

PART 1 - GENERAL

1.1 Use of Systems

- .1 Use of new permanent ventilating systems for supplying of temporary heat or ventilation is permitted only under the following conditions:
  - .1 Entire system is complete, pressure tested, cleaned, and flushed out.
  - .2 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .3 There is no possibility of damage from any cause.
  - .4 Supply ventilation systems are protected by 30% and 95% filters, which shall be inspected daily, changed periodically such that recommended filter pressure drop is not exceeded.
  - .5 Exhaust systems have approved filters over all openings, inlets, outlets.
  - .6 All systems will be:
    - .1 Operated as per manufacturer's recommendations or instructions.
    - .2 Operated by the Contractor.
    - .3 Monitored continuously by the Contractor.
  - .7 Warranties and guarantees are not thereby relaxed.
  - .8 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
  - .9 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, with filters in air systems replaced.
  - .10 Permission from the Departmental Representative must be obtained.
  - .11 Filters referred to herein are over and above those specified

- elsewhere in this specification.  
.12 Exhaust systems are not included in  
any approvals for temporary  
heating and/or ventilation.

END OF SECTION

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PART 1 - GENERAL

1.1 Related Sections

- .1 Section 01 74 21 - Construction / Demolition Waste Management and Disposal.
- .2 Section 01 74 11 - Cleaning.
- .3 Section 07 84 00 - Firestopping.
- .4 Section 21 05 01 - Mechanical General Requirements.

1.2 References

- .1 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .2 National Plumbing Code of Canada - 2015.
- .3 National Building Code of Canada - 2015.

1.3 Scope of Work

- .1 This section applies to installation of piping for each of the following systems:
  - .1 Sanitary drainage and Vent Pipe.
  - .2 Domestic Hot Water, Cold Water, and Recirculation Water.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 Connections  
to Equipment

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions, flanges, or mechanical couplings for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when

piping subject to movement.

### 3.2 Clearances

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

### 3.3 Drains

- .1 Install drain valve at low points in piping systems, at equipment and so that each section of piping can be drained. Slope piping in direction of flow. Locations of drain valves shall be indicated on the As-Built/Record drawings.
- .2 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .3 Drain valves: 19mm gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

### 3.4 Air Vents

- .1 Install automatic air vents at high points in piping systems. Locations shall be indicated on the As-Built/Record drawings.
- .2 Install isolating valve at each automatic air vent. Locations shall be indicated on the As-Built/Record drawings.
- .3 Install drain piping to approved location and terminate where discharge is visible.

### 3.5 Di-Electric Couplings

- .1 General: Compatible with system, to suit pressure rating of system.

- .2 Locations: Where dissimilar metals are joined.
- .3 50mm and under: isolating unions or bronze valves.
- .4 Over 50mm: Isolating flanges.

### 3.6 Pipework Installation

- .1 Screwed fittings to be jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install so that equipment can be isolated and removed without interruption to operation of any other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of the main. Hole saw (or drill) and ream main so as to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.
- .9 Except where indicated, install so as to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly. Copper fittings soldered as specified.

- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated and specified.
- .14 Install copper pipe/tube so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
- .15 Clean all excess flux and solder from joints.
- .16 Piping of pot feeders to use cross tees with screwed plugs to facilitate cleaning in lieu of elbows at changes of direction.

### 3.7 Valves

- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.
- .3 Install with stems above the horizontal position unless otherwise indicated.
- .4 Valves to be accessible for maintenance without removing adjacent piping.
- .5 Install globe valves in bypass around control valves.
- .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified. Provide isolation valves at all branch take-offs from mains, and at each take-off from risers on each floor.
- .7 Check Valves:
  - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.

### 3.8 Sleeves

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors - to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6.4mm minimum clearance all round between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
  - .1 Concrete, masonry walls: Terminate flush with finished surface.
  - .2 Other floors: Terminate 25mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 Provide space for firestopping. Maintain fire rating integrity.
  - .2 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
  - .3 Ensure no contact between copper pipe or tube and sleeve.

### 3.9 Escutcheons

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

### 3.10 Preparation for Firestopping

- .1 Material and installation within annular space between pipes, ducts, insulation

and adjacent fire separation to Section 07 84 00 - Firestopping.

- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

### 3.11 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 23.
- .3 Maintain specified test pressure without loss for four (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 the Departmental Representative.
- .6 Bear 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.

END OF SECTION

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PART 1 - GENERAL

1.1 Reference

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
  - .1 ASHRAE 90.1(latest edition), Energy Code for Buildings Except Low-Rise Residential Buildings.

1.2 Electrical

- .1 Electrical work to conform to Division 26 including the following:
  - .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedules on mechanical drawings.

PART 2 - PRODUCTS

2.1 General

- .1 Motors to be premium efficiency, in accordance with the requirements of ASHRAE 90.1.
- .2 Motors connected to variable frequency drives shall be rated for such service.

2.2 Motors

- .1 Provide motors for mechanical equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

- .4 Motors 373 Wand larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise shall be 40 Deg. C, 3 phase, 575 V, unless otherwise specified or indicated.

### 2.3 Belt Drives

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets; high efficiency notch design. Motors greater than 1.49 kW shall feature minimum two belts.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.46 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 to be determined during commissioning.
- .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.
- .7 Supply one set of spare belts for each belt-driven piece of equipment installed.

### 2.4 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 38mm 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, 19mm 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 Installation

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

END OF SECTION



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PART 1 - GENERAL

1.1 References

- .1 American Society of Mechanical Engineers (ASME):
  - .1 ASME B40.1, Gauges Pressure Indicating Dial Type-Elastic Element.
- .2 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self-Indicating, Commercial/Industrial Type.
  - .2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.2 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit manufacturer's product data for following items:
  - .1 Thermometers.
  - .2 Pressure gauges.

PART 2 - PRODUCTS

2.1 General

- .1 Operating point to be at mid-point of scale or range.

2.2 Direct Reading Thermometers

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB 14.4.

2.3 Pressure Gauges

- .1 114mm, dial type: to ASME B40.1, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.

- .2 All gauges to be complete with a bronze stop/gauge cock.
- .3 Gauge to be liquid filled.
- .4 Provide snubbers for pulsating operation.

### PART 3 - EXECUTION

#### 3.1 General

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

#### 3.2 Thermometers

- .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
  - .1 Inlet and outlet to domestic water heater.
  - .2 Where indicated on the plans.
- .3 Use extensions where thermometers are installed through insulation.

#### 3.3 Pressure Gauges

- .1 Install in locations as indicated and in the following locations:
  - .1 Suction and discharge of pumps.
  - .2 Upstream and downstream of PRV's.
  - .3 Inlet and outlet of domestic water heater.
  - .4 Where indicated on the plans.
- .2 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

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PART 1 - GENERAL

1.1 Related Sections

- .1 Section 03 30 00 - Cast in Place Concrete.
- .2 Section 05 50 00 - Metal Fabrications.
- .3 Section 23 05 01 - Installation of Pipework.
- .4 Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.

