

PART 1 - GENERAL

- 1.1 REFERENCES .1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB1.181-99, Organic ZincRich Coating.

PART 2 - PRODUCTS Not applicable.

PART 3 - EXECUTION

- 3.1 CONNECTIONS TO EQUIPMENT .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.
- .4 Maintain all minimum clearances required by the Canadian Electrical Code.
- .5 Minimum 750mm in front of VAV terminal units.
- .6 Maintain equipment and valves a maximum of 900mm above ceilings.
- 3.2 CLEARANCES .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.
-

3.3 DRAINS

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

3.4 AIR VENTS

- .1 Install manual air vents at high points in piping systems in areas within accessible mechanical spaces.
- .2 Install automatic air vent with isolating valve at each high point in finished areas.
- .3 Install drain piping on manual air vents to floor drain and terminate where discharge is visible.

3.5 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape or pipe dope as recommended by manufacturer.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.

3.5 PIPEWORK
INSTALLATION
(Cont'd)

- .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.
- .14 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use ball or butterfly valves at branch takeoffs for isolating purposes except where otherwise specified.
 - .7 Install butterfly valves on chilled water and related condenser water systems only.
 - .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .9 Install plug cocks or ball valves for glycol service.
 - .10 Use chain operators on valves NPS 2-1/2 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 in vertical pipes with downward flow and elsewhere as indicated.
 - .2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.
- .16 Install pipe straight and parallel to building lines.

3.6 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, dry-wall partitions and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe (sheet metal acceptable for non-rated dry wall partitions).

3.6 SLEEVES
(Cont'd)

- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and un-insulated 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.
 - .4 All mechanical room walls and wet areas above ground slab.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.7 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, sills, 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.

3.8 PREPARATION
FOR FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.
- .2 Un-insulated unheated pipes not subject to movement: No special preparation.
- .3 Un-insulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.

3.8 PREPARATION
FOR FIRESTOPPING
(Cont'd)

- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.9 FLUSHING OUT
OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems supplemented as specified in relevant sections of Division 21, 22 and 23.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.10 PRESSURE
TESTING OF
EQUIPMENT

- .1 Advise DTIR Inspector and Departmental Representative 72 hours minimum prior to performance of pressure tests.
- .2 Pipework: pressure test piping at either the main pressure, or 1.5 times the normal operating pressure, whichever is greater. Also refer to testing requirements specified in relevant sections of Divisions 21, 22 and 23.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Divisions 21, 22 and 23.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Submit tests results to the Departmental Representative. Work to be carried out in off hours after 5 p.m., weekends or holidays.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after review of tests by the Departmental Representative.

3.11 EXISTING
SYSTEMS

- .1 Connect into existing piping systems at times approved by the Departmental Representative. Work to be carried out off hours after 5 p.m., weekends or holidays.
- .2 Request written approval ten (10) days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Conduct daily clean-up of existing areas.

PART 1 - GENERAL

- | | | |
|---|----|--|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
| <u>1.2 REFERENCES</u> | .1 | ASME B40.1-2005, Gauges-Pressure, Indicating Dial Type-Elastic Element. |
| | .2 | CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type. |
| | .3 | CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type. |
| <u>1.3 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data in accordance with Section 01 78 00. |
| | .2 | Submit manufacturer's product data for following items: |
| | .1 | Thermometers. |
| | .2 | Pressure gauges. |
| | .3 | Stop cocks. |
| | .4 | Wells. |
| | .5 | Snubbers. |
| <u>1.4 MAINTENANCE DATA</u> | .1 | Provide maintenance data for incorporation into manual specified in Section 01 33 00. |

PART 2 - PRODUCTS

- | | | |
|--|----|--|
| <u>2.1 GENERAL</u> | .1 | Thermometers and pressure gauges to operate at mid point of scale or range. |
| <u>2.2 DIRECT READING THERMOMETERS</u> | .1 | Industrial, variable angle type, aluminum case, graduated in °C and °F brass stem, liquid filled, 225 mm scale length: to CAN/CGSB 14.4. |

- 2.3 REMOTE READING THERMOMETERS .1 112 mm diameter mercury activated dial type: to CAN/CGSB-14.5, stainless steel bourdon tube, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass or stainless steel case for wall mounting.
- 2.4 INDUSTRIAL THERMOMETER WELLS .1 Use copper, bronze, brass, or stainless steel to suit application, 3/4 NPT.
- .2 Provide extension to suit insulation thickness.
- 2.5 PRESSURE GAUGES .1 112 mm dia., dial type: to ANSI/ASME B40.1, Grade A, having 1% of full scale over middle half of range accuracy unless otherwise specified. Graduated in °C and °F.
- .2 Provide mini ball valve and:
.1 Snubber for pulsating operation.
.2 Diaphragm for corrosive service.

