

Part 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 21 05 01- General Provisions – Mechanical.
- .2 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 21 05 01- General Provisions - Mechanical and Section 01 00 00.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

- .6 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless directed by Contract Administrator.
 - .2 Make changes as required and re-submit as directed by Contract Administrator.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Contract Administrator will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
 - .2 Transfer information monthly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Contract Administrator for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 .Submit copies of as-built drawings for inclusion in final TAB report.

1.2 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 21 05 01- General Provisions - Mechanical as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 21 05 01- General Provisions - Mechanical.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Materials and products in accordance with Section 21 05 01- General Provisions – Mechanical and Section 01 00 00.

Part 3 EXECUTION

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 21 05 01- General Provisions – Mechanical.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

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

3.3 DEMONSTRATION

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

3.4 PROTECTION

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

END OF SECTION

.1 GENERAL

1.2 RELATED REQUIREMENTS

- .1 Refer to Section 21 05 01 - Common Work Results for Mechanical.

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
.2 Canadian Standards Association (CSA)
.1 CSA B149.1, Natural Gas and Propane Installation Code.
.3 National Fire Code of Canada (NFCC 2005) Applications.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Submittal Procedures.
.2 Product Data:
.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 21 05 01 – General Provisions - Mechanical and with manufacturer's written instructions.
.2 Delivery and Acceptance Requirements:
.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 PRODUCTS

2.1 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
.1 Paints: in accordance with manufacturer's recommendations for surface conditions.

Part 3 EXECUTION

3.1 APPLICATION

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

3.2 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.

3.3 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 without interrupting operation of other system, equipment, components.

3.4 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
 - .1 Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

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

3.6 DIELECTRIC CONNECTIONS

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.
- .5 Dielectric couplings are not permitted.

3.7 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
- .6 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible and as indicated.
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion as indicated.
- .15 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use butterfly valves at branch take-offs for isolating purposes except where specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .8 Install plug cocks or ball valves for glycol service.
 - .9 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .16 Check Valves:

- .1 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.8 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush new system in accordance with Section 23 25 00 – HVAC Water Treatment Systems.

3.9 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 heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .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.
- .7 Insulate or conceal work only after approval and certification of tests by Contract Administrator.

3.10 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Contract Administrator.
- .2 Request written approval by Contract Administrator 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

3.11 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Design, select, supply and install a piping support system suitable for the applications indicated
- .2 Provide accommodation for pipe expansion where required.

1.2 CODES AND STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-07, Power Piping.
 - .2 ASME B31.3, Process Piping.
 - .3 ASME B31.9, Building Services Piping.
- .2 ASTM International
 - .1 ASTM-A-125-1996 (2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 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 MSS SP 69-2003, Pipe Hangers and Supports – Selection and Application.
 - .3 MSS SP 89-2003, Pipe Hangers and Supports – Fabrication and Installation Practices.

*** All Codes and Standards are to the latest editions

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 21 05 01.
- .2 Submit manufacturer's product data for the following items:
 - .1 Upper Attachment
 - .2 Lower Attachment

Part 2 PRODUCTS

2.1 GENERAL

- .1 Fabricate bases, hangers and supports in accordance with the codes and standards mentioned in Section 1.2.

- .2 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .3 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.
- .4 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58
- .5 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 UPPER ATTACHMENTS

- .1 Requirements (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.
 - .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, ULC listed to MSS SP 58.
- .2 Requirements (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, ULC listed 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, ULC listed.
- .3 Requirements (Inserts for cast-in-place Concrete for All Piping):

Type: Wedge
Material: Galvanized Steel
To MSS SP-58, type 18, ULC listed for pipe $\frac{3}{4}$ – 8 in. diameter

 - .1 Acceptable Products:
 - .1 Grinnell Fig. 281 or Approved Equal
- .4 Requirements (Inserts for hollow-core Concrete for All Piping):

Type: Threaded Expansion
Material: Galvanized Steel

 - .1 Acceptable Product:
 - .1 Powers Mini Dropin or Approved Equal
- .5 Requirements (Galvanized Steel Plate with Clevis, for Surface Mount on Concrete to All Piping):

