibrated in degrees F and C range to suit the normal operating temperature of the fluid.

## 2.4 PRESSURE GAUGES

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.
  - .1 Acceptable material: Trerice 450 Series, Marsh PG-73, Ashcroft Duragauge 79.
- .2 Provide:
  - .1 Siphon for steam service.
  - .2 Snubber for pulsating operation.
  - .3 Diaphragm assembly for corrosive
  - .4 Gasketed pressure relief back with
  - .5 Bronze stop cock.

## 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 DHWS line and on inlet and outlet of:
  - .1 Tempering valves
  - .2 Pumps

- .3 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 3-way control valves.
  - .3 Inlet and outlet of heating coil
  - .4 In other locations as indicated.
- .2 Install gauge cocks with each pressure gauge.
- .3 Use extensions where pressure gauges are installed through insulation.

END

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PART 1 – GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for bronze valves as referenced in Sections 23 21 15 - Hydronic Systems: Copper, and 23 1 16 - Hydronic Systems: Steel.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 22 07 20 - Thermal Insulation for Piping.
- .3 Section 23 21 15 - Hydronic Systems: Copper.
- .4 Section 23 21 16 - Hydronic Systems: Steel.

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(R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 American Society for Testing and Materials (ASTM International):
  - .1 ASTM A276-08a, Specification for Stainless Steel Bars and Shapes.
  - .2 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.
  - .3 ASTM B283-08a, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  - .4 ASTM B505/B505M-08a, Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
  - .1 MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.
  - .2 MSS SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
  - .3 MSS SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Product Data: submit WHMIS MSDS – Material Safety Data Sheets in accordance with
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Section 01 33 00 - Submittal Procedures.

- .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 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Valves:
    - .1 Except for specialty valves, to be single manufacturer.
    - .2 All products to have CRN registration numbers.
    - .3 All valves to be lead free as per California Code 116875/Vermont Bill S.152.
  - .2 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.
  - .3 Lockshield Keys:
    - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.
  - .4 Gate Valves:
    - .1 Requirements common to gate valves, unless specified otherwise:
      - .1 Standard specification: MSS SP-80.
      - .2 Bonnet: union with hexagonal shoulders.
      - .3 Connections: screwed with hexagonal shoulders.
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- .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
  - .5 Packing: non-asbestos.
  - .6 Handwheel: non-ferrous.
  - .7 Handwheel Nut: bronze to ASTM B62.
  - .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125:
    - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
    - .2 Operator: handwheel.
  - .3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
    - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
    - .2 Operator: handwheel.
  - .4 NPS 2 and under, rising stem, split wedge disc, Class 125:
    - .1 Body: with long disc guides, screwed bonnet.
    - .2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.
    - .3 Operator: handwheel or lockshield handles as indicated.
  - .4 Gate Valves (Cont'd)
    - .5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
      - .1 Body: with long disc guides, screwed bonnet.
      - .2 Operator: handwheel.
    - .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
      - .1 Body: with long disc guides, screwed or union bonnet.
      - .2 Operator: handwheel.
    - .7 NPS 2 1/2 and over, flanged:
      - .1 Rising stem: to ANSI/MSS SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.
    - .8 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.
  - .5 Globe Valves:
    - .1 Requirements common to globe valves, unless specified otherwise:
      - .1 Standard specification: MSS SP-80.
      - .2 Bonnet: union with hexagonal shoulders.
      - .3 Connections: screwed with hexagonal shoulders.
      - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
      - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
      - .6 Handwheel: non-ferrous.
      - .7 Handwheel nut: bronze to ASTM B62.
    - .2 NPS 2 and under, renewable composition disc, Class 125:
      - .1 Body and bonnet: screwed bonnet.
      - .2 Disc and seat: renewable rotating disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
      - .3 Operator: handwheel or lockshield handles as indicated.
    - .3 NPS 2 and under, composition disc, Class 150:
      - .1 Body and bonnet: union bonnet.
      - .2 Disc and seat: renewable rotating disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
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- .3 Operator: handwheel or lockshield handles as indicated.
  - .4 NPS 2 and under, plug disc, Class 150, screwed ends:
    - .1 Body and bonnet: union bonnet.
    - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.
    - .3 Operator: handwheel.
  - .5 Angle valve, NPS 2 and under, composition disc, Class 150:
    - .1 Body and bonnet: union bonnet.
    - .2 Disc and seat: renewable rotating disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
    - .3 Operator: handwheel or lockshield handles as indicated.
  - .6 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.
- .6 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, Class 150:
    - .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.
  - .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 No. 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 No. 6 composition 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 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.
- .7 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 to ANSI B1.20.1 and with hex. shoulders.
    - .4 Disc and seat: renewable rotating disc.
    - .5 Stainless steel spring, heavy duty.
-

- .6 Seat: regrindable.
- .2 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.
- .8 Ball Valves:
  - .1 NPS 2 and under:
    - .1 Body and cap: cast high tensile bronze to ASTM B62.
    - .2 Pressure rating:
      - .1 Class 150, 1034 kPa steam.
      - .2 Class 600, 4136 kPa WOG.
    - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders, solder ends to ANSI.
    - .4 Full bore, two piece body, blow-out proof.
    - .5 Stem: tamperproof ball drive.
    - .6 Stem packing nut: external to body.
    - .7 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
    - .8 Stem seal: TFE with external packing nut.
    - .9 Operator: removable lever handle. Stem extensions required for insulated systems.
  - .2 Acceptable manufacturers: Crane, Newman Hattersley, Kitz.

### 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 17  
- Sustainable Requirements: Contractor's Verification.

END

---

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

- .1 This section includes specifications for cast iron valves as referenced in Sections 23 21 15 - Hydronic Systems: Copper, and 23 21 16 - Hydronic Systems: Steel.

### 1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 22 07 20 - Thermal Insulation for Piping.
- .3 Section 23 21 15 - Hydronic Systems: Copper.
- .4 Section 23 21 16 – Hydronic Systems: Steel.

### 1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME B16.1-2005, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- .2 American Society for Testing and Materials (ASTM International).
  - .1 ASTM A49-01(2006), Specification for Heat-Treated Carbon Steel Joint Bars, Microalloyed Joint Bars, and Forged Carbon Steel Compromise Joint Bars.
  - .2 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .3 ASTM B61-08, Specification for Steam or Valve Bronze Castings.
  - .4 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .5 ASTM B85/B85M-09, Standard Specification for Aluminum-Alloy Die Castings.
  - .6 ASTM B209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
  - .1 MSS SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .2 MSS SP-71-2005, Grey Iron Swing Check Angle Valves, Flanged and Threaded Ends.
  - .3 MSS SP-85-2002, Cast Iron Globe and Valves, Flanged and Threaded Ends.

### 1.4 SUBMITTALS

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

- .2 Product Data: submit WHMIS MSDS – Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.
  - .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 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

#### 1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### PART 2 - PRODUCTS

#### 2.1 MATERIAL

- .1 Valves:
    - .1 Except for specialty valves, to be of single manufacturer.
  - .2 Standard specifications:
    - .1 Gate valves: MSS SP-70.
    - .2 Globe valves: MSS SP-85.
    - .3 Check valves: MSS SP-71.
  - .3 Requirements common to valves, unless specified otherwise:
    - .1 Body, bonnet: cast iron to ASTM B209 Class B.
    - .2 Connections: flanged ends plain face to ANSI B16.1.
    - .3 Inspection and pressure testing: to MSS SP-82.
    - .4 Bonnet gasket: non-asbestos.
    - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
    - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
    - .7 Gland packing: non-asbestos.
    - .8 Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to
-

- ASTM A49. Nut of bronze to ASTM B62.
- .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

## 2.2 GATE VALVES

- .1 NPS 2 1/2 - 8, non-rising stem, inside screw, bronze trim, solid wedge disc:
  - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly. Class 125.
  - .2 Disc: solid offset taper wedge, bronze to ASTM B62.
  - .3 Seat rings: renewable bronze to ASTM B62, screwed into body.
  - .4 Stem: bronze to ASTM B62.
  - .5 Acceptable manufacturers: Crane, Jenkins, Kitz.
- .2 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:
  - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
  - .2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
  - .3 Seat rings: renewable bronze screwed into body.
  - .4 Stem: nickel-plated steel.
  - .5 Operator: handwheel.
  - .6 Acceptable manufacturers: Crane, Jenkins, Kitz.

## 2.3 GLOBE VALVES

- .1 NPS 2 1/2 - 10, OSY:
  - .1 Body: with multiple-bolted bonnet.
  - .2 WP: 860 kPa steam, 1.4 MPa CWP.
  - .3 Bonnet-yoke gasket: non-asbestos.
  - .4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
  - .5 Seat ring: renewable, regrindable, screwed into body.
  - .6 Stem: bronze to ASTM B62.
  - .7 Operator: handwheel.
  - .8 Acceptable manufacturers: Crane, Jenkins, Kitz.

## 2.4 VALVE OPERATORS

- .1 Install valve operators as follows:
    - .1 Handwheel: on valves except as specified.
-

- .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms.

## 2.5 CHECK VALVES

- .1 Swing check valves, Class 125:
  - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.
    - .1 Up to NPS 16: cast iron to ASTM A126 Class B.
    - .2 NPS 18 and over: cast iron to ASTM A126 Class C.
  - .2 Ratings:
    - .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
    - .2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.
    - .3 NPS 18 and over: 1.03 MPa CWP.
  - .3 Disc: rotating for extended life.
    - .1 Up to NPS 6: bronze to ASTM B62.
    - .2 NPS 8 and over: bronze-faced cast iron.
  - .4 Seat rings: renewable bronze to ASTM B62 screwed into body.
  - .5 Hinge pin, bushings: renewable bronze to ASTM B62.
  - .6 Seat: cast iron, integral with body.
  - .7 Hinge pin: exelloy; bushings: malleable iron.
  - .8 Identification tag: fastened to cover.
  - .9 Hinge: galvanized malleable iron.
  - .10 Acceptable manufacturers: Crane, Jenkins, Kitz.
- .2 Swing check valves, NPS 2 1/2 - 8 Class 250:
  - .1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
  - .2 Flanged ends: 2 mm raised face with serrated finish.
  - .3 Rating: 250 psi steam; 500 psi CWP.
  - .4 Disc: rotating for extended life.
    - .1 Up to NPS 3: bronze to ASTM B61.
    - .2 NPS 4 - 8: Iron faced with ASTM B61 bronze.
  - .5 Seat rings: renewable bronze to ASTM B61, screwed into body.
  - .6 Hinge pin, bushings: renewable, bronze to ASTM B61.
  - .7 Hinge: galvanized malleable iron.
  - .8 Identification tag: fastened to cover.
  - .9 Acceptable manufacturers: Crane, Jenkins, Kitz.

## 2.6 SILENT CHECK VALVES

- .1 Construction:
  - .1 Body: malleable or ductile iron with integral seat.
  - .2 Pressure rating: class 125, WP = 860 kPa.
  - .3 Connections: grooved ends.
  - .4 Disc: bronze or stainless steel renewable rotating disc.
  - .5 Seat: renewable, EPDM.
  - .6 Stainless steel spring, heavy duty.

- .7 Acceptable manufacturers: Crane, Jenkins, Kitz.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 VERIFICATION

- .1 Verification requirements in accordance with Section 01 47 17  
- Sustainable Requirements: Contractor's Verification.

END

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for hangers and support for piping and valves as referenced in Sections 22 11 18 – Domestic Water Piping Copper, 23 21 15 – Hydronic Systems: Copper, 23 21 16 (Hydronic Systems: Water Piping Copper, Steel.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 22 07 20 - Thermal Insulation for Piping.
- .3 Section 22 11 18 - Domestic Water Piping Copper.
- .4 Section 23 21 15 - Hydronic Systems: Copper.
- .5 Section 23 21 16 - Hydronic Systems: Steel.

