

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.

### **1.2 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 Nova Scotia, Canada when requested.
- .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 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6 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, Departmental 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.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .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

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- 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 3 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
    - .2 Make changes as required and re-submit as directed by Departmental 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 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 Departmental 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.
  - .10 Submit copies of as-built drawings for inclusion in final
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### **1.3 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

### **1.4 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .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.

### **1.5 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 applicable

## **PART 3 - EXECUTION**

### **3.1 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

### **3.2 CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.
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### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### **3.4 DEMONSTRATION**

- .1 Departmental 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: In accordance with allowances in Section 01 79 00 Demonstration and Training. Specialized instruction time for particular equipment as noted in equipment sections.
- .5 Departmental Representative will record these demonstrations on video tape for future reference.

### **3.5 PROTECTION**

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

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## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 11 - Cleaning.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Construction.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA) International
  - .1 CSA B149.1-10 Natural Gas and Propane Installation Code Handbook.

### **1.3 WASTE MANAGEMENT AND DISPOSAL**

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

## **PART 2 – PRODUCTS**

Not applicable

## **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, as well as applicable local codes and standards.
  - .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.
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### **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 ball valves unless indicated otherwise, with hose end male thread, cap and chain.

### **3.4 AIR VENTS**

- .1 Install manual air vents at high points in piping systems.
- .2 Install drain piping to approved location and terminate where discharge is visible.

### **3.5 DIELECTRIC COUPLINGS**

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

### **3.6 PIPEWORK INSTALLATION**

- .1 Screwed fittings jointed with Teflon tape.
  - .2 Protect openings against entry of foreign material.
  - .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
  - .4 Assemble piping using fittings manufactured to ANSI standards.
  - .5 Saddle type branch fittings may not be used
  - .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
  - .7 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
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- .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.
  - .6 Use butterfly or ball valves at branch take-offs for isolating purposes except where otherwise specified.
  - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .8 Use chain operators on gate and globe 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 (except drywall 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.
    - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint.
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- .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 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

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

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of Division 22 and 23. Where specific pressure testing criteria does not exist, pressure test piping to the greater of 860 kPa or 1-1/2 times the maximum system operating pressure.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Division 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 Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.



## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 21 - Construction/Demolition Management and Disposal.
- .2 Section 23 34 00 – HVAC Fans.
- .3 Section 23 72 00 – Energy Recovery Equipment.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .4 Closeout Submittals
  - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEEA, TDGA, and applicable Provincial regulations.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Motors: high efficiency, in accordance with local power company standards and to ASHRAE 90.1-10.

### **2.2 MOTORS**

- .1 Provide motors for mechanical equipment as specified.
- .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, 600 V, unless otherwise indicated.
- .4 Provide inverter duty motors for variable speed applications.

### **2.3 TEMPORARY MOTORS**

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental 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 stainless steel sheaves secured to shafts with removable keys unless otherwise 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 Correct size of sheave determined during TAB.
  - .5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
  - .6 Motor slide rail adjustment plates to allow for centre line adjustment.
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- .7 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 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

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

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in Section 01 33 00 - Submittal Procedures.
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### **3.4 CLEANING**

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

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Management and Disposal.
- .3 Section 23 05 53.01 - Mechanical Identification.

### **1.2 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.

### **1.3 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 Wells.

### **1.4 HEALTH AND SAFETY**

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

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Design point to be at mid point of scale or range.
  - .2 Ranges: as indicated.
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## **2.2 PRESSURE GAUGES**

- .1 112 mm, dial type: to ASME B40.100-2005, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.
  - .1 Acceptable Material:
    - .1 Trerice
    - .2 Weiss
    - .3 Taylor
  - .2 Provide:
    - .1 Snubber for pulsating operation.
    - .2 PVC Pressure gauge isolators complete with teflon diaphragm and SS fasteners. Diaphragm assembly for corrosive/saltwater service.
  - .3 Gasketed pressure relief back with solid front.
  - .4 Bronze stop cock for fresh water, PVC ball valve for saltwater between isolator and salt water pipe.
  - .5 Glycerine filled.

## **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 PRESSURE GAUGES**

- .1 Install in following locations:
  - .1 Upstream and downstream of control valves.
  - .2 Suction and discharge of pumps
  - .3 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

### **3.4 NAMEPLATES**

- .1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

## **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 35 29 - Health and Safety Requirements.
- .4 Section 01 78 00 - Closeout Submittals.

### **1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME B1.20.1-1983(R2001), Pipe Threads, General Purpose (Inch).
  - .2 ANSI/ASME B16.18-2001(R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A 276-08a, Specification for Stainless Steel Bars and Shapes.
  - .2 ASTM B 62-09, Specification for Composition Bronze or Ounce Metal Castings.
  - .3 ASTM B 283-09a, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  - .4 ASTM B 505/B505M-09, Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
  - .1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
  - .2 MSS-SP-80-2003, Bronze Gate Globe, Angle and Check Valves.
  - .3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

### **1.3 SUBMITTALS**

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

## **1.4 QUALITY ASSURANCE**

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

## **1.5 MAINTENANCE**

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

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Valves:
  - .1 Except for specialty valves, to be single manufacturer.
  - .2 All products to have CRN registration numbers.
- .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 B16.18-2001(R2005).
  - .3 Lockshield Keys:
    - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.
- .3 Gate Valves:
  - .1 Requirements common to gate valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Bonnet: union with hexagonal shoulders.
      - .1 Connections: screwed with hexagonal shoulders.
      - .2 Inspection and pressure testing: to MSS SP-80. Tests to be



- hydrostatic.
  - .3 Packing: non-asbestos.
  - .4 Handwheel: non-ferrous.
  - .5 Handwheel Nut: bronze to ASTM B 62-09.
- .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
  - .1 Body: with long disc guides, union or screwed bonnet with stem retaining nut.
  - .2 Disc: solid wedge, bronze to ASTM B283-09a, loosely secured to stem.
  - .3 Operator: Handwheel.
- .3 NPS 2 and under, rising stem, split wedge disc, Class 125:
  - .1 Body: with long disc guides, union or screwed bonnet.
  - .2 Disc: split wedge, bronze to ASTM B 283-09a, loosely secured to stem.
  - .3 Operator: Handwheel.
- .4 NPS 2 and under, rising stem, solid wedge disc, Class 125:
  - .1 Body: with long disc guides, union or screwed bonnet.
  - .2 Disc: solid wedge, bronze to ASTM B283-09a, loosely secured to stem.
  - .3 Operator: Handwheel.
- .4 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 B 62-09.
  - .2 NPS 2 and under, composition disc, Class 125:
    - .1 Body and bonnet: union or screwed bonnet.
    - .2 Disc and seat: renewable rotating PTFE disc, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505M-09.
    - .3 Operator: Handwheel.
  - .3 NPS 2 and under, plug disc, Class 150, screwed ends:
    - .1 Body and bonnet: union or screwed bonnet.
    - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A 276-08a, loosely secured to stem.
    - .3 Operator: Handwheel.
- .5 Check Valves:
  - .1 Requirements common to check valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.