Type: Socket and Expansion case and bolt (min. 2 per hanger)
Material: Malleable Iron
To MSS SP-58, type 18, ULC listed for pipe $\frac{3}{4}$ – 8 in. diameter

- .1 Acceptable Products:
 - .1 Grinnell, Plate Fig. 49, Eye Nut Fig. 290, Exp. Case Fig. 117 or Approved Equal
- .6 Requirements (Ceiling Plate and Flange, for Surface Mount to Wood Beams or Ceiling to All Piping):
 - Type: Galvanized Plate
 - Material: Malleable Iron
 - To MSS SP-58, type 18, ULC listed for pipe $\frac{3}{4}$ – 8 in. diameter
 - .1 Acceptable Products:
 - .1 Grinnell, Plate Fig. 128R, or Approved Equal
- .7 Requirements (Side Beam Bracket, for Surface Mount to Wood Beams to All Piping):
 - Type: Iron Side Beam Bracket
 - Material: Malleable Iron
 - To MSS SP-58, type 18, ULC listed for pipe $\frac{3}{4}$ – 8 in. diameter
 - .1 Acceptable Products:
 - .1 Grinnell, Plate Fig. 202, or Approved Equal

2.3 MIDDLE ATTACHMENT

- .1 Requirements:
 - Type: Threaded Rod with Electro-Galvanized Finish
 - Material: Galvanized Steel

2.4 PIPE ATTACHMENT

- .1 Requirements:
 - .1 Material to MSS SP 58
 - .1 Attachments for steel piping: galvanized carbon steel
 - .2 Attachments for copper piping: copper plated black steel
 - .3 Use insulation shields for hot pipework
 - .2 Adjustable Clevis:
 - .1 Material to MSS SP 69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .2 Acceptable Products:
 - .1 Grinnell Fig. 260 (Steel Pipe), Galvanized or Approved Equal
 - .2 Grinnell Fig. CT-65 (Copper Tubing), Copper Plated or Approved Equal
 - .3 Trapeze:
 - .1 Channel Assembly, Galvanized Carbon Steel to be used with a U-bolt Fig. 137 & Fig. 60 washer plates to secure pipe (loosely) to channel assembly.
 - .2 Acceptable Products:

- .1 Grinnell Fig. 45
- .4 U-Bolt:
 - .1 Material to MSS SP 58 and MSS SP 69, galvanized carbon steel.
 - .2 Acceptable Products:
 - .1 Grinnell Fig. 137, Galvanized or Approved Equal
- .5 Offset Pipe Clamp: (Supporting horizontal piping away from wall or floor)
 - .1 Material to MSS SP 58, galvanized carbon steel,
 - .2 Acceptable Products:
 - .1 Grinnell Fig. 103, Galvanized or Approved Equal
- .6 Provide Insulation protection shields for insulated piping
 - .1 Acceptable Products:
 - .1 Grinnell Fig. 167 or Approved Equal
- 2.5 SHOP AND FIELD-FABRICATED ASSEMBLIES**
 - .1 Steel brackets: In accordance with the requirements of ASME B31.1 and MSS SP 58.
- 2.6 FINISHES**
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Ensure steel hangers in contact with copper piping are epoxy coated.
- 2.7 SUPPLEMENTARY STRUCTURAL MEMBERS**
 - .1 Provide as required for support of piping, anchoring and sway bracing under active loading, shall be galvanized.
- 2.8 EXPANSION JOINTS**
 - .1 Provide prefabricated expansion joints where required for thermal movement.
- 2.9 RISER CLAMPS**
 - .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42.
 - .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
 - .3 Bolts: to ASTM A307.
 - .4 Nuts: to ASTM A563.
- 2.10 EQUIPMENT SUPPORTS**
 - .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel, submit calculations with shop drawings.
- 2.11 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**
 - .1 Provide templates to ensure accurate location of anchor bolts.

2.12 HOUSE-KEEPING PADS

- .1 Provide 4 inch high (unless otherwise specified on drawings) high concrete housekeeping pads for base-mounted equipment; size pads 50 mm(2 inch) larger than equipment; chamfer pad edges.

2.13 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel.
- .2 Submit structural calculations with shop drawings.