1.3 REFERENCES

- .1 National Fire Protection Association (NFPA)
    - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems, 2010 Edition.
  - .2 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
    - .1 ANSI/ASME B31.1-2010, Power Piping
  - .3 American Society for Testing and Materials (ASTM International)
    - .1 ASTM A125-96(2007), Specification for Steel Springs, Helical, Heat-Treated.
    - .2 ASTM A307-07b, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
    - .3 ASTM A563-07a, Specification for Carbon and Alloy Steel Nuts.
  - .4 Canadian Standards Association (CSA International)
    - .1 CSA G40.20-04/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
    - .2 CAN/CSA G164-M92(R2003), Hot-Dip Galvanizing of Irregularly Shaped Articles.
    - .3 CAN/CSA W59-03(R2008), Welded Steel Construction.
  - .5 Manufacturer's Standardization Society of the Valves and
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Fittings Industry (MSS)

- .1 MSS SP-58-2002, Pipe Hangers and Supports –  
Materials, Design and Manufacture.
- .2 ANSI/MSS SP-69-2003, Pipe Hangers and Supports –  
Selection and Application.
- .3 MSS SP-89-2003, Pipe Hangers and Supports –  
Fabrication and Installation Practices.
  
- .6 Underwriter's Laboratories of Canada (ULC)
  
- .7 National Plumbing Code of Canada - 2010.

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

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  
- .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
  
- .3 Submit shop drawings and product data for following items:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.
  
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 PWGSC Representative will make available 1 copy of systems

supplier's installation instructions.

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

#### 1.6 DELIVERY, STORAGE, AND HANDLING

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

#### 1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### PART 2 – PRODUCTS

#### 2.1 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.

#### 2.2 PIPE HANGERS

- .1 Finishes:
  - .1 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, 13 mm FM approved for sprinkler systems.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:

- .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, to MSS SP69.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut.
  
- .4 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate to MSS SP69.
  
- .5 Shop and field-fabricated assemblies:
  - .1 Trapeze hanger assemblies.
  - .2 Steel brackets.
  - .3 Sway braces for restraint systems: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
  
- .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 22 mm or 28 mm rod.
  
- .7 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel black.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
  
- .8 Adjustable clevis: material to MSS SP69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
  
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
  
- .10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: black.
  - .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic or epoxy coated.
  
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

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

#### 2.4 INSULATION PROTECTION SHIELDS

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

#### 2.5 EQUIPMENT SUPPORTS

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

#### 2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

#### 2.7 PLATFORMS AND CATWALKS

- .1 To Section 05 50 00 - Metal Fabrications.

#### 2.8 HOUSE-KEEPING PADS

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

### PART 3 - EXECUTION

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

3.3 HANGER SPACING

- .1 Plumbing piping: to most stringent requirements of National Plumbing Code of Canada, Provincial Code or authority having jurisdiction.
- .2 Copper piping: up to NPS 1/2: every 1.5 m.
- .3 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .4 Within 300 mm of each elbow.

Maximum Pipe

Maximum

Maximum

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<u>Size : NPS</u>	<u>Spacing Steel</u>	<u>Spacing Copper</u>
up to 1-1/4 (32)	2.1 m	1.8 m
1-1/2 (38)	2.7 m	2.4 m
2 (50)	3.0 m	2.7 m
2-1/2 (63)	3.6 m	3.0 m
3 (75)	3.6 m	3.0 m
3-1/2 (88)	3.9 m	3.3 m
4 (100)	4.2 m	3.6 m
5 (125)	4.8 m	
6 (150)	5.1 m	
8 (200)	5.7 m	
10 (250)	6.6 m	
12 (300)	6.9 m	

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- .7 Pipework greater than NPS 12: to 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.

END

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## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

- .1 This section includes specifications for identification of all mechanical systems and equipment.

### 1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.

### 1.3 REFERENCES

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CSA B139-10, Installation Code for Oil Burning Equipment.
- .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 (Fire) 13, Standard for the Installation of Sprinkler Systems, 2010 Edition.

### 1.4 SUBMITTALS

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

### 1.5 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.
-

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.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS' EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturers' name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
    - .1 Hazardous: red letters, white background.
    - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
  - .2 Construction:
    - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
  - .3 Sizes:
    - .1 Conform to following table:
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Size # mm	Sizes (mm) of	No. of Lines	Height letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: use size # 5.

.2 Equipment in Mechanical Rooms: use size #9.

## 2.3 IDENTIFICATION OF PIPING SYSTEMS

.1 Medium in piping to be identified as indicated below showing name and service, including temperature and pressure as indicated below, and directional flow arrows where relevant

.1 Material shall be vinyl/plastic coated cloth with protective over coating and waterproof contact adhesive undercoating, suitable for continuous operating temperature of 300°F and intermittent temperature of 400°F.

.2 Tape shall be 2" wide single wrap around pipe or pipe covering with ends overlapping not less than 1". Tape is to be cut, not torn.

.3 Block capital letters 2" high for pipes of 3" nominal and larger o.d. including insulation and not less than ¾" high for smaller diameters shall be used.

.4 Direction arrows 6" long by 2" wide for piping of 3" nominal or large o.d. including insulation and 4" long by ¾" wide for smaller diameters to be used.

Double headed

arrows to be used where direction of flow is reversible.

.5 Waterproof and heat resistant plastic marker tags to be used for pipes and tubing of ¾" nominal and smaller o.d.

.6 Use black pipe marker letters and direction arrows. Use white on red background for fire protection pipe markers.

.7 Stenciled identification if used shall be from a first quality low VOC paint, with letters a minimum of 2". Use stenciling on all purpose or canvas insulation jackets only.

.8 A high quality pre-manufactured identification system may be used in lieu of the identification noted above. Submit proposed product(s) to PWGSC and do not proceed until written approval received.

.2 Location of Identification

.1 Markers and classifying colours on piping systems to be located so they can be seen from floor or platform.

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- .2 Piping runs to be identified at least once in each room, regardless of whether concealed or in open areas.
- .3 Do not exceed 50'-0" between identification, regardless of whether concealed or in open areas.
- .4 In addition, where piping is concealed in pipe chase or other confined space, point of entry and leaving, and each access Opening to be identified.
- .5 Both sides where piping passes through walls, partitions and floors to be identified.
- .6 Piping to be identified at starting and ending points of runs and at each piece of equipment.
- .7 Identify branch, equipment or building served after each valve. (ie. Heating zones are to be identified in boiler rooms)
- .8 Provide primary and secondary colour banding.
- .9 Identification and colour coding shall be as per the following:

Pipe Marker	Valve Tag	Primary Colour	Second Colour
Hot water heating supply (up to 120° C)	H.W.H.S.	Yellow	Black
Hot water heating return (up to 120° C)	H.W.H.R.	Yellow	Black
Sanitary	SAN	Green	Black
Refrigerant suction (include Refrig No.)	REF.S (No.)	Yellow	Black
Refrigerant liquid (include Refrig No.)	REF.L (No.)	Yellow	Black
Refrigerant hot gas (include Refrig No.)	REF.H.G. (No.)	Yellow	Black
Domestic cold water	DCW	Green	Black
Domestic hot water	DHW	Green	Black
Domestic hot water recirc	DHWR	Green	Black

#### 2.4 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stenciled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or coordinated with base colour to ensure strong contrast.

#### 2.5 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.

#### 2.6 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.

## 2.7 LANGUAGE

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

## PART 3 - EXECUTION

### 3.1 MANUFACTURERS' INSTRUCTIONS

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

### 3.2 INSTALLATION

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

### 3.3 NAMEPLATES

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

### 3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs, equipment runs in open areas in boiler 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.

#### 3.4 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.

#### 3.5 CLEANING

- .1 Proceed in accordance with Section 01 71 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END

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PART 1 – GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for testing and balancing non-potable water pump, domestic water recirculation system, hydronic circulation system including pumps, ventilation distribution, fan coils units, air handling units, heat recovery units and all miscellaneous fans.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.

1.3 SUMMARY

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

1.4 QUALIFICATIONS OF TAB PERSONNEL

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

stringent than those listed in TAB Standard, use manufacturer's recommendations.

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

### 1.5 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 interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

### 1.6 EXCEPTIONS

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

### 1.7 CO-ORDINATION

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

### 1.8 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to PWGSC Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
  - .2 Review specified standards and report to Engineer in writing proposed procedures which vary from standard.
-

- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

#### 1.9 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 22 and Division 23.

#### 1.10 OPERATION OF SYSTEMS DURING TAB

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

#### 1.11 START OF TAB

- .1 Notify PWGSC Representative 5 days prior to start of TAB.
  - .2 Start TAB when building is essentially completed, including:
    - .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 in Division 22 and Division 23.
  - .4 Provisions for TAB installed and operational.
  - .5 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
    - .1 Proper thermal overload protection in place for electrical equipment.
    - .2 Air systems:
      - .1 Filters in place, clean.
      - .2 Duct systems clean.
      - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
      - .4 Correct fan rotation.
      - .5 Fire, smoke, volume control dampers installed and open.
      - .6 Coil fins combed, clean.
      - .7 Access doors, installed, closed.
      - .8 Outlets installed, volume control dampers open.
    - .3 Liquid systems:
      - .1 Flushed, filled, vented.
      - .2 Correct pump rotation.
      - .3 Strainers in place, baskets clean.
      - .4 Isolating and balancing valves installed, open.
      - .5 Calibrated balancing valves installed, at factory settings.
      - .6 Chemical treatment systems complete, operational.
-

1.12 APPLICATION TOLERANCES

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

1.13 ACCURACY TOLERANCES

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

1.14 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 3 months of TAB. Provide certificate of calibration to DTIR Representative.

1.15 SUBMITTALS

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

1.16 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.

1.17 TAB REPORT

- .1 TAB report to show results in SI units and to include:
    - .1 Project record drawings.
    - .2 System schematics.
  - .2 Submit 6 copies of TAB Report to DTIR Representative for verification and
-

approval, in English in D-ring binders, complete with index tabs.

#### 1.18 VERIFICATION

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

#### 1.19 SETTINGS

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

#### 1.20 COMPLETION OF TAB

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

#### 1.21 AIR SYSTEMS

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC NEBB SMACNA ASHRAE.
  - .2 Do TAB of systems, equipment, components, controls specified Division 23.
  - .3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.
  - .4 Quality assurance: perform TAB under direction of supervisor qualified by standards of AABC or NEBB.
  - .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, 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).

## 1.22 HYDRONIC SYSTEMS

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC, NEBB, or ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified Division 23.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified by standards of AABC or NEBB.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: pressure, flow rate, pressure drop (or loss), pipe size, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
  - .1 Inlet and outlet of pumps, coil, all calibrated balancing valves, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.

## 1.23 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified this section.
  - .2 Quality assurance: as for air systems specified this section.
- .2 Zone pressure differences:
  - .1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combinations of normal operating modes.

## PART 2 - PRODUCTS

### 2.1 NOT USED

- .1 Not used.
-

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END

---

PART 1 – GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for pressure testing ventilation systems for leaks.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.

1.3 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 1143, HVAC Air Duct Leakage Test Manual, 1985.

1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories 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 for approval at least two weeks before proposed date of first series of tests. Do not start tests until approval received in writing from Engineer.
  - .2 Prepare report of results and submit to DTIR Representative 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.
  - .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 specified.

1.5 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
    - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
      - .1 Verify project requirements.
      - .2 Review installation and substrate conditions.
-

- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

## 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 two weeks before anticipated start date.
- .4 Test instruments: calibrated and certificate of calibration deposited with PWGSC Representative no more than 28 days before start of tests.
- .5 Re-calibrated every six months thereafter.

### 2.2 EQUIPMENT LEAKAGE TOLERANCES

- .1 Equipment and system components such as VAV boxes, duct heating leakage: 10%.

## PART 3 - EXECUTION

### 3.1 MANUFACTURERS' INSTRUCTIONS

- .1 Compliance: comply with manufacturers' 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 HP duct systems up to 1000 Pa pressure classification, leakage 1%.
- .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 Manufacturers' Field Services.
    - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
    - .2 Manufacturers' Field Services: provide manufacturers' field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturers' instructions.
    - .3 Schedule site visits, to review Work, at stages listed:
      - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section
-

- depends, is complete but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within 3 days of review, and submit, immediately, to Engineer.
- .2 Performance Verification:
- .1 PWGSC Representative to witness tests and to verify reported results.
  - .2 To be certified by same TAB agency approved by Engineer to undertake TAB 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

---

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for all ventilation duct insulation requirements.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.