1.2 References

- .1 American National Standards Institute/  
American Society of Mechanical Engineers  
(ANSI/ASME):
  - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .2 American Society for Testing and  
Materials (ASTM):
  - .1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 4.1 MPa Tensile Strength.
  - .3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society  
of the Valves and Fittings Industry  
(MSS):
  - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP-69, Pipe Hangers and Supports - Erection and Application.
  - .3 MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation.

1.3 Design Requirements

- .1 Construct pipe hanger and support utilizing manufacturer's regular production components, parts and assemblies.

- .2 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .3 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.
- .3 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.
- .4 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

#### 1.4 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures and Section 21 05 01 - Mechanical General Requirements.
- .2 Submit shop drawings and product data for following items:
  - .1 All 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 Submittals.

### PART 2 - PRODUCTS

#### 2.1 General

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58.
- .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 used outside the building: galvanized after manufacture with hot dipped galvanizing process.
  - .2 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
  - .3 Apply to hangers, supports and equipment fabricated from ferrous metals at least one (1) coat of corrosion resistant paint before shipment to job site. Touch-up damaged finish surfaces to satisfaction of the Departmental Representative.
- .2 Upper attachment structural: Suspension from lower flange of I-Beam.
  - .1 Cold piping 50mm maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut.
    - .1 Rod: 13mm FM approved.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
  - .1 Cold piping 50mm 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.
- .4 Upper attachment to concrete.
  - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6.4mm minimum greater than rod diameter.
- .5 Hanger rods: threaded rod material to MSS SP-58.
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Use 16mm hanger rod for 100mm dia. piping, and 9.5mm hanger rod for

smaller piping.

- .6 Pipe attachments: material to MSS SP-58.
  - .1 Attachments for steel piping: carbon steel black.
  - .2 Attachments for copper piping: copper plated or epoxy coated black steel.
  - .3 Attachments for cold water pipes: oversize to accommodate insulation thickness.
- .7 Adjustable clevis: material to MSS SP-69 UL listed, 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 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.
- .9 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A 563.
  - .1 Finishes for steel pipework: black.
  - .2 Finishes for copper or aluminum pipework: black, with formed portion plastic coated, epoxy coated.
- .10 Wall brackets: carbon steel prime coated.

### 2.3 Riser Clamps

- .1 Steel or cast iron pipe: black carbon steel to MSS-SP-58, type 42, ULC listed.
- .2 Copper pipe: carbon steel copper plated to MSS-SP-58, type 42 or epoxy coated.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

### 2.4 Insulation Protection Shields

- .1 Insulated cold piping:
  - .1 4 lb/ft<sup>3</sup> density insulation plus insulation protection shield to:

MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 10 ft. span.

- .2 Insulated hot piping:
  - .1 Curved plate 305mm long, with edges turned up, welded-in centre plate for pipe sizes 305mm dia. and over, carbon steel to comply with MSS SP-69.

## 2.5 Constant Support Spring Hangers

- .1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

## 2.6 Variable Support Spring Hangers

- .1 Vertical movement: 13mm minimum, 50mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger to be complete

with factory calibrated travel stops.

- .4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

### 2.7 Equipment Supports

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel; prime coated after construction/erection. Submit structural calculations with shop drawings.

### 2.8 Equipment Anchor Bolts and Templates

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

### 2.9 Concrete Housekeeping Pads

- .1 For base-mounted equipment: Concrete, at least 100mm high, 100mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: to Section 03 30 00 - Cast in place Concrete.

## PART 3 - EXECUTION

### 3.1 Installation

- .1 Install in accordance with Manufacturer's instructions and recommendations.
- .2 All pipes shall be hung securely from structure.
- .3 Vibration Control Devices:
  - .1 Install on piping systems as indicated and at pumps and fans.
- .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

- .3 Steel pipes: Install below industry standards.
- .4 Cast iron pipes: Install below coupling or shear lugs welded to pipe.
- .4 Cast iron pipes: Install below joint.
- .5 Clevis plates:
  - .1 Attach to concrete with four 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.

3.2 Hanger Spacing

- .1 Hangers shall be spaced as far apart as technically possible. Maximum spacing shall be as follows:

Material/Service	Pipe Size (mm)	Maximum Spacing (mm)
Cast Iron	All Sizes	At or adjacent to each hub or joint, at 3.0m and at 1000mm if the pipe has mechanical joints and the length of pipe between adjacent fittings is 305mm or less.
Horizontal storm, sanitary sewer pipes	All Sizes	1500mm
Hard Temper Copper	Less than 32mm	2100mm
	32mm and larger	3000mm
Soft Temper Copper	All Sizes	2400mm
Copper Water Pipe	Up to 13mm	1500mm

- .2 Vertical sanitary pipes shall be supported at each floor by means of iron hooks or straps placed directly below hub or fittings. Maximum distance between vertical pipe hangers to be 15.2m. Vertical drops to fixture shall be supported at top of riser to prevent

strain on fixture connection.

### 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 100mm from vertical.
- .2 Where horizontal pipe movement is less than 13mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### 3.5 Final Adjustment

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

3.6 Concrete  
Housekeeping Pads

- .1 The following equipment to be mounted on 100mm high, 100mm larger (all around) concrete housekeeping pads (pads are provided by others):
  - .1 Domestic hot water heater tank.
  - .2 Other equipment as detailed on the drawings.
  
- .2 Co-ordinate sizes of equipment pads with the General Contractor.

END OF SECTION



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PART 1 - GENERAL

1.1 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide separate shop drawings for each isolated system complete with performance and product data.

PART 2 - PRODUCTS

2.1 General

- .1 Size and shape of bases type and performance of vibration isolation to be as indicated.

2.2 Elastomeric Pads

- .1 Type EP1 - neoprene waffle or ribbed; 10 mm minimum thick; 50 durometer; maximum loading 345 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 10 mm minimum thick; 30 durometer natural rubber; maximum loading 413 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 10 mm minimum thick neoprene bonded to 1.7 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 345 kPa.
- .4 Type EP4 - rubber-steel-rubber; 10 mm minimum thick rubber bonded to 1.7 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 413 kPa.

2.3 Elastomeric Mounts

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

## 2.4 Springs

- .1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.
- .3 Cadmium plate for outdoor installations.
- .4 Colour code springs.

## 2.5 Spring Mount

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6.4mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6.4mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6.4mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 900 kg maximum.

## 2.6 Hangers

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact,

25mm static deflection.

- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

## 2.7 Horizontal Thrust Restraint

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 13mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centreline of thrust.

## PART 3 - EXECUTION

### 3.1 Installation

- .1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with

25mm minimum static deflection as follows:

- .1 Up to 100mm dia.: first 3 points of support. 125mm to 200mm: first 4 points of support.
- .2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50mm.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

END OF SECTION

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PART 1 - GENERAL

1.1 Related Sections

- .1 Section 09 91 23 - Painting.
- .2 Section 10 44 20 - Fire Extinguishers.
- .3 Section 25 05 54 - EMCS Identification.
- .4 Section 21 05 01 - Mechanical General Requirements.
- .5 Section 21 07 20 - Thermal Insulation for Piping.
- .6 Section 23 07 13 - Thermal Insulation for Ducting.
- .7 Section 21 07 18 - Thermal Insulation for Equipment.
- .8 Section 23 05 01 - Installation of Pipework.