Part 3 EXECUTION

3.1 HANGER SPACING

- .1 Spacing and middle attachment (rod) diameter as specified in paragraphs below or as found in table below, whichever is more stringent
 - .1 Plumbing Piping: most stringent requirements of Canadian Plumbing Code, or authority having jurisdiction
 - .2 Fire Protection: all work shall be done to meet the applicable fire code(s)
 - .3 Gas Piping: up to 15 mm(½ in.) diameter piping supports/hangers shall be required every 1.8 m(6 ft).
 - .4 Flexible Joint Roll Groove Pipe: in accordance with table below, but not less than one (1) hanger at joints
 - .5 Within 300 mm(12 in.) of each horizontal elbow

Pipe Size (DN [NPS])	Maximum Spacing for Steel (m [ft])	Maximum Spacing for Copper (m [ft])	Rod Diameter (mm)
Up to 32 [1 ¼]	2.1 [7]	1.8 [6]	10
40 [1 ½]	2.7 [9]	2.4 [8]	10
50 [2]	3.0 [10]	2.4 [8]	10
65 [2 ½]	3.7 [12]	3.0 [10]	10
80 [3]	3.7 [12]	3.0 [10]	10
90 [3 ½]	4.0 [13]	3.4 [11]	10
100 [4]	4.3 [14]	3.7 [12]	16
125 [5]	4.9 [16]		16
150 [6]	5.2 [17]		22
200 [8]	5.8 [19]		22

3.2 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
- .4 Paint all supplementary support steel as noted in Section 21 05 01.

END OF SECTION

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.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 21 05 01.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 21 05 01.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section and 21 05 01.

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.
- .2 Refer to Section 21 05 01.

Part 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.

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

2.2 SYSTEM NAMEPLATES

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

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 100	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 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Contract Administrator.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive [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 If facility has existing colours and legends, match existing.
 - .2 Where not listed, obtain direction from Contract Administrator.
 - .3 Colours for legends, arrows: to following table:

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

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

Contents:	Background colour marking:	Legend:
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic cold water supply	Green	DOM. CWS
Sanitary Plumbing vent		SAN SAN. VENT

2.6 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.

2.7 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.

2.8 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.

2.9 LANGUAGE

- .1 Identification in English.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting has been completed.

3.3 INSTALLATION

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

3.4 NAMEPLATES

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

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

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

3.6 VALVES, CONTROLLERS

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

3.7 CLEANING

- .1 Proceed in accordance with Section 21 05 01.

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

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Complete air balance of the following systems as shown on the drawings. Refer to drawings for summarizing each system:
 - .1 Existing exhaust fans on roof. Measure airflow rate prior to removal and re-balance to pre-existing airflow once reinstalled.

1.2 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 TAB to be performed by balancing company who is a registered member of AABC and final TAB report shall bear seal and certification number of AABC registration.

1.3 PURPOSE OF TAB

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

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 and confirm adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Contract Administrator 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 Divisions 21 & 23.

1.7 OPERATION OF SYSTEMS DURING TAB

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

1.8 START OF TAB

- .1 Notify Contract Administrator 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 weatherstripping, sealing, caulking.
 - .3 All pressure, leakage, other tests specified elsewhere in Divisions 21 & 23.
 - .4 All provisions for TAB installed and operational.
 - .5 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 5%, minus 5%.

1.10 ACCURACY TOLERANCES

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

1.11 INSTRUMENTS

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .2 Calibrate within 3 months of TAB.

1.12 SUBMITTALS

- .1 Submit, prior to commencement of TAB:

- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.13 TAB REPORT

- .1 TAB report to show all results in Imperial units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
 - .3 Date of TAB, date of report.
- .2 Submit one copy of TAB Report to Contract Administrator for verification and approval, in English in D-ring binders, complete with index tabs.
- .3 Incorporate review comments and submit 3 copies of final report.

1.14 SETTINGS

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

1.15 COMPLETION OF TAB

- .1 TAB to be considered complete only when final TAB Report received and approved by Contract Administrator.