1.3 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ANSI/ASHRAE 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings, SI Edition. Includes Addenda a, b, c, g, h, i, j, k, l, m, n, p, q, s, t, u, w, y, ad, and aw, and errata (2009).
- .2 American Society for Testing and Materials (ASTM International)
- .1 ASTM B209M-07, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
- .2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553-08, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612-09, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795-08, Standard Specification for Thermal Insulation Stainless Steel.
- .9 ASTM C921-09, for Use with Austenitic Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
- .1 CGSB 1-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.
- .5 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-07, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701-05, Thermal Insulation Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings.
- .4 CAN/ULC-S702.2-10, Mineral Fibre Thermal Insulation for Buildings, Part 2:
-

Application Guidelines.

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 provided the mechanical service is not visible from floor level.
  - .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 manufacturers' 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, qualified to standards.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging.
-

- labelled with manufacturers' 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 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### 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 or without factory-applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with or without factory-applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C553.

#### 2.3 JACKETS

- .1 Canvas:
    - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921
    - .2 Rectangle ductwork should come with corner beads were covered with canvas jacket were exposed.
  - .2 Lagging adhesive: compatible with insulation.
-

- .3 Aluminum:
  - .1 To ASTM B209 with and without moisture barrier as scheduled in PART 3 of this section.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: stucco embossed.
  - .4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

## 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor vapour retarder finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC-listed canvas jacket:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor vapour retarder mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, plain, 75 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .11 Fasteners: 4 mm diameter pins with 35 mm 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.
- .7 Blank off sections of louvres to be insulated with 100 mm thick insulation sandwiched between 2 galvanized sheets of metal.

3.3 DUCTWORK INSULATION SCHEDULE

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

	TIAC CODE	VAPOUR RETARDER	THICKNESS (MM)
Rectangular cold and dual temperature supply air ducts	C-1	Yes	25
Round cold and dual temperature supply air ducts	C-2	Yes	25
Supply and return exposed in space being served			None- unless indicated on drawings
Fresh air ducts	C-1	Yes	50
Mixing Plenums	C-1	yes	50
All ducts to 3000 mm from discharge location between dampers and louvres	C-1	No.	50
Acoustically lined ducts	None		

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
  - .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.
- .3 Finishes: Conform to following table:

	<b>TIAC CODE</b>	
	<b>RECTANGULAR</b>	<b>ROUND</b>
Indoor, concealed	None	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	DRD/4
Outdoor, elsewhere	CRF/4	CRD/5

3.4 PLENUMS AND PLENUM BOXES

- .1 Plenums and plenum boxes to be insulated as if considered ducts in the system they service.

END

---

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for procedures to clean hydronic piping systems.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 23 21 15 - Hydronic Systems: Copper.
- .3 Section 23 21 16 - Hydronic Systems: Steel.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM International):
  - .1 ASTM E202-09, 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 manufacturers' 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 manufacturers' installation instructions.

1.5 QUALITY ASSURANCE

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety.

1.6 DELIVERY, STORAGE, AND HANDLING

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

### 1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 CLEANING SOLUTIONS

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

## PART 3 - EXECUTION

### 3.1 MANUFACTURERS' INSTRUCTIONS

- .1 Compliance: comply with manufacturers' 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 Clean HVAC piping systems to Section 23 08 02.

### 3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
    - .1 Establish circulation and expansion tank level, set pressure controls.
    - .2 Ensure air is removed.
    - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
    - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
    - .5 Clean out strainers repeatedly until system is clean.
    - .6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.
    - .7 Check water level in expansion tank with cold water with circulating pumps OFF
-

- and again with pumps ON.
- .8 Repeat with water at design temperature.
  - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
  - .10 Bring system up to design temperature and pressure slowly over a 48 hour period.
  - .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .12 Adjust pipe supports, hangers, springs as necessary.
  - .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
  - .14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
  - .15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
  - .16 Check operation of drain valves.
  - .17 Adjust valve stem packings as systems settle down.
  - .18 Fully open balancing valves (except those that are factory-set).
  - .19 Check operation of over-temperature protection devices on circulating pumps.
  - .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.
  - .21 Check pressure by-pass operation.
  - .22 Test operation of operating, limit and safety controls.
  - .23 Check operation of make-up systems by simulating blowdown and leakage. Adjust PRV on water make-up.

### 3.4 CLEANING

- .1 Proceed in accordance with Section 01 71 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END

## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Division 01 – General Requirements.
- .2 Section 23 13 23 – Facility Aboveground Fuel-Oil, Storage Tank

### 1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME-B16.3, Malleable-Iron Threaded Fittings: Classes 150 and 300.
  - .2 ASME-B16.9, Factory-Made Wrought Steel Buttwelding Fittings.
- .2 ASTM International
  - .1 ASTM A 47/A 47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A 53/A 53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.
  - .4 ASTM B 75M, Standard Specification for Seamless Copper Tube [Metric].
- .3 Canadian Environmental Protection Act (CEPA)
  - .1 CCME PN 1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
- .4 CSA International
  - .1 CSA-B139, Installation Code for Oil Burning Equipment.
  - .2 CSA-B140.0, Oil Burning Equipment: General Requirements.
  - .3 CSA-C282, Emergency Electrical Power Supply for Buildings.
- .5 Green Seal Environmental Standards (GSES)
- .6 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
  - .1 MSS-SP-80-[08], Bronze Gate, Globe, Angle and Check Valves.
- .7 National Fire Code of Canada
- .8 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC S603.1, External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids.
  - .2 ULC ORD-C107.12, Line Leak Detection Devices for Flammable Liquid Piping.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meeting:
    - .1 Convene pre-installation meeting one week prior to beginning work of this Section and
-

- on-site installation
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.

#### 1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Shop drawings: submit drawings stamped where required, and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
  - .3 Shop drawings to show:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .4 Closeout Submittals:
    - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
    - .2 Operation and maintenance manual approved by, and final copies deposited with, Public Works and Government Services Canada (PWGSC) Representative before final inspection.
    - .3 Maintenance data to include:
      - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
      - .2 Data to include schedules of tasks, frequency, tools required and task time.
    - .4 Approvals:
      - .1 Submit 2 copies of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless directed by Engineer.
      - .2 Make changes as required and re-submit as directed by Engineer.
    - .5 Additional data:
      - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
    - .6 Site records:
      - .1 PWGSC Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
      - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
      - .3 Use different colour waterproof ink for each service.
-

- .4 Make available for reference purposes and inspection.
- .7 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Engineer for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
  - .6 Submit copies of as-built drawings for inclusion in final TAB report.

#### 1.5 QUALITY ASSURANCE

- .1 Ensure piping is installed by company employing individuals who are authorized to complete the work by authority having jurisdiction. Individuals shall be Red Seal certified Steamfitter / Pipefitters or be a journeyman apprentice under the direct supervision of a Red Seal certified member, and have the required experience and certifications to work with fuel oil.

#### 1.6 DELIVERY, STORAGE AND HANDLING

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

### PART 2 - PRODUCTS

#### 2.1 FILL VENT AND CARRIER PIPE

- .1 Materials as per CSA-B139.
  - .2 Piping exterior and interior of building
    - .1 Steel: to ASTM A 53/A 53M, Schedule 40, continuous weld or electric resistance welded, screwed.
-

## 2.2 STEEL PIPE COATING

- .1 Bituminous paint: in accordance with manufacturer's recommendations.
- .2 Primers, Paints, and Coating: in accordance with manufacturer's recommendations for surface conditions.

## 2.3 JOINTING MATERIAL

- .1 Screwed fittings: Teflon tape or pulverized lead paste.

## 2.4 FITTINGS

- .1 Steel:
  - .1 Malleable iron: screwed, banded, Class 150 to ASME-B16.3.
  - .2 Welding: butt-welding to ASME-B16.9.
  - .3 Unions: malleable iron, brass to iron, ground seat, screwed, to ASTM A 47/A 47M.
  - .4 Nipples: Schedule 40, to ASTM A 53/A 53M.

## 2.5 GATE VALVES

- .1 NPS 2 and under, screwed bonnet: rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, solid wedge disc as specified under Section 23 05 23.01 - Valves - Bronze.

## 2.6 GLOBE VALVES

- .1 NPS 2 and under, screwed: to MSS-SP-80, Class 125, 860 kPa, bronze body, screwed over bonnet, renewable composition disc suitable for oil service as specified under Section 23 05 23.01 - Valves - Bronze.
  - .1 Lockshield handles: as indicated.

## 2.7 BALL VALVES

- .1 NPS 2 and under: bronze body, screwed ends, TFE seal, hard chrome ball, 4 MPa, WOG as specified under Section 23 05 23.01 - Valves - Bronze.

## 2.8 SWING CHECK VALVES

- .1 NPS 2 and under, screwed: to MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc suitable for oil service, screw in cap, regrindable seat as specified under Section 23 05 23.01 - Valves - Bronze.
-

2.9 LUBRICATED PLUG COCKS

- .1 NPS 2 and under, screwed: to ASTM B 61, Class 150, 1 MPa, bronze body.

2.10 OIL FILTER

- .1 Duplex type replaceable cartridge type as recommended by oil burner manufacturer.
- .2 Furnish spare filter cartridge.

2.11 CATHODIC PROTECTION

- .1 Supply cathodic protection for Fuel Oil Tank

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 PIPING

- .1 Install oil piping system in accordance with CSA-B139 and CSA-B140.0.
  - .2 Slope piping down in direction of storage tank unless otherwise indicated.
  - .3 Underground piping to be protected in conformance with CAN/ULC-S603.1.
  - .4 Above ground piping to be protected from physical impact due to impact.
  - .5 Piping inside building:
    - .1 Connect to existing fuel oil distribution system as currently installed in the mechanical room.
    - .2 Use approved fitting to CSA-B139 for steel piping.
  - .6 Fill, vent, suction and return piping outside building:
    - .1 Steel piping welded throughout except at tanks where electrically isolating fittings are used.
    - .2 Grading: slope piping at 1% minimum back to tanks.
  - .7 Install buried piping in double-wall piping to CSA-B139 and authority having jurisdiction.
-

- .8 Piping at tanks:
  - .1 Suction: terminate 150 mm from bottom of tank with foot valve and strainer.
  - .2 Return: terminate 200 mm from bottom of tank with return bend.
  - .3 Comply with CSA-B139 and authority having jurisdiction for piping for venting at tanks including venting whistle and venting alarm.
  - .4 Fill pipes: install to comply with CSA-B139.
    - .1 Include liquid tight tamperproof cover.
  - .5 Dipstick: extend tube to within 150 mm from bottom of tank. Terminate at grade with lockable cap and chain, and watertight cover.

### 3.3 VALVES

- .1 Install valves with stems upright or horizontal unless approved otherwise by Consultant.
- .2 Install ball valves at branch take-offs, to isolate pieces of equipment and as indicated.
- .3 Install globe valves for balancing and in by-pass around control valves.
- .4 Install plug cocks as indicated.

### 3.4 OIL FILTERS

- .1 Install ULC approved in supply line to.
- .2 At time of acceptance, replace filter cartridge with new.

### 3.5 OVERFILL AND SPILL PROTECTION

- .1 To CSA-B139.

### 3.6 LEAK DETECTION

- .1 Install line leak detector to ULC ORD C107.12.
- .2 Install secondary containment systems that will allow leaks to accumulate in containment sump available for visual inspection.