1.2 References

- .1 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .1 CAN/CGSB-24.3, Identification of Piping Systems.
- .2 National Fire Protection Association:
  - .1 NFPA 10 - 2013, Portable Extinguishers

1.3 Product Data

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include paint colour chips, all other products specified in this section.

1.4 Samples

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

PART 2 - PRODUCTS

2.1 Manufacturer's  
Equipment Nameplates

- .1 Metal nameplate with raised or recessed letters mechanically fastened to each piece of equipment by manufacturer.
- .2 Information to include, as appropriate:
  - .1 Equipment: Manufacturer's name, model, size, serial number, capacity, registration plates where specified or required (e.g. pressure vessel, ULC, CSA).
  - .2 Motor: voltage, Hz, phase, power, power factor, duty, frame size, rpm.

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 3.2mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

Size #	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	9.5 x 50	1	3.2
2	13 x 75	1	6.4
3	13 x 75	2	3.2
4	19 x 100	1	8.5
5	19 x 100	2	6.4
6	19 x 200	1	8.5
7	25 x 125	1	13
8	25 x 125	2	8.5
9	38 x 200	1	19

- .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 Fire Extinguishers: To NFPA 10.

### 2.4 Identification of Piping Systems

- .1 Identify contents by background colour marking, stencils, and/or pictogram (as necessary) showing name and service including temperature and pressure and directional flow arrows where relevant. To CAN/CGSB 24.3 except where specified otherwise.
- .2 On PVC jacket, use the following material:
  - .1 Legend Markers, Arrows and Colour Bands: Pressure sensitive plastic coated cloth vinyl with protective overcoating and waterproof contact adhesive undercoating, suitable for 100% RH and continuous operating temperature of 149°C and intermittent temperature of 204°C. Apply to dry, clean prepared surfaces. Wrap 25mm colour band around pipe or pipe covering with ends overlapping one pipe diameter.
  - .2 Waterproof and Heat Resistant Pressure Sensitive Plastic Marker Tags: for pipes and tubing 19 mm dia. nominal and smaller.
- .3 Stencilled Identification:
  - .1 As an alternate to manufactured pipe markers identification may be stencilled on pipe except PVC piping using a first quality oil base paint and colour bands. Letters shall be a minimum of 19mm high. Text to be black.

- .4 Identification of pipe to include Pictograms where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.
- .5 Use block capital letters 50 mm high for pipes of 75 mm nominal and larger o.d. including insulation and not less than 19 mm high for smaller diameters.
- .6 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.
- .7 Background colour marking to be full circumference of pipe or insulation, length to accommodate pictogram, full length of legend and arrows.
- .8 Colours and Legends:
  - .1 Where not listed, obtain direction from the Consultant.
  - .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	Legend Marking
Domestic hot water Supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic Cold Water Supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Control Systems	See section 25 05 54 - EMCS Identification	

2.5 Identification of Ductwork Systems

- .1 50mm high stencilled letters and directional arrows 150mm long x 50mm high.

- .2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

## 2.6 Valves, Controllers

- .1 Brass tags with 13mm 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 Fire Extinguishers

- .1 Identify with "Fire Equipment" sign with lettering at least 50mm high.
- .2 Attach bilingual tag or label to each fire extinguisher, indicating month and year of installation. Provide space for service dates.

## 2.8 Controls Components Identification

- .1 See Section 25 05 54 - Control System Identification.

## 2.9 Equipment

- .1 Identify Mechanical equipment (ERV, DHW etc) with black lamicaid plates with white letters attached to equipment. Letters to be a minimum of 19mm high.
- .2 Identification to be visible by an individual standing on the floor.

## 2.10 Above Ceiling Equipment Identification

- .1 Pull and junction boxes for control wiring to be coloured inside and out (red and white).
- .2 Where valves and balancing dampers are installed above accessible ceilings, adhesive discs coloured in accordance with the table below shall be installed on the ceiling spline directly below the

valves and boxes. Discs shall be 19mm diameter, white or black disc to be 1/4" diameter. In no case shall a valve or box be installed in a ceiling space that is not considered accessible unless a proper access hatch is provided by the appropriate Trade Contractor. Discs shall be similarly applied to access hatches.

.3 Provide framed legend of colour coding used and mount in location as directed by the Owner. Include a copy of legend in Maintenance Manuals.

.4 Boxes, valves and dampers shall be colour coded as follows:

Service	Colour of Disc
Plumbing System Valves	Green
Fire Dampers	Dark Blue
Balancing Dampers	Dark Blue
Control Panels/Junction Boxes	Red/White

.5 Use white lamicaid plates with black letters to identify backflow preventer, balancing damper, exhaust fans locations.

.6 Use red lamicaid plates with white lettering to identify fire damper locations.

.7 Lamicaid plates referred to in above two (2) sentences to be attached to T-bar splines with two (2) rivets each.

### 2.11 Language

.1 Identification to be in English.

## PART 3 - EXECUTION

### 3.1 Timing

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

### 3.2 Installation

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

### 3.3 Nameplates

- .1 Locate nameplates in conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Provide standoffs for nameplates on hot and/or insulated surfaces.
- .3 Do not paint, insulate or cover in any way.

### 3.4 Location of Identification on Piping and Ductwork Systems

- .1 On long straight runs in open areas in mechanical rooms and electrical rooms. At not more than 6.0 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping, or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, other confined spaces, at entry and exit points, and at each access opening.
- .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, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points. Position of identification to be 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.

### 3.5 Valves, Controllers

- .1 Valves and operating controllers, except at plumbing fixtures, 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 the Owner. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

END OF SECTION

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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 all other work as specified in this section.
- .2 Submit three copies of air balancing report to Consultant for review. Make changes and re-submit if necessary.

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

1.3 Exceptions

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

1.4 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.

### 1.5 Pre-TAB Review

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

### 1.6 Start-Up

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

### 1.7 Operation of Systems During TAB

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

### 1.8 Start Of TAB

- .1 Notify Departmental Representative seven (7) days prior to start of TAB.
- .2 Start TAB only when building is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weather stripping, sealing, caulking.
  - .3 All pressure, leakage, other tests specified elsewhere Division 15.
  - .4 All provisions for TAB installed and operational.

- .3 Start-up, verification for proper, normal and safe operation of all 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 All outlets installed, volume control dampers open.

#### 1.9 Application Tolerances

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

#### 1.10 Accuracy Tolerances

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

#### 1.11 Instruments

- .1 Prior to TAB, submit to Consultant list of instruments to be used together with make, model and serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within three (3) months of TAB. Provide certificate of calibration to Consultant.

#### 1.12 Submittals

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

different from referenced  
standard.

### 1.13 Preliminary TAB Report

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

### 1.14 TAB Report

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

### 1.15 Verification

- .1 All reported results subject to verification by the Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 10% of all reported results.
- .3 Number and location of verified results to be at discretion of the Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of the Departmental Representative.

### 1.16 Settings

- .1 After TAB is completed to satisfaction of the Departmental Representative,

replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.