1.16 AIR SYSTEMS

- .1 Standard TAB to be to most stringent of TAB standards of AABC or ASHRAE.
- .2 Do TAB of following systems, equipment, and components including all grilles, dampers and zone pressurization unless otherwise stated.
 - .1 Existing exhaust fans on roof. Measure airflow rate prior to removal and re-balance to pre-existing airflow once reinstalled.
- .3 Measurements: to include, but not limited to, the following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb), duct cross-sectional area, RPM electrical power.
- .4 Locations of equipment measurements; to include, but not limited to, the following as appropriate:
 - .1 Outlet of each damper, grille, terminal unit and fan.
 - .2 At controllers, 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 (or grille, register or diffuser).

1.17 OTHER TAB REQUIREMENTS

- .1 Smoke management systems:

- .1 Test for proper operation of all smoke and fire dampers, sensors, detectors installed as component parts of air systems specified Division 23.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM B 209M-07, Standard Specification for Aluminum and Aluminum –Alloy Sheet and Plate (Metric).
 - .2 ASTM C 335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C 411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulation and Finishing Cement.
 - .5 ASTM C 547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C 612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C 795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 ASTM C 921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Thermal Insulation Association of Canada (TIAC)
 - .1 TIAC National Insulation Standards (2005).

*** All Codes and Standards are to the latest editions

1.2 DEFINITIONS

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

Part 2 PRODUCTS

2.1 GENERAL

- .1 Components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
- .2 Materials to be tested in accordance with ASTM C411.

2.2 D-2 MINERAL FIBRE BLANKET WITH VAPOUR BARRIER -40 TO +600 C

- .1 Application: on exterior of round ductwork where exposed above roof and within 10 feet below roof and where noted on the drawings.
- .2 Material:
 - .1 CAN/CGSB-51.11, CAN/CGSB-51.5M; Type II, (FSKfacing), inorganic glass fibre blanket, 16 kg/m³ (1 lb/ft³).
 - .2 Acceptable material: Knauf Duct Wrap or approved equal.
- .3 Thickness:
 - .1 Fresh air intakes: 50mm, (2 in).
 - .2 Exhaust ducts where noted: 40mm, (1 ½ in).
 - .3 Supply air ducts: 40mm, (1 ½ in).

2.3 INSULATION BOARD

- .1 Application: on exterior of any outdoor rectangular ductwork where exposed above roof and within 10 feet below roof and where noted on the drawings..
- .2 Material:
 - .1 CAN/ULC S102-M88, CAN/CGSB-51-GP-10M, CAN/CGSB 51-GP-52M (facings); Type II, (FSKfacing), inorganic glass fibre, 48.1 kg/m³ (3 lb/ft³) (concealed areas), 96.1 kg/m³ (6 lb/ft³) (exposed areas).
 - .2 Acceptable material: Knauf Duct Wrap or approved equal.
- .3 Thickness:
 - .1 Fresh air intakes: 50mm, (2 in).
 - .2 Exhaust ducts where noted: 40mm, (1 ½ in).
 - .3 Supply air ducts: 40mm (1 ½ in).

2.4 FASTENINGS

- .1 Tape: self adhesive, 100 mm(4 in.) wide, ULC labeled for less than 25 flame spread and less than 50 smoke developed.

2.5 JACKETTING

- .1 Aluminum (outdoor service)
 - .1 To ASTM B209 with moisture barrier
 - .2 Thickness: 0.50 mm sheet
 - .3 Finish: Smooth

- .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel
 - .1 Stainless Steel: Type 304
 - .2 Thickness: 0.25 mm sheet
 - .3 Finish: Smooth
- .2 PVC (indoor service, exposed)
 - .1 High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - .2 Adhesive: As recommended by insulation material manufacturer.
 - .3 PVC Jacket Color: White.

2.6 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, 75mm wide minimum.

Part 3 EXECUTION

3.1 APPLICATION

- .1 Apply insulation after required tests have been completed and approved by Contract Administrator.
- .2 Surfaces shall be clean and dry during application of insulation and finishes.
- .3 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified.
- .4 Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves and supports.
- .5 Insulate strap hangers 100 mm beyond insulated duct.
- .6 Use stand-offs for duct mounted control accessories.
- .7 Apply 1.0 mm thick galvanized sheet metal corners (nosings) in traffic areas to ductwork in mechanical rooms.

