1 General

1.1 USE OF SYSTEMS

.1 Use of new permanent heating systems for supplying temporary ventilation is not permitted .

2 Products

2.1 NOT USED

.1 Not Used.

3 Execution

3.1 NOT USED

.1 Not Used.

End of Section

1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

2 Products

2.1 NOT USED

.1 Not Used.

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 REZONING WALL CONVECTORS

.1 In accordance with drawings, revise piping to provide individual control in each office. Install / revise control valves as required to match layout.
.2 Offset all piping in floor below and rise up through new penetrations. Rise up within partition wall and offset into wall.
.3 No piping shall be visible from finished space.
.4 Provide isolation valves on all new take offs.
.5 Replace all existing isolation valves with ball valves.
.6 all piping must be installed without draining system. Contractor to use tee drill or freeze kits to make tie ins where piping cannot be isolated.
7. Contractor shall be fully responsible for eliminating air locks in all systems once complete, whether or not it is located in the renovated space. Currently there are no air locks in the system.

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 or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.4 DRAINS

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

3.5 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 COUPLINGS

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

3.7 PIPEWORK INSTALLATION

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

.2 Remove interior parts before soldering.
.3 Install with stems above the horizontal position unless otherwise indicated.
.4 Valves to be accessible for maintenance without removing adjacent piping.
.5 Install globe valves in bypass around control valves.
.6 Use gate , butterfly or ball valves for hot system branch take-offs & for isolating purposes.
.7 Use butterfly valves or ball valves for cold system branch take-offs & for isolating purposes. Flange bolts to thread into lug style butterfly valves.
.8 Use chain operators on valves NPS 2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.15 Check Valves:
.1 Install silent check valves on discharge of pumps and elsewhere as indicated.
.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.8 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated. Refer to 21 05 01 for further requirements.
.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 all round 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 fire stopping. 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.

3.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRESTOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Fire stopping.
.2 Uninsulated unheated pipes not subject to movement: No special preparation.
.3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging fire stopping material or installation.
.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance with Cleaning and Start-up of Mechanical Piping Systems.
.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Engineer 48 hours minimum prior to performance of pressure tests.
.2 Pipework: Test at 1034 kPa or as specified in relevant sections .
.3 Maintain specified test pressure without loss for four 4 hours minimum unless specified for longer period of time in relevant sections.
.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
.5 Bear costs for repairs or replacement, retesting, and making good. Engineer to determine whether repair or replacement is appropriate.
.6 Insulate or conceal work only after tests have been reviewed by the representative of the general contractor.

3.13 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Departmental Representative / OWNER facility operators.
.2 Request written approval 10 days minimum, prior to commencement of work.
.3 Be responsible for damage to existing plant by this work.
.4 Ensure daily clean-up of existing areas.

End of Section

1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  .1 ASHRAE 90.1-01, Energy Code for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

1.2 SECTIONS INCLUDES

.1 Electrical work to conform to Electrical Specifications including the following:
  .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
  .2 Refer to Electrical Specifications for control wiring and conduit except for conduit, wiring and connections below 50 V which are related to control systems specified in Mechanical. Refer to Electrical Specifications for quality of materials and workmanship.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Submittal Procedures.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Submittal Procedures.

2 Products

2.1 GENERAL

.1 Motors not fitted with variable speed drives to be high efficiency, in accordance with the requirements of ASHRAE 90.1.

.2 All motors to be used with variable frequency drives to be inverter grade with insulation suitable for 2000 V minimum & operating frequency range from 10 to 60 hz. The characteristics of the inverter grade motors are to be suitable for use on variable frequency drives as specified in Mechanical & Electrical divisions.

.3 See also equipment schedule.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 600 V, premium efficiency unless otherwise specified or indicated.

.4 All motors to be used with variable frequency drives to be inverter labeled with insulation suitable for 2000 V minimum, & operating frequency range from 10 to 60 hz. The characteristics of the inverter labeled motors are to be suitable for use on variable frequency drives.

2.3 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.

.3 For motors under 7.5 kW : standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave to be determined during start-up.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed.

2.4 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
- .3 38 mm dia holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

- .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
- .2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

3 Execution

3.1 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.2 START- UP

1. Set-up, Start-up by factory approved representative.

End of Section

1 General

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM A53/A53M-01, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .2 ASTM A105/A105M-01, Specification for Carbon Steel Forgings, for Piping Applications.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.
.2 Indicate for items as applicable:
- .1 Manufacturer, model number, line contents, pressure and temperature rating.
- .2 Movement handled; axial, lateral, angular and the amounts of each.
- .3 Nominal size and dimensions including details of construction and assembly.

1.3 CLOSEOUT SUBMITTALS

.1 Submit maintenance data in accordance with Closeout Submittals.
.2 Data to include:
- .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

2 Products

2.1 FLEXIBLE CONNECTION

.1 Application: to suit motion at piping connection points to equipment.
.2 Minimum length in accordance with manufacturer's recommendations to suit application
.3 Inner hose: bronze corrugated.
.4 Braided wire mesh bronze outer jacket.
.5 Diameter and type of end connection to suit application.
.6 Operating conditions:
- .1 To match system requirements.

2.2 ANCHORS AND GUIDES

.1 Anchors:
- .1 Construct anchors of welded structural steel members or use manufactured anchors suitable for the application. When anchoring copper piping, provide dielectric barrier to protect piping.
- .2 Concrete: to Cast-in-Place Concrete.

.3 Reinforcement: to Concrete Reinforcement.

.2 Alignment guides:

.1 Use pre-manufactured guides suitable for material and application.

.2 To accommodate specified thickness of insulation.

.3 Vapour barriers, jackets to remain uninterrupted.

3 Execution

3.1 INSTALLATION

.1 Install expansion joints with cold setting. Make record of cold settings.

.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.3 Install expansion joints, pipe anchors and guides where indicated and in other locations as required to suit application. Anchors to withstand 150% of axial thrust.

.4 Calculate expected movement for the installed lengths and the following temperature ranges and select expansion joints accordingly:

.1	Heated water:	10^{o}C min,	150^{o}C max
.2	DHW, DHWR	10^{o}C min,	60^{o}C max

3.2 CLEANING AND START- UP

.1 In accordance with Cleaning and Start-up of Mechanical Piping Systems.

3.3 PERFORMANCE VERIFICATION

.1 In accordance with Performance Verification: Mechanical Piping Systems.

End of Section

1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME B1.20.1-1983(R1992), Pipe Threads, General Purpose (Inch).

.2 American Society for Testing and Materials (ASTM)
- .1 ASTM A276-98b1, Specification for Stainless and Heat Resisting Steel Bars and Shapes.
- .2 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
- .3 ASTM B283-91, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
- .4 ASTM B505-96, Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
- .1 SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
- .2 SP-80-1999, Bronze Gate Globe, Angle and Check Valves.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.

.2 Submit data for all valves specified in this section.

1.3 CLOSEOUT SUBMITTALS

.1 Submit maintenance data for incorporation into manual specified in Closeout Submittals.

2 Products

2.1 GENERAL

.1 Except for specialty valves, to be single manufacturer.

.2 All products to have CRN registration numbers.

2.2 END CONNECTIONS

.1 Connection into adjacent piping/tubing:
- .1 Steel pipe systems: Screwed ends.
- .2 Copper tube systems: Solder ends.

2.3 GATE VALVES

.1 Requirements common to all gate valves, unless specified otherwise:
- .1 Standard specification: MSS SP-80.
- .2 Bonnet: with hex. shoulders.
- .3 Connections: with hex. shoulders.
- .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
- .5 Packing: high grade non-asbestos packing.
- .6 Handwheel: non-ferrous. Nut: bronze to ASTM B62.

.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125:
- .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
- .2 WP = 860 kPa steam, 1.4 MPa WOG.
- .3 Operator: Handwheel.

.3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
- .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
- .2 WP = 1.03 MPa steam, 2.07 MPa WOG.
- .3 Operator: Handwheel.

.4 NPS 2 and under, rising stem, split wedge disc, Class 125:
- .1 Body: with long disc guides, screwed bonnet.
- .2 WP = 860 MPa steam, 1.4 MPa WOG.
- .3 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.
- .4 Operator: Handwheel.

.5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
- .1 Body: with long disc guides, screwed bonnet.
- .2 WP = 860 MPa steam, 1.4 MPa WOG.
- .3 Operator: Handwheel.

.6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
- .1 Body: with long disc guides, screwed bonnet.
- .2 WP = 1.03 MPa steam, 2.07 MPa WOG.
- .3 Operator: Handwheel.

2.4 GLOBE VALVES

.1 Requirements common to all globe valves, unless specified otherwise:
- .1 Standard specification: MSS SP-80.
- .2 Bonnet: with hex. shoulders.
- .3 Connections: with hex. shoulders.
- .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
- .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
- .6 Handwheel: non-ferrous. Nut: bronze to ASTM B62.

.2 NPS 2 and under, composition disc, Class125:
- .1 Body and bonnet: screwed bonnet.
- .2 WP = 860 kPa steam, 1.4 MPa WOG.
- .3 Disc and seat: renewable rotating PTFE disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.4 Operator: Handwheel.