- .2 Connections: screwed with hexagonal shoulders.
  - .2 NPS 2 and under, swing type, bronze disc, Class 125:
    - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
    - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
  - .3 NPS 2 and under, swing type, bronze disc, 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.
- .7 Ball Valves:
  - .1 NPS 2 and under:
    - .1 Body and cap: cast high tensile bronze to ASTM B 62-09.
    - .2 Pressure rating: Class 125.
    - .3 Connections: Screwed ends to ANSI B1.20.1 with hexagonal shoulders, or solder ends to ANSI as specified in relevant sections of Division 22 and 23.
    - .4 Stem: tamperproof ball drive.
    - .5 Stem packing nut: external to body.
  - .6 Ball and seat: replaceable hard chrome solid ball and teflon seats.
  - .7 Stem seal: TFE with external packing nut.
  - .8 Operator: removable lever handle.

## **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.

## **PART 1 - GENERAL**

### **1.1 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.
  - .2 American Society for Testing and Materials International (ASTM).
    - .1 ASTM A 49-01(2006), Specification for Heat-Treated Carbon Steel Joint Bars.
    - .2 ASTM A 126-04(2009), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - .3 ASTM B 61-08, Specification for Steam or Valve Bronze Castings.
    - .4 ASTM B 62-09, Specification for Composition Bronze or Ounce Metal Castings.
    - .5 ASTM B 8M5-09, Specification for Aluminum-Alloy Die Castings.
    - .6 ASTM B 209-07, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
    - .1 MSS SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
    - .2 MSS SP-71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
    - .3 MSS SP-82-1992, Valve Pressure Testing Methods.
  - .4 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

### **1.2 SUBMITTALS**

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

### **1.3 MAINTENANCE**

- .1 Extra Materials:
  - .2 Furnish following spare parts:
    - .1 Valve seats: one for every 10 valves each size, minimum 1.
    - .2 Discs: one for every 10 valves, each size. Minimum 1.
-

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

## **PART 2 - PRODUCTS**

### **2.1 MATERIAL**

- .1 Valves:
  - .1 Except for speciality 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 B 209 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 B 85 or malleable iron to ASTM A 49. Nut of bronze to ASTM B 62.
  - .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, 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 B 62 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.
    - .6 Seat rings: integral with body.
    - .7 Stem: nickel-plated steel.
-

- .8 Pressure-lubricated operating mechanism.
- .9 Operator: Handwheel.

### **2.3 GLOBE VALVES**

- .1 NPS 2 1/2 - 10, OS&Y:
  - .1 Body: with multiple-bolted bonnet.
  - .2 WP: 1.4 MPa CWP.
  - .3 Bonnet-yoke gasket: non-asbestos.
  - .4 Disc: bronze to ASTM B 62, 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 B 62.
  - .7 Operator: Handwheel.

### **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 VALVE**

- .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 A 126 Class B.
  - .2 Ratings:
    - .1 NPS 2 1/2 - 12: 1.4 MPa CWP.
  - .3 Disc: rotating for extended life.
    - .1 Up to NPS 6: bronze to ASTM B 62.
  - .4 Seat rings: renewable bronze to ASTM B 62 screwed into body.
  - .5 Hinge pin, bushings: renewable bronze to ASTM B 62.
  - .6 Disc: ASTM A126 Class B, secured to stem, rotating for extended life.
  - .7 Seat: cast iron, integral with body.
  - .8 Hinge pin: exelloy; bushings: malleable iron.
  - .9 Identification tag: fastened to cover.
  - .10 Hinge: galvanized malleable iron.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

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

## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Demolition/Construction Waste Management and Disposal.
- .3 Section 01 35 29 - Health and Safety Requirements.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 22 13 19 - Non-Potable Water Piping.

### **1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
    - .1 ANSI/ASME B1.20.1-1983(R2001), Pipe Threads, General Purpose (Inch).
    - .2 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.
    - .3 ANSI/ASME B16.5-03-2003, Pipe Flanges and Flanged Fittings.
    - .4 ANSI/ASME B16.11-01, Forged Fittings, Socket-Welding and Threaded.
    - .5 ANSI/ASME B16.25-1997, Buttwelding Ends.
    - .6 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding Ends.
  - .2 American National Standards Institute (ANSI)/American Petroleum Institute (API).
    - .1 ANSI/API 609-1997, Lug- and Water-Type Butterfly Valves.
  - .3 American Society for Testing and Materials International, (ASTM).
    - .1 ASTM A 126-04, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - .2 ASTM B 62-02, Specification for Composition Bronze or Ounce Metal Castings.
    - .3 ASTM B 209M-06, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
    - .1 MSS SP-67-02, Butterfly Valves.
-

### **1.3 SUBMITTALS**

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

### **1.4 QUALITY ASSURANCE**

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

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

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

## **PART 2 – PRODUCTS**

### **2.1 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG**

- .1 Except for specialty valves, to be of single manufacturer.
  - .2 To be suitable for dead-end service.
  - .3 Sizes: Wafer type: NPS 2 to 30.
  - .4 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
    - .1 NPS 2 - 12: 1380 kPa
  - .5 Application: on-off operation.
  - .6 Full lug body (threaded).
  - .7 Operators: lockable polypropylene hand lever with trigger, unless otherwise indicated.
  - .8 Designed to comply with MSS SP-67.
-

- .9 Compatible with PVC ANSI Class 150 flanges.
- .10 Construction:
  - .1 Body PVC.
  - .2 Disc: Polypropylene.
  - .3 Seat: EPDM.
  - .4 Shaft: 403 stainless steel.
  - .5 Taper pin: 316 SS
  - .6 Key: stainless.
  - .7 O-Ring: EPDM.
  - .8 Bushings: Teflon.
  - .9 Stabilizing Ring: 304 Stainless steel
- .11 Acceptable Material:
  - .1 Chemline
  - .2 Hayward
  - .3 Ipex

## **2.2 BALL VALVES**

- .1 Connections: Full port union ends for connection to PVC piping.
- .2 Ball Valves:
  - .1 PVC body, handle and ball to ASTM D1784-06, Cell Classification 12454, rated for 1034 kPa normal operating pressure, stem with double blowout-proof o-rings.