3.2 INSTALLATION

- .1 General:
 - .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
 - .2 Adhere and seal vapour barrier using vapour seal adhesives.
 - .3 Stagger longitudinal and horizontal joints on multi layered insulation.

- .2 Mechanical fastenings:
 - .1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 200 mm centres, but not less than 2 rows per side and bottom.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B 209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C 335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C 547-2003, Mineral Fiber Pipe Insulation.
 - .7 ASTM C 795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C 921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 21 05 01.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 21 05 01- Mechanical. Include product characteristics, performance criteria, and limitations.
 - .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 21 05 01.
- .4 Samples:
 - .1 Submit samples in accordance with Section 21 05 01.
 - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 21 05 01.
 - .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.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 21 05 01.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

Part 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket and reinforced kraft paper all service jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 .
 - .2 Maximum "k" factor: to CAN/ULC-S702.
 - .3 Acceptable Products:
 - .1 Knauf 1000° with Proto 25/50 rated fitting covers or Approved Equal
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket and reinforced kraft paper all service jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 .
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 .
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 .
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
- .7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

- .1 Insulation: to ASTM C 533.
- .2 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

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

2.4 CEMENT

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

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

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

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 1.6 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Aluminum:
 - .1 To ASTM B 209.
 - .2 Thickness: 0.50 mm sheet.

- .3 Finish: stucco embossed.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .3 Stainless steel:
- .1 Type: 316.
 - .2 Thickness: 0.4 mm.
 - .3 Finish: stucco embossed.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

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

3.3 INSTALLATION

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

3.4 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturer's instructions. Ensure tight joints.

- .2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Insulation securements:.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code:.
- .5 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Insulation securements:.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .6 TIAC Code: A-2.
 - .1 Insulation securements:.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-H.
- .7 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp (°C)	TIAC Code	Pipe sizes (DN [NPS]) and insulation thickness (mm)			
			To 25 [1]	32 to 50 [1-1/4 to 2]	65 to 100 [2-1/2 to 4]	125 to 150 [5 to 6]
Domestic HWS		A-1	25	25	25	25
Domestic CWS		A-3	25	25	25	25
Sanitary Vent		A-3	25	25	25	25
Refrigerant	4-13	A-6	25	25	25	25

(hot gas, liquid, suction)						
Refrigerant (hot gas, liquid, suction)	below	A-6	25	38	38	38

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

3.6 CLEANING

- .1 Proceed in accordance with Section 21 05 01.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for copper tubing and fittings for refrigerant.

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 A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B 280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA International)
 - .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.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 21 05 01.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Submit WHMIS MSDS; 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 21 05 01.

1.5 QUALITY ASSURANCE

- .1 Pre-Installation Meeting:
 - .1 Convene pre-installation meeting one week prior to beginning work and on-site installations.
 - .2 Verify project requirements.
 - .3 Review installation and substrate conditions.
 - .4 Co-ordination with other building subtrades.
 - .5 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 00 20.
- .3 Construction requirements: in accordance with front end specification sections.
- .4 Performance Verification:
 - .1 Provide calculations to show adequate pipe velocities and ensure oil return to compressors.
- .5 Installer Qualifications:
 - .1 The prime mechanical contracting company submitting the bid for this project shall have certified refrigeration mechanics/technicians on staff.
 - .1 Provide copies of at minimum two employee Government of Manitoba Certificate of Qualification as a Journeyman in Refrigeration & Air Conditioning Mechanic having completed an apprenticeship period and passed the required examinations complete with Certificate No.
- .6 Approved Refrigeration Contractor:
 - .1 **Global Mechanical (Current Maintenance Contractor for Split Cooling Systems)**

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.7 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for unit ventilators for incorporation into manual specified in Section 21 05 01.
- .2 Provide brief description of systems at beginning of manual, properly indexed, with details of function, operation, control, and service for each piece of apparatus.

.3 Manufacturer's instructions for installation and, unless otherwise noted, operation, maintenance and service of items.

.1 Include names and addresses of spare parts suppliers.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Materials and resources in accordance with Section 21 05 01.

2.2 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.

