

## **PART 1 - GENERAL**

### **1.1 WASTE MANAGEMENT AND DISPOSAL**

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal materials from landfill to metal recycling facility.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 CONNECTIONS TO EQUIPMENT**

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

### **3.2 CLEARANCES**

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

### **3.3 PIPEWORK INSTALLATION**

- .1 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
  - .2 Assemble piping using fittings manufactured to ANSI standards.
  - .3 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
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- .4 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .5 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .6 Ream pipes, remove scale and other foreign material before assembly.
- .7 Provide for thermal expansion.
- .8 Valves:
  - .1 Install in accessible locations.
  - .2 Install with stems above horizontal position unless otherwise indicated.
  - .3 Valves accessible for maintenance without removing adjacent piping.
  - .4 Use gate ball valves at branch take-offs for isolating purposes except where otherwise specified.

### 3.4 SLEEVES

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

### 3.5 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
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- .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.

### **3.6 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition.

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

- .1 Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of Division 15.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Division 15.
- .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 Contract Administrator.
- .6 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

### **1.2 REFERENCES**

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1-04, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 125-1996(R2001), Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A 307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A 563-04a, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP 58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP 89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 Underwriter's Laboratories of Canada (ULC)

### **1.3 SYSTEM DESCRIPTION**

- .1 Design Requirements:
    - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
    - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP 58. ASME B31.1 or
    - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
    - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
    - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.
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#### 1.4 SUBMITTALS

- .1 Submit shop drawings and product data for following items:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

### 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 Ensure steel hangers in contact with copper piping are epoxy coated.
  - .2 Upper attachment structural: suspension from lower flange of I-Beam:
    - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
      - .1 Rod: 9 mm UL listed 13 mm FM approved.
    - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed FM approved to MSS-SP 58 and MSS-SP 69.
  - .3 Upper attachment structural: suspension from upper flange of I-Beam:
    - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved to MSS SP 69.
    - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed FM approved.
  - .4 Shop and field-fabricated assemblies:
    - .1 Trapeze hanger assemblies: requirements of ASME B31.1 and MSS SP 58.
    - .2 Steel brackets: requirements of ASME B31.1 and MSS SP 58.
  - .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.
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- .5 Hanger rods:(Cont'd)
  - .3 Do not use 22 mm or 28 mm rod.
- .6 Pipe attachments: material to MSS SP 58:
  - .1 Attachments for steel piping: carbon steel blackgalvanized.
  - .2 Attachments for copper piping: copper plated black steel.
- .7 Adjustable clevis: material to MSS SP 69 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .8 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 galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: black galvanized, with formed portion plastic coated epoxy coated.

## **2.3 RISER CLAMPS**

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

## **2.4 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

## **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 Certified Mill Test Report (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.
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- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm 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: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .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. Submit calculations with shop drawings.

## **2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **2.9 OTHER EQUIPMENT SUPPORTS**

- .1 Submit structural calculations with shop drawings.

## **PART 3 - EXECUTION**

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

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

### **3.2 INSTALLATION**

- .1 Install in accordance with:
    - .1 manufacturer's instructions and recommendations.
  - .2 Vibration Control Devices:
    - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
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- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .4 Provide supplementary structural steelwork where structural bearings do not exist.
- .5 Use approved constant support type hangers where:
  - .1 vertical movement of pipework is 13 mm or more,
  - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
- .6 Use variable support spring hangers where:
  - .1 transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 variation in supporting effect does not exceed 25 % of total load.

### 3.3 HANGER SPACING

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

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

- .7 Piping greater than NPS 12: to MSS SP 69.

### 3.4 HANGER INSTALLATION

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

### **3.5 HORIZONTAL MOVEMENT**

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

### **3.6 FINAL ADJUSTMENT**

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

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

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

### **1.2 REFERENCES**

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

## **PART 2 - PRODUCTS**

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

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

### **2.2 SYSTEM NAMEPLATES**

- .1 Colours:
    - .1 Hazardous: red letters, white background.
    - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
  - .2 Construction:
    - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
  - .3 Sizes:
    - .1 Conform to following table:
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- .3 Sizes:(Cont'd)
- .1 Conform to following table:(Cont'd)
- | Size # | mm       | Sizes (mm) | No. of<br>Lines | Height of<br>Letters<br>(mm) |
|--------|----------|------------|-----------------|------------------------------|
| 1      | 10 x 50  | 1          | 3               |                              |
| 2      | 13 x 75  | 1          | 5               |                              |
| 3      | 13 x 75  | 2          | 3               |                              |
| 4      | 20 x 100 | 1          | 8               |                              |
| 5      | 20 x 100 | 2          | 5               |                              |
| 6      | 20 x 200 | 1          | 8               |                              |
| 7      | 25 x 125 | 1          | 12              |                              |
| 8      | 25 x 125 | 2          | 8               |                              |
| 9      | 35 x 200 | 1          | 20              |                              |
- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
- .1 Terminal cabinets, control panels: use size # 5.
- .2 Equipment in Mechanical Rooms: use size # 9.