### 3.7 CATHODIC PROTECTION SYSTEM

- .1 Install in accordance with Section 26 42 00.01 - Telethermics - Cathodic Protection.
  - .2 Cathodic protection to NACE SP0169.
  - .3 Use electric isolating type fittings and electric isolating components for tank manhole covers supplied with fuel oil storage tanks to isolate piping from tanks.
  - .4 Isolate buried piping into separate sections as indicated.
-

- .5 Isolate buried piping systems from remainder of system inside building.
- .6 Coat buried steel outer casing piping, before installation, with electrically resistant coating highly resistant to mechanical damage.
  - .1 Ensure 100% coverage.
  - .2 Repeat after installation at joints and damaged parts only.
- .7 Inspect buried steel outer casing piping and repair damaged coatings using same materials as original coatings.

### 3.8 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
  - .1 Test system to CSA-B139 and CSA-B140.0 and authorities having jurisdiction.
  - .2 Isolate tanks from piping pressure tests.
  - .3 Maintain test pressure during backfilling.
- .2 Manufacturer's Field Services:

### 3.9 CLEANING

- .1 Clean in accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems and manufacturer's written recommendations, supplemented as follows:
  - .1 Flush after pressure test with diesel for a minimum of two hours. Clean strainers and filters.
  - .2 Dispose of diesel used for flushing out in accordance with requirements of authority having jurisdiction.
  - .3 Ensure vents from regulators, control valves are terminated in approved location and are protected against blockage and damage.
  - .4 Ensure entire installation is approved by authority having jurisdiction.
  - .5 Clean in accordance with Section 01 74 11 - Cleaning.
    - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END

---

## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Division 01 – General Requirements.
- .2 Section 23 11 13 – Facility Fuel-Oil Piping

### 1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME-B16.3, Malleable-Iron Threaded Fittings: Classes 150 and 300.
  - .2 ASME-B16.9, Factory-Made Wrought Steel Buttwelding Fittings.
- .2 ASTM International
  - .1 ASTM A 47/A 47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A 53/A 53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.
  - .4 ASTM B 75M, Standard Specification for Seamless Copper Tube [Metric].
- .3 Canadian Environmental Protection Act (CEPA)
  - .1 CCME PN 1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
- .4 CSA International
  - .1 CSA-B139, Installation Code for Oil Burning Equipment.
  - .2 CSA-B140.0, Oil Burning Equipment: General Requirements.
  - .3 CSA-C282, Emergency Electrical Power Supply for Buildings.
- .5 Green Seal Environmental Standards (GSES)
- .6 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
  - .1 MSS-SP-80-[08], Bronze Gate, Globe, Angle and Check Valves.
- .7 National Fire Code of Canada
- .8 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC S601, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids
  - .2 ULC ORD-C107.12, Line Leak Detection Devices for Flammable Liquid Piping.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Shop drawings: submit drawings stamped where required, and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
  - .3 Shop drawings to show:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .4 Shop drawings and product data accompanied by:
    - .1 Detailed drawings of bases, supports, and anchor bolts.
    - .2 Acoustical sound power data, where applicable.
    - .3 Points of operation on performance curves.
    - .4 Manufacturer to certify current model production.
    - .5 Certification of compliance to applicable codes.
  - .5 Closeout Submittals:
    - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
    - .2 Operation and maintenance manual approved by, and final copies deposited with, PWGSC Representative before final inspection.
    - .3 Operation data to include:
      - .1 Control schematics for systems including environmental controls.
      - .2 Description of systems and their controls.
      - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
      - .4 Operation instruction for systems and component.
      - .5 Description of actions to be taken in event of equipment failure.
    - .4 Maintenance data to include:
      - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
      - .2 Data to include schedules of tasks, frequency, tools required and task time.
    - .5 Performance data to include:
      - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
      - .2 Equipment performance verification test results.
      - .3 Special performance data as specified.
      - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
    - .6 Approvals:
      - .1 Submit 2 copies of draft Operation and Maintenance Manual to PWGSC Representative for approval. Submission of individual data will not be accepted unless directed by PWGSC Representative.
      - .2 Make changes as required and re-submit as directed by PWGSC Representative.
    - .7 Additional data:
      - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
-

- .8 Site records:
  - .1 PWGSC Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to PWGSC Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
  - .6 Submit copies of as-built drawings for inclusion in final TAB report.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Submit list of manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

#### 1.5 DELIVERY, STORAGE AND HANDLING

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

- recommendations in clean, dry, well-ventilated area.
- .2 Store and protect metal ducts from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

## PART 2 - PRODUCTS

### 2.1 FUEL OIL STORAGE TANK

- .1 Fuel Oil storage tank shall be of aboveground construction, double wall, horizontal configuration, with 360 degree double wall containment.
  - .1 Materials ASTM A1011 Steel for both inner and outer walls.
  - .2 Tank to be equipped with integral liquid tight fuel spill collector, with 12 mm low point, lockable drain connection.
  - .3 Tank to be equipped with ULC approved overfill prevention, 50 mm valve assembly for installation into 100 mm nozzle.
  - .4 Tank to be equipped with integral vacuum monitoring box, complete with gauge and protective cover.
  - .5 Tank to sit on structural steel support frame, or members as per CSA B139 and ULC S601 requirements.
  - .6 Tank to sit on a reinforced concrete slab, with compressive strength of no less than 21 MPa. Pad to be a minimum of 150 mm thick and extend 150 mm past the foot print of the tank on all sides.

### 2.2 FUEL OIL STORAGE TANK PROTECTION

- .1 Tank shall be protected by bollards
- .2 Refer and coordinate with Civil drawings for exact construction and locations of bollards

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### 3.2 INSTALLATION

- .1 Install in accordance with CSA B139, and to manufacturer's instructions.
-

3.3            TESTING

- .1        Test assembled and sealed tank as per manufacturer's written instructions for a period of no less than 2 hours.

3.4            CLEANING

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

END

---

## PART 1 - GENERAL

### 1.1 RELATED SECTIONS

- .1 Division 01 - General Requirements.

### 1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME Boiler and Pressure Vessel Code - 2010.
- .2 American Society for Testing and Materials (ASTM International).
  - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A278M-01(2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
  - .3 ASTM A516/A516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  - .4 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.
  - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International).
  - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code. Includes Update No. 1 (2009).

### 1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS – Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.
  - .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.

### 1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
-

## PART 2 - PRODUCTS

### 2.1 AUTOMATIC AIR VENT

- .1 Standard float vent: brass body and NPS 1/8 (3 mm) connection and rated at 310 kPa working pressure.
- .2 Float: solid material suitable for 115 degrees C working temperature.
- .3 Acceptable manufacturer: ITT Bell & Gossett, Armstrong, Taco.

### 2.2 PIPE LINE STRAINER

- .1 NPS 1/2 to 2 (13 to 50): bronze body to ASTM B62, screwed Connections, Y pattern.
- .2 NPS 2 1/2 to 12 (63 to 300): cast steel body to ASTM A278M, Class 30, flanged connections.
- .3 NPS 2 to 12 (50 to 300): T type with ductile iron body to ASTM A536 or malleable iron body to ASTM A47M, grooved ends.
- .4 Blowdown connection: NPS 1 (25) c/w ball valve with cap and chain. Valve to Section 23 05 22 - Valves - Bronze.
- .5 Screen: stainless steel with 1.19 mm perforations.
- .6 Working pressure: 860 kPa.

## PART 3 - EXECUTION

### 3.1 GENERAL

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

END

---

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for copper hydronic piping systems and valves.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 22 07 20 - Thermal Insulation for Piping.
- .3 Section 23 05 00 - Common Work Results for Mechanical.
- .4 Section 23 05 05 - Installation of Pipework.
- .5 Section 23 05 21 - Thermometers and Pressure Gauges - Piping Systems.
- .6 Section 23 05 22 - Valves - Bronze.
- .7 Section 23 05 23 - Valves - Cast Iron.
- .8 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .9 Section 23 05 54 - Mechanical Identification.
- .10 Section 23 08 02 - Cleaning and Star-up of Mechanical Piping Systems.
- .11 Section 23 21 14 - Hydronic Specialties.
- .12 Section 23 21 16 - Hydronic Systems: Steel.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
    - .1 ANSI/AWS A5.8/A5.8M-04, Specification Filler Metals for Brazing and Bronze Welding.
  - .2 American Society of Mechanical Engineers (ASME)
    - .1 ANSI/ASME B16.4-2006, Gray-Iron Threaded Fittings: Classes 125 and 250.
    - .2 ANSI/ASME B16.15-2006, Cast Bronze Threaded Fittings: Classes 125 and 250.
    - .3 ANSI B16.18-2001(R2005), Cast Copper Alloy, Solder Joint Pressure Fittings.
    - .4 ANSI/ASME B16.22-2001(R2005), Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
  - .3 American Society for Testing and Materials (ASTM International)
    - .1 ASTM B32-08, Standard Specification for Solder Metal.
    - .2 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
    - .3 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
    - .4 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube Metric.
    - .5 ASTM E202-09, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
-

- .5 Manufacturers Standardization Society (MSS)
  - .1 MSS SP-67-2002a, Butterfly Valves.
  - .2 MSS SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS SP-71-2006, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

#### 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.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Shop Drawings:
    - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .2 Indicate on manufacturers' catalogue literature the following: VALVES.
  - .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.

#### 1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, CEAA, and applicable Provincial/Territorial regulations.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety.

#### 1.6 MAINTENANCE

- .1 Extra Materials:
    - .1 Furnish 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.

#### 1.7 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.

#### 1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### PART 2 - PRODUCTS

#### 2.1 TUBING

- .1 Type K hard drawn copper tubing: to ASTM B88M.

#### 2.2 FITTINGS

- .1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
- .2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
- .3 Cast iron threaded fittings: to ANSI/ASME B16.4.
- .4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

#### 2.3 FLANGES

- .1 Brass or bronze: threaded.
  - .2 Cast iron: threaded.
  - .3 Orifice flanges: slip-on, raised face, 2100 kPa.
-

## 2.4 JOINTS

- .1 Solder, tin-antimony, 95:5: to ASTM B32.
- .2 Silver solder BCUP: to ANSI/AWS A5.8.
- .3 Brazing: as indicated.

## 2.5 VALVES

- .1 All valves to be lead free as per California Code 116875/Vermont Bill S.152.
  - .2 Connections:
    - .1 NPS 2 and smaller: ends for soldering.
    - .2 NPS 2 1/2 and larger: flanged ends.
  - .3 Gate Valves Application: isolating equipment, control valves, pipelines:
    - .1 NPS 2 and under:
      - .1 Mechanical Rooms: Class 125, rising stem split wedge disc, as specified Section 23 05 22 - Valves - Bronze.
      - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.
    - .2 NPS 2 1/2 and over:
      - .1 Mechanical Rooms: rising stem, split wedge disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron.
      - .2 Elsewhere: non-rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron.
  - .4 Globe valves: application: throttling, flow control, emergency bypass:
    - .1 NPS 2 and under:
      - .1 Mechanical Rooms: with PFTE disc, as specified Section 23 05 22 - Valves - Bronze.
      - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 22 - Valves - Bronze.
    - .2 NPS 2 1/2 and over:
      - .1 With composition disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron.
  - .5 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.
  - .6 Swing check valves:
    - .1 NPS 2 and under:
      - .1 Class 125, swing, with composition disc, as specified Section 23 05 22 - Valves - Bronze.
      - .2 NPS 2 1/2 and over:
-

- .1 Flanged ends: as specified Section 23 05 23 - Valves – Cast Iron.
- .7 Ball valves:
  - .1 NPS 2 and under: as specified Section 23 05 22 - Valves - Bronze.
- .8 Circuit balance valves (CBV):
  - .1 General:
    - .1 Y style globe valve, designed to provide precise flow measurement and control, with valved ports connected to differential pressure.
  - .2 Accuracy:
    - .1 Readout to be within plus or minus 2% of actual flow at design flow rate.
  - .3 Pressure die-cast dezincification resistant copper alloy construction, 1.7 MPa, 121°C, screwed ends, EPDM "O" ring seal, screw-in bonnet.
    - .1 Flow control: at least four (4) full turns of handwheel with digital handwheel and tamperproof concealed mechanical memory.
  - .4 Insulation:
    - .1 Use prefabricated shipping packaging of 5.4 R polyurethane as insulation.
  - .5 Drain connection:
    - .1 NPS 3/4 valved and capped, suitable for hose socket.
  - .6 Acceptable manufacturers: Armstrong CBV, Tour & Anderson STA, Victaulic.