.1 Hard copper: to ASTM B 280, type ACR.

.2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.3 FITTINGS

.1 Service: design pressure 4140 kPa and temperature 135 degrees C.

.2 General:

.1 Long radius type for elbows and return bends.

.2 Flexible connections: 10 mm nominal or less using coiled soft copper tubing.

.1 For larger sizes, use seamless flexible bronze hose with bronze wire braid covering.

.2 Use factory sealed neoprene jacket unit where freezing may occur.

.3 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.

.4 Flanged:

.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.

.2 Gaskets: suitable for service.

.3 Bolts, nuts and washers: to ASTM A 307, heavy series.

.5 Flared:

.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.4 PIPE SLEEVES

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

2.5 VALVES

.1 Valves: to ASME B16.34 for valve construction.

- .2 Service valves:
 - .1 Forged brass Class 500 up to 3.5 MPa packless and cast bronze Class 375 up to 4.5 MPa.
 - .2 Moisture proof seal type for below freezing applications.
 - .3 Back seated and ball check for inspection and replacement under pressure.
 - .4 Removable seal cap and gauge port for control capillary connections for compressors.
 - .5 Stop valves:
 - .1 22 mm nominal outside diameter or less, diaphragm packless type with integral mounting bracket, forged brass bodies and bonnets, globe and angle, non-directional type.
 - .2 28 mm nominal outside diameter or larger, heavy globe or angle body, positive sealing, self-aligning, heavy nylon disc.
 - .3 Purge, drain, charging, angle or globe type with flare or brazing type outlet connection with stem for socket wrench and removable seal cap.
- .3 Relief valves:
 - .1 Safety relief type with fusible plug or rupture disc in forged brass body.
 - .2 Reseating type with forged brass body.
 - .3 Duplex valves as indicated or by code regulations arranged so that only one valve can be rendered inoperative at one time.
- .4 Check valves:
 - .1 Spring operated, guided piston type with forged brass body in flare connection sizes up to 22 mm nominal outside diameter.
 - .2 Guided piston type, spring operated with bolted bonnet or cover plate in sweat connections 28 mm nominal outside diameter and above.
 - .3 Provide primary directional check valve and secondary reverse direction check valve arrangement to prevent both charge migration back into the unit from the condenser and prevent over pressurizing of the liquid line caused by volume changes due to liquid line temperature changes in the off mode.
- .5 Solenoid valves:
 - .1 Existing valves shall be used.
- .6 Expansion valves:
 - .1 Existing valves shall be used.

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 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5

3.3 BRAZING PROCEDURES

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

3.4 PIPING INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constriction.
 - .2 Hard drawn copper tubing: do not bend. Minimize use of fittings.
 - .3 When multiple runs are installed, spread pipes 150 mm minimum to allow for expansion and contraction.
 - .4 Install straight, parallel and close to walls and ceilings, with specified pitch.
 - .5 Locate double risers in hot gas or suction piping as indicated.
 - .6 Locate trap every 4.5 m of vertical rise in any suction riser greater than 9 m long.
 - .7 Install piping to prevent condensate or oil from flowing back into compressor or evaporator.
 - .8 Connect branch suction lines from top of suction main using wye-fitting.
 - .1 Install ancillaries and accessories such as back pressure compensating regulators and back pressure regulators horizontal.
 - .9 Do not obstruct view of oil level bulls-eye or run piping to avoid interference for services to compressors.
 - .10 Enclose tubing exposed to mechanical injury in rigid or flexible conduit.
 - .11 Keep piping joints sealed except when fabricating.
 - .12 Limit breakable joints to equipment connections not normally brazed.
 - .1 Limit flared joints to 10 mm nominal outside diameter for field assembly and 16 mm nominal outside diameter for factory assembly.
 - .13 Bleed dry nitrogen into piping when sweating connections.
 - .14 Braze flexible pipe vibration isolators and stub connectors on sealed hermetic compressors using alloys which melt at 620 degrees C or less.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m/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 2MPa and 1MPa 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 degrees C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to Consultant.
- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to Consultant.
- .9 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 Consultant.