## **PART 3 – EXECUTION**

### **3.1 PREPARATION**

- .1 Valve and mating flange preparation.
  - .1 Inspect adjacent pipeline, remove foreign material.
  - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
  - .3 Install butterfly valves with disc in almost closed position.
  - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

### **3.2 INSTALLATION OF VALVES**

- .1 Install in accordance with manufacturer's instructions.
  - .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
-



- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Mount actuator on to valve prior to installation.
- .5 Handle valve with care so as to prevent damage to disc and seat faces.
- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Management and Disposal.

### **1.2 REFERENCES**

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1-2012, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM A 125-96(2007), Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A 307-07b, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A 563-07a, Specification for Carbon and Alloy Steel Nuts.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Factory Mutual (FM)
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP-58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 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)

### **1.3 DESIGN REQUIREMENTS**

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1-2007 or MSS SP-58-2009.
  - .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 all 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 to be in accordance with MSS SP-58-2009.

#### **1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data for following items:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.

#### **1.5 CLOSEOUT SUBMITTALS**

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

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58-2009.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

#### **2.2 PIPE HANGERS**

- .1 Finishes:
    - .1 Pipe hangers and supports: galvanized after manufacture, using hot dipped galvanizing process, or stainless steel.
    - .2 Use hot dipped galvanizing process.
    - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
  - .2 Upper attachment structural: Suspension from lower flange of I-Beam.
    - .1 Cold piping NPS 2 maximum: Malleable iron C-clamp with hardened steel
-

- cup point setscrew, locknut and carbon steel retaining clip.
  - .1 Rod: 13 mm UL listed, FM approved.
  - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS SP-58-2009 and MSS SP-69-2003.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
  - .1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP-69-2002.
  - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Shop and field-fabricated assemblies.
  - .1 Trapeze hanger assemblies.
  - .2 Steel bracket.
- .5 Hanger rods: threaded rod material to MSS SP-58-2009.
  - .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.
- .6 Pipe attachments: material to MSS SP-58-2009.
  - .1 Attachments for copper piping: copper plated steel.
  - .2 Use insulation shields for hot pipework.
  - .3 Oversize pipe hangers and supports.
- .7 Adjustable clevis: material to MSS SP-69-2003 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .8 U-bolts: galvanized to MSS SP-69-2003 with 2 nuts at each end to ASTM A 563-07.
  - .1 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion epoxy coated.

### **2.3 RISER CLAMPS**

- .1 Copper pipe: carbon steel copper plated to MSS SP-58-2009, type 42.
  - .2 Bolts: to ASTM A 307-07b.
  - .3 Nuts: to ASTM A 563-07.
-

## **2.4 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP-69-2003, 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 SP-69-2003.

## **2.5 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **2.6 HOUSE-KEEPING PADS**

- .1 For base-mounted equipment: Concrete, at least 100 mm high, 100 mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: to Section 03 30 00 - Cast-In-Place Concrete.
- .3 Coordinate to have work performed by general contractor.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Provide all items to fasten services to the ceiling at pre-fabricated building suppliers approved locations and with recommended fasteners.
  - .2 Install in accordance with manufacturer's instructions and recommendations.
  - .3 Vibration Control Devices and seismic restraint:
    - .1 Install on piping systems at pumps, boilers, elsewhere as indicated.
  - .4 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 be to industry standards.
  - .5 Clevis plates:
    - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
-

- .6 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .7 Use variable support spring hangers where:
  - .1 transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 variation in supporting effect does not exceed 25 % of total load.
- .8 Use prefabricated roof piping supports for all roof piping.

### **3.2 HANGER SPACING**

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code and 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 Saltwater Piping: to Canadian Plumbing Code for PVC.
- .6 Pipework greater than NPS 12: to MSS SP-69-2002.

### **3.3 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.

### **3.4 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.

### **3.5 FINAL ADJUSTMENT**

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- .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.

## **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 09 91 23 - Interior Painting.

### **1.2 REFERENCES**

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14-2013, Standard for the Installation of Standpipe and Hose Systems.

### **1.3 SUBMITTALS**

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

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
-



- .2 Lettering and numbers raised or recessed.
  
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

## **2.2 SYSTEM NAMEPLATES**

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

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

## **2.3 PIPING SYSTEMS GOVERNED BY CODES**

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

## **2.4 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3-92 except where specified otherwise.
  - .2 Pictograms:
    - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
  - .3 Legend:
    - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3-92.
  - .4 Arrows showing direction of flow:
    - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
    - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
    - .3 Use double-headed arrows where flow is reversible.
  - .5 Extent of background colour marking:
    - .1 To full circumference of pipe or insulation.
    - .2 Length to accommodate pictogram, full length of legend and arrows.
  - .6 Materials for background colour marking, legend, arrows:
    - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
    - .2 Other pipes: pressure sensitive plastic-coated cloth vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
  - .7 Colours and Legends:
    - .1 Where not listed, obtain direction from Departmental Representative.
    - .2 Colours for legends, arrows: to following table:
-

Background colour: Legend, arrows:

Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic cold water supply	Green	DOM. CWS
Salt water	Green	SALT WATER
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Non-potable water	Green	NON-POTABLE

## **2.5 IDENTIFICATION DUCTWORK SYSTEMS**

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: black, or co-ordinated with base colour to ensure strong contrast.

## **2.6 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.

## **2.7 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.

## **2.8 LANGUAGE**

- .1 Identification in English.
-

### **PART 3 - EXECUTION**

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

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

#### **3.2 TIMING**

- .1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

#### **3.3 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3-92 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.

#### **3.4 NAMEPLATES**

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

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

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

### **3.6 VALVES, CONTROLLERS**

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

### **3.7 CLEANING**

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

## **PART 1 – GENERAL**

### **1.1 GENERAL**

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

### **1.2 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Names of personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 Member of AABC in good standing.

### **1.3 PURPOSE OF TAB**

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

### **1.4 EXCEPTIONS**

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

### **1.5 CO-ORDINATION**

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as 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.
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## **1.6 PRE-TAB REVIEW**

- .1 Review contract documents before project construction is started and confirm in writing to Departmental 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 Departmental Representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

## **1.7 START-UP**

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Divisions 22 and 23.