.3 NPS 2 and under, composition disc, Class 150:
- .1 Body and bonnet: union bonnet.
- .2 WP = 1.03 MPa steam, 2.07 MPa WOG.
- .3 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
- .4 Operator: Handwheel.

.4 NPS 2 and under, plug disc, Class 150, screwed ends:
- .1 Body and bonnet: union bonnet.
- .2 WP = 1.03 MPa steam, 2.07 MPa WOG.
- .3 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.
- .4 Operator: Handwheel.

.5 Angle valve, NPS 2 and under, composition disc, Class 150:
- .1 Body and bonnet: union bonnet.
- .2 WP = 1.03 MPa steam, 2.07 MPa WOG.
- .3 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
- .4 Operator: Handwheel.

2.5 CHECK VALVES

.1 Requirements common to all check valves, unless specified otherwise:
- .1 Standard specification: MSS SP-80.
- .2 Connections: with hex. shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:
- .1 Body: Y-pattern with integral seat at 45º, screw-in cap with hex head.
- .2 WP = 860 kPa steam, 1.4 MPa WOG.
- .3 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.3 NPS 2 and under, swing type, bronze disc:
- .1 Body: Y-pattern with integral seat at 45º, screw-in cap with hex head.
- .2 Class 150, WP = 1.03 MPa steam, 2.07 MPa WOG.
- .3 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.4 NPS 2 and under, swing type, composition disc, Class 200:
- .1 Body: Y-pattern with integral seat at 45º, screw-in cap with hex head. WP = 1.4 MPa cold water.
- .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.

.5 NPS 2 and under, horizontal lift type, composition disc, Class150:
- .1 Body: with integral seat, union bonnet ring with hex shoulders, cap. WP = 1.03 MPa steam, 2.7 MPa WOG.
- .2 Disc: renewable PTFE rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.

.6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
- .1 Body: with integral seat. WP = 860 kPa steam, 1.4 MPa WOG.
- .2 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

2.6 SILENT CHECK VALVES

.1 NPS 2 and under:
- .1 Body: cast high tensile bronze to ASTM B62 with integral seat.
- .2 Pressure rating: Class 125, WP = 860 kPa steam, 1.4 MPa WOG.
- .3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.
- .4 Disc and seat: renewable rotating disc.
- .5 Stainless steel spring, heavy duty.
- .6 Seat: regrindable.

2.7 BALL VALVES

.1 NPS 2 and under:
- .1 Body and cap: cast high tensile bronze to ASTM B62.
- .2 Pressure rating: Class125, 860 kPa steam, WP = 1.4 MPa WOG.
- .3 Connections: Screwed ends to ANSI B1.20.1 and with hex. shoulders.
- .4 Stem: tamperproof ball drive.
- .5 Stem packing nut: external to body.
- .6 Ball and seat: replaceable stainless steel solid ball and teflon seats.
- .7 Stem seal: TFE with external packing nut.
- .8 Operator: removable lever handle.

3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.
.2 Remove internal parts before soldering.
.3 Use full port ball valves for isolation services 50mm and lower.
.4 Replace all existing isolation valves in cabinets with new ball valves.
.5 Ensure full motion of handles are unobstructed.

End of Section

1 General

1.1 REFERENCES

.1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
  .1 ANSI/ASME B31.1-01, Power Piping, (SI Edition).
.2 American Society for Testing and Materials (ASTM)
  .1 ASTM A125-1996, Specification for Steel Springs, Helical, Heat-Treated.
  .2 ASTM A307-00, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  .3 ASTM A563-00, 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 SP58-1993, Pipe Hangers and Supports - Materials, Design and Manufacture.
  .2 MSS SP69-1996, Pipe Hangers and Supports - Selection and Application.
  .3 MSS SP89-1998, Pipe Hangers and Supports - Fabrication and Installation Practices.
.5 Underwriter's Laboratories of Canada (ULC)

1.2 DESIGN REQUIREMENTS

.1 Design and construct pipe hangers and supports to component manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
.4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
.5 Provide for vertical adjustments after erection. Amount of adjustment to be in accordance with MSS SP58.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Submittal Procedures.
.2 Submit shop drawings and product data for following items:
  .1 Bases, hangers and supports.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Closeout Submittals.

2 Products

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

.1 Finishes:
- .1 Pipe hangers and supports: galvanized after manufacture.
- .2 Use electro-plating galvanizing process.
- .3 Ensure steel hangers in contact with copper piping are copper plated.

.2 Upper attachment structural: Suspension from lower flange of I-Beam.
- .1 Cold piping NPS 2 maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut and.
  - .1 Rod: 9 mm UL listed.
- .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed FM approved.

.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.
- .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

.4 Upper attachment to concrete.
- .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
- .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.

.5 Shop and field-fabricated assemblies.
- .1 Provide Trapeze hanger assemblies.
- .2 Provide Steel brackets.

.6 Hanger rods: threaded rod material to MSS SP58.
- .1 Ensure that hanger rods are subject to tensile loading only.
- .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .3 Do not use 22 mm or 28 mm rod.

.7 Pipe attachments: material to MSS SP58.
- .1 Attachments for steel piping: carbon steel black.
- .2 Attachments for copper piping: copper plated black steel.
- .3 Use insulation shields for hot pipework.
- .4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
- .1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
- .1 Finishes for steel pipework: black.
- .2 Finishes for copper, glass, brass or aluminum pipework: black.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:
- .1 64 kg/m3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:
- .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.5 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, 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.

.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 to be complete with factory calibrated travel stops.
.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/- 5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Structural Steel for Buildings. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.9 PLATFORMS AND CATWALKS

.1 Provide platforms & catwalks required for equipment access & servicing. Refer to 21 05 01.

2.10 OTHER EQUIPMENT SUPPORTS

.1 From structural grade steel meeting requirements of Section Structural Steel for Buildings.
.2 Refer to 21 05 01

3 Execution

3.1 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, elsewhere as indicated.
.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 be to industry standards.

.3 Steel pipes: Install below coupling or shear lugs welded to pipe.
.4 Cast iron pipes: Install below joint.

.4 Clevis plates:
.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 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.

.7 Use variable support spring hangers where:
.1 transfer of load to adjacent piping or to connected equipment is not critical.
.2 variation in supporting effect does not exceed 25 % of total load.

3.2 HANGER SPACING

.1 Plumbing piping: most stringent requirements of Canadian Plumbing Code.
.2 Fire protection: to applicable fire code.
.3 Gas and fuel oil 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.
.7

Max Pipe Size	Max Spacing Steel	Max 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	

.8 Pipework greater than NPS 12: to MSS SP69.

3.3 HANGER INSTALLATION

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

3.4 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

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

3.5 FINAL ADJUSTMENT

.1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.

.2 Adjustable clevis:
- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.

.3 C-clamps:
- .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:
- .1 Hammer jaw firmly against underside of beam.

End of Section

1 General

1.1 REFERENCES

.1 National Fire Protection Association (NFPA)
  .1 NFPA 13, Installation of Sprinkler Systems.
.2 National Building Code of Canada (NBC)

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Submittal Procedures.

2 Products

2.1 GENERAL

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

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9mm minimum thick; 50 durometer; maximum loading 350 kPa.
.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

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

2.4 SPRINGS

.1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond

rated load. Units to be complete with leveling devices.

.2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.

.3 Cadmium plate for outdoor installations.

.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with iso-stiff springs and limit stop.

2.6 HANGERS

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

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

.6 Type H5 - Neoprene in shear hanger. Neoprene isolation grommet as recommended by equipment manufacturer.

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.8 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

3 Execution

3.1 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.3 Where isolation is bolted to floor use vibration isolation rubber washers.

.4 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

.6 Isolation Schedule

Equipment	**Base Type**	**Isolation Thickness**	**type**	**Defl.**
fan-coil units	H5	6mm		
small fans hung from structure	H5	6mm		
large fans hung from structure	H2	20mm		
base-mount pumps	B3	150mm	M3	40mm
roof-mount condensers	EP3	6mm		
pulse boilers	M5	40mm		

3.2 SITE VISIT

.1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Engineer.

.2 Provide Engineer with notice 24 h in advance of visit.

.3 Make adjustments and corrections in accordance with written report.

3.3 TESTING

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Testing Adjusting and Balancing.

.2 Vibration measurements shall be taken for chillers, boilers, pumps (over 1 hp), fans (over 1 hp)

.3 Provide Engineer with notice 24 h in advance of commencement of tests.

.4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.5 Submit complete report of test results.

End of Section

1 General

1.1 REFERENCES

.1 Canadian Gas Association (CGA)
  .1 CSA/CGA B149.1-00, 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
  .1 NFPA 13-1999, Installation of Sprinkler Systems.
  .2 NFPA 14-2000, Standpipe and Systems.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.
.2 Product data to include paint colour chips, other products specified in this section.

1.3 SAMPLES

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

2 Products

2.1 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, 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	Hgt of Letters(mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8

9	35 x 200	1	20

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

.4 Locations:

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

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

2.2 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

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

.2 Propane gas: to CSA/CGA B149.1.