3.7 DEMONSTRATION

- .1 Instructions:
 - .1 Post instructions in frame with glass cover in accordance with CSA B52.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Supply and installation of ductwork and accessories as shown on the drawings for all ventilation systems.
- .2 Related Requirements
 - .1 Section 23 07 13.

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 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-01, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
- .5 NBCC, National Building Code of Canada, Part 6.
- .6 NECB, National Energy Code of Canada for Buildings, Part 5.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 21 05 01 –General Provisions - Mechanical.

1.4 QUALITY ASSURANCE

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

Part 2 PRODUCT SEAL CLASSIFICATION

- .1 Classification as follows:

<u>Maximum Pressure Pa</u>	<u>SMACNA Seal Class</u>
500	A

- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.2 SEALANT

- .1 Sealant; oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30° C to plus 93° C.
- .2 Acceptable material: Ductmate Proseal/Fibreseal or approved equal.

2.3 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: standard radius or short radius with single thickness turning vanes Standard (1.5 times width of duct).
 - .2 Round: smooth radius (1.5 times diameter).
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:

- .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45° entry on branch.
- .2 Round main and branch: enter main duct to 45° with conical connection.
- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20° maximum included angle.
 - .2 Converging: 30° maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.

2.4 FIRE STOPPING

- .1 Fire stopping material and installation must not distort duct.

2.5 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.

2.6 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° C to plus 90° C, density of 1.3 kg/m².

2.7 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: 20 in.
- .2 Hanger configuration: to SMACNA.
- .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA following table:

<u>Duct Size</u>	<u>Angle Size</u>	<u>Rod Size</u>
(mm)	(mm)	(mm)
up to 750	25x25x3	6

751 to 1050 40x40x3 6

<u>Duct Size</u> (mm)	<u>Angle Size</u> (mm)	<u>Rod Size</u> (mm)
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50x50x6	10

- .4 Upper hanger attachments:
 - .1 For steel joist: manufactured joist clamp or steel plate washer.
 - .2 For steel beams: manufactured beam clamps.
 - .3 For wood framing: 80 mm(3 in.) long, galvanized lag screws, fastened to structural framing.
 - .4 For concrete: manufactured concrete inserts.

Part 3 EXECUTION

3.1 GENERAL

- .1 Do work in accordance with SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA as indicated/where applicable.
- .4 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .5 Balancing dampers on all branch supply run-outs.

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 SMACNA as follows:

<u>Duct Size</u> (mm [inch])	<u>Spacing</u> (mm [inch])
to 1500 [60]	3000 [120]
1525 [61] and over	2500 [100]

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intakes.
 - .2 Exhaust air wall penetrations.
 - .3 Dishwasher exhaust.
 - .4 Minimum 3 m(118 inches) from duct mounted humidifier in all directions.
- .2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards hoods served. Slope header ducts down toward risers.
- .4 Provide insulating blanket on duct exterior at outside air intakes.

3.4 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.

3.5 FLEXIBLE CONNECTIONS

- .1 Install where 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 each side of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Provision of flexible connectors, and accessories as shown on the drawings.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 21 05 01.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Access doors.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published rating 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 GENERAL

- .1 Manufacture in accordance with CSA B228.1.

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° C to plus 90° C, density of 1.3 kg/m².

2.3 BACK DRAFT DAMPERS

- .1 Where not provided with specific equipment.
- .2 Acceptable product: Price, Nailor, Farr or approved equal.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Flexible connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to all fans.
 - .2 Length of connection: 100 mm.

- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
 - .1 Ducting on each side of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access doors:
 - .1 Size:
 - .1 Minimum 305 x 152 mm for servicing entry.
 - .2 Location:
 - .1 At control dampers.
 - .2 At devices requiring maintenance.
 - .3 At fire dampers and locations required by code.
 - .4 Elsewhere as indicated.
- .3 Turning vanes:
 - .1 Install in accordance with recommendations of supplier, SMACNA and as indicated.

END OF SECTION

1. GENERAL

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Section 21 05 01 – Mechanical General Provisions.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM),
 - .1 ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 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.