## **1.8 OPERATION OF SYSTEMS DURING TAB**

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

## **1.9 START OF TAB**

- .1 Notify Departmental Representative 7 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 weatherstripping, sealing, caulking.
  - .3 All pressure, leakage, other tests specified elsewhere Divisions 22 and 23.
  - .4 All 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.

#### **1.10 APPLICATION TOLERANCES**

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

#### **1.11 ACCURACY TOLERANCES**

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

#### **1.12 INSTRUMENTS**

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be 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 Departmental Representative.

#### **1.13 SUBMITTALS**

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

#### **1.14 PRELIMINARY TAB REPORT**

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



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**1.15 TAB REPORT**

- .1 Format to be in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

**1.16 VERIFICATION**

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

**1.17 SETTINGS**

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

**1.18 COMPLETION OF TAB**

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

**1.19 AIR SYSTEMS**

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.
  - .2 Do TAB of systems, equipment, components, controls specified in Divisions 22 and 23.
  - .3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
-

- .4 Quality assurance: Perform TAB under direction of supervisor qualified by AABC or NEBB.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
  - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

#### **1.21 DOMESTIC HW SYSTEMS**

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC NEBB SMACNA ASHRAE.
- .2 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.
- .3 Quality assurance: perform TAB under direction of supervisor qualified by to standards of AABC or NEBB.
- .4 Location of equipment measurements: to include, but not be limited to, the following as appropriate: inlet and outlet of heaters, DHW tank, DHW circulator, at controllers and controlled devices.
- .5 Locations of systems measurements to include, but not be limited to, the following, as appropriate: main, main-branch, branch, sub-branch.

#### **1.22 OTHER SYSTEMS**

- .1 Plumbing systems:
  - .1 TAB procedures:
    - .1 Flush valves: adjust to suit project pressure conditions.

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

- .1 General requirements applicable to work specified this paragraph:

- .1 Qualifications of TAB personnel: as for air systems specified this section.
- .2 Quality assurance: as for air systems specified this section.

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

- .1 Measure DBT, WBT, air velocity, air flow patterns, in occupied areas as designated.
- .2 Participate in systems checks twice during warranty period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of warranty period.

#### **PART 2 – PRODUCTS**

Not applicable.

#### **PART 3 – EXECUTION**

Not applicable.

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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 Management and Disposal.
- .3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1 ANSI/ASHRAE/IESNA 90.1-2010, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2 American Society for Testing and Materials International, (ASTM)
    - .1 ASTM B 209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
    - .2 ASTM C 335-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
    - .3 ASTM C 411-11 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4 ASTM C 449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .5 ASTM C 547-12, Specification for Mineral Fiber Pipe Insulation.
    - .6 ASTM C 553-11, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .7 ASTM C 612-10, Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .8 ASTM C 795-08, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
    - .9 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
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- .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.

### **1.3 DEFINITIONS**

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

### **1.4 SHOP DRAWINGS**

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

### **1.5 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.

### **1.6 MANUFACTURERS' INSTRUCTIONS**

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

- .1 Installer: specialist in performing work of this section, and have experience in this size and type of project, qualified to standards member of TIAC.

## **PART 2 - PRODUCTS**

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

- .1 In accordance with CAN/ULC-S102-07:
  - .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 C 335-10e1.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612-10, 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 C 553-11 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 C 553-08.
  - .2 Jacket: to CGSB 51-GP-52MA.
  - .3 Maximum "k" factor: to ASTM C 553-08.

### **2.3 JACKETS**

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921-10.
- .2 Lagging adhesive: Compatible with insulation.

### **2.4 ACCESSORIES**

- .1 Vapour retarder lap adhesive:
    - .1 Water based, fire retardant type, compatible with insulation.
-

- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449-07.
- .4 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921-10 untreated.
- .5 Tape: self-adhesive, aluminum, plain reinforced, 75 mm wide minimum.
- .6 Contact adhesive: quick-setting
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm stainless steel.
- .9 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .10 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

### **PART 3 - EXECUTION**

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

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

#### **3.2 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

- .1      Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6      Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

### **3.3    DUCTWORK INSULATION SCHEDULE**

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-2	yes	25
Round cold and dual temperature supply air ducts	C-2	yes	25
Return and exhaust ducts exposed in space being served	none		
Outside air ducts to mixing plenum and combustion air ducting	C-1	yes	50
Mixing plenums	C-1	yes	50
Exhaust duct between dampers and louvres and exhaust ducts from ERVs	C-1	yes	50

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Acoustically lined ducts	none
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.2 Insulation finishes: conform to the following table:

Location	Finish
Exposed rectangular duct	Canvas
Exposed round duct	Canvas or PVC
Concealed ducts	None

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1 ASHRAE Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
  - .2 American Society for Testing and Materials International (ASTM)
    - .1 ASTM C 335-10, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
    - .2 ASTM C 411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .3 ASTM C 449/C449M-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .4 ASTM C 547-07e1, Mineral Fiber Pipe Insulation.
    - .5 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
    - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
  - .4 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
  - .6 Manufacturer's Trade Associations
    - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
  - .7 Underwriters' Laboratories of Canada (ULC)
    - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
    - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
    - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings.
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.4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

## **1.2 DEFINITIONS**

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

## **1.3 SUBMITTALS**

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

## **1.4 QUALITY ASSURANCE**

- .1 Installer: specialist in performing work of this Section, and qualified to standards of TIAC.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
-

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **PART 2 - PRODUCTS**

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

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

### **2.2 INSULATION**

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
  - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
  - .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
    - .1 Mineral fibre: to CAN/ULC-S702.
    - .2 Maximum "k" factor: to CAN/ULC-S702.
  - .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
    - .1 Mineral fibre: to CAN/ULC-S702.
    - .2 Jacket: to CGSB 51-GP-52Ma.
    - .3 Maximum "k" factor: to CAN/ULC-S702.
-

- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to CAN/ULC-S702.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
  - .1 Insulation: with vapour retarder jacket.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

### **2.3 INSULATION SECUREMENT**

- .1 Tape: self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

### **2.4 CEMENT**

- .1 Thermal insulating and finishing cement:
  - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449/C449M.