.3 Sprinklers: to NFPA 13.

.4 Standpipe and hose systems: to NFPA 14.

2.3 MECHANICAL IDENTIFICATION

.1 Identify piping, ductwork and equipment throughout with pre-manufactured coloured banding, labels and direction of flow arrows. Paint natural gas lines yellow, throughout their entire length. Include service labeling and direction of flow arrows.

.2 pipe diameters listed include insulation thickness

.1 Piping up to 1 3/8" dia: Brady B-689 high performance coiled wrap-around, ½" letter height

.2 Piping 1 ½" to 2 3/8" dia: Brady B-689 high performance coiled wrap-around, ¾" letter height

.3 Piping 2 ½" to 7 7/8" dia: Brady B-689 high performance coiled wrap-around, 1 1/4" letter height

.4 Piping over 8" dia: Brady B-681 high performance strap-on HPHV, 3 ½" letter height

.5 Ductwork Brady B-946 self-sticking vinyl, 3 ½" letter height

.2 Tag automatic controls, instruments and relays and key to schematics on which instruments are numbered. Tags for controls to be laminated plastic, tie-wrapped to device.

.3 Tag valves with 2" dia brass tag with impression-stamped service & valve no. Service ID to Departmental Representative Standard. When valves are located above suspended ceilings, provide Brady Valve-Finder ceiling tack to identify valve location.

.4 Permanently attach to each piece of equipment a custom 2 ½" x 5" stainless steel nameplate, mechanically fastened with raised or recessed letters.

.5 Include on nameplates, CRN numbers, Underwriter's Laboratories and CSA approval numbers, size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors, pump design flow rates at design head, fan airflow rates at

design static pressure, rpm, fan class, maximum fan rpm for classification.

.6 Submit proposed nameplate arrangements for review and approval.

.7 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

.8 Location of Identification:

.1 Locate markers on piping systems so they can be read from floor platform.

.2 Identify piping & ductwork runs at 30' intervals and at least once in each room.

.3 Identify both sides where piping passes through walls, partitions and floor platform.

.4 Identify piping at starting and ending points of runs and at each piece of equipment.

.5 Identify piping at major manual and automatic valves immediately upstream of valves. Where this is not possible, place identification as close to valve as possible.

.6 Identify branch, equipment or building served after such valve.

.7 Identify location of fan-coils, VAV terminal units, terminal heat / cool units and other equipment above T-bar ceilings with stick-on clear labels with equipment identifier number, ie; RU-FC-305 Use Arial size 10 font. Locate labels on Tee's in vicinity of equipment.

.8 Submit sample equipment nameplates, controls tags, valve tags, equipment location labels, pipe banding with flow arrows & service, duct identification for review as part of shop drawing submission.

.9 Colours and Legends:

.1 Where not listed, obtain direction from Engineer.

.2 Colours for legends, arrows: To following table:

Background colour:	**Legend, arrows:**
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	**Background colour**	**marking Legend**
City water	Green	CITY WATER
Treated water	Green	TREATED WATER

Condenser water sup.	Green	COND. WTR. SUPPLY
Condenser water ret.	Green	COND. WTR. RETURN
Chilled water sup.	Green	CH. WTR. SUPPLY
Chilled water ret.	Green	CH. WTR. RETURN
Heated water sup.	Yellow	HEATING SUPPLY
Heated water ret.	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Steam 40 kPa	Yellow	40 kPa STEAM
Condensate	Yellow	ST.COND.RET
Safety valve vent	Yellow	STEAM VENT
Dom. hot water sup.	Green	DHW
Dom. HW recirc.	Green	DHW RECIRC
Dom. hot wtr. soft	Green	DHWS
Dom. cold water sup.	Green	DCW
Dom. cold wtr. soft	Green	DCWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrig. suction	Yellow	REF. SUCTION
Refrig. liquid	Yellow	REF. LIQUID
Refrig. hot gas	Yellow	REF. HOT GAS
Natural gas	Yellow	NAT GAS __kPa
Gas regulator vents	Yellow	to Codes
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

.10 Identify Conduit for low voltage control wiring in accordance with Electrical Specifications.

.11 Identify in-slab piping loop supply and return ends with factory-manufactured permanent labels at manifolds and cross-reference to piping loops indicated on as-built drawings.

3 Execution

3.1 TIMING

.1 Provide identification only after all painting specified Section Interior Painting has been completed.

3.2 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to Departmental Representative PMSS.

3.3 NAMEPLATES

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

3.4 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, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
.9 Identification to be easily and accurately readable from usual operating areas and from access points.
  .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

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

End of Section

1 General

1.1 GENERAL

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

1.2 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.3 EXCEPTIONS

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

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 third party Systems Commissioning and acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.5 PRE-TAB REVIEW

.1 Review contract documents before project construction is started confirm in writing to Engineer adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Engineer in writing all proposed procedures which vary from standard.

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

1.6 START- UP

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

1.7 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

1.8 START OF TAB

.1 Notify Engineer 14 days prior to start of TAB.
.2 Start TAB when building is essentially completed, including:
.3 Installation of ceilings, doors, windows, other construction affecting TAB.
.4 Application of weather stripping, sealing, caulking.
.5 All pressure, leakage, other tests specified elsewhere.
.6 All provisions for TAB installed and operational.
.7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
    .1 Proper thermal overload protection in place for electrical equipment.
    .2 Air systems:
        .1 Filters in place, clean.
        .2 Duct systems clean.
        .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
        .4 Correct fan rotation.
        .5 Fire, smoke, volume control dampers installed and open.
        .6 Coil fins combed, clean.
        .7 Access doors, installed, closed.
        .8 Outlets installed, volume control dampers open.
    .3 Liquid systems:
        .1 Flushed, filled, vented.
        .2 Isolating and balancing valves installed, open.
        .3 Calibrated balancing valves installed, at factory settings.
        .4 Chemical treatment systems complete, operational.

1.9 APPLICATION TOLERANCES

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

1.10 ACCURACY TOLERANCES

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

1.11 INSTRUMENTS

.1 Calibrate instruments in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
.2 Calibrate within 3 months of TAB. Provide certificate of calibration to Engineer.

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 Format to be in accordance with referenced standard .
.2 TAB report to show results in SI units and to include:
  .1 Project record drawings.
  .2 System schematics.
  .3 ACAD floor plans schematically indicating as-built equipment, flow control valves, terminal unit, thermostat, diffuser, grille locations, design air/fluid flow rates, actual adjusted air / fluid flow rates.
.3 Submit 6 copies of TAB Report to Engineer for verification and approval, in English in D-ring binders, complete with index tabs.

1.14 VERIFICATION

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

1.15 SETTINGS

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

1.16 COMPLETION OF TAB

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

1.17 AIR SYSTEMS

.1 Standard: TAB to be to most stringent of TAB standards of AABC.
.2 Do TAB of systems, equipment, components, controls identified in Mechanical drawings & specifications.
.3 Qualifications: personnel performing TAB to have a working knowledge of AABC methods & requirements.
.4 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
.5 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
    .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
    .2 At controllers, controlled device.
.6 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.18 OTHER TAB REQUIREMENTS

.1 Building pressure conditions:
    .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during summer design conditions.
.2 Measurement of noise and vibration from mechanical equipment specified where required by engineer.
.3 Measurement of spatial noise where required by Engineer.
.4 Notify consultant of any excessive noise generated during balancing. Values may require field modification or ductwork rectification before balancing can be completed

1.19 POST- OCCUPANCY TAB

.1 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

2 Products

2.1 NOT USED

.1 Not used.

3 Execution

3.1 NOT USED

.1 Not used.

End of Section

1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ASHRAE Standard 90.1- 1989 .

.2 American Society for Testing and Materials (ASTM).
- .1 ASTM B 209M- 92a , Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- .2 ASTM C 335- 95 , Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C 411- 82(1992) , Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C 449M- 88 , Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C 795- 92 , Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
- .6 ASTM C 921- 89 , Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-51.2- 95 , Thermal Insulation, Calcium Silicate, for Piping, Machinery and Boilers.
- .2 CAN/CGSB-51.9- 92 , Mineral Fibre Thermal Insulation for Piping and Round Ducting.
- .3 CAN/CGSB-51.10- 92 , Mineral Fibre Board Thermal Insulation.
- .4 CAN/CGSB-51.11- 92 , Mineral Fibre Thermal Insulation Blanket.
- .5 CAN/CGSB-51.12- 95 , Cement, Thermal Insulating and Finishing.
- .6 CAN/CGSB-51.40- 95 , Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
- .7 CGSB 51-GP-52Ma- 89 , Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Manufacturer's Trade Associations.
- .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102- M88 , Surface Burning Characteristics of Building Materials and Assemblies.

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" - means "not concealed" as defined herein.
- .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:
.1 CRD: Code Round Ductwork,
.2 CRF: Code Rectangular Finish.

1.3 SHOP DRAWINGS

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

1.4 MANUFACTURER'S INSTRUCTIONS

.1 Follow manufacturer's installation instructions.
.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.5 QUALIFICATIONS

.1 Installer to be specialist in performing work of this section, and have at least3 years successful experience in this size and type of project qualified to standards of TIAC.