2. PRODUCTS

2.1 GOOSENECK HOODS

- .1 Thickness: to ASHRAE and SMACNA.
- .2 Fabrication: to ASHRAE and SMACNA.
- .3 Joints: to ASHRAE and SMACNA and or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal.
- .4 Supports: as indicated.
- .5 Complete with integral birdscreen of 2.7 mm diameter stainless steel wire. Use 12 mm mesh on exhaust, 19 mm mesh on intake.

2.2 GENSET NFPA COMPLIANT VENTILATED ROOF THIMBLE

- .1 Code Compliance: to NFPA 37, NFPA 110 and NFPA 211.
- .2 Product: Non-combustible stainless steel ventilated roof thimble.
 - .1 inExhaust 80 NFPA Roof Thimble with customized length to accommodate variable roof thickness. Contractor to coordinate with roofing contractor to confirm customized length to accommodate roof thickness.

- .3 Joints: to NFPA 37 and manufacturer installation requirements, see section 3 for additional installation requirements.
- .5 Accessories:
 - .1 Rain Guard; Series 82.

3. EXECUTION

3.1 INSTALLATION

- .1 In accordance with manufacturers and SMACNA recommendations.
- .2 Reinforce and brace air vents, intakes and goosenecks as indicated.
- .3 Anchor securely into opening. Seal with caulking all around to ensure weather tightness.
- .4 Thimble in accordance with manufacturers and NFPA 37 & 211 requirements.
Pre-Installation:
 - 1. Use a hi-temperature rated sealant (Mil-A-46106B, 100 Series RTV) or similar for use in this application.
 - 2. Prior to unpacking, check all components for shipping damage.
 - 3. Keep shipping materials intact to protect the unit until installation is complete.
 - 4. Verify the correct parts are received by comparing the nameplate with the packing list.
 - 5. Verify that the thimble and recommended components are of proper size for the mating surface openings and ensure that all mating surfaces are clean and free of foreign material before installation.
 - 6. When cleaning the surfaces, do not use abrasive materials such as steel wool or wire brushes. Use only isopropyl alcohol and clean with soft rags. (Do not use chloride or halidebased cleaners.)
 - 7. Ensure the installation location is free of electrical, plumbing, or any other obstacle.

Installation:

- 1. Cut a hole in the desired installation surface ¼” larger than the thimble diameter or as the installing contractor recommends.
- 2. Apply a bead of sealant around the perimeter of the exterior flashing that will be in contact with the surface and is a minimum of one inch from the edge of the flashing.
- 3. Install the thimble through the hole so that the exterior flashing is flush against the outside surface, clocking as needed.
- 4. Apply a bead of sealant around the perimeter of the interior flashing that will be in contact with the surface and is a minimum of one inch from the edge of the flashing.
- 5. Install the interior flashing and clock as needed.

6. Install corrosion resistant fasteners into both the exterior and interior flashing surfaces, installing the fasteners with the recommended sealant in order to secure the thimble.
7. With thimble installed and fastened to surface, insert exhaust piping through the ID hole of the thimble. Ensure that enough exhaust piping is installed to be able to allow installation of the rain cap and clamp. Ensure that the exhaust piping is not in contact with the inner wall of the thimble.
8. Install a ½” bead of sealant at the gap around the perimeter of the thimble body and the exterior flashing to cover any gaps and prevent leakage.
9. From the exterior of the building, install the rain guard over the exhaust pipe with the included clamp.
10. Tighten the clamp to secure the rain guard to the thimble.
11. Ensure that the ventilation holes/slots are not blocked and are free of obstructions.

Post-Installation

1. Review that all components of your exhaust system are properly installed and ready
2. for operation.
3. If there is any indication of leaks or damage, cease operation immediately and conduct a broader inspection to determine the cause and resolve.
4. After the initial engine run and cool down, re-check all bolts for tightness and torque as required.
5. Exhaust back-pressure must not exceed the allowable back-pressure specified by the engine manufacturer. Excessive exhaust back-pressure reduces engine power and engine life and may lead to high exhaust temperatures and smoke. Engine exhaust back-pressure should be estimated before the layout of the exhaust system is finalized and is recommended to be measured at the exhaust outlet under full-load operation, as needed.
6. Verify that the type and amount of movement generated by the system are acceptable and do not cause damage to the installed product(s).

END OF SECTION