### PART 3 - EXECUTION

#### 3.1 MANUFACTURERS' INSTRUCTIONS

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

#### 3.2 PIPING INSTALLATION

- .1 Connect to equipment in accordance with manufacturers' instruction unless otherwise indicated.
  - .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping, wherever practical.
  - .3 Slope piping in direction of drainage and for positive venting.
  - .4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
  - .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
  - .6 Assemble piping using fittings manufactured to ANSI standards.
-

### 3.3 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install globe valves for balancing and in by-pass around control valves as indicated.
- .4 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

### 3.4 CIRCUIT BALANCING VALVES

- .1 Install flow balancing valves as indicated.
- .2 Install written in accordance with manufacturer's instructions.

### 3.5 FLUSHING AND CLEANING

- .1 Flush and clean in presence of DTIR Representative.

### 3.6 FILLING OF SYSTEMS

- .1 Refill system with clean water adding water treatment as specified.

### 3.7 FIELD QUALITY CONTROL

- .1 Testing:
  - .1 Test system in accordance with Section 23 05 00 - Common Work Results - for Mechanical.
- .2 Balancing:
  - .1 Balance water systems to within plus or minus 5% of design output.
  - .2 Refer to Section 01 45 00 – Quality Management System for applicable procedures.

### 3.8 CLEANING

- .1 Proceed in accordance with Section 01 71 11 - Cleaning.
  - .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
-

3.9            BALANCING

- .1        Balance water systems to within plus or minus 5% of design output.
- .2        Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

END

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for steel hydronic piping systems and valves.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 22 07 20 - Thermal Insulation for Piping.
- .3 Section 23 05 00 - Common Work Results for Mechanical.
- .4 Section 23 05 05 - Installation of Pipework.
- .5 Section 23 05 17 - Pipe Welding.
- .6 Section 23 05 21 - Thermometers and Pressure Gauges - Piping Systems.
- .7 Section 23 05 22 - Valves - Bronze.
- .8 Section 23 05 23 - Valves - Cast Iron.
- .9 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .10 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .11 Section 23 21 14 - Hydronic Specialties.
- .12 Section 23 21 16 - Hydronic Systems: Steel.

1.3 REFERENCES

- .1 American National Standards Institute ANSI/American Society of Mechanical Engineers (ASME).
    - .1 ANSI/ASME B16.1-2005, Cast Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
    - .2 ANSI/ASME B16.3-2006, Malleable Iron Threaded Fittings: Classes 150 and 300.
    - .3 ANSI/ASME B16.5-2009, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
    - .4 ANSI/ASME B16.9-2007, Factory-Made Wrought Buttwelding Fittings.
    - .5 ANSI/ASME B18.2.1-1996(R2005), Square and Hex Bolts and Screws (Inch Series).
  - .2 American Society for Testing and Materials (ASTM International).
    - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
    - .2 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
    - .3 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.
    - .4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
    - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .3 American Water Works Association (AWWA).
    - .1 AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
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- .4 Canadian Standards Association (CSA International).
  - .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CAN/CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .3 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
  
- .5 Manufacturers' Standardization of the Valve and Fittings Industry (MSS).
  - .1 MSS SP-67-2002a, Butterfly Valves.
  - .2 MSS SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS SP-71-2005, Cast Iron Swing Check Valves Flanged and Threaded Ends.
  - .4 MSS SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

#### 1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  
- .2 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:
    - .1 Special servicing requirements.

#### 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 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### PART 2 - PRODUCTS

#### 2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 To NPS 6: Schedule 40.

#### 2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape.
-

- .2 NPS 2-1/2 and over: welding fittings and flanges to CAN/CSA W48.
- .3 Roll grooved: rigid coupling to CSA B242.
- .4 Flanges: weld neck to AWWA C111/A21.11.
- .5 Orifice flanges: slip-on raised face, 2100 kPa.
- .6 Flange gaskets: to AWWA C111/A21.11.
- .7 Pipe thread: taper.
- .8 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
- .9 Roll grooved coupling gaskets: type EPDM.
- .10 Roll grooved coupling are not permitted for headers at pump supply and return and vertical risers at connections to coils.

### 2.3 FITTINGS

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

### 2.4 VALVES

- .1 Connections:
    - .1 NPS 2 and smaller: screwed ends.
    - .2 NPS 2 1/2 and larger: flanged ends.
  - .2 Gate valves: to to MSS-SP-80 Application: Isolating equipment, control valves, pipelines:
    - .1 NPS 2 and under:
      - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, as specified Section 23 05 22 - Valves - Bronze.
-

- 
- .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.
  - .2 NPS 2 1/2 and over:
    - .1 Mechanical Rooms: rising stem, split wedge disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron.
      - .1 Operators: handwheel.
    - .2 Elsewhere: non- rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron.
      - .1 Operators: handwheel.
  - .3 Butterfly valves: to MSS-SP-67 Application: Isolating cells or section of multiple component equipment (eg. multi-section coils):
    - .1 NPS 2 1/2 and over: lug type grooved ends: as specified Section 23 05 26 - Butterfly Valves.
  - .4 Globe valves: to MSS-SP-85 Application: Throttling, flow control, emergency bypass:
    - .1 NPS 2 and under:
      - .1 With PTFE disc, as specified Section 23 05 22 - Valves - Bronze.
    - .2 NPS 2 1/2 and over:
      - .1 With composition bronze disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron.
      - .2 Operators: lockshield handles.
  - .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.
  - .6 Swing check valves: to MSS-SP-71.
    - .1 NPS 2 and under:
      - .1 Class 125, swing, with composition disc, as specified Section 23 05 22 Valves - Bronze.
    - .2 NPS 2 1/2 and over:
      - .1 Flanged ends: as specified Section 23 05 23 - Valves - Cast Iron.
  - .7 Silent check valves:
    - .1 NPS 2 and under:
      - .1 As specified Section 23 05 22 - Valves - Bronze.
    - .2 NPS 2 1/2 and over:
      - .1 Flanged ends: as specified Section 23 05 23 - Valves - Cast Iron.
  - .8 Ball valves:
    - .1 NPS 2 and under: as specified Section 23 05 22 - Valves - Bronze.
    - .2 Provide complete with valve extensions on insulated piping systems.
  - .9 Circuit balancing valves (CBV):
    - .1 General:
      - .1 Y style globe valve, designed to provide precise flow measurement
-

- and control, with valved ports for connected to differential pressure meter.
- .2 Accuracy:
    - .1 Readout to be within plus or minus 2% of actual flow at design flow rate.
  - .3 Pressure die-cast dezincification resistant copper alloy construction, 1.7 MPa, 121°C, screwed ends, EPDM 'O' ring seal, screw-in bonnet.
    - .1 Flow control: at least four (4) full turns of handwheel with digital handwheel and tamperproof concealed mechanical memory.
  - .4 Insulation:
    - .1 Use prefabricated shipping packaging of 5.4 R polyurethane as insulation.
  - .5 Drain connection:
    - .1 NPS 3/4 valved and capped, suitable for hose socket.
    - .2 Incorporated into valve body or provided as separate item.
  - .6 Acceptable manufacturers: Armstrong CBV, Tour & Anderson STA, Victaulic.

### PART 3 - EXECUTION

#### 3.1 PIPING INSTALLATION

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

#### 3.2 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install gate valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install globe valves for balancing and in by-pass around control valves as indicated.
- .4 Provide swing check valves in horizontal lines on discharge of pumps and as indicated.
- .5 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Mechanical Equipment Rooms.
- .6 Coordinate ball valve extension length with pipe insulation thickness.

#### 3.3 CIRCUIT BALANCING VALVES

- .1 Install flow balancing valves as indicated.
  - .2 Install written in accordance with manufacturers' instructions.
-

3.4 CLEANING, FLUSHING AND START-UP

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

3.5 TESTING

- .1 Test system in accordance with Section 23 05 00 - Common Work Results - Mechanical.

3.6 BALANCING

- .1 Balance water systems to within plus or minus 5% of design output.
- .2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

END

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## PART 1 - GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Section 23 73 11 - Air Handling Units-Packaged.

### 1.2 REFERENCES

- .1 ASME
  - .1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  - .2 ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
  - .3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International
  - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .2 ASTM B 280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 CSA Group
  - .1 CSA B52, B52 Package, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
  - .1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
    - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements 01 35 43 - Environmental Procedures. 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.
-

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

#### 1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for refrigerant piping for incorporation into manual.
- .3 Submit 2 copies of operation and maintenance manual.

#### 1.5 DELIVERY, STORAGE AND HANDLING

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

### PART 2 - PRODUCTS

#### 2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
  - .1 Hard copper: to ASTM B 280, type ACR.
- .2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.

#### 2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
  - .2 Brazed:
    - .1 Fittings: wrought copper to ASME B16.22.
    - .2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
-

- .3 Flanged:
  - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
  - .2 Gaskets: suitable for service.
  - .3 Bolts, nuts and washers: to ASTM A 307, heavy series.
- .4 Flared:
  - .1 Bronze or brass, for refrigeration, to ASME B16.26.

### 2.3 PIPE SLEEVES

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

### 2.4 VALVES

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialties and accessories installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative or Consultant.
  - .2 Inform Departmental Representative and Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative or Consultant.

### 3.2 MANUFACTURER'S INSTRUCTIONS

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

### 3.3 GENERAL

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

### 3.4 BRAZING PROCEDURES

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

### 3.5 PIPING INSTALLATION

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

### 3.6 PRESSURE AND LEAK TESTING

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

### 3.7 FIELD QUALITY CONTROL

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

### 3.8 DEMONSTRATION

- .1 Instructions:
    - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.
-

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END

---

PART 1 – GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications and procedures for HVAC ductwork construction and installation.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 23 05 48 - Vibration and seismic Controls for HVAC Piping and Equipment.
- .3 Section 23 05 54 - Mechanical Identification.
- .4 Section 23 32 48 - Sound Attenuation.
- .5 Section 23 33 00 - Air Duct Accessories.
- .6 Section 23 33 14 - Dampers - Balancing.
- .7 Section 23 33 15 - Dampers - Operating.
- .8 Section 23 33 16 - Dampers - Fire and Smoke.
- .9 Section 23 33 46 - Flexible Ducts.
- .10 Section 23 34 00 - HVAC Fans.
- .11 Section 23 37 13 - Diffusers, Registers and Grilles.

1.3 REFERENCES

- .1 American Society of Heating, Refrigerating and Air- Conditioning Engineers, Inc. (ASHRAE).
  - .2 American Society for Testing and Materials (ASTM International).
    - .1 ASTM A480/A480M-10, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
    - .2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
    - .3 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
  - .3 Department of Justice Canada (Jus).
    - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).
  - .5 National Fire Protection Association (NFPA).
    - .1 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems, 2009 edition.
    - .2 NFPA (Fire) 90B, Installation of Warm Air Heating and Air-Conditioning Systems, 2009 edition.
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- .3 NFPA (Fire) 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 2008 Edition.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA 1966, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition 2005.
  - .2 SMACNA 1143, HVAC Air Duct Leakage Test Manual, 1985, 1st Edition, Technical Research Update - 92.

#### 1.4 SUBMITTALS

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

#### 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.

#### 1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 4 21 - Construction/Demolition Waste Management and Disposal.

### PART 2 - PRODUCTS

#### 2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

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

#### 2.2 SEALANT

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.
- .1 Acceptable manufacturers: Duro Dyne, Foster, Bakor.

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2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
- .1 Acceptable manufacturers: Duro-Dyne, Bakor, Foster.