1.6 DELIVERY, STORAGE AND HANDLING

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

2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
.2 Thermal conductivity ("k" factor) not to exceed specified values at 24C mean temperature when tested in accordance with ASTM C 335.
.3 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB51.10, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to CAN/CGSB-51.11 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  .1 Mineral fibre: to CAN/CGSB-51.11.
  .2 Jacket: to CGSB 51-GP-52Ma.
  .3 Maximum "k" factor: to CAN/CGSB-51.11.

2.3 JACKETS

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

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:
  .1 Water based, fire retardant type, compatible with insulation.
.2 Indoor Vapour Retarder Finish:
  .1 Vinyl emulsion type acrylic, compatible with insulation.
.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
.4 ULC Listed Canvas Jacket:
  .1 220 gm/m 2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921 .
.6 Tape: self-adhesive, aluminum, plain , 50 mm wide minimum.
.7 Contact adhesive: quick-setting
.8 Canvas adhesive: washable.
.9 Tie wire: 1.5 mm stainless steel.
.10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
.11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation .
.12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

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

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.
.2 Apply materials in accordance with manufacturers instructions and this specification.
.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  .1 Hangers, supports to be outside vapour retarder jacket.
.5 Supports, Hangers
  .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
.6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

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

Service	TIAC Code	Vapour Retarder	mm	Thickness
Rect.cold and dual temperature supply air ducts	C-1	yes	25	
Round cold and dual temp. supply air ducts	C-2	yes	25	
Rectangular warm air ducts	C-1	yes	25	
Round warm air ducts	C-2	yes	25	
Supply, return and exhaust ducts exposed in space being served	none			
Mixing plenums		C-1	yes	50
Exhaust ducts between dampers and discharge	C-1	yes	50	
Acoustically lined ducts	none			

End of Section

1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ASHRAE Standard 90.1-99, Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings (Including Addenda B, C, D, E, F, G, I and M) (includes supplements).

.2 American Society for Testing and Materials (ASTM)
- .1 ASTM B209M-01, Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
- .2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C795-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .6 ASTM C921-89(1996), 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) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Manufacturer's Trade Associations
- .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 1999).

.5 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-M88(R2000), 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

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" - means "not concealed" as defined herein.

.2 TIAC ss:
- .1 CRF: Code Rectangular Finish.
- .2 CPF: Code Piping Finish.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Submittal Procedures.
.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.4 MANUFACTURERS' INSTRUCTIONS

.1 Follow manufacturer's installation instructions.
.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.5 QUALIFICATIONS

.1 Installer to be specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.6 DELIVERY, STORAGE AND HANDLING

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

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 oC mean temperature when tested in accordance with ASTM C335.
.3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
  .1 Mineral fibre: to CAN/ULC-S702.
  .2 Maximum "k" factor: to CAN/ULC-S702.
.4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.5 TIAC Code C-2: Mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.6 TIAC Code A-6: Flexible unicellular tubular elastomer.
.1 Insulation: with vapour retarder jacket.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 To be certified by manufacturer to be 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 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

.1 Tape: Self-adhesive, aluminum, plain, 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 on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 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: white
.3 Minimum service temperatures: -20oC.
.4 Maximum service temperature: 65oC.

.5 Moisture vapour transmission: 0.02 perm.
.6 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.
.7 Special requirements:
.1 Outdoor: UV rated material at least 0.5 mm thick.
.2 ABS Plastic:
.1 not approved for building
.3 Canvas:
.1 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.2 Lagging adhesive: Compatible with insulation.

2.8 WEATHERPROOF CAULKING FORJACKETS INSTALLED OUTDOORS

.1 Caulking to: Section Joint Sealers.

3 Execution

3.1 PRE- INSTALLATION REQUIREMENT

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

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.
.2 Apply materials in accordance with manufacturers instructions and this specification.
.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Hangers, supports to be 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.
.6 Clad all piping with PVC jacketting, except where concealed within walls, in crawlspace or above concealed ceilings.
.7 Clad all piping outside the building with aluminum jacketing. Ensure jacket is 100% sealed and water tight.

3.3 INSTALLATION OF ELASTOMERIC INSULATION

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

3.4 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
.2 TIAC Code: A-1.
  .1 Securements: SS Wire at 300 mm oc.
  .2 Seals: lap seal adhesive, lagging adhesive.
  .3 Installation: TIAC Code 1501-H.
.3 TIAC Code: A-3.
  .1 Securements: SS Wire at 300 mm oc.
  .2 Seals: VR lap seal adhesive, VR lagging adhesive.
  .3 Installation: TIAC Code: 1501-C.
.4 TIAC Code: A-6.
  .1 Installation: TIAC Code.
.5 TIAC Code: C-2 vapour retarder jacket.
  .1 Seals: lap seal adhesive, lagging adhesive.
  .3 Installation: TIAC Code: 1501-C.
.6 TIAC Code: A-2.
  .1 Seals: lap seal adhesive, lagging adhesive.
  .3 Installation: TIAC Code: 1501-H.
.7 Thickness of insulation to be as listed in following table.
  .1 Do not insulate exposed run outs to plumbing fixtures, chrome plated piping, valves, fittings.

Service	**TIAC Code**	**Pipe Size**	**Thickness Insulation**
Condensate:	none required		
Hot Water	Code A-3:	run-out to 25 dia.	25mm
		32 dia to 50mm	38mm
		63 dia to 250 dia	50mm
Hot Water Outside	Code A-3:	all .	75mm
Dom. Hot Water, DHWS	Code A-3:	run-out to 50 dia.	25mm
		63 dia to 250 dia	38mm
Dom. Cold Water, DCWS	Code A-3:	run-out to 25 dia.	13mm
		32 dia to 150 dia	25mm

Rainwater Piping,	Code C-2:	all sizes 25mm plumbing vents

.8 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms: PVC jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Installation: To appropriate TIAC code CRF/1 through CPF/5.

End of Section

1 General

1.1 CLEANING AND START- UP OF MECHANICAL PIPING SYSTEMS

.1 In accordance with Cleaning and Start-up of Mechanical Piping Systems.

1.2 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Timing:
- .1 After cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:
- .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
- .2 Verify performance of hydronic system circulating pumps as specified in relevant technical sections, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
  - .1 Pump operation.
  - .2 Boiler and/or chiller operation.
  - .3 Pressure bypass open/closed.
  - .4 Control pressure failure.
  - .5 Maximum heating demand.
  - .6 Maximum cooling demand.
  - .7 Boiler and/or chiller failure.
  - .8 Dry Cooler fan failure.
  - .9 Outdoor reset. Re-check output supply temperature at 100% and 50% reset, maximum water temperature.

1.3 POTABLE WATER SYSTEMS

.1 When cleaning is completed and system filled:
- .1 Verify performance of equipment and systems as specified elsewhere in Mechanical.
- .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and

flush valve.

.3 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

1.6 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS

.1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere.

.2 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.7 SANITARY DRAINAGE SYSTEMS

.1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.

.2 Ensure that traps are fully and permanently primed.

.3 Ensure that fixtures are properly anchored, connected to system.

.4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

.5 Cleanouts: Refer to Plumbing Specialties and Accessories.

.6 Roof drains:

.1 Refer to Plumbing Specialties and Accessories.

.2 Remove caps as required.

1.8 REPORTS

.1 In accordance with TAB Specifications.

2 Products

2.1 NOT USED

.1 Not Used.

3 Execution

3.1 NOT USED

.1 Not Used.

End of Section

1 General

1.1 SUMMARY

.1 Section Includes:
- .1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.3 DELIVERY, STORAGE, AND HANDLING

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

.2 Waste Management and Disposal:
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

2 Products

2.1 CLEANING SOLUTIONS

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

3 Execution

3.1 CLEANING HYDRONIC SYSTEMS

.1 Timing
- .1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:
- .1 Retain qualified water treatment specialist to perform system cleaning. Agency shall be firm contracted / approved by OWNER. Contractor shall carry this agency in their tender price.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering

valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations to be used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water to be used to ensure water will not damage systems or equipment.

.7 means for temporary connection of cleaned piping.

.5 Conditions at time of cleaning of systems

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers to be clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems :

Clean in accordance with chemical treatment agency contracted to OWNER.

.1 Fill system with water, ensure air is vented from system.

.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

.3 Use water metre to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment supplier.

.5 Closed loop systems: circulate system cleaner at 60oC for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.6 Flush velocity in system mains and branches so as to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.7 Add chemical solution to system.