- .2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

#### 1.17 Completion of TAB

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

#### 1.18 Air Systems

- .1 Standard: TAB to be to most stringent of TAB standards of AABC, NEBB, SMACNA or ASHRAE.
- .2 Do TAB of all systems, equipment, components and controls specified.
- .3 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, amps, voltage, and noise.
- .4 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
  - .1 Inlet and outlet of each damper, filter, coil, fan, other equipment causing changes in conditions.
  - .2 At each controller, controlled device.
- .5 Locations of systems measurements to include, but not be limited to, following as appropriate: each main duct, main branch, sub-branch, run-out including grilles, registers or diffusers.
- .6 Include room identification for grilles, registers, and diffusers in report.
- .7 Voltage and current measurements for

motors to be reported for each phase for three (3) phase motor systems.

- .8 Permanently mark the final position of the numerous balancing dampers with a permanent ink marker.

#### 1.20 Domestic HW Systems

- .1 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

#### 1.21 Other TAB Requirements

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

#### 1.22 Post-Occupancy TAB

- .1 Participate in systems checks twice during the one year standard Warranty Period - #1 check approximately three months after acceptance and #2 check within one month of termination of Warranty Period.

END OF SECTION

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PART 1 - GENERAL

1.1 General

- .1 Test a minimum of 15m section of supply and exhaust ductwork (i.e. two tests required) including vertical run and horizontal runout to diffuser. Test section to include: transitions, branch connections, joints, and elbows. This test shall be typical for one supply and one exhaust section within the new building.

1.2 Timing

- .1 Ducts to be tested before installation of insulation or any other form of concealments.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, gaskets, etc.

1.3 References

- .1 SMACNA HVAC Air Duct Leakage Test Manual, latest edition.

1.4 Test Procedures

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

1.5 Testing Agency

- .1 Installing Contractor.

### 1.6 Verification

- .1 The Departmental Representative to witness tests and to verify reported results. Submit reports to the Departmental Representative for review.
- .2 To be certified by the same TAB agency approved by the Departmental Representative to undertake TAB on this project.

### 1.7 Test Instruments

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

### 1.8 System Leakage Tolerances

- .1 System leakage tolerances specified herein are stated as a percentage of total flow rate handled by the system. Therefore, when

testing sections of ductwork this acceptable leakage shall be pro-rated to entire system. Leakage for sections of duct systems shall not exceed the total allowable leakage.

- .2 Leakage tests on following systems not to exceed specified leakage rates.
  - .1 Small duct systems up to 250Pa w.c.: Leakage 2%.
  - .2 Large low-pressure duct systems up to 500Pa w.c.: Leakage 2%.
  - .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

#### 1.9 Equipment Leakage Tolerances

- .1 Equipment and system components: Leakage 2%.

#### 1.10 Report Forms

- .1 Submit proposed report form and test report format to the Departmental Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from the Departmental Representative.

#### 1.11 Pressure Test Reports

- .1 Prepare report of results and submit to the Departmental Representative within 48 hours of completion of tests. Include:
  - .1 Schematic of entire system.
  - .2 Schematic of section under test showing test site.
  - .3 Required and achieved static pressures.
  - .4 Orifice differential pressure at test sites.
  - .5 Permissible and actual leakage flow rate (cfm) for test sites.
  - .6 Witnessed certification of results.
- .2 Include test reports in final TAB report.

#### PART 2 - PRODUCTS

Not Used

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BIO Search & Rescue  
Marine Operations Building  
Dartmouth, NS  
Job No. R.096002.001

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PRESSURE TESTING  
OF DUCTED AIR SYSTEMS

Section 23 05 94  
Page 4

PART 3 - EXECUTION

Not Used

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
  - .1 ASHRAE Standard 90.1 latest edition.
- .2 American Society for Testing and Materials (ASTM):
  - .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
  - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C 449M, Standard Specification for Mineral Fibre-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  - .6 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB):
  - .1 CAN/CGSB-51.2, Thermal Insulation, Calcium Silicate, for Piping, Machinery and Boilers.
  - .2 CAN/CGSB-51.9, Mineral Fibre Thermal Insulation for Piping and Round Ducting.
  - .3 CAN/CGSB-51.11, Mineral Fibre Thermal Insulation Blanket.
  - .4 CAN/CGSB-51.12, Cement, Thermal Insulating and Finishing.
  - .5 CAN/CGSB-51.40, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
  - .6 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .7 CGSB 51-GP-53M, Jacketing, Polyvinyl, Chloride Sheet, for

Insulating Pipes, Vessels and  
Round Ducts.

- .4 Underwriters' Laboratories of Canada (ULC):
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .5 National Building Code of Canada - 2015.
- .6 National Plumbing Code of Canada - 2015.
- .7 Model National Energy Code - 2015.
- .8 Manufacturer's Trade Associations:
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

## 1.2 Definitions

- .1 For purposes of this section:
  - .1 A/C - Air Conditioned Air.
  - .2 E/A Exhaust Air.
  - .3 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible, chases and furred-in spaces.
  - .4 EXPOSED" - will mean "not concealed" as defined herein.
  - .5 O/A - Outside Air.
  - .6 R/A - Return Air.
  - .7 S/A - Supply Air.
- .2 TIAC ss:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

## 1.3 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 pipe, fittings, valves and jointing recommendations.

## 1.4 Manufacturer's Instructions

- .1 Manufacturer's installation instructions to be submitted to the Consultant upon request.

- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.5 Delivery,  
Storage and Handling

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather, construction traffic, and against damage from any source.
- .3 Store at temperatures and conditions required by manufacturer.

PART 2 - PRODUCTS

2.1 Fire and  
Smoke Rating

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

2.2 Insulation

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 23.9°C mean temperature when tested in accordance with ASTM C 335.
- .3 Rigid Duct Insulation
  - .1 Rigid duct insulation will be rigid fibre glass board, having a minimum density of 96.2 kg/m<sup>3</sup>.
  - .2 Rigid duct insulation vapour jacket will be factory applied foil-scrim kraft facing consisting of aluminum foil reinforced with fibre glass yarn mesh and laminated to 2.73 kg chemically treated fire resistant kraft.
- .4 Flexible Duct Insulation
  - .1 Flexible duct insulation will be fibre glass formed into a flexible blanket having a nominal density of 12 kg/m<sup>3</sup>.

- .5 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB 51.10, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
- .6 TIAC Code C-2: Mineral fibre blanket to CAN/CGSB-51.11 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
  - .1 Mineral fibre: to CAN/CGSB-51.11.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/CGSB-51.11.

### 2.3 Jackets

- .1 Canvas:
  - .1 227g cotton, plain weave, treated with ULC listed dilute fire retardant lagging adhesive to ASTM C 921.
- .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 Tape: self-adhesive, aluminum, reinforced, 2" wide minimum.
- .4 Contact adhesive: quick-setting.
- .5 Canvas adhesive: washable.
- .6 Stainless steel wire, 1.27mm, Type 304, dead soft annealed.
- .7 Galvanized wire, 1.79mm, annealed.
- .8 Stainless steel mesh, hexagonal mesh, 0.95mm, Type 204.
- .9 Galvanized mesh, hexagonal mesh, 1.79mm, galvanized annealed.
- .10 Aluminum straps, will be 13mm x 0.51mm.
- .11 Stainless steel straps, will be 13mm x

0.51mm, Type 304, dead soft.