2.4 DUCT LEAKAGE

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

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
  - .1 Rectangular: standard radius or short radius with single thickness turning vanes. Centreline radius: 1.5 times width of duct, where possible.
- .3 Branches:
  - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct, where possible.
  - .2 Round main and branch: enter main duct at 45° with conical tee.
  - .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with splitter damper.
- .5 Any round duct branches shall be conical tee constructed.
- .4 Transitions:
  - .1 Diverging: 20° maximum included angle.
  - .2 Converging: 30° maximum included angle.
- .5 Offsets:
  - .1 Full radiused elbows as required or as indicated.
- .6 Round ducts and fittings shall be galvanized steel of the following minimum gauges:

Duct Diameter	Spiral Duct Gauge	Plain Duct Gauge
8" and smaller	28	24
9" – 14"	26	24
15" – 26"	24	N/A
27" – 36"	22	N/A

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2.6 FIRESTOPPING

- .1 Retaining angles all around duct, on both sides of fire separation in accordance with section 07 84 00 - Firestopping.
- .2 Firestopping material and installation must not distort duct.
- .3 Coordinate with installer of fireproofing.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 coating.
- .2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.
- .3 Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal.
  - .1 Acceptable material: Ductmate Canada Ltd., Mez Industries, Ward Industries (for proprietary joints).

2.8 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.
- .2 Hanger configuration: to ASHRAE and SMACNA.
- .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA following table:

Duct Size (mm)	Angle (mm)	Size	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.
    - .1 Acceptable manufacturers: Myatt, Grinnell, Erico.
  - .2 For steel joists: manufactured joist clamp or steel plate washer.
    - .1 Acceptable manufacturers: Grinnell, Myatt, Erico.
  - .3 For steel beams: manufactured beam clamps:

- .1 Acceptable manufacturers: Grinnell, Myatt, Erico.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- .1 Do work in accordance with ASHRAE, SMACNA and as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with ASHRAE and 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: as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
<u>1501 and over</u>	<u>2500</u>

#### 3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
- .1 Fresh air intake.
- .2 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
- .1 Weld joints of bottom and side sheets.
- .2 Seal other joints with waterproof mastic.
- .3 Slope horizontal branch ductwork down towards equipment served.
-

- .1 Slope header ducts down toward risers.

### 3.4 SEALING AND TAPING

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

### 3.5 LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.
- .8 Test to be witnessed by DTIR Representative. Provide 21 days' notice prior to testing.

END

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for sound attenuation devices for HVAC systems.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.
- .3 Section 23 34 00 - HVAC Fans.
- .4 Section 23 37 13 - Diffusers, Registers and Grilles.

1.3 REFERENCES

- .1 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM C423-09a, Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- .3 ASTM E90-09, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- .4 ASTM E477-06a, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide separate shop drawings for each piece of attenuation equipment complete with product data.

1.5 PERFORMANCE RATING DATA

- .1 Provide performance rating data, certified by a professional engineer or accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:
    - .1 Silencer: insertion loss, pressure drop at design conditions.
    - .2 Acoustic plenums: transmission loss and acoustical absorption.
-

## PART 2 – PRODUCTS

### 2.1 SILENCERS WITH ACOUSTIC MEDIA (MEDIUM VELOCITY)

- .1 Outer casings of silencers shall be fabricated from not less than 20 ga. galvanized steel in accordance with ASHRAE Guide or SMACNA recommended construction for high pressure ductwork. Seams shall be lock-formed and mastic pressure ductwork. Center body tail sections shall be fabricated from not less than 22 ga. Galvanized perforated steel.
- .2 Silencers shall not leak air or fail structurally when subjected to a differential air pressure of 8 inches of water gauge inside to outside of the casing.
- .3 Filler material shall be inorganic material or glass fibre packed under at least 15% compression. Materials shall be inert, vermin and moisture proof.
- .4 Combustion rating of the filler material shall be not less than the following when tested in accordance with ASTM E-84-75, NFPA Standard 90A or UL No. 723:
  - .1 Flame spread rating: 15
  - .2 Smoke development rating: 5
- .5 Acoustical testing shall conform to ASTM E477 standard method of testing duct liner material and manufactured silencers for acoustical and air flow performance. Tests shall be run both with and without air flowing through the silencer at not less than three different airflow rates. All ratings shall be based on test data from a nationally known, qualified, independent laboratory. Test methods shall eliminate effects due to end reflection, vibration, flanking transmission, and standing waves in the reverberant room. Airflow and pressure loss measurements shall be made in accordance with applicable portions of ASME, AMCA, and ADC airflow tests.
- .6 The Dynamic Insertion Loss in dB for silencers shall not be less than that shown on the schedule on Drawing No. H-W5-7709-413.
- .7 Performance as indicated.
- .8 Acceptable manufacturer: Vibro Acoustics, Vibron, VAW, EH Price.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
  - .2 Noise flanking: where indicated, install in wall sleeve with uniform clearance all around to ensure no contact of silencer with wall sleeve. Pack with flexible, non-hardening caulking on both sides of sleeves.
-

- .3 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.
- .4 Suspension: to manufacturer's instructions.

END

---

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications and procedures for HVAC ductwork construction and installation.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 pa.
- .3 Section 23 33 14 - Dampers - Balancing  
Section 23 33 15 - Dampers - Operating
- .4 Section 23 33 16 - Dampers - Fire and Smoke
- .5 Section 23 34 00 - HVAC Fans

1.3 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
- .1 SMACNA 1966, HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition 2005.

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.
  - .3 Instructions: submit manufacturer's installation instructions.
  - .4 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Verify project requirements.
-

- .2 Review installation conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.

## 1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards CSA B228.1.

### 2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame .66 mm thick 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.
  - .4 Hardware:
    - .1 Up to 300 x 300 mm: 2 sash locks complete with safety chain.
    - .2 301 to 450 mm: 4 sash locks complete with safety chain.
    - .3 451 to 1000 mm: piano hinge and minimum 2 sash locks.
    - .4 Doors over 1000 mm: piano hinge and 2 handles operable from both sides with
-

- hold open devices.
- .5 Acceptable manufacturers: Mifab, SMS, Acudor.

## 2.4 TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.
- .2 Acceptable manufacturers: Duro Dyne, Dynair, AeroDyne.

## 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.
- .5 Acceptable manufacturer: Duro Dyne.

## 2.6 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to corresponding round duct standards.
- .3 Acceptable manufacturers: Duro Dyne, NovaFlex, Imperial Mfg. Group.

## PART 3 - EXECUTION

### 3.1 MANUFACTURERS' 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.
  - .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:
    - .1 Provide adequately sized galvanized steel access doors for all devices requiring inspection, maintenance or cleaning.
    - .2 Access doors shall be located before and after coils, filters, fans, automatic dampers, at fire dampers, fresh air and exhaust air plenums, bottoms of risers, and where required elsewhere.
    - .3 Access doors shall be minimum 12" x 12" for hand access and 24" x 24" for body access.
    - .4 Access doors shall be tight fitting with sealing gaskets and suitable quick fastening locking devices. Insulate access doors where they are installed in insulated ductwork or plenums.
    - .5 Access points in ductwork shall be no more than 30 feet apart.
    - .6 Gasketed panels (patches) minimum size 12" x 12" and fabricated from the same material as the duct and fastened with sheet metal screws are permitted if the access is for cleaning only; otherwise access doors shall be provided.
  
  - .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 air handling systems.
        - .3 Main and sub-main ducts.
        - .4 And as indicated.
      - .2 For temperature readings:
        - .1 At outside air intakes.
        - .2 In mixed air applications in locations.
        - .3 And as indicated.
  
  - .4 Turning vanes:
    - .1 Install in accordance with recommendations of SMACNA and as indicated.
- 

END

PART 1 - GENERAL

1.1 SECTION

- .1 This section includes specifications for HVAC Includes duct balancing damper construction and installation.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements. Sections
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.
- .3 Section 23 33 00 - Air Duct Accessories.
- .4 Section 23 37 13 - Diffusers, Registers and Grilles.

1.3 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
  - .1 SMACNA 1966, HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition 2005.

1.4 SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in Management and accordance with Section 01 74 21 – Disposal Construction/Demolition Waste Management and Disposal.
-

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of MACNA, except maximum height of 300 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon or bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.
- .6 Acceptable manufacturers:
  - .1 Nailor.
  - .2 E.H. Price.
  - .3 Titus.

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.
  - .7 Acceptable manufacturers:
    - .1 Nailor.
    - .2 E.H. Price.
    - .3 Titus.
-

PART 3 - EXECUTION

3.1 MANUFACTURERS' 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 on all branch ducts as well as where indicated on plans.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .4 All dampers to be vibration-free.
- .5 Ensure damper operators are observable and accessible.

3.3 FIELD QUALITY CONTROL

- .1 Tests:
  - .1 Tests to demonstrate that system is functioning as specified.

END

---

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for HVAC Includes duct operating damper construction and installation.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements. Sections
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.
- .3 Section 23 34 00 - HVAC Fans

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
  - .1 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Where applicable, 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 Indicate the following:
    - .1 Performance data.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product

Requirements.

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

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MULTI-LEAF DAMPERS

- .1 Opposed unless otherwise specified.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .4 Performance:
  - .1 Leakage: in closed position to be less than 2% of rated air flow at 250 Pa differential across damper.
- .5 Operator: by Division 25.
- .6 Insulated aluminum dampers:
  - .1 Frames: insulated with extruded polystyrene foam with R factor of 5.0.
  - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 5.0.
- .7 Acceptable manufacturers:
  - .1 Belimo.
  - .2 Tamco.
  - .3 Ventex.

2.2 BACKDRAFT DAMPERS

- .1 Automatic gravity operated, multi leaf, steel construction spring-assisted with nylon bearings, install where indicated.
- .2 Acceptable manufacturers:
  - .1 Nailor.
  - .2 E.H. Price.
  - .3 Titus.

### PART 3 - EXECUTION

#### 3.1 MANUFACTURERS' INSTRUCTIONS

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

#### 3.2 INSTALLATION

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

#### 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

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for HVAC Includes duct fire and smoke damper construction and installation.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.

1.3 REFERENCES

- .1 National Fire Protection Association (NFPA).
  - .1 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems, 2009 edition.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S112-M1990(R2001), Fire Test of Fire Damper Assemblies.
  - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
  - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.4 SUBMITTALS

- .1 Product Data:
    - .1 Submit manufacturers' printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
      - .1 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
      - .2 Indicate the following:
        - .1 Fire dampers.
        - .2 Smoke dampers.
        - .3 Fire stop flaps.
        - .4 Operators.
        - .5 Fusible links.
        - .6 Breakaway joint design.
    - .2 Quality assurance submittals: submit following in accordance with Section 01 33
-

00 - Submittal Procedures.

- .1 Certificates: submit certificates by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 MAINTENANCE

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

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.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement to have blades out of airstream, listed and bear label of ULC, and meet requirements of CFFM and ANSI/NFPA90A. Fire damper assemblies fire tested in accordance with CAN/ULC-S112.
  - .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
    - .1 Fire dampers: Fire dampers to be rated for the same duration as the assembly in which it is installed, with a minimum of 1 – 1/2 hour.
    - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
-

- .3 Top hinged: offset (out of stream style) single damper, round or square; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
  - .1 Activation temperature: 74 deg. C. unless noted.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed in order not to disrupt ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.
- .11 All dampers to be functionally tested after installation. Provide tag near access verifying test.
- .12 Acceptable manufacturers: Ruskin, Nailor, E.H. Price, Greenheck.

### PART 3 - EXECUTION

#### 3.1 MANUFACTURERS' INSTRUCTIONS

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

#### 3.2 INSTALLATION

- .1 Install in all assemblies which are identified as fire rated assemblies on the architectural drawings, as well as where they are shown on mechanical drawings. Dampers shall be installed in accordance with ANSI/NFPA 90A and in strict
-

accordance with conditions of ULC listing. All fire damper installations shall be equipped with an access door appropriately sized to allow for maintenance of the damper.

- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
  - .1 100% of damper operation shall be verified and witnessed by PWGSC Representative. Fusible link removal and replacement are to be witnessed, as well as full range movement of the damper.
  - .2 Tags are to be placed on the fire damper access door after verification and are to be signed off by PWGSC Representative. The tag should provide additional space to document subsequent periodic testing.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories. Firestopping to be completed by Division 7 and in strict accordance with the fire damper manufacturer's installation instructions.
- .5 Co-ordinate with installer of firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install heavy gauge angles and break-away joints of approved design on each side of fire separation.

### 3.3 FIELD QUALITY CONTROL

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

### 3.4 CLEANING

- .1 Proceed in accordance with Section 01 71 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END

---

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section includes specifications for HVAC flexible duct construction and installation.

1.2 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.
- .3 Section 23 37 13 - Diffusers, Registers and Grilles.

1.3 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 National Fire Protection Association (NFPA).
  - .1 NFPA (Fire) 90A, Installation of Air Conditioning and Ventilating Systems, 2009 edition.
  - .2 NFPA (Fire) 90B, Installation of Warm Air Heating and Air-Conditioning Systems, 2009 edition.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA 1966, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition 2005.
- .4 Underwriters' Laboratories Inc. (UL).
  - .1 UL 181 Factory-Made Air Ducts and Air Connectors (2005).
- .5 Underwriters' Laboratories of Canada (ULC).
  - .1 CAN/ULC S110-2010, Standard Method of Tests for Air Ducts.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- .1 Certification of Ratings:
    - .1 Catalogue or published ratings to be those obtained from tests carried out by
-

manufacturer or independent testing agency signifying adherence to codes and standards.

#### 1.6 DELIVERY, STORAGE AND HANDLING

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

#### 1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### PART 2 – PRODUCTS

#### 2.1 GENERAL

- .1 UL listed for Class I air duct material,UL-181.
- .2 In accordance with NFPA Standard 90A.
- .3 Constructed of a non-collapsible, corrosion resistant, spring steel helix bonded to a vinyl inner liner and covered with a factory applied, wrapped, glass fiber acoustic insulation and vapour barrier jacket.
- .4 Capable of operating at pressure from 10" positive to 1" negative.
- .5 Capable of operating at temperatures from 0°F to 200°F.
- .6 Install flexible ductwork fully extended and use only foil tape, not grey fabric tape, to seal ends of flexible ductwork.

### PART 3 - EXECUTION

#### 3.1 DUCT INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110.
  - .2 Install in accordance with manufacturer's instructions.
  - .3 Install in accordance with SMACMA.
  - .4 Support in accordance with SMACMA.
  - .5 Flexible ductwork shall be used for acoustical purposes at supply air terminal units. The minimum length shall be 3 feet, the maximum length shall be 5
-

feet, with at least one support required. Note: Flexible ductwork is not permitted on the return or exhaust side.

- .6 There is to be no more than a 15 degree change in direction in flexible ductwork. For changes in direction of more than 15 degrees, use rigid ductwork for the change (i.e. provide sheet metal elbows at air terminals).

END

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PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Division 01 - General Requirements.

1.2 REFERENCES

- .1 Air Movement and Control Association (AMCA)
  - .1 AMCA Publication 99-2003, Standards Handbook.
  - .2 AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)/Air Movement and Control Association (AMCA)
  - .1 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .2 ANSI/AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

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

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 Shop Drawings:
  - .1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.
- .3 Provide:
  - .1 Fan performance curves showing point of operation, BHP and efficiency.
  - .2 Sound rating data at point of operation.
- .4 Indicate:
  - .1 Motors, sheaves, bearings, shaft details.
  - .2 Minimum performance achievable with variable speed controllers.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .6 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### 1.5 MAINTENANCE

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.
    - .1 Spare parts to include:
      - .1 Matched sets of belts.

#### 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.

#### 1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
-

## PART 2 - PRODUCTS

### 2.1 FANS GENERAL

- .1 Motors:
  - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
  - .2 For use with variable speed controllers where applicable.
  - .3 Sizes as indicated.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable motor bases, belt guards, coupling guards fan.
- .3 Factory-primed before assembly in colour standard to manufacturer.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .5 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

### 2.2 CENTRIFUGAL FANS

- .1 Fan wheels:
  - .1 Welded steel or aluminum construction.
  - .2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.
  - .3 Air foil, forward curved or backward inclined blades, as indicated.
- .2 Bearings: heavy duty grease lubricated ball or roller self-aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.
- .3 Housings:
  - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel, for smaller wheels, braced, and with welded supports.
  - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
  - .3 Provide airtight access doors with handles.
- .4 Acceptable manufacturers: Cook, Greenheck, Penn.

### 2.3 CABINET FANS - GENERAL PURPOSE

- .1 Fan characteristics and construction: as centrifugal fans.
  - .2 Cabinet-hung single or multiple wheel centrifugal fans in factory-fabricated casing complete with vibration isolators, motor, inside casing.
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- .3 Fabricate casing of zinc coated or phosphate treated steel reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 25 mm thick rigid acoustic insulation, pinned and cemented.
- .4 Acceptable manufacturers: Cook, Greenheck, Penn.

### 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 FAN INSTALLATION

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

#### 3.3 ANCHOR BOLTS AND TEMPLATES

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

#### 3.4 CLEANING

- .1 Proceed in accordance with Section 01 71 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

#### 3.5 BALANCING

- .1 Balance in accordance with Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

END

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PART 1 - GENERAL

1.1 RELATED SELECTION

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 45 00 – Quality Control.
- .3 Section 01 74 21 – Construction/Demolition Waste Submittal and Disposal.
- .4 Section 01 78 00 – Closeout Submittals.
- .5 Section 23 32 48 – Acoustical Air Plenums.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
  - .1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .2 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 AHSRAE 130, Methods of Testing for Rating Ducted Air Terminal Units.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 International Organization of Standardization (ISO)
  - .1 ISO 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .5 Underwriter's Laboratories (UL)
  - .1 UL 181, Factory-Made Air Ducts and Air Connectors.

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 certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.4 SUBMITTALS

- .1 Product Data:
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- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.
    - .2 Test data: to ANSI/AMCA 210.
      - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
      - .2 Sound power level with minimum inlet pressure of 0.25, 0.5, 1, and 1.5 kPa in accordance with ISO 3741 for 2<sup>nd</sup> through 7<sup>th</sup> octave band, also made by independent testing agency.
      - .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.
  - .2 Shop Drawings:
    - .1 Submit shop drawing in accordance with Section 01 33 00 – Submittal Procedures.
    - .2 Indicate the following:
      - .1 Capacity.
      - .2 Pressure drop.
      - .3 Noise rating.
      - .4 Leakage.
      - .5 Dimensions.
  - .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.

## 1.5 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.
-

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- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .2 Waste Management and Disposal:
    - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with 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 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 MANUFACTURED UNITS

- .1 Terminal units of the same type to be product of one manufacturer.

### 2.2 VARIABLE AIR VOLUME BOXES

- .1 Pressure independent factory reset to air flow between minimum and maximum air volume.
  - .2 Sizes, capacities, differential pressures and sound ratings: as indicated in schedule.
  - .3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.
  - .4 Sound ratings of assembly not to exceed 35 NC at 750 Pa. Use sound attenuator if necessary to achieve rating.
  - .5 Complete with:
    - .1 Operator and controller: as specified under Section 25 30 02 – EMCS: Field Control Devices.
    - .2 Sound attenuator: as indicated or as specified in Section 23 32 48 – Acoustical Air Plenums.
    - .3 Reheat coil: as indicated.
  - .6 Adjustable reset start point.
  - .7 Operator to be factory or field mounted and calibrated where indicated.
    - .1 Gauge taps for balancing with standard pressure gauge.
    - .2 Controller to have adjustable flow settings.
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- .8 Casing: constructed of 0.75 mm thick galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.
  - .9 Damper: galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.
  - .10 Acceptable Product: E. H. Price, Trane, Titus, Nailor, Carrier.

### 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 ductwork.
- .3 Install with at least 1000 mm of rigid inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate so that controls, dampers and access panels are easily accessible.

#### 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.

#### 3.4 COMMISSIONING

- .1 Commission in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.

END

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PART 1 – GENERAL

1.1 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.

1.2 SYSTEM DESCRIPTION

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

1.3 SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with 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.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 – PRODUCTS

2.1 GENERAL

- .1 To meet capacity, pressure drop, velocity, throw, noise level, neck velocity as indicated.
-

- .2 Frames:
  - .1 Plaster frames where set into gypsum board.
  - .2 Concealed fasteners.
- .3 Colour: white.

## 2.2 SUPPLY GRILLES AND REGISTERS

- .1 General: steel, size as indicated, opposed blade dampers.
- .2 Adjustable louvres, 20 mm spacing.
- .3 Acceptable manufacturers: E.H. Price, Nailor, Titus.

## 2.3 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 General: steel, size as indicated, opposed blade dampers.
- .2 Types: as indicated.
- .3 Acceptable manufacturers: E.H. Price, Nailor, Titus.

## 2.4 DIFFUSERS

- .1 Steel, 600 mm x 600 mm square with adjustable cones, neck size as indicated.
- .2 Steel: cones, 345 and 457 mm round with adjustable neck size as indicated.
- .3 Steel louvred face supply registers with blades fixed at 45°, size as indicated.
- .4 Acceptable manufacturers: E.H. Price, Nailor, Titus.

## PART 3 - EXECUTION

### 3.1 MANUFACTURERS' INSTRUCTIONS

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

### 3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
  - .2 Install with flat head cadmium plated screws in countersunk holes where fastenings are visible, color to match.
-

3.3            CLEANING

- .1      Proceed in accordance with Section 01 71 11 - Cleaning.
- .2      Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4            BALANCING

- .1      Balance in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

END

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PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 00 - Common Work Results For Mechanical.
- .2 Section 23 05 93 - Testing Adjusting and Balancing for HVAC
- .3 Section 23 31 14 - Metal Ducts - Low Pressure To 500 Pa
- .4 Section 23 33 00 - Air Duct Accessories

1.2 REFERENCES

- .1 ASTM International
  - .1 ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
    - .2 Indicate following:
      - .1 Pressure drop.
      - .2 Face area.
      - .3 Free area.
  - .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.
-

#### 1.4 DELIVERY, STORAGE AND HANDLING

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

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

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

#### 2.2 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

- .1 Factory manufactured galvanized steel.
  - .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire.
  - .2 Horizontal backdraft dampers on 2 faces.
  - .3 Maximum throat velocity: 3.3 m/s intake.
  - .4 Maximum loss through unit: 15 Pa exhaust static pressure.
  - .5 Maximum velocity through damper area: 1.5 m/s.
  - .6 Shape: Square.
- .2 Birdscreens:
  - .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust, 19 mm mesh on intake.

#### 2.3 GOOSENECK HOODS

- .1 Thickness: to ASHRAE and SMACNA.
    - .1 Kitchen: to NFPA 96.
    - .2 Elsewhere: to ASHRAE SMACNA.
  - .2 Fabrication: to ASHRAE and SMACNA.
-

- .1 Kitchen: to NFPA 96.
- .2 Elsewhere: to ASHRAE SMACNA.
- .3 Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint considered class A seal.
- .4 Supports: as indicated.
- .5 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust, 19 mm mesh on intake.
- .6 Horizontal backdraft dampers on 2 faces.

#### 2.4 FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel, anodized. Colour: in accordance to Architectural Drawings and Departmental approval.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialities and accessories installation in accordance with manufacturer's written instructions.
    - .1 Visually inspect substrate in presence of Departmental Representative or Consultant.
    - .2 Inform Departmental Representative and Consultant of unacceptable conditions
-

- immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative or Consultant.

### 3.2 INSTALLATION

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

### 3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
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## PART 1 - GENERAL

### 1.1 REFERENCES

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

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for kitchen hood, grease filter, and grease extractor, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province Newfoundland and Labrador, Canada.