.8 Establish circulation, raise temperature slowly to maximum design. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38oC. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.2 START- UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

- .1 Establish circulation and expansion tank level, set pressure controls.
- .2 Ensure air is removed.
- .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
- .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
- .5 Clean out strainers repeatedly until system is clean.
- .6 Commission water treatment systems as specified in HVAC Water Treatment Systems.
- .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
- .8 Repeat with water at design temperature.
- .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
- .10 Bring system up to design temperature and pressure slowly.
- .11 Perform TAB as specified in Testing, Adjusting and Balancing (TAB).
- .12 Adjust pipe supports, hangers, springs as necessary.
- .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .14 If sliding type expansion joints bind, shut down system, re-align, repeat start- up procedures.
- .15 Re-tighten bolts, etc. using torque wrench, to compensate for heat-caused relaxation.
- .16 Check operation of drain valves.
- .17 Adjust valve stem packings as systems settle down.
- .18 Fully open all balancing valves (except those that are factory-set).
- .19 Check operation of over-temperature protection devices on circulating pumps.
- .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

End of Section

1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME-98, Boiler and Pressure Vessels Code

.2 American Society for Testing and Materials (ASTM)
- .1 ASTM A47/A47M-99, Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A278M-93, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 345ºC Metric.
- .3 ASTM A516/A516M-96(e1), Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
- .4 ASTM A536-84(1999)e1, Specification for Ductile Iron Castings.
- .5 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA)
- .1 CSA B51-1997, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Submittal Procedures.

1.4 CLOSEOUT SUBMITTALS

.1 Submit maintenance data in accordance with Closeout Submittals.

2 Products

2.1 AIR VENTS

.1 Manual Air Vents

- .1 At top & bottom of high points in piping systems, provide threaded 20mm ball valve with a hose end with bronze cap & chain: Apollo 78-100-01
- .2 At radiation: Apollo 78-260 instrumentation ball valve.

.2 Automatic Air Vents

- .1 Provide Spirotherm Spirotop automatic float type with isolating valve, cast

body, copper float. Stainless steel valve and seat. Temperature and pressure to suit.

.2 Standard float vent: brass body and NPS 1/8 connection and rated at 310 kPa working pressure.

.3 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

.4 Float: solid material suitable for 115ºC working temperature.

2.2 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, solder end connections, Y pattern.
.2 NPS 2 1/2 to 12: cast steel body to ASTM A278M, Class 30, connections.
.3 NPS 2 to 12: T type with ductile iron body to ASTM A536, grooved ends.
.4 Blow down connection: NPS 1. Provide Apollo 78-100-01 blow-down valve with cap & chain.
.5 Screen: stainless steel with 1.19 mm perforations.
.6 Working pressure: 860 kPa.

3 Execution

3.1 GENERAL

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

3.2 STRAINERS

.1 Install in horizontal or down flow lines.
.2 Ensure clearance for removal of basket.
.3 Install ahead of each control valve or automatic flow regulating valve as indicated.

3.3 AIR VENTS

.1 Install at high points of systems.
.2 Install ball valve on automatic air vent inlet. Run discharge to nearest drain.

3.4 PERFORMANCE VERIFICATION

.1 In accordance with Section - Performance Verification of Mechanical Piping Systems, supplemented as specified herein.

End of Section

1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Welding Society (AWS)
- .1 ANSI/AWS A5.8-92, Specification Filler Metals for Brazing and Bronze Welding.

.2 American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME B16.4-99, Gray-Iron Threaded Fittings.
- .2 ANSI/ASME B16.15-1985(R1994), Cast Bronze Threaded Fittings.
- .3 ANSI B16.18-1984(R1994), Cast Copper Alloy, Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.22-95(R1998), Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 American Society for Testing and Materials (ASTM)
- .1 ASTM B32-00, Specification for Solder Metal.
- .2 ASTM B61-93, Specification for Steam or Valve Bronze Castings.
- .3 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
- .4 ASTM B88M-99, Specification for Seamless Copper Water Tube Metric.

.4 Manufacturers Standardization Society (MSS)
- .1 MSS SP67-1995, Butterfly Valves.
- .2 MSS SP70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS SP71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS SP80-1997, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS SP85-1994, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Closeout Submittals.

2 Products

2.1 TUBING

.1 Type L hard drawn copper tubing: to ASTM B88M.

2.2 FITTINGS

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

2.3 FLANGES

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

2.4 JOINTS

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

2.5 VALVES

.1 Connections:
  .1 NPS2 and smaller: ends for soldering.
  .2 NPS21/2 and larger: Flanged ends.
.2 Gate Valves:
  .1 NPS2 and under:
    .1 Mechanical Rooms: Class 125, rising stem split wedge disc, as specified Valves - Bronze.
    .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Valves - Bronze.
  .2 NPS 2 1/2 and over:
    .1 Mechanical Rooms: stem, split wedge disc, bronze trim, as specified Valves - Cast Iron: Gate, Globe, Check.
    .2 Elsewhere: rising stem, solid wedge disc, bronze trim, as specified Valves - Cast Iron: Gate, Globe, Check.
.3 Butterfly valves:
  .1 NPS21/2 and over: Lug type: as specified Pipe Welding.
.4 Globe valves:
  .1 NPS2 and under:
    .1 Mechanical Rooms: with PFTE disc, as specified Valves - Bronze.
    .2 Elsewhere: Globe, with composition disc, as specified Valves - Bronze.
  .2 NPS21/2 and over:
    .1 With composition disc, bronze trim, as specified Valves - Cast Iron: Gate, Globe, Check.
.5 Flow Balancing Valves, for TAB:

.1 As specified

.6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Valves - Bronze.

.7 Bypass valves on gate valves NPS8 and larger: NPS3/4, Globe, with PFTE disc as specified Valves - Bronze.

.8 Swing check valves:

.1 NPS2 and under:

.1 Class 125, swing, with composition disc, as specified Valves - Bronze.

.2 NPS21/2 and over:

.1 Flanged ends: as specified Valves - Cast Iron: Gate, Globe, Check.

.9 Silent check valves:

.1 NPS2 and under:

.1 As specified Valves - Bronze.

.2 NPS21/2 and over:

.1 Flanged ends: as specified Valves - Cast Iron: Gate, Globe, Check.

.10 Ball valves:

.1 NPS2 and under: as specified Valves - Bronze.

3 Execution

3.1 PIPING INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

3.2 VALVE INSTALLATION

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

.2 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.3 Install globe valves for balancing and in by-pass around control valves as indicated.

.4 Install silent check valves on discharge of pumps and as indicated.

3.3 FLUSHING AND CLEANING

.1 Flush and clean in presence of OWNER facility operator.
.2 Flush after pressure test for a minimum of 4h.
.3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8h.
.4 Refill system with clean water. Circulate for at least 4h. Clean out strainer screens/baskets regularly. Then drain.
.5 Refill system with clean water. Circulate for at least 2h. Clean out strainer screens/baskets regularly. Then drain.
.6 Drainage to include drain valves, dirt pockets, strainers, low points in system.
.7 Re-install strainer screens/baskets only after obtaining Engineer's approval.

3.4 FILLING OF SYSTEM

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

3.5 TESTING

.1 Test system in accordance with Specifications
.2 Repair leaking joints, fittings or valves.

3.6 BALANCING

.1 Balance water systems to within plus or minus 5% of design output.
.2 Refer to Testing Adjusting and Balancing for applicable procedures.

End of Section

1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings, (Class 25, 125 and 250).
- .2 ANSI/ASME B16.3-98, Malleable-Iron Threaded Fittings, (Classes 150 and 300).
- .3 ANSI/ASME B16.5-96, Pipe Flanges and Flanged Fittings.
- .4 ANSI/ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.
- .5 ANSI/ASME B18.2.1-96, Square and Hex Bolts and Screws.
- .6 ANSI/ASME B18.2.2-87(R1999), Square and Hex Nuts.

.2 American Society for Testing and Materials (ASTM)
- .1 ASTM A47/A47M-99, Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-01, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .3 ASTM A536-84(1999)e1, Specification for Ductile Iron Castings.
- .4 ASTM B61-93, Specification for Steam or Valve Bronze Castings.
- .5 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.

.3 American Water Works Association (AWWA)
- .1 ANSI/AWWA C111/A21.11-00, Rubber Gasket Joints for Ductile-Iron and Fittings.

.4 Canadian Standards Association (CSA)

.5 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.

.6 CSA W47.1-92(R1998), Certification of Companies for Fusion Welding of Steel Structures.

.7 CSA W47.1SI-M1989, Supplement No.1-M1989 to W47.1-1983, Certification of Companies for Fusion Welding of Steel Structures.

.8 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
- .1 MSS-SP-67-95, Butterfly Valves.
- .2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.
- .4 MSS-SP-80-97, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS-SP-85-94, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Closeout Submittals.

1.4 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.
.2 Submit confirmation that pipe & fittings are manufactured from minimum 50% recycled materials.

2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53, GradeB, as follows:
  .1 NPS6, Schedule40.
  .2 NPS8 and over, Schedule 30.
  .3 NPS12 and over, 10 mm wall thickness.
  .4 Produce from minimum 50% recycled materials.