- .12 Fasteners: 4.1mm diameter pins with 38mm square clips, length to suit thickness of insulation.

### PART 3 - EXECUTION

#### 3.1 Pre-Installation Requirements

- .1 Pressure testing of ductwork systems to be complete.
- .2 Surfaces to be clean, dry, free from foreign material.

#### 3.2 Installation

- .1 Apply materials in accordance with manufacturer's instructions and this specification.
- .2 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.
- .3 Supports, hangers in accordance with Section 23 05 29.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .4 Install in accordance with TIAC National Standards.
- .5 Fasteners at 305mm intervals in both horizontal and vertical direction, minimum two rows each side.

#### 3.3 Rigid Duct Installation

- .1 Rigid duct insulation with canvas covering and lagging will be used on exposed ducts.
- .2 Insulation will be applied with edges tightly butted and sealed with a 75mm wide strip of the vapour barrier material, applied with a compatible adhesive.
- .3 The insulation will be impaled on stick

clips or pins welded to the duct, and secured with speed washers. Maximum spacing of pins will be 1 pin per square foot.

- .4 Penetrations of the vapour barrier will be patched with a strip of vapour barrier material.
- .5 Duct insulation and vapour barrier, where applicable, shall be continuous through walls and floor openings, except at fire dampers.
- .6 Where more than one thickness of insulation is required, stagger both longitudinal and horizontal joints.
- .7 Use TIAC code C-1 insulation, scored to suit diameter of duct on exposed round ducts 610mm and larger, smaller sizes where subject to abuse.

#### 3.4 Flexible Duct Insulation

- .1 Flexible duct insulation 25mm thick shall be used on all concealed supply air ducts.
- .2 Cut insulation slightly longer than the circumference of the duct to ensure full thickness at corners.
- .3 Tightly stretch edges with staples and cover with a 75mm wide strip of pressure sensitive aluminum foil tape.
- .4 On ducts 450mm and wider the insulation will be secured to the bottom of the ducts by means of welded pins and speed clips. Cut pins flush after the clip has been applied.
- .5 Seal all joints and penetrations of the vapour barrier, including locations where it is penetrated by securing pins, with 75mm pressure sensitive aluminum foil tape.

3.5 Ductwork  
Insulation Schedule

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

Service	TIAC Code	Vapour Retarder	Insulation Thickness
E/A ducts (Note 1)	C-1	yes	50mm
O/A ducts/Plenums/Exterior Supply Ducts	C-1	yes	50mm
F/A ducts downstream of heat recovery ventilators	C-1	yes	25mm

Note 1 - Insulate exhaust air ducts for greater of 3000mm from exterior wall/roof penetration or distance between shut-off motorized damper and exterior wall/roof penetration.

END OF SECTION



PART 1 - GENERAL

1.1 Related Section

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction /  
Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 21 05 01 - Mechanical General  
Requirements.
- .5 Section 23 05 54 - Mechanical  
Identification.
- .6 Section 21 07 20 - Thermal Insulation for  
Piping.
- .7 Section 23 05 01 - Installation of  
Pipework.

1.2 References

- .1 American Society of Mechanical Engineers  
(ASME).
  - .1 ASME B16.22, Wrought Copper and Copper  
Alloy Solder - Joint Pressure  
Fittings.
  - .2 ASME B16.24, Cast Copper Pipe Flanges  
and Flanged Fittings: Class 150, 300,  
400, 600, 900, 1500 and 2500.
  - .3 ASME B16.26, Cast Copper Alloy  
Fittings for Flared Copper Tubes.
  - .4 ASME B31.5, Refrigeration Piping and  
Heat Transfer Components.
- .2 American Society for Testing and Materials  
International (ASTM).
  - .1 ASTM A307, Standard Specification for  
Carbon Steel Bolts and Studs, 60,000  
PSI Tensile Strength.
  - .2 ASTM B280, Standard Specification for  
Seamless Copper Tube for Air  
Conditioning and Refrigeration Field  
Service.
- .3 CSA Group.
  - .1 CSA B52, Mechanical Refrigeration  
Code.

- .4 Environment Canada (EC).
  - .1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### 1.3 Submittals

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
  - .2 Submit WHMIS MSDS information for review.
  - .3 Indicate VOC's for adhesive and solvents during application and curing.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### 1.4 Quality Assurance

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

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

.2 Health and Safety:

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

1.5 Delivery,  
Storage and Handling

.1 Waste Management and Disposal:

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with the Waste Management Plan (WMP).
- .4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with the Waste Management Plan (WMP).
- .5 Divert unused metal materials from landfill to metal recycling facility as approved by the Consultant.

PART 2 - PRODUCTS

2.1 Piping

- .1 Processed for refrigeration installations, deoxidized, dehydrated, and sealed/capped.
  - .1 Hard copper: to ASTM B280, type ACR.
  - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

## 2.2 Fittings

- .1 Service: design pressure 2068 kPa and temperature of 121°C.
  - .1 Brazed:
    - .1 Fittings: wrought copper to ASME B16.22.
    - .2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
  - .2 Flanged:
    - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
    - .2 Gaskets: suitable for service.
    - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
  - .3 Flared:
    - .1 Bronze or brass, for refrigeration, to ASME B16.26.

## 2.3 Pipe Sleeves

- .1 Hard copper or steel sized to provide 6.25mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

## 2.4 Valves

- .1 22mm and under: Class 500, 3450 kPa, globe or angle non-directional type, diaphragm, pack-less type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22mm: Class 375, 2585 kPa, globe or angle type, diaphragm, pack-less type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

## PART 3 - EXECUTION

### 3.1 General

- .1 Keep piping free from scale and dirt. Protect open pipe during construction, to prevent foreign bodies entering or lodging,

using temporary plugs. Where dehydrated capped pipe is used, keep pipe sealed until installation.

- .2 Piping and insulation located outdoors shall be covered with aluminum jacket.
- .3 Provide refrigerant charge for each system.
- .4 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05 - Installation of Pipework.
- .5 Provide cushion pipe clamps for all refrigerant piping.
- .6 All pipe fittings to be torqued to manufacture's specifications

### 3.2 Manufacturer's Instructions

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

### 3.3 Brazing Procedures

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

### 3.4 Piping Installation

- .1 General:
  - .1 Soft annealed copper tubing: bend without crimping or constriction. Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
  - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
  - .2 Provide trap at base of risers greater

than 2.4m high and at each 7.5m thereafter.

- .3 Provide inverted deep trap at top of risers.
- .4 Provide double risers for compressors having capacity modulation.
  - .1 Large riser: install traps as specified.
  - .2 Small riser: size for 5.2m/s at minimum load. Connect upstream of traps on large riser.