### 2.3 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
- .1 Natural gas: to CSA/CGA B149.1 authority having jurisdiction.
- .2 Sprinklers: to NFPA 13.
- .3 Standpipe and hose systems: to NFPA 14.

### 2.4 IDENTIFICATION OF PIPING SYSTEMS

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

<u>Background colour: Legend, arrows:</u>	
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
City water	Green	CITY WATER
Domestic hot water supply	Green	DOM. HW SUPPLY
Natural gas	to Codes	
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

## 2.5 IDENTIFICATION DUCTWORK SYSTEMS

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

## 2.6 VALVES, CONTROLLERS

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

## 2.7 CONTROLS COMPONENTS IDENTIFICATION

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

## **2.8 LANGUAGE**

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

## **PART 3 - EXECUTION**

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

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

### **3.2 INSTALLATION**

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

### **3.3 NAMEPLATES**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor, but not easily accessible by vandals.
- .2 Protection:
  - .1 Do not paint, insulate or cover.

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

- .1 On long straight runs in open areas: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
  - .2 Adjacent to each change in direction.
  - .3 On both sides of visual obstruction or where run is difficult to follow.
  - .4 At beginning and end points of each run and at each piece of equipment in run.
  - .5 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
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- .6 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.5 VALVES, CONTROLLERS**

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

### **3.6 CLEANING**

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

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation procedures for heating, cooling and ventilation controls.

## **PART 2 - PRODUCTS**

### **2.1 THERMOSTAT (LINE VOLTAGE-HEATING AND COOLING)**

- .1 Line voltage, wall-mounted thermostat, for cooling with:
  - .1 Full load rating: 16 A at 120 V.
  - .2 Temperature setting range: 5 degrees C to 30 degrees C.
  - .3 Thermometer range: 5 degrees C to 30 degrees C.
  - .4 Markings in 5 degree increments.
  - .5 Differential temperature fixed at 0.6 degrees C.

### **2.2 THERMOSTAT (HEAVY-DUTY, LINE VOLTAGE, HEATING AND COOLING)**

- .1 Heavy-duty line voltage thermostat for heating cooling electric heating heating/cooling with manual changeover two-stage heating or cooling heating/cooling automatic changeover with:
  - .1 Full load rating: 16 A at 120 V.
  - .2 Temperature setting range: 5 degrees C to 30 degrees C.
  - .3 Thermometer range: 5 degrees C to 30 degrees C.
  - .4 Markings in 10 5 degree increments.
  - .5 Differential temperature fixed at 1.1 degrees C.

### **2.3 PUSH BUTTON ACTIVATOR WITH TIMER**

- .1 Line voltage vandal proof push button to activate natural gas radiant heater.
- .2 Button to activate timer so heater run 10 min. then turns off.

### **2.4 THERMOSTAT GUARDS**

- .1 Thermostat guards: clear plastic. Slots for air circulation to thermostat.
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### **PART 3 - EXECUTION**

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

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

#### **3.2 INSTALLATION**

- .1 Install control devices.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.



## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A 480/A 480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A 635/A 635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A 653/A 653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .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, 1997.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.

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

- .1 Protect on site stored or installed absorptive material from moisture damage.
  - .2 Waste Management and Disposal:
    - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
    - .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
    - .3 Separate for reuse and recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan.
    - .4 Place materials defined as hazardous or toxic in designated containers.
    - .5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
    - .6 Fold up metal and plastic banding, flatten and place in designated area for recycling.
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## PART 2 - PRODUCTS

### 2.1 SEAL

- .1 Seal classification:
  - .1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.

### 2.2 SEALANT

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

### 2.3 TAPE

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

### 2.4 DUCT LEAKAGE

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

### 2.5 FITTINGS

- .1 Fabrication: to SMACNA.
  - .2 Radiused elbows.
    - .1 Rectangular: standard radius short radius with single thickness turning vanes Centreline radius: 1.5 times width of duct
    - .2 Round: smooth radius five piece. Centreline radius: 1.5 times diameter.
  - .3 Mitred elbows, rectangular:
    - .1 To 400 mm: with single double thickness turning vanes.
    - .2 Over 400 mm: with double thickness turning vanes.
  - .4 Branches:
    - .1 Round main and branch: enter main duct at 45 degrees with conical connection.
  - .5 Transitions:
    - .1 Diverging: 20 degrees maximum included angle.
    - .2 Converging: 30 degrees maximum included angle.
  - .6 Offsets:
    - .1 Short radiused elbows as indicated.
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- .7 Obstruction deflectors: maintain full cross-sectional area.
  - .1 Maximum included angles: as for transitions.