2.2 PIPE JOINTS

.1 NPS2 and under: screwed fittings with teflon tape.
.2 NPS2-1/2 and over: welding fittings and flanges to CSA W47.1 and CSA W47.1S1.
.3 Roll grooved: standard coupling to CSA B242.
.4 Flanges: plain, slip-on.
.5 Orifice flanges: slip-on raised face, 2100 kPa.
.6 Flange gaskets: to ANSI/AWWA C111/A21.11.
.7 Pipe thread: taper.
.8 Bolts and nuts: to ANSI/ASME B18.2.1 and ANSI/ASME B8.2.2.
.9 Roll grooved coupling gaskets: type EPDM.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.
.2 Pipe flanges and flanged fittings:
  .1 Cast iron: to ANSI/ASME B16.1, Class 125.
  .2 Steel: to ANSI/ASME B16.5.
.3 Butt-welding fittings: steel, to ANSI/ASME B16.9.
.4 Unions: malleable iron, to ASTM A47/A47M and ANSI/ASME B16.3.
.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M.
.6 Produce from minimum 50% recycled materials.

2.4 VALVES

.1 Connections:
- .1 NPS2 and smaller: screwed ends.
- .2 NPS2.1/2 and larger: Flanged ends.

.2 Gate valves:
- .1 NPS2 and under:
  - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, as specified Valves - Bronze.
  - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Valves - Bronze.
- .2 NPS21/2 and over:
  - .1 Mechanical Rooms: stem, split wedge disc, bronze trim, as specified Valves - Cast Iron: Gate, Globe, Check.
  - .2 Elsewhere: rising stem, solid wedge disc, bronze trim, as specified Valves - Cast Iron: Gate, Globe, Check.

.3 Butterfly valves:
- .1 NPS21/2 and over: Lug type: as specified

.4 Globe valves:
- .1 NPS2 and under:
  - .1 Mechanical Rooms: with PFTE disc, as specified Valves - Bronze.
  - .2 Elsewhere: Globe, with composition disc, as specified Valves - Bronze.
- .2 NPS21/2 and over:
  - .1 With composition disc, bronze trim, as specified Valves - Cast Iron: Gate, Globe, Check.

.5 Flow Balancing Valves
- .1 As specified.

.6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Valves - Bronze.

.7 Bypass valves on gate valves NPS8 and larger: NPS3/4, Globe, with PFTE disc as specified Valves - Bronze.

.8 Swing check valves:
- .1 NPS2 and under:
  - .1 Class 125, swing, with composition disc, as specified Valves - Bronze.
- .2 NPS21/2 and over:
  - .1 Flanged ends: as specified Valves - Cast Iron: Gate, Globe, Check.

.9 Silent check valves:
- .1 NPS2 and under:
  - .1 As specified Valves - Bronze.
- .2 NPS21/2 and over:
  - .1 Flanged ends: as specified Valves - Cast Iron: Gate, Globe, Check.

.10 Ball valves:
- .1 NPS2 and under: as specified Valves - Bronze.

3 Execution

3.1 PIPING INSTALLATION

.1 In accordance with Installation of Pipe Work.
.2 Use roll groove pipe fittings only in exposed or accessible locations.

3.2 FLUSHING AND CLEANING

.1 In accordance with Cleaning and Start-Up of Mechanical Piping Systems.

3.3 TESTING

.1 Test systems in accordance with Specifications.

3.4 BALANCING

.1 Balance water systems to within plus or minus 5% of design output.
.2 Refer to Testing Adjusting and Balancing (TAB) of Mechanical Systems for applicable procedures.

3.6 PERFORMANCE VERIFICATION

.1 In accordance with Performance Verification of Mechanical Piping.

End of Section

1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B16.22-95, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
- .2 ASME B16.24-91(R1998), Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
- .3 ASME B16.26-88, Cast Copper Alloy Fittings for Flared Copper Tubes.
- .4 ASME B31.5-00, Refrigeration Piping.

.2 American Society for Testing and Materials (ASTM)
- .1 ASTM A307-00, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 ASTM B280-99ei, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA)
- .1 CSA B52-99, Mechanical Refrigeration Code.

.4 Environment Canada (EC)

.5 EPS 1/RA/1-96, Environmental Code of Practice for the Reduction of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Waste Management and Disposal.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

.3 Fold up metal banding, flatten and place in designated area for recycling.

2 Products

2.1 TUBING

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

.2 Produce from minimum 50% recycled materials.

2.2 FITTINGS

.1 Service: design pressure 2070 kPa and temperature 121 deg C.
.2 Brazed:
  .1 Fittings: wrought copper to ASME B16.22.
  .2 Joints: silver solder, 45% Ag-15% Cu and non-corrosive flux.
.3 Flanged:
  .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
  .2 Gaskets: suitable for service.
  .3 Bolts, nuts and washers: to ASTM A307, heavy series.
.4 Flared:
  .1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 SUPPORTS

1. Unistrut system with integral neoprene vibration isolation.

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

3 Execution

3.1 GENERAL

.1 In accordance with Installation of Pipework, supplemented as specified herein
.2 Size lines and install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5. and manufacturers recommendations based on actual line routing.

3.2 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.

3.3 PIPING INSTALLATION

.1 General:
- .1 Soft annealed copper tubing: bend without crimping or constriction.
- .2 Provide anchors and guides where required to allow piping systems to expand and contract without distortion of hangers or stressing of systems.
- .3 Provide teflon pads within guides where required to protect piping from wear.

.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 above.
  - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.4 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.

3.5 DEHYDRATION AND CHARGING

.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 deg 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 14Pa absolute and hold for 4 h.
- .2 Break vacuum with refrigerant to 14kPa.
- .3 Final to 5Pa 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 Engineer.

.7 Charging:

.1 Provide nitrogen purge in accordance with manufacturer prior to charging.
.2 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
.3 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.
.4 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 Engineer.

End of Section

1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
  .1 ASME Boiler and Pressure Vessel Code, Section VII-2001.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for incorporation into manual specified in Closeout Submittals.
.2 Include following:
  .1 Log sheets as recommended by manufacturer.

2 Products

2.1 MANUFACTURER

.1 Equipment, chemicals, service by one supplier.

2.2 POT FEEDER & SIDE-STREAM FILTER HOUSINGS

.1 Welded stainless steel construction.

2.3 WATER TREATMENT FOR HYDRONIC SYSTEMS

.1 Heated water systems: Pot feeder, 25 L, twin cartridge side stream filter, site glass
.2 Micron filters for each pot feeder:
  .1 Provide 180 additional filter cartridges.

2.4 CHEMICALS

.1 Provide chemicals for chilled water and heated water systems as required to maintain chlorides, TDS, suspended solids, algae, slime, inhibitor level, pH, alkalinity, hardness, other impurities and microbiological organisms at acceptable levels.

3 Execution

3.1 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.2 CLEANING OF MECHANICAL SYSTEM

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Engineer.

.2 Thoroughly flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.

.3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.

.4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Disposal of cleaning solutions to be approved by authority having jurisdiction.

3.3 WATER TREATMENT SERVICES

.1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

- .1 Initial water analysis and treatment recommendations.
- .2 System start-up assistance.
- .3 Operating staff training.
- .4 Visit plant every 7 days during period of operation and as required until system stabilizes, and advise on treatment system performance.
- .5 Provide necessary recording charts and log sheets for one year operation.
- .6 Provide necessary laboratory and technical assistance.
- .7 Instructions and advice to operating staff to be clear, concise and in writing.

3.4 START- UP

.1 Start up water treatment systems in accordance with manufacturer's instructions.

End of Section

1 General

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM A480/A480M-01, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .2 ASTM A635/A635M-00, Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
- .3 ASTM A653/A653M-00, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.2 National Fire Protection Agency (NFPA)
- .1 NFPA 90A-99, Installation of Air Conditioning and Ventilating Systems.
- .2 NFPA 90B-99, Installation of Warm Air Heating and Air Conditioning Systems.
- .3 NFPA 91-1995, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particle Solids.
- .4 NFPA 96-98, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.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 Duct Leakage Test Manual, 1985, Technical Research Update-92.

1.2 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.

2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

.2

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

.3 Seal classification:
- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and

connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

.3 Class C: transverse joints and connections made air tight with gaskets. Longitudinal seams unsealed.

2.2 SEALANT

.1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 40 deg C to plus 93 deg C.

2.3 TAPE

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

2.4 DUCT LEAKAGE

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

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:
- .1 Rectangular: standard radius.
- .2 Round: five piece. Centreline 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.
- .2 Round main and branch: enter main duct at 45 deg 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 deg maximum included angle.
- .2 Converging: 30 deg maximum included angle.

.6 Offsets:
- .1 Full radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6 FIRESTOPPING

.1 Provide fire damper in separation with retaining angles around duct, on both sides of fire separation.
.2 Fire stopping material and installation must not distort duct.
.3 Do not fire stop around fire damper unless required by manufacturer.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653, Z90 zinc coating.
.2 Thickness, fabrication and reinforcement: to ASHRAE.
.3 Joints: to ASHRAE. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 HANGERS AND SUPPORTS

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.
.2 Hanger configuration: to ASHRAE.
.3 Hangers: black steel angle with black steel rods to ASHRAE
.4

Duct Size (mm)	**Angle Size** (mm)	**Rod Size** (mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50 x 50 x 6	10

.5 Upper hanger attachments:
  .1 For concrete: manufactured concrete inserts.
  .2 For steel joist: manufactured joist clamp.
  .3 For steel beams: manufactured beam clamps.
  .4 Spring type friction clamps not acceptable.