### 3.5 Pressure and Leak Testing

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2068 kPa and 1034 kPa on high and low sides respectively.
- .3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

### 3.6 Field Quality Control

- .1 Site Tests/Inspection:
  - .1 Close service valves on factory charged equipment.
  - .2 Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration.
  - .3 Use copper lines of largest practical size to reduce evacuation time.
  - .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
  - .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .2 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge

as follows:

- .1 Twice to 14 kPa absolute and hold for 4 h.
  - .2 Break vacuum with refrigerant to 14 kPa.
  - .3 Final to 7 kPa absolute and hold for at least 12 h.
  - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
    - (1) Submit test results to the Departmental Representative for review.
- .3 Charging:
- .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
  - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
  - .3 Re-purge charging line if refrigerant container is changed during charging process.
  - .4 Checks:
    - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
    - .2 Record and report measurements to the Departmental Representative.
  - .5 Manufacturer's Field Services:
    - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
    - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's

- instructions.
- .3 Schedule site visits, to review Work, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
    - .4 Obtain reports, within 3 days of review, and submit, immediately, to the Departmental Representative.

### 3.7 Demonstration

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

### 3.8 Cleaning

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

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM A 480/A480M, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A 635/A635M, Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A 653/A653M, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .2 National Fire Protection Agency (NFPA):
  - .1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition 1995 and Addendum No. 1.
  - .2 SMACNA HVAC Duct Leakage Test Manual, Technical Research.

1.2 Shop Drawings and Product Data

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate following:
  - .1 Sealants.
  - .2 Tape.
  - .3 Proprietary Joints.

1.3 Certification of Ratings

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

PART 2 - PRODUCTS

2.1 Seal  
Classification

- .1 Classification as follows:
- | <u>Maximum Pressure (Pa)</u> | <u>SMACNA Seal Class</u> |
|------------------------------|--------------------------|
| 250                          | C                        |
| 250                          | C                        |
| 125                          | C                        |
| <125                         | Unsealed                 |
- .2 Seal classification:
- .1 Class C: transverse joints and connections made air tight with gaskets or sealant and tape. Longitudinal seams unsealed.

2.2 Sealant

- .1 Sealant: oil resistant, polymer type, water based, high pressure, non-toxic, flame resistant duct sealant. Temperature range of minus 29.4°C to plus 79.4°C.

2.3 Tape

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

2.4 Duct Leakage

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

2.5 Fittings

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
- .1 Rectangular: standard radius. Centreline radius: 1.5 times width of duct.
- .2 Round: smooth radius. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
- .1 To 400mm: with single thickness turning vanes.
- .2 Over 400mm: with double thickness turning vanes.
- .3 Branches:
- .1 Rectangular main and branch: with 45° entry on branch.
- .2 Round main and branch: enter main duct at 45° with conical connection.

- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with balancing dampers.
- .4 Transitions:
  - .1 Diverging: 20<sup>0</sup> maximum included angle, unless indicated.
  - .2 Converging: 30<sup>0</sup> maximum included angle, unless indicated.
- .5 Offsets:
  - .1 Full radiused elbows or as indicated.
- .6 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

## 2.6 Firestopping

- .1 Retaining angles around duct, on both sides of fire separation.
- .2 Firestopping material and installation must not distort duct.
- .3 Breakaway duct joints at fire damper locations.
- .4 See also Section 21 05 01 and Section 07 84 00.

## 2.7 Galvanized Steel

- .1 Lock forming quality: to ASTM A 653, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA HVAC duct construction standards.
- .3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered a Class A seal.

## 2.8 Hangers and Supports

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm wide.
- .2 Hanger configuration: to SMACNA.

- .3 Hangers: galvanized steel angle with galvanized steel rods to the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
Up to 900	25 x 25 x 3.2	6.4
925 - 1050	32 x 32 x 3.2	6.4
1075 - 1500	38 x 38 x 3.2	9.5
1525 - 2075	50 x 50 x 3.2	9.5
2100 - 2375	50 x 50 x 4.8	9.5
2400 and Over	50 x 50 x 13	13

## 2.9 Sheet Metal Plenums

- .1 Nominal 18 ga. galvanized steel sheet re-squared and formed into 600mm wide panels with 50mm deep standing seams in accordance with SMACNA HVAC equipment and casings standard.
- .2 Formed channel sections top and bottom of vertical sections and at all wall and floor intersections.
- .3 Galvanized 50mm x 50mm x 3 mm thick angle frames around all duct and access door openings.

## 2.10 Duct Joints

- .1 Ductwork is to be prefabricated using drive slip joints sized 450 mm or greater. Joints 375 mm or larger are to be reinforced.

## 2.11 Round Ducts

- .1 Concealed round branch ducts up to 400 mm diameter may be constructed with longitudinal seams.
- .2 Concealed round branch ducts over 400mm and all exposed round ducts shall be factory fabricated conduit consisting of helically wound galvanized iron strips with spiral lock seams. Fittings for these conduits shall be fabricated of 20 gauge galvanized sheet steel

with butt welded seams.

### PART 3 - EXECUTION

#### 3.1 General

- .1 Do work in accordance with CSA B228.1 and SMACNA and as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA and as indicated.
- .4 Install breakaway joints in ductwork on both sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Clean all ductwork, plenums, ERV, exhaust fans, etc. prior to system start-up. Submit report to Consultant for review.
- .7 Duct size 475mm wide and larger with more than 10sq.ft. or embraced panel shall be beaded or cross broken. This shall also apply to 20 ga or less thickness and 750 Pa w.c. or less.
- .8 Ductwork at all intakes, all exhaust and other places where water from condensation or snow melting may occur through louvres shall be watertight. At these places, ductwork shall be sloped towards a low point where a 32mm copper pipe connection for (i.e. tailpiece with trap) drainage purposes shall be installed.
- .9 All vertical ducts in shafts shall be rigidly supported with steel angle. In no case shall angles be less than 32 x 32 x 6.4mm (galvanized steel).
- .10 Where ducts over 600mm wide are shown passing through masonry walls provide lintels and a continuous 32 x 32 x 6.4mm galvanized steel angle frame which shall be bolted to the

construction and made air-tight to the same by applying caulking compound. Sheet metal at these locations shall be bolted to the angle iron.

### 3.2 Hangers

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

<u>Duct Size</u>	<u>Spacing</u>
to 1525 mm	3000 mm
1550 mm and over	2400 mm

### 3.3 Watertight Duct

- .1 Provide watertight duct for:
  - .1 Fresh air intake/exhaust air plenums.
  - .2 Plenums.
  - .3 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams. Solder, weld joints of bottom and side sheets. Seal other joints with duct sealer.
- .3 Install drains at base of risers, where noted on drawings, and other places where water may gather. Trap and piping to drain by others.

### 3.4 Sealing and Taping

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

### 3.5 Sheet Metal Plenums

- .1 Add sealant during closure of standing seams and channel sections and fasten with bolts or

blind rivets at 305mm on centre.

- .2 Secure angle frames to wall or floor at 610mm on centre and caulk air-tight.
- .3 Provide light metal channel at wall and floor into which insulation can be finished.

### 3.6 Leakage Tests

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Make trial leakage tests as instructed to demonstrate workmanship.
- .3 Install no additional ductwork until trial test has been passed.
- .4 Test section minimum of 6600 mm long with not less than three branch take-offs and two 90E elbows.
- .5 Complete test before insulation or concealment.
- .6 Refer also to Specification Section 23 05 94.

END OF SECTION



PART 1 - GENERAL

1.1 References

- .1 Sheet Metal and Air Conditioning Contractors' 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.
- .2 Indicate the following:
  - .1 Flexible connections.
  - .2 Duct access doors.