### **2.5 VAPOUR RETARDER LAP ADHESIVE**

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

### **2.6 INDOOR VAPOUR RETARDER FINISH**

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

### **2.7 OUTDOOR VAPOUR RETARDER FINISH**

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

## **2.8 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .2 Minimum service temperatures: -20 degrees C.
  - .3 Maximum service temperature: 65 degrees C.
  - .4 Moisture vapour transmission: 0.02 perm.
  - .5 Thickness: 0.5 mm.
  - .6 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
  - .7 Special requirements:
    - .1 Outdoor: UV rated material at least 0.5 mm thick.

## **2.9 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Same insulation thickness as adjoining piping systems.
- .2 PVC jacket.
- .3 Designed to permit periodic removal and re-installation without requiring repair to adjacent insulated surfaces.

## **PART 3 - EXECUTION**

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

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

### **3.2 PRE-INSTALLATION REQUIREMENT**

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
  - .2 Surfaces clean, dry, free from foreign material.
-

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

### **3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

### **3.5 INSTALLATION OF ELASTOMERIC INSULATION**

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

### **3.6 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
  - .2 TIAC Code: A-1.
    - .1 Securements: SS wire bands, Tape at 300 mm on centre.
    - .2 Seals: lap seal adhesive, lagging adhesive. Installation: TIAC Code 1501-H.
  - .3 TIAC Code: A-3.
    - .1 Securements: SS wire bands, Tape at 300 mm on centre.
    - .2 Seals: VR lap seal adhesive, VR lagging adhesive. Installation: TIAC
-

Code: 1501-C

Appli- cation	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness mm)					
			Run Out	to 1	1 ¼ to 2	2 ½ to 4	5 to 6	8 & over
Domestic hot water supply and recirc, tempered water		A-1	25	25	25	38	38	38
Domestic cold water		A-3	25	25	25	25	25	25
Above ground storm, non-potable salt water		A-3	25	25	25	25	25	25

- .7 Finishes:
- .1 Exposed indoors: PVC jacket.
  - .2 Exposed in mechanical rooms: PVC jacket.
  - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
  - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
  - .5 Outdoors: water-proof aluminum jacket.
  - .6 Finish attachments: SS screws bands, at 150 mm on centre. Seals: wing closed.
  - .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

### **3.7 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.



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

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 21 - Construction/Demolition Management and Disposal.
- .2 Section 22 42 01 - Plumbing Specialties and Accessories.
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

### **1.2 POTABLE, NON-POTABLE AND SALT WATER**

- .1 Coordinate with requirements of Commissioning Plan, Domestic Water System Verification of Operation Form.
- .2 When cleaning is completed and system filled:
  - .1 Verify performance of equipment and systems as specified elsewhere in Division 22.
  - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
  - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.
  - .4 Bleed off measured flow rate of water from pressure tank. Measure cumulative length of time that booster pumps operate to recover pressure.
- .4 Test compressor unloading systems at all stages of operation. This may be performed by repeating above test at several bleed-off rates.

### **1.10 SANITARY DRAINAGE SYSTEMS**

- .1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
  - .2 Ensure that traps are fully and permanently primed.
  - .3 Ensure that fixtures are properly anchored, connected to system.
  - .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
  - .5 Cleanouts: Refer to Section 22 42 01 - Plumbing Specialties and Accessories.
  - .6 Coordinate with requirements of Commissioning Plan, form MF4-055 Plumbing: Sanitary Drains, Roof Drain & Vents Inspection Form.
-

## **PART 2 - PRODUCTS**

Not applicable.

## **PART 3 - EXECUTION**

Not applicable.

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
  - .1 ASTM A 480/A 480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A 635/A 635M-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 A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
  - .3 NFPA 96-11, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

### **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 metal ducts 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 Province of Nova Scotia, Canada.
- .4 Test and Evaluation Reports:
  - .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.
- .5 Construction Waste Management:
  - .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .6 Construction IAQ Management Plan:
  - .1 Submit Indoor Air Quality (IAQ) Plan for construction and pre-occupancy phases of building.
  - .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings Under Construction.

#### **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 metal ducts from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **PART 2 - PRODUCTS**

#### **2.1 SEAL CLASSIFICATION**

- .1 Classification as follows:

<u>Maximum Pressure Pa</u>	<u>SMACNA Seal Class</u>
500	C
250	C

- |     |          |
|-----|----------|
| 125 | C        |
| 125 | Unsealed |

- .2 Seal classification:
- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
  - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.
  - .3 Class C: transverse joints and connections made air tight with gaskets sealant tape or combination thereof. Longitudinal seams unsealed.
  - .4 Unsealed seams and joints.

## **2.2 SEALANT**

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

## **2.3 TAPE**

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

## **2.4 DUCT LEAKAGE**

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

## **2.5 FITTINGS**

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
- .1 Rectangular: standard radius short radius with single thickness turning vanes centreline radius: 1.5 times width of duct .
  - .2 Round: smooth radius five piece, centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
- .1 To 400 mm: with single double thickness turning vanes.
  - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
- .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45 degrees entry on branch.
  - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
  - .3 Provide volume control damper in branch duct near connection to main duct.
  - .4 Main duct branches: with splitter damper.

- .5 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
  - .1 Full Short radiused elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
  - .1 Maximum included angles: as for transitions.

## **2.6 FIRE STOPPING**

- .1 Retaining angles around duct, on both sides of fire separation.
- .2 Fire stopping material and installation must not distort duct.

## **2.9 ALUMINUM**

- .1 To ASHRAE and SMACNA. Aluminum type: 3003-H-14.
- .2 Thickness, fabrication and reinforcement: to ASHRAE SMACNA as indicated.
- .3 Joints: to ASHRAE SMACNA be continuous weld.

## **2.12 HANGERS AND SUPPORTS**

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
    - .1 Maximum size duct supported by strap hanger: 500.
  - .2 Hanger configuration: to ASHRAE and SMACNA.
  - .3 Hangers: black galvanized steel angle with black galvanized steel rods to ASHRAE and SMACNA following table:

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

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

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of 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 GENERAL**

- .1 Do work in accordance with NFPA 90A NFPA 90B ASHRAE SMACNA as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Insulate strap hangers 100 mm beyond insulated duct Ensure diffuser is fully seated.
- .3 Support risers in accordance with ASHRAE SMACNA as indicated.
- .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.

### **3.3 HANGERS**

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

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

### **3.4 WATERTIGHT DUCT**

- .1 Provide watertight duct for:
  - .1 Fresh air intake.



- .2 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
  - .1 Solder Weld joints of bottom and side sheets.
  - .2 Seal other joints with duct sealer.
- .3 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and valve trap primer and discharging to open funnel drain as indicated.