PART 3 - EXECUTION

- 3.1 GENERAL .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Provide engraved lamicoid nameplates as specified in Section 23 05 53, identifying medium.
- .3 Locate between equipment and first fitting or valve.
- 3.2 THERMOMETERS .1 Install in wells on all piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
.1 Water heating coils.
.2 3-way mixing valves.
.3 Heat exchangers supply and return piping.
.4 Supply and return piping from main heating zones.
.5 Supply and return from chiller and each boiler.
.6 Discharge from domestic hot water tanks.

3.2 THERMOMETERS .3 Use extensions on all thermometers wells and
(Cont'd)

3.3 PRESSURE GAUGES .1 Install in following locations:
 .1 Domestic and fire water entrance.
 .2 Suction and discharge of pumps over 1/2 hp.
 .3 Upstream and downstream of control valves.
 .4 Inlet and outlet of water side of coils:
 provide pressure gauge cocks and taps for
 balancing/commissioning.
 .5 Inlets and outlets of all heat exchangers.
 .6 Inlet and outlet of each boiler and chiller.

 .2 Use extensions on all pressure gauge connections to
 permit mini-ball valve complete with snubber to be
 clear of insulation and jacket.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 23 05 05 - Installation of Pipework
- 1.2 REFERENCES
- .1 Codes and standards referenced in this section refer to the latest edition thereof.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME B1.20.1(R2006), Pipe Threads, General Purpose (Inch.)
- .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 American Society of Testing and Materials:
- .1 ASTM A276-2013, Specification for Stainless Steel Bars and Shapes.
- .2 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.
- .3 ASTM B283-2012a, Specification for Copper and Copper Alloy Die Forgings (Hot Pressed)
- .4 ASTM B505/B505M-2012, Specification for Copper-Base Alloy Continuous Castings.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
- .1 MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.
- .2 MSS SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.
- .3 MSS SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- 1.3 SUBMITTALS
- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29 - Occupational Health and Safety (OH&S).
- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit data for valves specified this section.

- | | | |
|---|----|---|
| <u>1.3 SUBMITTALS</u>
(Cont'd) | .3 | Closeout Submittals
.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. |
| <u>1.4 QUALITY ASSURANCE</u> | .1 | Health and Safety
.1 Do construction occupational health and safety in accordance with Section 01 35 29 - Occupational Health and Safety (OH&S). |
| <u>1.5 DELIVERY, STORAGE AND DISPOSAL</u> | .1 | Waste Management and Disposal
.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
.2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan. |
| <u>1.6 MAINTENANCE</u> | .1 | Extra Materials
.1 Furnish following spare parts:
.1 Valve seats: one (1) for every ten (10) valves each size. Minimum one (1).
.2 Discs: one (1) for every ten (10) valves, each size. Minimum one (1).
.3 Stem packing: one (1) for every ten (10) valves, each size. Minimum one (1).
.4 Valve handles: two (2) of each size.
.5 Gaskets for flanges: one (1) for every ten (10) flanged joints. |

PART 2 - PRODUCTS

- | | | |
|----------------------|----|---|
| <u>2.1 MATERIALS</u> | .1 | Except for specialty valves, to be single manufacturer. |
| | .2 | All products to have Canadian registration numbers (CRN), if required. |
| | .3 | End Connections
.1 Connection into adjacent piping/tubing:
.1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.
.2 Copper tube systems: Solder ends ANSI/ASME B16.18. |

2.1 MATERIALS
(Cont'd)

- .4 Lockshield Keys
 - .1 Where lockshield valves are specified, provide ten (10) keys of each size: malleable iron cadmium plated.

2.2 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.
 - .7 Handwheel Nut: bronze to ASTM B62.
 - .8 Glass 125, WP=860 kPa steam, 1.4 mPa WOG
 - .9 Class 150 WP=1.03 mPa steam, 2.07 mPa WOG.
- .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 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 Operator: Handwheel
- .4 NPS 2 and under, rising stem, split wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.
 - .3 Operator: Handwheel
- .5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: Handwheel
- .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: Handwheel

2.3 GLOBE VALVES

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

2.3 GLOBE VALVES
(Cont'd)

- .1 (Cont'd)
 - .3 Connections: screwed with hex. shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: non-asbestos.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B62.
 - .8 Glass 125, WP=860 kPa steam, 1.4 mPa WOG
 - .9 Class 150 WP=1.03 mPa steam, 2.07 mPa WOG.
- .2 NPS 2 and under, composition disc, Class 125:
 - .1 Body and bonnet: screwed bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - .3 Operator: Handwheel.
- .3 NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - .3 Operator: Handwheel
- .4 NPS 2 and under, plug disc, Class 150, screwed ends:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.
 - .3 Operator: Handwheel
- .5 Angle valve, NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
 - .3 Operator: Handwheel.