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. Insulate strap hangers 100 mm beyond insulated duct.
.3 Support risers in accordance with SMACNA.
.4 Install breakaway joints in ductwork on sides of fire separation.
.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

.7 Exposed ductwork on roof shall be supported 400mm clear above roof. Provide thermal break between ductwork and support. Do not support ductwork on rigid insulation / cladding.

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:

.4

Duct Size (mm)	**Spacing** (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.

3.4 LEAKAGE TESTS

.1 Not required.

End of Section

1 General

1.1 REFERENCES

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

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.
.2 Indicate the following:
  .1 Flexible connections.
  .2 Duct access doors.
  .3 Turning vanes.
  .4 Instrument test ports.

1.3 CERTIFICATION OF RATINGS

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

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

2.3 ACCESS DOORS IN DUCTS

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
.3 Gaskets: neoprene.
.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.
.2 301 to 450 mm: four sash locks complete with safety chain.
.3 451 to 1000 mm: piano hinge and minimum two sash locks.
.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
.5 Hold open devices.

2.4 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.
.2 Cam lock handles with neoprene expansion plug and handle chain.
.3 28 mm minimum inside diameter. Length to suit insulation thickness.
.4 Neoprene mounting gasket.

2.5 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
.2 Sheet metal thickness to co-responding round duct standards.

3 Execution

3.1 INSTALLATION

.1 Flexible connections:
  .1 Install in following locations:
    .1 Inlets and outlets to supply air units and fans where fans are not internally spring isolated.
    .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.
.2 Access doors and viewing panels:
  .1 Size:
    .1 800 x 800 mm for person size entry.
    .2 400 x 400 mm for servicing entry.
    .3 300 x 300 mm for viewing.
    .4 As indicated.
  .2 Locations:
    .1 Fire and smoke dampers.
    .2 Control dampers.
    .3 Devices requiring maintenance.
    .4 Required by code.
    .5 Reheat coils.

.6 Elsewhere as indicated.

.3 Instrument test ports.

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations.

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Enginee r.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.4 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

End of Section

1 General

1.1 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible- 1985 .

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.

2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

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

2.3 MULTI-BLADED BALANCING DAMPERS

.1 Factory manufactured of material compatible with duct.
.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
.3 Maximum blade height: 100 mm .
.4 Bearings: pin in bronze bushings .
.5 Linkage: shaft extension with locking quadrant.
.6 Channel frame of same material as adjacent duct, complete with angle stop.

3 Execution

3.1 INSTALLATION

.1 Install where indicated.
.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
.3 For new and existing supply, return and exhaust systems locate balancing dampers in

each branch duct.

.4 Run outs to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 All dampers to be vibration free.

.6 Ensure damper operators are observable and accessible.

.7 Locate dampers in accessible areas. Where inaccessible, provide access doors/hatches.

End of Section

1 General

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)
  .1 ASTM A 653M- 95 , Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.
.2 Indicate the following:
  .1 Performance data.

1.3 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

2 Products

2.1 CONTROL DAMPERS

.1 Refer to Section 23 73 12 for control dampers supplied with ventilation units.
.2 Refer to Section 25 30 02 for control dampers supplied by EMCS subcontractor.

2.2 BACK DRAFT DAMPERS

.1 Automatic gravity operated , multi leaf, aluminum construction with nylon bearings, centre pivoted , as indicated .

2.3 RELIEF DAMPERS

.1 Automatic multi-leaf steel dampers with ball bearing centre pivoted and counter-weights set to open at static pressure, as indicated .

3 Execution

3.1 INSTALLATION

.1 Install where indicated.
.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
.3 Seal multiple damper modules with silicon sealant.
.4 Install access door adjacent to each damper. See Duct Accessories .

.5 Ensure dampers are observable and accessible.

End of Section

1 General

1.1 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  .1 ANSI/NFPA 90A- 1989 , Installation of Air Conditioning and Ventilating Systems.

.2 Underwriters Laboratories of Canada (ULC)
  .1 CAN4-S112- M82(R1987) , Fire Test of Fire Damper Assemblies.
  .2 CAN4-S112.2- M84 , Fire Test of Ceiling Fire stop Flap Assemblies.
  .3 ULC-S505- 1974 , Fusible Links for Fire Protection Service.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.

.2 Indicate the following:
  .1 Fire dampers.
  .2 Smoke dampers.
  .3 Fire stop flaps.
  .4 Operators.
  .5 Fusible links.
  .6 Design details of break-away joints.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Closeout Submittals.

1.4 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Closeout Submittals.

.2 Provide following:
  .1 20 fusible links of each type.

1.5 CERTIFICATION OF RATINGS

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

2 Products

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type A or B, listed and bear label of ULC , meet requirements of provincial fire authority . Fire damper assemblies to be fire tested in accordance with CAN4-S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation. Note that 3 hour fire dampers required for 2 hour rated Mechanical Room walls.

.3 Top hinged: offset single damper , round or square; multi-blade hinged or interlocking type; sized to maintain full duct cross section as indicated .

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Install smoke and combination fire / smoke dampers (supplied by controls) where indicated.

.7 Provide adequately sized access doors for inspection and cleaning before and after fire and smoke dampers. Review locations prior to fabrication.

3 Execution

3.1 INSTALLATION

.1 Install in all ductwork passing through fire separations in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing. Refer to architectural drawings for locations of fire separations.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Specification Section Duct Accessories .

.5 Coordinate with installer of fire stopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

.8 Wiring of smoke dampers and combination fire/smoke dampers by Electrical.

.9 Install Type B fire dampers in Ductwork 300mm or smaller. Larger ductwork shall use Type A.

End of Section

1 General

1.1 REFERENCES

.1 National Fire Protection Association (NFPA)
- .1 NFPA 90A-99, Installation of Air Conditioning and Ventilating Systems.
- .2 NFPA 90B-99, Installation of Warm Air Heating and Air Conditioning Systems.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 and Addendum No.1 1997.

.3 Underwriter's Laboratories of Canada (ULC)
- .1 CAN/ULC-S110-M86(R2001), Fire Tests for Air Ducts.
- .2 UL 181-96, Factory Made Air Ducts and Connectors.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.

.2 Indicate the following:
- .1 Thermal properties.
- .2 Friction loss.
- .3 Acoustical loss.
- .4 Leakage.
- .5 Fire rating.

1.3 CERTIFICATION OF RATINGS

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

2 Products

2.1 GENERAL

.1 Factory fabricated to CAN/ULC S110.

.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC - ACOUSTIC INSULATED

.1 Non-collapsible, coated mineral base perforated fabric type helically supported by and mechanically bonded to steel wire with factory applied flexible glass fibre acoustic insulation and encased in aluminum foil and Mylar laminate vapour barrier.

.2 Performance:

.1 Factory tested to 2.5 kPa without leakage.

.2 Maximum relative pressure drop coefficient: 3.

.3 Acoustical performance: Minimum attenuation (dB/m) to following table: Frequency (Hz)

Duct Diameter:	125	250	500	1000	2000
100	0.6	3	12	27	0
150	1.2	3	12	22	27
200	2.0	5	12	19	20
300	2.4	5	12	16	15

.3 Product to be suitable for 90^{O} elbow diffuser & grille connections.

3 Execution

3.1 DUCT INSTALLATION

.1 Install in accordance with: CAN/ULC-S110.

.2 Connect diffusers & grilles with round inlets to duct systems using maximum 1m length of acoustically lined flexible ductwork.

End of Section

1 General

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM C177-97, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-10M-76, Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.
- .2 CGSB 51-GP-11M-76, Thermal Insulation, Mineral Fibre, Blanket, for Piping, Ducting, Machinery and Boilers.

.3 National Fire Protection Association (NFPA)
- .1 NFPA 90A-99, Installation of Air Conditioning and Ventilating Systems.
- .2 NFPA 90B-99, Installation of Warm Air Heating and Air Conditioning Systems.

.4 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
- .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-95 (Addendum No.1, Nov. 97).

.5 Underwriter's Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Submittal Procedures.

2 Products

2.1 DUCT LINER

.1 General:
- .1 Fibrous glass duct liner: air stream side faced with mat facing.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.

.2 Rigid:
- .1 Use on flat surfaces where indicated.
- .2 25 mm thick or as indicated, to CGSB 51-GP-10M, fibrous glass rigid board duct liner.
- .3 Density: 36 kg/m3minimum.
- .4 Thermal resistance to be minimum 0.76 m2. deg C/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 deg C mean temperature.

.3 Flexible:
- .1 Use on round or oval surfaces.
- .2 25 mm thick or as indicated, to CGSB-51-GP-11M, fibrous glass blanket duct

liner.

.3 Density: 24 kg/m3 minimum.

.4 Thermal resistance to be minimum 0.37 m2. deg C/W for 12 mm thickness when tested in accordance with ASTM C177, at 24 deg C mean temperature.

2.2 ADHESIVE

.1 Meet requirements of NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 deg C to plus 93 deg C.