## 2.6 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA. Proprietary manufactured flanged duct joint to be considered to be a class B seal.
- .4 Ductwork to be cleaned for painting if required.

## 2.7 HANGERS AND SUPPORTS

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

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

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

## PART 3 - EXECUTION

### 3.1 GENERAL

- .1 Do work in accordance with ASHRAE and SMACNA as indicated.

### 3.2 HANGERS

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

.3 Hanger spacing:(Cont'd)

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

### **3.3 SEALING AND TAPING**

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

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

### **1.2 REFERENCES**

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

### **1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
    - .1 Flexible connections.
- .2 Instructions: submit manufacturer's installation instructions.

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

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

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

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

### **2.2 FLEXIBLE CONNECTIONS**

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

## **PART 3 - EXECUTION**

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

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

### **3.2 INSTALLATION**

- .1 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets of exhaust air fans.
    - .2 As indicated.
  - .2 Length of connection: 100 mm.
  - .3 Minimum distance between metal parts when system in operation: 75 mm.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.

### **3.3 CLEANING**

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

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Fans, motors, accessories and hardware for commercial use.

### **1.2 REFERENCES**

- .1 Air Conditioning and Mechanical Contractors (AMCA)
  - .1 AMCA Publication 99-2003, Standards Handbook.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

### **1.3 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
  - .2 Capacity: flow rate, total static pressure, bhp W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
  - .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
  - .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.
  - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

### **1.4 SUBMITTALS**

- .1 Provide :
    - .1 Fan performance curves showing point of operation, BHP kW and efficiency.
    - .2 Sound rating data at point of operation.
    - .3 For EF-1, EF-2, EF-3, EF-4.
  - .2 Indicate:
    - .1 Motors, sheaves, bearings, shaft details
-

- .3 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual.

## 1.5 MAINTENANCE

## 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

## PART 2 - PRODUCTS

### 2.1 FANS GENERAL

- .1 Motors:
  - .1 Sizes as indicated.
  - .2 Coordinate with electrical for starter requirements.
  - .3 Starter input from 24 clock.
- .2 Factory primed before assembly in colour standard to manufacturer.
- .3 Scroll casing drains: as indicated.
- .4 Finish on fume hood exhaust fans: consult architect.
- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .6 See drawing 'M3 Equipment Schedule' for recommended units.

### 2.2 CENTRIFUGAL FANS

- .1 Centrifugal V belt driven:
  - .1 Housings: spun aluminum complete with resilient mounted motor and fan.
  - .2 Impeller: aluminum non-overloading.
  - .3 Adjustable motor sheave.
  - .4 Disconnect switch within fan housing.
  - .5 Continuous curb gaskets, cadmium plated or stainless steel securing bolts and screws, and special mated sound insulating 300 mm high curbs where indicated. Hinge curb plate for access to internals for maintenance.

### 2.3 AXIAL FLOW FANS (TUBE-AXIAL OR VANE-AXIAL)

- .1 Casings: welded steel with welded motor support, hinged or bolted access plates, streamlined inlet cone and discharge bell sections and integral silencer casing.
  - .2 Blade material: steel. Hub material: steel.
-



- .3 Supports:
  - .1 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing.
- .4 Bearings: ball or roller with extension tubes to outside of casing.
- .5 Belt drive:
  - .1 Drive fixed blades by externally mounted motors through V-belt drive. Provide internal belt fairing, external belt guards and adjustable motor mounts.

## **2.4 PROPELLER FANS**

- .1 Unit to have propellers of aluminum within bell mouth entrance on integral mounts, with grease lubricated ball bearings, with extended lubrication fittings, suited for operating in any position, direct driven, complete with motor as indicated.
- .2 Provide duct section to house fan unit.

## **PART 3 - EXECUTION**

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

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

### **3.2 FAN INSTALLATION**

- .1 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.

### **3.3 ANCHOR BOLTS AND TEMPLATES**

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

### **3.4 CLEANING**

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

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.
- .2 Related Sections:
  - .1.

### **1.2 REFERENCES**

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

### **1.3 SYSTEM DESCRIPTION**

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

### **1.4 SUBMITTALS**

- .1 Product Data:
  - .1 Indicate following:
    - .1 Pressure drop.
    - .2 Face area.
    - .3 Free area.
- .2 Quality assurance submittals:
  - .1 Instructions: submit manufacturer's installation instructions.
    - .1 Contract Administrator will make available 1 copy of systems supplier's installation instructions.

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

- .1 Packing, shipping, handling and unloading:
    - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
-

## **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 specified by manufacturer.
- .4 Frame, head, sill and jamb: 100 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at maximum centres specified by manufacturer.
- .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 Finish: anodized. Colour: to Architects approval.