2.4 CHECK VALVES

- .1 Requirements common to all check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: with hex agonal shoulders.
 - .3 Glass 125, WP=860 kPa steam, 1.4 mPa WOG
 - .4 Class 150 WP=1.03 mPa steam, 2.07 mPa WOG
 - .5 Class 200 1.4 mPa CWP
- .2 NPS 2 and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 , screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

-
- 2.4 CHECK VALVES
(Cont'd)
- .3 NPS 2 and under, swing type, bronze disc:
.1 Body: Y-pattern with integral seat at 45°, screw-in cap with hex head.
.2 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 45°, screw-in cap with hex. head.
.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, Class 150:
.1 Body: with integral seat, union bonnet ring with hex. shoulders, cap.
.2 Disc: renewable PTFE for steam, #6 composition rotating disc for water, oil or gas service 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 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- 2.5 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.
.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.
- 2.6 BALL VALVES
- .1 NPS 2 and under:
.1 Body and cap: cast high tensile bronze to ASTM B62.
.2 Pressure rating: Class 125, 860 MPa steam.
.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 or hard chrome solid ball and teflon seats.
.7 Stem seal: TFE with external packing nut.
.8 Operator: removable lever handle with extension for insulated pipe.
-

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install rising stem valves in upright position with stem above horizontal.
 - .2 Remove internal parts before soldering.
 - .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.
 - .4 Up to and including NPS 2 use line size ball valves for isolation of all equipment and every pipe branch circuit. Gate or ball valves are acceptable for sizes over NPS 2.
 - .5 Provide discrete but noticable markers on ceiling systems for all equipment located above ceiling tiles.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Section 23 05 05 - Installation of Pipework

1.2 REFERENCES

- .1 Codes and standards referenced in this section refer to the latest edition thereof.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B16.1-2010, Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125 and 250.
- .3 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A49-2012, Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A126-04(2009), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 ASTM B61-08, Specification for Steam or Valve Bronze Castings.
 - .4 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.
 - .5 ASTM B85/B85M-2010e1, Specification for Aluminum-Alloy Die Castings.
 - .6 ASTM B209-2010, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS SP-61-2013, Pressure Testing of Valves.
 - .2 MSS SP-70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-71-2011, Grey Iron Swing Check Valves, Flanged and Threaded Ends
 - .4 MSS SP-85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
- .5 Underwriters Laboratories of Canada.
 - .1 ULC C262-1992, Gate Valves for Fire Protection Services.

1.3 SUBMITTALS

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

-
- | | | |
|--|----|---|
| 1.3 SUBMITTALS
(Cont'd) | .2 | Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29 - Occupational Health and Safety (OH&S).
.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit data for valves specified this section. |
| | .3 | Closeout Submittals
.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. |
|
 | | |
| 1.4 QUALITY
ASSURANCE | .1 | Health and Safety
.1 Do construction occupational health and safety in accordance with Section 01 35 29 - Occupational Health and Safety (OH&S). |
|
 | | |
| 1.5 DELIVERY,
STORAGE AND
DISPOSAL | .1 | Waste Management and Disposal:
.1 Separate and recycle waste materials in accordance with Section 01 74 19
.2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan. |
|
 | | |
| 1.6 MAINTENANCE | .1 | Extra Materials
.1 Furnish following spare parts:
.1 Valve seats: one (1) for every ten (10) valves each size. Minimum one (1).
.2 Discs: one for every ten (10) valves, each size. Minimum one (1).
.3 Stem packing: one (1) for every ten (10) valves, each size. Minimum one (1).
.4 Valve handles: two (2) of each size.
.5 Gaskets for flanges: one (1) for every ten (10) flanged joints. |
-

PART 2 - PRODUCTS

- 2.1 MATERIAL
- .1 Except for specialty valves, to be of single manufacturer.
 - .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
 - .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B209 Class B.
 - .2 Connections: flanged ends, plain face, to ANSI B16.1.
 - .3 Inspection and pressure testing: to MSS SP-61.
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision- machined Acme or 60oV threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
 - .7 Gland packing: non-asbestos.
 - .8 Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
 - .9 Identification tag: with catalogue number, size, other pertinent data.
 - .4 All products to have Canadian Registration Numbers (CRN).
 - .5 Bronze trim for steam, water, air or glycol service, iron trim for oil, gas or gasoline.
- 2.2 GATE VALVES
- .1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze or iron trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
 - .2 Bronze Trim:
 - .1 Disc: Solid offset taper wedge, bronze to ASTM B62.
 - .2 Seat rings: renewable bronze to ASTM B62, screwed into body.
 - .3 Stem: bronze to ASTM B62.
 - .3 Iron Trim:
 - .1 Disc: Solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.
 - .2 Seat: Integral with body.