1.3 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 and CSA B228.1.

2.2 Flexible Connections

- .1 Frame: nominal 24 ga. galvanized sheet metal frame, 75mm wide with fabric clenched by means of double locked seams.
- .2 Material:
  - .1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 4.4<sup>0</sup>C to plus 90.6<sup>0</sup>C, density of 3.2 kg/m<sup>3</sup>.

2.3 Access Doors In Ducts

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.51mm thick complete with sheet metal angle frame, gasketed.
- .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 25mm thick rigid glass fibre insulation, gasketed.

- .3 Hardware:
  - .1 Up to 305mm x 305mm: two sash locks complete with safety chain.
  - .2 325 to 450: four sash locks complete with safety chain.
  - .3 475 to 1000: piano hinge and minimum two sash locks.
  - .4 Doors over 1000: piano hinge and two handles operable from both sides.
  - .5 Hold open devices.
  - .6 305 x 305 glass viewing panels.

#### 2.4 Access Doors In Plenums

- .1 Insulated: sandwich construction of same material as plenum wall (nominal 22 ga.) complete with 16 ga. sheet metal angle frame and 50mm thick rigid glass fibre insulation.
- .2 Gaskets: Neoprene.
- .3 Hardware:
  - .1 Piano hinge and two T handle cam-locks operable from both sides, corrosion resistant materials.
  - .2 Hold open device.
  - .3 305 x 305mm wired glass viewing panel.
  - .4 Minimum size: 915mm x 915mm.

#### 2.5 Turning Vanes

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

#### 2.6 Instrument Test Ports

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 32mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

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: 100mm.
  - .3 Minimum distance between metal parts when system in operation: 32mm to 63mm.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access doors:
  - .1 Locations:
    - .1 Fire dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Elsewhere as indicated.

END OF SECTION



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PART 1 - GENERAL

1.1 References

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

1.2 Product Data

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following: the construction and sizes.

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.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

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.
- .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: 100mm.
- .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.

## 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 grilles 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.

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM A 653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.2 Shop Drawings

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
  - .1 Performance data.
  - .2 Dimensions, quantity

1.3 Closeout Submittals

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

1.4 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.

PART 2 - PRODUCTS

2.1 Multi-Leaf Dampers

- .1 Opposed or parallel blade type as indicated. Parallel blade type for mixing application.
- .2 Extruded aluminum, interlocking blades, complete with internal polyurethane blade insulation, extruded EPDM elastomer seals, extruded thermoplastic frame seals, extruded aluminum frame complete with polystyrene insulation. Low leakage construction.
- .3 Bearings comprised of a celcon inner bearing fixed to a 10.9mm aluminum hexagon blade pin rotating within a polycarbonate outer bearing inserted in the frame, no metal-to-metal or metal-to-plastic contact.

- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod. Linkage hardware is installed in frame side and constructed of aluminum and corrosion resistant zinc and nickel-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
- .5 Operator: as specified in the controls specification sections.
- .6 Performance: leakage in closed position to be less than 20.3 L/s/m<sup>2</sup> at 1000 Pa w.c. differential across damper. Pressure drop at full open position for a 1200mm x 1200mm damper to be less than 75 Pa w.c. differential across damper at 1000 fpm air flow.

## 2.2 Back Draft Dampers

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

## PART 3 - EXECUTION

### 3.1 Installation

- .1 All control dampers shall be supplied by the Controls Contractor and installed by the Ventilation Contractor.
- .2 Opposed blade balancing dampers with locking quadrant shall be provided where indicated.
- .3 Install insulated dampers at fresh air intakes and exhaust louvers, hoods, etc.
- .4 Install other places where shown where indicated.
- .5 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .6 Seal multiple damper modules with silicon sealant. Seal air tight between duct and damper frame for tight close-off.
- .7 Install access door adjacent to each damper, See Section 23 33 00 - Air Duct Accessories, so that each damper is observable, serviceable

and accessible.

- .8 Extend damper control rod or jackshaft through damper casing to the outside of the duct or equipment casing to allow proper connection of direct-coupled damper actuator.

END OF SECTION



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PART 1 - GENERAL

1.1 References

- .1 American National Standards  
Institute/National Fire Protection  
Association (ANSI/NFPA):
  - .1 ANSI/NFPA 90A, Installation of Air  
Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC):
  - .1 CAN4-S112, Fire Test of Fire Damper  
Assemblies.
  - .2 CAN4-S112.2, Fire Test of Ceiling  
Firestop Flap Assemblies.
  - .3 ULC-S505, Fusible Links for Fire  
Protection Service.

1.2 Shop Drawings

- .1 Submit product data in accordance with  
Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
  - .1 Fire dampers.
  - .2 Operators.
  - .3 Fusible links.

1.3 Closeout  
Submittals

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

1.4 Extra Materials

- .1 Provide maintenance materials in accordance  
with Section 01 78 00 - Closeout  
Submittals.
- .2 Provide following:
  - .1 Four (4) 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.

1.6 Waste Management  
and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction / Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 Fire Dampers

- .1 Fire dampers: arrangement Type A or B or C, listed and bear label of ULC, meet requirements of ANSI/NFPA 90A and authorities having jurisdiction. Fire damper assemblies to be fire tested in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: round or square; guillotine type; sized to maintain full duct cross section as indicated.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 32mm x 32mm x 3.125mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

PART 3 - EXECUTION

3.1 Installation

- .1 Install in accordance with ANSI/NFPA 90A, SMACNA 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.

END OF SECTION



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PART 1 - GENERAL

1.1 References

- .1 National Fire Protection Association (NFPA):
  - .1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 and Addendum No.1.
- .3 Underwriter's Laboratories of Canada (ULC):
  - .1 CAN/ULC-S110, Fire Tests for Air Ducts.
  - .2 UL 181, Factory Made Air Ducts and Connectors.

1.2 Product Data

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
  - .1 Thermal properties.
  - .2 Friction loss.
  - .3 Acoustical loss.
  - .4 Leakage.
  - .5 Fire rating.

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

2.2 Non-Metallic  
- Insulated

- .1 Non-collapsible, coated aluminum foil Mylar type mechanically bonded to, and helically supported by, external steel wire with factory applied, 32 mm thick flexible glass fibre thermal insulation with vapour barrier and reinforced Mylar/neoprene laminate jacket.
- .2 Performance:
  - .1 Factory tested to 2500 Pa w.c. without leakage.
  - .2 Maximum relative pressure drop co-efficient: 2.

PART 3 - EXECUTION

3.1 Duct  
Installation

- .1 Install in accordance with: CAN/ULC-S110, UL-181, NFPA 90A, NFPA 90B, and SMACNA.
- .2 Maximum length of flexible duct: 1500 mm.
- .3 Support properly at maximum 900 mm intervals with wide straps to prevent kinks in duct.
- .4 Use rigid sheet metal elbow at diffuser inlet neck. Maximum 15° offset with flexible duct.
- .5 Flexible ducts shall not rest on the finished T-bar or GWB ceilings.

END OF SECTION

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PART 1 - GENERAL

1.1 Related Sections

- .1 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- .2 Section 23 33 00 - Air Duct Accessories.