### **2.2 ADJUSTABLE LOUVRES**

- .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 specified by manufacturer.
  - .4 Frame, head, sill and jamb: 100 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
  - .5 Mullions: at manufacturers specified 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 Finish: anodized. Colour: to Architects approval.
  - .8 Operator: Manual for L-3 Gravity for L-2.
-

### **PART 3 - EXECUTION**

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

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

#### **3.2 INSTALLATION**

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

#### **3.3 CLEANING**

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

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

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

### **1.2 REFERENCES**

- .1 Canadian Gas Association (CGA)
  - .1 CSA-B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-02, General Requirements, Canadian Electrical Code, Part II.

### **1.3 SUBMITTALS**

- .1 Product Data:
  - .1 Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 Contract Administrator will make available 1 copy of systems supplier's installation instructions.

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

- .1 Packing, shipping, handling and unloading:

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

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

### **2.2 CAPACITY**

- .1 Input:
    - .1 13 mm (1/2") gas line at 7" wc.
    - .2 136,500 kilojoules (130,000 BTU/HR).
-

- .2 Electrical characteristics: 120 V, 1 phase, 60 Hz.

## 2.3 TYPE

- .1 Non-condensing unvented. Low Intensity. Design compatible with natural gas fuel.

## 2.4 BURNERS

- .1 Burners to include following features:
  - .1 Manufactured to ANSI Z83.20 (vented infrared heater standards).
  - .2 CGA CSA certified for use with natural gas.
  - .3 Air-fuel mixture controlled combustion system designed for compatibility with combustion supply air blower.
  - .4 Fail-safe design to shut off supply of fuel in following situations:
    - .1 Blower motor failure.
    - .2 Main flame failure.
    - .3 Inadequate inlet air.
    - .4 Excessive flue back pressure.
  - .5 Combustion air terminal suitable for connection of outside air duct.
  - .6 Electrical control system isolated from combustion air system.
  - .7 Pre-wired burner control system with electric ignition.
  - .8 Suitable for operation with 120 V AC, single phase, 60 Hz electrical service.
  - .9 Enamel-finished steel enclosure complete with removable access panels.
  - .10 Heating output capacity compatible with associated downstream radiant tube.
  - .11 Centrifugal, direct-drive blower with adequate air flow capacity to accommodate ducted inlet and exhaust air requirements.

## 2.5 REFLECTORS

- .1 Reflectors to include following features:
  - .1 Polished aluminum construction complete with corrugations and configuration to maximize radiant heat directed toward floor.
  - .2 Standard lengths to facilitate installation complete with overlaps at joints to accommodate expansion and contraction.
  - .3 Hangers/supports at spacing recommended by system manufacturer to maintain maximum reflector efficiency.
  - .4 Side extension reflector complete with supports, retainers, and brackets, to prevent radiant heat from striking adjacent surfaces.

## 2.6 OUTSIDE AIR SUPPLY

- .1 Outside air supply to include following features:
    - .1 Ducted outside air supply to each burner to provide sealed-combustion system.
    - .2 Insulation and vapour retarder on duct to prevent condensation.
    - .3 Duct size to ensure adequate air supply to each burner.
    - .4 Exterior air inlet terminal complete with bird screen and weatherproof hood.
-

- .1 (Cont'd)
- .5 Flexible duct connector adjacent to burner complete with removable joint clamp at burner.

## 2.7 CONTROLS

- .1 System controls to include following features:
  - .1 Pre-wired control panel complete with transformers, relays, terminal blocks, wiring, circuits, hinged door, visible door-mounted system status lights, steel cabinet complete with baked enamel finish and keyed access.
  - .2 Control is either burner 'on' or 'off'.
  - .3 Integral prepurge and postpurge cycles for combustion chambers and heat exchanger pipes.
  - .4 Vandal proof push button to activate burner 'on' cycle for 10 min, then turn 'off'.

## PART 3 - EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 INSTALLATION

- .1 Install infrared radiant system in accordance with CSA-B149.1, as recommended by manufacturer and as indicated.
  - .2 Provide grading of radiant pipe as required.
  - .3 Make provision for pipe movement caused by normal operation and expansion, approximately 50 mm (2").
  - .4 Maintain required clearances from combustibles.
  - .5 Follow manufacturer's detailed installation, testing, operation and maintenance instructions.
  - .6 Install push buttons where indicated. Supply heat shields where recommended by manufacturer.
  - .7 Test radiant system as recommended by manufacturer and required by authorities having jurisdiction. Check burner safety controls.
  - .8 Arrange equipment, including burners, to facilitate removal without dismantling pipe, reflectors, or associated apparatus.
-

**3.3 CLEANING**

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

**3.4 EQUIPMENT SCHEDULE**

- .1 Equipment schedule on 'M3 Equipment Schedule'.