### 1.3 DELIVERY, STORAGE AND HANDLING

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

## PART 2 - PRODUCTS

### 2.1 GREASE FILTER TYPE

- .1 To NFPA 96.
-

- .2 ULC labelled.
- .3 Configuration: as indicated.
- .4 Materials:
  - .1 Welded type 304 stainless steel.
  - .2 Lights: LED.
  - .3 Washable filters: Aluminum Baffle Grease Filter.
  - .4 Drain connection.
  - .5 Performance: 1,100 L/s, 125 Pa pressure drop.
  - .6 75 mm rear spacer
  - .7 Complete with fire suppression system
  - .8 450 x 450 factory cut centre collar

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for plumbing specialities and accessories installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative or Consultant.
  - .2 Inform Departmental Representative and Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative or Consultant.

#### 3.2 INSTALLATION

- .1 Install hoods in accordance with manufacturers instructions, and in accordance with NFPA 96.
- .2 Install filter/filter media prior to acceptance.
- .3 Operation sequences:
  - .1 Continuous wash down grease extractor type.

#### 3.3 CLEANING

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

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END

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PART 1 – GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .3 Section 01 78 00 – Closeout Submittals.
- .4 Section 23 33 00 – Air Duct Accessories.
- .5 Section 23 33 15 – Dampers - Operating.

1.2 REFERENCES

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
  - .1 ANSI/ARI 430, Central Station Air Handling Units.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA)
  - .1 CSA B52 Mechanical Refrigeration Code.
- .4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
- .5 American Bearing Manufacturer's Association (ABMA)
  - .1 ANSI/ABMA 9 Load Ratings and Fatigue Life for Ball Bearings
  - .2 ANSI/ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- .6 Air Movement and Control Association (AMCA)
  - .1 AMCA 210, Laboratory Method of Testing Fans for Aerodynamic Performance Rating (ASHRAE)
  - .2 AMCA 300 Reverberant Room Method for Sound Testing of Fans.
- .7 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
  - .1 ASHRAE 68, Laboratory Method of Testing to Determine the Sound Power in a Duct.
  - .2 ANSI/ASHRAE 90.1, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .3 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .8 National Electrical Manufacturer's Association (NEMA)
  - .1 NEMA MG1 Motors and Generators

- .2 NEMA ICS 7-1 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
- .9 Provincial Boiler, Pressure Vessel and Compressed Gas Regulations.

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate following: fan, fan curves showing point of operation, motor drive, bearings, filters, mixing box, dampers, VAV, coil, include performance data.

### 1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include following: fan, bearings, motor, damper, VAV control, air volume, total cooling, sensible cooling, EDB, EWB, OAT.

### 1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities. Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .4 Divert unused paint material from landfill to official hazardous material collections site approved by Departmental Representative.
- .5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

### 1.6 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one spare set of filters.

- .3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .4 Spare filters: in addition to filters installed for startup and commissioning. Immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

## PART 2 – PRODUCTS

### 2.1 GENERAL

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated.
- .2 Certify ratings: to ARI 430 with ARI seal.
- .3 Horizontal and vertical type, as indicated, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, dampers, bypass section, heating coil, cooling coil, , mixing box, economizer.
- .4 Acceptable Product: York, McQuay, Trane, Carrier, Engineered Air.

### 2.2 CASINGS

- .1 Galvanized or phosphate treated steel 1.6 mm thickness outer casing reinforced and braced for rigidity.
  - .1 Walk-in access doors: provide access for maintenance of internal parts with wired glass 200 x 200 mm viewing port or 200mm diameter polycarbonate double porthole.
  - .2 Paint steel parts, where not galvanized, with corrosion resistant paint to CGSB 1.181.
  - .3 Finish structural framed units, inside and out, with rust resistant enamel to Section 09 91 23 – Exterior Painting.
- .2 Line entire casing with minimum 1 mm thick, solid galvanized, steel liner.

### 2.3 DRAIN PANS

- .1 Construction: stainless steel, plastic or FRP, rounded corners, double wall.
- .2 Insulation: extruded foam type, minimum 13 mm thick.
- .3 Drain connection: in bottom at low point.
- .4 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.

- .5 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil or eliminator and to include return bends and headers.

## 2.4 FANS

- .1 Cabinet hung or frame mounted AMCA-rated for sound and performance, centrifugal fans with backward inclined or airfoil wheels, selected to operate in stable part of performance curve and heavy duty L10 100,000 hours minimum service self aligning or split pillow block bearings.
  - .1 Provide internally mounted motor as indicated complete with adjustable V-belt drive and guard.
  - .2 Motor: see schedule.
- .2 Maximum sound power levels, as indicated.

## 2.5 VIBRATION ISOLATION

- .1 Flexible connections at inlet and outlet of fan section: to Section 23 33 00 – Air Duct Accessories.
- .2 Provide vibration isolators on fan section.

## 2.6 VARIABLE VOLUME DEVICES

- .1 Adjustable inlet vanes operated from centre mechanism linked to each damper vane or cantilevered vane mechanism as indicated.
  - .1 Support vanes in self lubricated bronze bearings.
  - .2 On DWDI fans interconnect vanes to operate simultaneously.
  - .3 Provide locking devices for manual operation.
- .2 Variable fan width sleeve mechanism with control linkage as indicated.
  - .1 For DWDI fans, provide interconnected linkage to operate simultaneously.
  - .2 Provide locking devices for manual operation.
- .3 Variable speed drives as indicated: motors to be suitable for variable speed drive.

## 2.7 FILTER BOX

- .1 Material to match casing. For flat plus rigid type filter arrangement.
  - .1 Provide access to filter through hinged door with suitable hardware.
- .2 Provide blank-off plates and gaskets to prevent air bypass.

## 2.8 MIXING BOX

- .1 Material to match casing and produce uniformly mixed air temperature within plus or minus 5 °C of design across face of outlet.
- .2 Dampers:
  - .1 Dampers for mixing boxes: to Section 23 33 15 - Dampers - Operating.

## 2.9 COILS

- .1 Capacity: see schedule.
- .2 Ratings: ARI certified.
- .3 Construction:
  - .1 Casings: 1.5 mm thick galvanized sheet steel.
    - .1 Supports of galvanized steel channel or double angle frames.
    - .2 Blank-off plates. Insulated sandwich construction.
  - .2 Direct expansion refrigerant coils:
    - .1 Serpentine type, arranged to prevent trapping of oil.
      - .1 Liquid distributors to ensure even distribution of liquid refrigerant to all circuits.
      - .2 Silver solder or braze joints in refrigerant tubing.
      - .3 Evacuate and charge coil with nitrogen and seal before sending to site.
    - .2 Tubes: copper.
    - .3 Fins: aluminum, plate or spiral wound.
    - .4 Headers: copper.
    - .5 Pressure tests: CSA B52 and carry a Canadian Refrigeration Number. Dehydrated. Sealed with nitrogen charge.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- .1 Install units in accordance with manufacturer's instructions and as indicated.
- .2 Ensure adequate clearance for servicing and maintenance.

### 3.2 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

3.3            DRIP PANS

- .1        Install deep seal P-traps and trap seal primer on drip lines.
  - .1        Depth of water seal to be 1.5 times static pressure at this point.

3.4            COMMISSIONING

- .1        Commission in accordance with Section 01 91 13 – General Commissioning (Cx)  
Requirements one day per unit for startup and one day for commissioning.

**END OF SECTION**

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
  - .1 Base board and finned tube radiation, and cabinet convectors including installation.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .3 Section 01 78 00 – Closeout Submittals.
- .4 Section 01 91 13 – General Commissioning (Cx) Requirements.

1.3 REFERENCES

- .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS)
- .2 Hydronic Institute of Boiler and Radiator Manufacturers (IBR)
- .3 Air-Conditioning, Heating and Refrigeration Institute (AHRI)

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 Shop Drawings:
    - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .2 Indicate:
      - .1 Equipment, capacity, piping, and connections.
      - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
      - .3 Special enclosures.
  - .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.
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- .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.

#### 1.5 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/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### PART 2 - PRODUCTS

#### 2.1 CAPACITY

- .1 As indicated, based on 77°C average water temperature, 11°C temperature drop.

#### 2.2 FINNED TUBE RADIATION

- .1 Heating elements: NPS 1 1/4 sized to maintain minimum 0.9 m/s velocity, seamless copper tubing as indicated, 1.2 mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced aluminum fins, 100 x 100 mm nominal, 164 fins per metre suitable for sweat fittings.
  - .2 Element hangers: ball bearings or sliding guide rod cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm centres maximum.
  - .3 Standard enclosures: 1.3 mm thick steel complete with components for wall-to-wall or complete with die formed end caps having no knock-outs, with inside corners, outside corners, as indicated. Provide full length channel and sealer strip at top of wall edge. Height as indicated. Joints and filler pieces to be flush with cabinet. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces to be clear of grilles located to provide easy access to valves and vents. Provide access doors for valves, vents, traps. Finish cabinet with factory applied baked primer coat.
  - .4 Special enclosures: as indicated.
-

- .5 Dimensions for enclosures: measure site conditions. Do not scale from drawing.
- .6 Provide for noiseless expansion of all components.
- .7 Acceptable Product: Engineered Air, Trane, Slant-Fin, Rosemex, Modine, Beacon/Morris.

### 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 manufacturer's instructions.
- .2 Install in accordance with piping layout and reviewed shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with Departmental Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .6 Valves
  - .1 Install valves with stems upright or horizontal unless approved otherwise.
  - .2 Install isolating gate or ball valves on inlet and balancing valves on outlet of each unit as indicated
- .7 Venting:
  - .1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.
  - .2 Install automatic air vent on continuous finned tube radiation.
- .8 Clean finned tubes and comb straight.
- .9 Install flexible expansion compensators as indicated.

#### 3.3 CLEANING

- .1 Proceed in accordance with Section 01 71 11 - Cleaning.
-

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

3.4 COMMISSIONING

- .1 Commissioning in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.

END

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## PART 1 - GENERAL

### 1.1 RELATED SECTIONS

- .1 Division 01 – General Requirements.
- .2 Section 23 05 00 - Common Work Results for Mechanical.

### 1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Submit product data sheets for unit heaters. Include:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Mounting methods.
  - .4 Physical size.
  - .5 kW rating, voltage, phase.
  - .6 Cabinet material thicknesses.
  - .7 Limitations.
  - .8 Colour and finish.
- .4 Manufacturers' Instructions: Provide to indicate special handling criteria, installation sequence, and cleaning procedures.

### 1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
  - .1 Equipment, capacity and piping connections.
  - .2 Dimensions, internal and external construction details, recommended method of installation with proposed support, sizes and location of mounting bolt holes.

### 1.4 CLOSEOUT SUBMITTALS

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

### 1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Waste management and disposal to be in accordance with Section
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01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 CABINET UNIT HEATERS CH-1-1, CH-1-2, CH-2-1, CH-2-2

- .1 Cabinet: type as indicated, 18-gauge steel with rounded exposed corners and edges, removable panels, glass fibre insulation and integral air outlet and inlet.
  - .2 Finish with epoxy powder paint.
  - .3 Heating element: durable tubular hydronic heating element with fins.
  - .4 Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted.
  - .5 Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload and protection resilient rubber isolation mounting.
  - .6 Filters:
    - .1 Filters shall be located behind integral access door. Filters are 25 throwaway.
  - .7 Capacity: as indicated, based on entering water temperature of 77°C, a temperature drop of 11°C, and an entering air temperature of 18°C.
  - .8 Control:
    - .1 2 speed switch with integral overloads in cabinet.
    - .2 Control thermostat: by Section 25.
  - .9 Acceptable manufacturers:
    - .1 Trane.
    - .2 Reznor.
    - .3 Rosemex.
-

PART 3 - EXECUTION

3.1           INSTALLATION

- .1       Install in accordance with manufacturer's instructions.
- .2       Provide double swing pipe joints as indicated.
- .3       Check final location with PWGSC Representative if different from that indicated prior to installation.
  - .1       Should deviations beyond allowable clearances arise, and follow PWGSC Representative's directive.
- .4       Provide supplementary suspension steel as required.
- .5       Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.2           COMMISSIONING

- .1       To Section 01 91 13 - General Commissioning (CX) Requirements.
- .2       All operating controls shall be packaged and fully wired.

END

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