1.2 References

- .1 AMCA 99, Standards Handbook.
- .2 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Rating.
- .3 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
- .4 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 ANSI/ASHRAE 51, Laboratory Methods of Testing Fans for Rating.
- .6 CAN/CGSB-1.181, Ready Mixed Organic Zinc-Rich Coating.

1.3 Shop Drawings

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

1.4 Closeout Submittals

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

1.5 Extra Materials

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

PART 2 - PRODUCTS

2.1 Fans - General

- .1 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
- .2 Fans: statically and dynamically balanced,

- constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.
  - .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
  - .5 Motors (premium efficiency type):
    - .1 In accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
    - .2 For use with variable speed controllers (where indicated).
    - .3 Sizes as indicated.
  - .6 Accessories and hardware: matched sets of V-belt drives, (high efficiency Anotched@ type - minimum two required per fan) 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 complete with plug.
  - .9 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

### 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 Provide fan restraining snubbers.
- .5 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

END OF SECTION



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PART 1 - GENERAL

1.1 Related Sections

- .1 Door grilles: Supplied by the Mechanical Contractor, installed by the G.C.
- .2 Section 21 05 01 - Mechanical General Requirements

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.
  - .6 Finish.
  - .7 Sizes.

PART 2 - PRODUCTS

2.1 General

- .1 Standard product to meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Where grilles and diffusers penetrate fire walls and fire partitions, provide approved steel sleeve secured to structure in accordance with NFPA 90A and NBC.
- .3 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board and as specified.
  - .3 Concealed fasteners.
  - .4 Mitred corners.
- .4 Concealed manual volume control damper operators where applicable.
- .5 Colour: off-white baked enamel.

2.2 Return and Exhaust  
Grilles and Registers

- .1 General: opposed blade dampers only if balancing damper cannot be installed on the branch duct.
- .2 As indicated.

2.3 Diffusers

- .1 As indicated.

2.4 Door Grilles  
/Linear Grilles

- .1 As indicated.
- .2 Sight-proof heavy duty construction.
- .3 Complete with border both sides with countersunk screws.

PART 3 - EXECUTION

3.1 Installation

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with flat head screws in countersunk holes where fastenings are visible.

END OF SECTION

PART 1 - GENERAL

1.1 References

- .1 American National Standards Institute (ANSI)/  
National Fire Protection Association (NFPA):
  - .1 ANSI/NFPA 96, Vapour Removal from  
Cooking Equipment.
- .2 American Society for Testing and Materials  
(ASTM):
  - .1 ASTM E 90, Method for Laboratory  
Measurement of Airborne Sound  
Transmission Loss of Building  
Partitions.

1.2 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.
  - .4 Dimensions and weights.
  - .5 Installation directions.
  - .6 Finishes and materials of construction.

1.3 Test Reports

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

1.4 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.

1.5 Waste Management  
and Disposal

- .1 Separate and recycle waste materials in  
accordance with Section 01 74 19 - Construction  
/ Demolition Waste Management and Disposal,  
and with the Waste Reduction Workplan.
- .2 Place materials defined as hazardous or toxic  
waste in designated containers.
- .3 Ensure emptied containers are sealed and  
stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 Fixed Louvres  
- Aluminum

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500mm.
- .4 Frame, head, sill and jamb: 150mm deep one-piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 13mm exhaust, 13mm intake mesh.
- .8 Finish: fluoropolymer, Kynar or Duranar. Colour: To be selected by architect at time of shop drawing submittal.
- .9 Louvres shall have an extended sill frame.

PART 3 - EXECUTION

3.1 Installation

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace for wind speed in accordance with NBC.
- .3 Anchor securely. Seal with caulking all around to ensure weather tightness.

END OF SECTION

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PART 1 - GENERAL

1.1 Related Sections

- .1 Section 26 05 00 - Common Work Results - Electrical.

1.2 References

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.46-M1988, Electric Air-Heaters.
- .2 Underwriters' Laboratories (UL) Inc.
  - .1 UL 1042-1994, Electric Baseboard Heating Equipment.

1.3 Product Data

- .1 Submit product data in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Submit product data sheets for baseboard convectors. Include:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Mounting methods.
  - .4 Physical size.
  - .5 kW rating, voltage, phase.
  - .6 Cabinet material thicknesses.
  - .7 Limitations.
  - .8 Colour and finish.

1.4 Closeout Submittals

- .1 Submit operation and maintenance data for baseboard convectors in accordance with Section 26 05 00 - Common Work Results - Electrical.

PART 2 - PRODUCTS

2.1 Baseboard Convectors

- .1 Heaters: to CSA C22.2 No.46 standard high wattage density as indicated with connection box both ends.
  - .1 Element through-type fitted with aluminum convector vanes and

resistor wire enclosed in mineral insulation in sheath.

- .2 Element: locked to cabinet and supported at additional points throughout length to allow for linear expansion with non metallic supports.
- .3 Cabinet: to CSA C22.2 No.46, pre-drilled back for securing to wall. Integral air diffusion reflector with wireway at bottom.
  - .1 Front inlet/top outlet.
  - .2 Panel: steel, metal thickness, 18 gauge cabinet, 16 gauge front panel.
  - .3 Finish: phosphatized and finished with powder coated finish, white colour.

## 2.2 Controls

- .1 Relays and transformers to switch loads in excess of thermostat rating.

## PART 3 - EXECUTION

### 3.1 Installation

- .1 Install baseboard convector heaters and controls.
- .2 When wireway is used, remove knock-outs and insert insulating bushing between units.
- .3 Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.
- .4 Install thermostats in locations indicated.
- .5 Make power and control connections.

3.2 Field  
Quality Control

- .1 Perform tests in accordance with Section 26 05 0 - Common Work Results - Electrical.
- .2 Ensure heaters and controls operate correctly.

END OF SECTION



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PART 1 - GENERAL

1.1 Related Sections

- .1 Section 26 05 00 - Common Work Results - Electrical.

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 26 05 00 - Common Work Results - Electrical.
- .2 Submit product data sheets for baseboard convectors. Include:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Mounting methods.
  - .4 Physical size.
  - .5 kW rating, voltage, phase.
  - .6 Cabinet material thicknesses.
  - .7 Limitations.
  - .8 Colour and finish.

1.4 Closeout Submittals

- .1 Submit operation and maintenance data for cabinet convectors in accordance with Section 26 05 00 - Common Work Results - Electrical.

PART 2 - PRODUCTS

2.1 Cabinet Convectors

- .1 Cabinet: to CSA C22.2 No.46, pre-drilled back for securing to wall. Integral air diffusion reflector with wireway at bottom.
  - .1 Front inlet/top outlet.
  - .2 Panel: steel, metal thickness, 18 gauge cabinet, 16 gauge front panel.

- .3 Finish: phosphatized and finished with powder coated finish, white colour.

## 2.2 Controls

- .1 Relays and transformers to switch loads in excess of thermostat rating.

## PART 3 - EXECUTION

### 3.1 Installation

- .1 Install cabinet convector heaters and controls.
- .2 When wireway is used, remove knock-outs and insert insulating bushing between units.
- .3 Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.
- .4 Install thermostats in locations indicated.
- .5 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 Ensure heaters and controls operate correctly.

END OF SECTION