### **3.5 SEALING AND TAPING**

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

### **3.6 LEAKAGE TESTS**

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Do leakage tests in sections.
- .3 Make trial leakage tests as instructed to demonstrate workmanship.
- .4 Do not install additional ductwork until trial test has been passed.
- .5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .6 Complete test before performance insulation or concealment Work.

### **3.7 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.

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Management and Disposal.

### **1.2 REFERENCES**

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

### **1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
  - .1 Flexible connections.
  - .2 Duct access doors.

### **1.4 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.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

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

### **2.2 FLEXIBLE CONNECTIONS**

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

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

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet
-

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

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Flexible connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100 mm.
  - .3 Minimum distance between metal parts when system in operation: 75 mm.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access doors and viewing panels:
  - .1 Size:
    - .1 609x609 mm for person size entry.
    - .2 457x457 mm for servicing entry.
    - .3 300x300 mm for viewing.
    - .4 As indicated.
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.

.5      Elsewhere as indicated.

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

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

### **1.2 PRODUCT DATA**

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

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Manufacture to SMACNA standards.

### **2.2 SINGLE BLADE DAMPERS**

- .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

### **2.3 MULTI-BLADED DAMPERS**

- .1 Factory manufactured of material compatible with duct.
  - .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
  - .3 Maximum blade height: 100 mm.
  - .4 Bearings: self-lubricating nylon.
  - .5 Linkage: shaft extension with locking quadrant.
  - .6 Channel frame of same material as adjacent duct, complete with angle stop.
  - .7 Maximum leakage: 4% AT 500 Pa
-

### **PART 3 - EXECUTION**

#### **3.1      INSTALLATION**

- .1      Install where indicated.
- .2      Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3      For supply, return and exhaust systems, locate balancing dampers in each branch duct.
- .4      Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5      All dampers to be vibration free.
- .6      Ensure damper operators are observable and accessible.

## **PART 1 – GENERAL**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 653/A 653M-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 Material Safety Data Sheets (MSDS).
- .3 American National Standards Institute (ANSI)
  - .1 ANSI/AMCA Standard 500-D-07, Laboratory Methods of Testing Dampers for Rating.

### **1.2 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate the following:
    - .1 Performance data.
    - .2 Leakage.
    - .3 Pressure drop.
    - .4 Torque required.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **PART 2 - PRODUCTS**

### **2.2 MULTI-LEAF DAMPERS**

- .1 Opposed for modulating service and parallel blade type for isolating.
  - .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals,
-

- spring stainless steel side seals, structurally formed and welded galvanized steel frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Performance:
  - .1 Leakage: in closed position less than 2% of rated air flow at 1000 Pa differential across damper.
  - .2 Pressure drop: at full open position less than 25 Pa differential across damper at 5 m/s.
- .6 Insulated aluminum dampers for all fresh air and exhaust air applications:
  - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
  - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

### **PART 3 – EXECUTION**

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

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

#### **3.2 INSTALLATION**

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

#### **3.3 CLEANING**

- .1 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.

## **PART 1 – GENERAL**

### **1.1 REFERENCES**

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  - .1 NFPA 80-2010, Standard for Fire Doors and Other Opening Protectives.
- .2 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S112-90 (R2001), Fire Test of Fire Damper Assemblies.
  - .2 CAN/ULC-S112.2-07, Fire Test of Ceiling Firestop Flap Assemblies.
  - .3 ULC-S505, Fusible Links for Fire Protection Service.

### **1.2 PRODUCT DATA**

- .1 Submit product data 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 Design details of break-away joints.

### **1.3 CLOSEOUT SUBMITTALS**

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

### **1.4 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Procedures.
- .2 Provide following:
  - .1 1 fusible links of each type.

### **1.5 CERTIFICATION OF RATINGS**

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

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## **PART 2 – PRODUCTS**

### **2.1 FIRE DAMPERS**

- .1 Fire dampers: arrangement Type B, listed and bear label of ULC UL Warnock Hersey and ANSI/NFPA 80. Fire damper assemblies to be fire tested in accordance with CAN/ULC-S112-90 (R2001).
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
  - .1 Ratings to match fire rated separation.
  - .2 Dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset, round or square; multi-blade hinged or interlocking type; 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.
- .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 Acceptable material: Controlled Air, Nailor, Ruskin, NCA.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install in accordance with NFPA 80-2010 and in accordance with conditions of ULC listing.
  - .2 Maintain integrity of fire separation.
  - .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
  - .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
  - .5 Coordinate with installer of firestopping.
  - .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
  - .7 Install break-away joints of approved design on each side of fire separation.
-

- .8 Dampers shall be installed with its centerline located in the centerline of the fire separation depth or thickness.
- .9 Testing in accordance with NFPA 80-2-10, to be performed by Departmental Representative.

## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 - Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .2 Transportation of Dangerous Goods Act, 2008 (TDGA), c. 34.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA).
  - .1 NFPA 90A-09, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B-09, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005, 3rd Edition.
  - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2007, 2nd Edition.
- .6 Underwriters' Laboratories Inc. (UL).
  - .1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
- .7 Underwriters' Laboratories of Canada (ULC).
  - .1 CAN/ULC-S110-07, Fire Tests for Air Ducts.

### **1.3 SUBMITTALS**

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

### **1.4 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.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

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

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

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Factory fabricated to CAN/ULC-S110-07.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

### **2.2 METALLIC - INSULATED**

- .1 Type 1: spiral wound flexible aluminum.
- .2 Performance:
  - .1 Factory tested to 2.5 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.
  - .3 Minimum 25mm thick mineral wool or fibreglass insulation complete with vapour barrier and jacket.

## **PART 3 - EXECUTION**

### **3.1 DUCT INSTALLATION**

- .1 Install in accordance with: CAN/ULC-S110-07, UL-181, NFPA 90A, NFPA 90B, SMACNA and the requirements of the jurisdictional authority.
- .2 Maximum length of flexible ducting is 2.4m.

## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 - Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM).
    - .1 ASTM C 423-09, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
    - .2 ASTM C 916-85(2007), Standard Specification for Adhesives for Duct Thermal Insulation.
    - .3 ASTM C 1071-05e1, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
    - .4 ASTM C 1338-08, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .2 Department of Justice Canada (Jus).
    - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).
  - .4 National Fire Protection Association (NFPA).
    - .1 NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.
    - .2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
  - .5 North American Insulation Manufacturers Association (NAIMA).
    - .1 NAIMA AH116-5th Edition, Fibrous Glass Duct Construction Standards.
  - .6 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
    - .1 SMACNA, HVAC DCS, HVAC, Duct Construction Standards, Metal and Flexible-95 (Addendum No.1, Nov. 97).
    - .2 SMACNA IAQ Guideline for Occupied Buildings 95.
  - .7 Transport Canada (TC).
    - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
  - .8 Underwriter's Laboratories of Canada (ULC).
    - .1 CAN/ULC-S102-03-EN, Methods of Test for Surface Burning
-

Characteristics of Building Materials and Assemblies.

**1.3 SUBMITTALS**

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

**1.4 DELIVERY, STORAGE AND HANDLING**

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

**PART 2 - PRODUCTS**

**2.1 DUCT LINER**

- .1 General:
  - .1 Mineral Fibre duct liner: air surface coated mat facing.
  - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102 and NFPA 90A.
  - .3 Recycled Content: EcoLogo certified with minimum 35 % by weight recycled content.
  - .4 Fungi resistance: to ASTM C 1338 ASTM G 21.
- .2 Rigid:
  - .1 Use on flat surfaces where indicated.
  - .2 25 mm thick, to ASTM C 1071, Type 2, fibrous glass rigid board duct liner.
  - .3 Density: 48 kg/m<sup>3</sup> minimum.
  - .4 Thermal resistance to be minimum 0.76 (m<sup>2</sup>. degrees C)/W for 25 mm thickness when tested in accordance with ASTM C 177, at 24 degrees C mean temperature.
  - .5 Maximum velocity on faced air side: 20.3 m/sec.
  - .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C 423.
  - .7 Recycled Content: EcoLogo certified containing minimum 45 % by weight recycled content.

**2.2 ADHESIVE**

- .1 Adhesive: to NFPA 90A and NFPA 90B, ASTM C 916.
  - .2 Flame spread rating shall not to exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.
  - .3 Water-based fire retardant type.
-



### **2.3 FASTENERS**

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

### **2.4 JOINT TAPE**

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

### **2.5 SEALER**

- .1 Meet requirements of NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

## **PART 3 – EXECUTION**

### **3.1 GENERAL**

- .1 Do work in accordance with SMACNA HVAC DCS except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

### **3.2 DUCT LINER**

- .1 Install in accordance with manufacturer's recommendations, and as follows:
  - .1 Fasten to interior sheet metal surface with 90% coverage of adhesive to ASTM C 916
    - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
  - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.
    - .1 Spacing of mechanical fasteners in accordance with SMAC HVAC DCS.

- .2 In systems, where air velocities exceeds 20.3 m/sec, install galvanized sheet metal nosing to leading edges of duct liner.

### **3.3 JOINTS**

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
  - .1 Bed tape in sealer.
  - .2 Apply two coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Departmental Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 21 - Construction/Demolition Management and Disposal.
- .2 Section 23 33 03 - Air Duct Accessories.

### **1.2 REFERENCES**

- .1 AMCA 99, Standards Handbook.
- .2 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Rating.
- .3 AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
- .4 AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 ANSI/ASHRAE 51-2007/AMCA 210-07, Laboratory Methods of Testing Fans for Rating.

### **1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide:
  - .1 Fan performance curves showing point of operation, BHP, kW and efficiency.
  - .2 Sound rating data at point of operation.
- .3 Indicate:
  - .1 Motors, sheaves, bearings, shaft details
  - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.

### **1.4 CLOSEOUT SUBMITTALS**

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

### **1.5 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout
-

Procedures.

- .1 Spare parts to include:
  - .1 Matched sets of belts.
- .2 Furnish 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.

## **1.6 MANUFACTURED ITEMS**

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

## **PART 2 – PRODUCTS**

### **2.1 FANS GENERAL**

- .1 Capacity: flow rate, total static pressure, W, efficiency, revolutions per minute, power, model, size, and sound power data as indicated on schedule.
  - .2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
  - .3 Sound ratings: comply with AMCA 301-06, tested to AMCA 300-08. Unit shall bear AMCA certified sound rating seal.
  - .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210-07, and ANSI/ASHRAE 51-2007/AMCA 210-07. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
  - .5 Motors:
    - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
    - .2 Sizes as indicated.
    - .3 Motors to be electronically controlled DC motors.
  - .6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards. Fan inlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
  - .7 Factory primed before assembly in colour standard to manufacturer.
-

- .8 Scroll casing drains: as indicated.
- .9 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .10 Flexible connections: to Section 23 33 03 - Air Duct Accessories.

## **2.2 IN-LINE CENTRIFUGAL FANS**

- .1 Fan wheels: Characteristics and construction:
  - .1 Welded steel construction.
  - .2 Maximum operating speed of centrifugal fans not more than 40% of first critical speed.
  - .3 Forward curved blades.
- .2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.
- .3 Bearings: split pillow-block flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 hours.
- .4 Housings:
  - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, 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 bolted airtight access doors with handles.
- .5 Acceptable material: Trane, York, Greenheck, Woods, Penn, Cook.

## **PART 3 – EXECUTION**

### **3.1 FAN INSTALLATION**

- .1 Provide sheaves and belts required for final air balance.
  - .2 Bearings and extension tubes to be easily accessible.
  - .3 Access doors and access panels to be easily accessible.
  - .4 Size anchor bolts to withstand seismic acceleration and velocity forces.
-

- .5 Arrange connecting duct work to follow manufacturer's recommendation regarding proper air flow patterns entering and exiting unit to avoid system fan effects.

## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Management and Disposal.
- .3 Section 01 78 00 - Closeout Procedures.

### **1.2 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
  - .1 Capacity.
  - .2 Throw and terminal velocity.
  - .3 Noise criteria.
  - .4 Pressure drop.
  - .5 Neck velocity.

### **1.3 SAMPLES**

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

### **1.4 CERTIFICATIONS**

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing, agency signifying adherence to codes and standards.

### **1.5 EXTRA MATERIALS**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Procedures.
  - .2 Include:
    - .1 Keys for volume control adjustment.
    - .2 Keys for air flow pattern adjustment.
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## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
  - .1 Full perimeter gaskets.
  - .2 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: standard.
- .5 Acceptable material: EH Price, Nailor, Titus.

### **2.2 MANUFACTURED UNITS**

- .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

### **2.3 RETURN AND EXHAUST GRILLES AND REGISTERS**

- .1 General: with opposed blade dampers.
- .2 Aluminum, 19mm border, aluminum eggcrate. Finish: aluminum based enamel finish.
- .3 Specific size and type: as indicated.