2.3 FASTENERS

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

2.4 JOINT TAPE

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

2.5 SEALER

.1 Meet requirements of NFPA 90A and NFPA90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 deg C to plus 93 deg C.

3 Execution

3.1 GENERAL

.1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.

.2 Line inside of all rectangular fan-coil, air handler, exhaust fan discharge ductwork and return air plenums and other ducts where indicated by hatch.

.3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

.1 Install in accordance with manufacturer's recommendations, and as follows:
  .1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
  .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres.

3.3 JOINTS

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

End of Section

1 General

1.1 PRODUCT DATA

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

1.2 CERTIFICATIONS

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

1.3 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Closeout Submittals.
.2 Include:
  .1 Keys for volume control adjustment.
  .2 Keys for air flow pattern adjustment.

2 Products

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated. Refer to equipment schedule.
.2 Frames:
  .1 Full perimeter gaskets.
  .2 Concealed fasteners.
.3 Concealed manual volume control damper operators where indicated.
.4 Colour: As selected by Architect.

2.2 SUPPLY GRILLES AND REGISTERS

.1 Refer to schedule.

2.3 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 Refer to schedule.
.2 For grilles in T-bar ceilings, coordinate size with actual T-bar grid spacing so that diffusers don't fall out of the grid and don't jam against the T centres.

2.4 DIFFUSERS

.1 Refer to schedule.
.2 For diffusers in T-bar ceilings, coordinate diffuser size with actual T-bar grid spacing so that diffusers don't fall out of the grid and don't jam against the T centres.

3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturers instructions.
.2 Install with cadmium plated screws in countersunk holes where fastenings are visible.
.3 Acoustically line all plenums of ducted return/exhaust grilles.
.4 All interior of ductwork visible through grille face shall be painted flat black.

End of Section

1 General

1.1 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  .1 ASHRAE 52- 76 , Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
.2 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-51.40- M80 , Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
.3 CAN/CGSB-115.10- M90 , Disposable Air Filters For Removal of Particulate Matter from Ventilating Systems.
.4 CAN/CGSB-115.15- M91 , High Efficiency, Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
.5 Canadian Standards Association (CSA)
  .1 CSA B52- M1995 , Mechanical Refrigeration Code.
  .2 CAN/CSA-C656- M92 , Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.
.6 Environment Canada
  .1 EPS 1/RA/2- 1996 , Code of Practice for the Reduction of Chlorofluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
  .2 Environment Canada- 1994 , Ozone-Depleting Substances Alternatives and Suppliers List.
  .3 Federal Halocarbon Regulations, 2003 (FHR 2003)

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Submittal Procedures.
.2 Indicate major components and accessories including sound power levels of units.
.3 Type of refrigerant used.

1.3 FEDERAL HALOCARBON REGULATIONS

.1 Obtain and complete forms for submission during project. Submit a copy as the work is being done, and a final copy for the project manuals. All new equipment must be properly tagged and forms completed prior to arrival on site.

.2 New units will need to be leak tested, and a leak test tag and log book entry completed in accordance with current federal halocarbon regulations.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual specified in Closeout Submittals.
.2 Include following: manufacturer's start-up reports.
.3 Provide all relevant FHR forms.

1.5 WARRANTY

.1 On year warranty from date of substantial completion in accordance with General Conditions..

.2 Provide extended four year manufacturer's parts & labour warranty for equipment. Refrigerant replenishment is to be included in manufacturer's warranty. Warranty to take effect one year after date of installation contract substantial completion. Extended warranty certificate to be issued to Owner.

2 Products

2.1 GENERAL

.1 Integrated package: to CAN/CSA-C656.
.2 System type:
  .1 Air flow arrangement: down-flow .
  .2 Cooling: direct expansion .
  .3 Condensing: air cooled.
.3 Cooling and dehumidifying capacity, with fan heat extracted based on computer room environment of 22 ºC dry bulb and 50 % R.H. (plus or minus 1ºC and 5% R.H.), with minimum supply air temperature of 14 ºC and minimum control dead-band of 3 % R.H. separating humidification and dehumidification.
.4 Unit capacity: as indicated on drawings.
.5 Fan capacity to provide for dry coil operation at 22ºC and 50% R.H. .

2.2 EVAPORATOR CABINET

.1 Galvanized steel with rounded exposed corners and edges, lined with 25 mm thick closed cell acoustic insulation, factory finish.
.2 Cabinet to house: valves, cooling coil, variable speed dc fans, filters, unit environmental control system, motor starters or contactors .
.3 Provide adequate access to components for servicing.
.4 Hangars with spring isolators suitable for suspending from underside of structure.

2.3 RETURN PLENUM AND FILTER HOUSING

.1 Galvanized steel unit construction, corrosion protected, 25 mm thick acoustic insulation, factory baked on external finish. Provide 90 degree elbow on return. End of return duct shall have a front loading filter rack to ease filter replacement. Seal all return air ductwork

2.4 FAN

.1 DWDI centrifugal, statically and dynamically balanced, with self-aligning, permanently lubricated, 100,000 hours minimum life ball or roller bearings.
.2 Fan shall be direct drive.

2.5 FAN MOTOR(S)

.1 Drip-proof permanently lubricated bearings for continuous duty, 40ºC maximum rise and variable speed dc motor.

2.6 COMPRESSORS

.1 Semi hermetic type, variable speed compressor and condenser fan, with: vibration isolators, adjustable high and low pressure switches, anti-slug device, motor overload and over temperature protection pump down controls, refrigerant service valves and capacity controls.

2.7 COOLING COIL

.1 Aluminum fins, mechanically bonded to copper tubes, tested to 1.7 MPa, maximum face velocity 2.8 m/s, with stainless steel insulated condensate tray and drain connections.
.2 Direct expansion: with separate refrigerant circuit for each compressor.
.3 Cooling coil condensate drain pans: designed to avoid any standing water, to be easily cleaned or removable for cleaning. Drain connection to have deep seal trap and be complete with trap seal primer.

2.8 FILTERS

.1 Washable foam type, to CAN/CGSB-115.15. Initial Dust Spot efficiency, 30%, to ASHRAE 52.
.3 Mounting: in corrosion resistant racks with service access.

2.9 CONDENSER

.1 Air cooled: free standing, welded steel unit construction, corrosion protected. Circuited to provide separate refrigerant circuit for each compressor/evaporator combination.
- .1 Aluminum fins, mechanically bonded to copper tubes, tested to 3.1 MPa.
- .2 Propeller type fans. Variable speed direct drive.
- .3 Electrical and control components housed in weather-tight access panels with electrical disconnect switch and control cable for control interconnection and designed for year round operation.
- .4 Vibration isolation: providing at least 95 % isolation efficiency.
- .5 Mount on neoprene pads to structural roof supports in accordance with manufacturers recommendations.

2.10 REFRIGERANT PIPING, VALVES, FITTINGS AND ACCESSORIES WITHIN UNIT

.1 To CSA B52.

.2 Include for each refrigerant circuit:
- .1 Modulation thermal expansion valve, external equalizing type.
- .2 Combination filter-dryer.
- .3 Solenoid valves.
- .4 Liquid sight glass with moisture indicator.
- .5 All lines to be insulated insulation: flexible elastomeric unicellar to CAN/CGSB-51.40, 12 mm minimum thickness.
- .6 clad exposed piping with aluminum jacketing.
- .7 label all piping based on refrigerant type.

2.11 ENVIRONMENTAL CONTROLS

.1 Include remote control panel / thermostat.

2.12 REFRIGERANT CHARGE

.1 Charge systems with R410a or similar environmentally friendly HFC refrigerant with 0 global warming potential.

.2 Charge refrigerant system at factory, seal and test.

.3 Holding charge of refrigerant applied at factory.

.4 Provide additional charge as required.

3 Execution

3.1 GENERAL

.1 Install as indicated, to manufacturers' recommendations, and in accordance with EPS 1/RA/2.

.2 Manufacturer to certify installation and provide start-up.

.3 Provide float operated automatic air vents with stop valve.

3.2 EQUIPMENT PREPARATION

.1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

3.3 REFRIGERATION SYSTEMS

.1 All piping to be sized and installed in accordance with the manufacturers recommendations and guidelines.
.2 Piping shall be sealed nitrogenized type L copper pipe with all copper to copper joints brazed using 15% Sil-fos brazing rod.
.3 Install piping traps and expansion loops as recommended by equipment manufacturer.
.4 All brazing shall be performed with a nitrogen purge to eliminate copper oxidation.
.5 All refrigeration piping supports and hangers shall be installed to minimize vibration transmission.
.6 Pipe supports shall be installed at intervals of 8’ or less on horizontal runs and 12’ or less on vertical runs.
.7 All refrigerant lines shall be insulated with Armaflex pipe insulation with glued joints.
.8 Provide evacuation leak check.
.9 Include a full refrigerant charge and start-up service.
.10 Provide & install evaporator unit, condenser, and all accessories as required and as recommended by manufacturer for complete operational system.
.11 Provide control wiring and interlocks
.12 Each fan coil has a dedicated humidifier. Provide air flow proving sensor and interlock with each humidifier to lock it out while fan is not running.

End of Section