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

- .1 General: with opposed blade dampers.
- .2 Aluminum, 19 mm border, double deflection with airfoil shape, horizontal face and vertical rear bars. Finish B12 white powder coat.

### **2.5 DIFFUSERS**

- .1 General: volume control dampers with flow straightening devices and blank-off quadrants and gaskets.
-



- .3 Steel, round type, having fixed pattern, duct mounted. Finish: white enamel finish.
- .4 Specific size and type: as indicated.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with flat head stainless steel screws in countersunk holes where fastenings are visible.
- .3 Provide seismic restraints on suspended ceiling components.

## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Management and Disposal.

### **1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
  - .1 ANSI/NFPA 96-08, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM E 90-09, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .4 Society of Automotive Engineers (SAE)

### **1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
  - .1 Pressure drop.
  - .2 Face area.
  - .3 Free area.

### **1.4 TEST REPORTS**

- .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90-09.

### **1.5 CERTIFICATION OF RATINGS**

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.
-

## **PART 2 – PRODUCTS**

### **2.1 FIXED LOUVRES - ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Performance and Size: as indicated.
- .3 Material: extruded aluminum alloy 6063-T5.
- .4 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .5 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .6 Mullions: at 1500 mm maximum centres.
- .7 Fastenings: stainless steel (Society of Automotive Engineers) 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.
- .8 Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diam wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .9 Finish: factory applied enamel.
- .10 Acceptable material:
  - .1 Aerolite K6776.
  - .2 Ruskin.
  - .3 Ventex.

## **PART 3 – EXECUTION**

### **3.1 INSTALLATION**

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.
- .4 Louvre flange to fit in throat of curtainwall assembly as indicated on the drawings. Contractor to coordinate.

## **PAGE 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.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.46-M1988, Electric Air-Heaters.

### **1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for duct heaters. Include:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Mounting methods.
  - .4 Physical size.
  - .5 kW rating, voltage, phase.
  - .6 Limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS acceptable to Labour Canada, and Health Canada.
- .4 Submit product data sheets for unit heaters.
  - .1 Include product characteristics, performance criteria, physical size, limitations and finish.
- .5 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

### **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.
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## **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 Waste Reduction Workplan.

## **PART 2 - PRODUCTS**

### **1.2 ELECTRIC DUCT HEATERS**

- .1 Modulating duct heater complete with adjustable temperature control.
  - .1 Coils: High grade nickel-chrome alloy, insulated from galvanized steel frame by floating ceramic bushings. Coil terminal pins to be stainless steel, insulated by non-rotating ceramic bushings.
  - .2 Slip-in type heater, suitable for insertion into duct through an opening on the side. Heater will come complete with flange for securing it to the duct. Mounting flange shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.
  - .3 Heaters to be complete with fail safe, automatic reset disc-type thermal cut-outs as required by CSA.
  - .4 Duct heater shall be complete with a built-in disconnect to switch power off at the unit.
  - .5 Duct heaters shall be complete with magnetic contactors, 24 volt transformer, airflow sensor, duct thermostat, SCR control, load fuses, solid state relays, pilot lights and protective screens required to provide a consistent air temperature output.
  - .6 Cut-outs shall be shielded from accidental impact and shall de-energize the heater in case of insufficient airflow.
  - .7 Capacities and sizes as indicated on drawings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install heaters in ductwork, as indicated.
  - .2 Make power and control connections.
-

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 84-1991, Method of Testing Air-to-Air Heat Exchangers (ANSI approved).
- .2 Air Conditioning and Refrigeration Institute (ARI)
  - .1 ARI-1060-2005 Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Heat Equipment.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 SUBMITTALS**

- .1 Product Data:
    - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
      - .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.
      - .1 Indicate following: efficiencies, pressure loss, performance dimensional drawings, weights, field wiring diagrams.
      - .2 For Reverse Flow Energy Recovery Equipment: Submit detailed verification of energy recovery performance showing variation of efficiency over entire damper cycle. Statement of energy efficiency must include test results utilizing consistent temperature condition consistent with design values indicated and must be stamped by a professional engineer licensed to practice in Canada.
  - .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Certificates: submit certificates signed by manufacturer certifying that
-

- materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation i.to manual specified in Section 01 78 00 - Closeout Submittals
- .5 Certificates:
  - .1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
  - .2 Provide confirmation of testing.

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

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

#### **1.5 MAINTENANCE**

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

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- .1 Comply with ASHRAE 84.
  - .2 Energy recovery components included in packaged air handling units shall also conform to requirements.
-



## **2.2 ENERGY RECOVERY VENTILATOR**

- .1 General: packaged air-to-air energy recovery ventilator complete with fans, controllers, filters, sensors, and controls and factory wiring.
  - .2 Casing: 20 gauges galvanized steel. Foil faced insulating liner. Flanged connections for ductwork.
  - .3 Heat transfer surfaces: hydroscopic resin plates edge sealed and bonded to casing. Energy recovery core to allow both sensible and latent energy transfer. Core not to exceed 25/50 flame and smoke spread per NFPA 90 A and B.
  - .4 Cross contamination: not permitted.
  - .5 No condensation shall be generated during operation down to -23°C. For colder temperatures the unit shall prevent frosting or condensation build-up through automatic intermittent fan operation. Recirculation of air is not an acceptable frost control method.
  - .6 Removable access panels.
  - .7 Filtration: MERV 8 rated, 50 mm pleated disposable on both air streams. Provide dial type filter gauges on both filter sections.
  - .8 Accessories:
    - .1 Individual contactors to allow independent operation of supply and exhaust fans for frost protection control.
    - .2 Provide sensors for frost detection and integral frost controller. Provide contacts for the following:
      - .1 On/Off Control
    - .3 Configured for single point power connection.
    - .4 Non-fused disconnect.
  - .9 Fans: belt driven with adjustable sheaves for volume control.
  - .10 Performance characteristics: as indicated.
  - .11 Provide gasketted motorized shut-off dampers on supply and return air inlets interlocked to supply fan and return fan respectively. Dampers to close tight on unit shut down. Damper wiring and power to be integral to unit.
  - .12 Provide wall mounted control for unit.
  - .13 Acceptable material: Renew Aire, Lossnay, Venmar, Van-EEE.
-

### **PART 3 - EXECUTION**

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

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

#### **3.2 INSTALLATION**

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

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

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

#### **3.4 CLEANING**

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