- 2.2 GATE VALVES (Cont'd)
- .1 (Cont'd)
 - .3 Iron Trim:(Cont'd)
 - .3 Stem: wrought steel.
 - .4 Operator: Handwheel
 - .2 NPS 10 - 24, non rising stem, inside crew, bronze or iron trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: cast iron to ASTM A126 Class B for sizes up to NPS 14, Class C for sizes NPS 16 and over, with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re- assembly, body tie ribs between bonnet and end flanges.
 - .2 Pressure ratings: Class 125.
 - .3 Bronze Trim:
 - .1 Disc: Solid offset taper wedge, with bronze rings to ASTM B62 rolled into cast iron disc, secured to stem.
 - .2 Seat rings: renewable bronze to ASTM B62 screwed into body.
 - .3 Stem: bronze to ASTM B62.
 - .4 Iron Trim:
 - .1 Disc: Solid offset taper wedge, cast iron secured to stem.
 - .2 Seat: integral with body up to NPS 14, renewable nodular iron on other sizes.
 - .3 Stem: wrought steel.
 - .4 Operator: Handwheel
 - .3 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze or iron trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut, Class 125.
 - .2 Bronze Trim:
 - .1 Disc: Solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc- stem connection.
 - .2 Seat rings: renewable bronze screwed into body.
 - .3 Stem: manganese- bronze.
 - .3 Iron Trim:
 - .1 Disc: Solid offset taper all-cast iron, secured to stem through integral forged T-head disc- stem connection.
 - .2 Seat rings: integral with body.
 - .3 Stem: nickel-plated steel for iron trim.
 - .4 Pressure-lubricated operating mechanism.
 - .5 Operator: Handwheel.

2.2 GATE VALVES
(Cont'd)

- .4 NPS 10 - 24, outside screw and yoke (OS&Y), bronze or iron trim, solid wedge disc:
- .1 Body and multiple-bolted bonnet: NPS 10 - 14: cast iron to ASTM A126 Class B; NPS 16 - 24: cast iron to ASTM A126 Class C. With bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges, yoke, yoke hub, yoke sleeve and nut.
 - .2 Pressure ratings: Class 125.
 - .1 NPS 10-12: WP = 1.4 MPa CWP
 - .2 NPS 14-24: WP = 1.03 MPa CWP
 - .3 Bronze Trim
 - .1 Disc: Solid offset taper wedge, bronze disc rings to ASTM B62 rolled into cast iron disc, secured to stem through integral forged T-head disc-stem connection.
 - .2 Seat rings: renewable bronze to ASTM B62 screwed into body.
 - .3 Stem: manganese- bronze.
 - .4 Iron Trim:
 - .1 Disc: Solid offset taper all-cast iron, secured to stem through integral forged T-head disc- stem connection.
 - .2 Seat: integral with body up to NPS 14, renewable nodular iron on other sizes.
 - .3 Stem: nickel-plated steel.
 - .5 Pressure-lubricated operating mechanism.
 - .6 Operator: Handwheel.

2.3 UNDERWRITERS
APPROVED GATE VALVE

- .1 NPS 2 1/2 - 14, OS&Y:
- .1 Approvals: UL and FM approved for fire service.
 - .2 UL and FM Label: on valve yoke.
 - .3 Body, Bonnet: cast iron to ASTM A126 Class B. Wall thicknesses to ANSI B16.1 and ULC C-262 (B).
 - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.
 - .5 Packing gland: bronze.
 - .6 Stem: manganese bronze. Diameter to ULC C-262 (B).
 - .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
 - .8 Bosses for bypass valve, drain: on NPS 4 and over.
 - .9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: cast iron with bronze disc rings.
 - .10 Disc seat ring: self- aligning, Milwood undercut on NPS 3 - 12.
 - .11 Pressure rating:
 - .1 NPS 2-1/2 - 12: 1.7 MPa CWP
 - .2 NPS 14: 1.2 MPa CWP
 - .12 Operator: Handwheel.

-
- 2.4 GLOBE VALVES .1 NPS 2½ - 10, OSY:
- .1 Body: with multiple-bolted bonnet.
 - .2 WP: 860 kPa steam, 1.4 MPa CWP
 - .3 Bonnet-yolk gasket: non- asbestos.
 - .4 Disc: bronze to ASTM B 62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
 - .5 Seat ring: renewable, regrindable, screwed into body.
 - .6 Stem: bronze to ASTM B 62.
 - .7 Operator: handwheel.
- 2.5 BYPASSES FOR GATE AND GLOBE VALVES .1 Locations: on valves as indicated.
- .2 Position of bypass valve on main valves: spindle uprights or parallel position.
- .3 Size of bypass valve:
- .1 Main valve up to NPS 8: NPS 3/4.
 - .2 Main valve NPS 10 and over: NPS 1.
- .4 Type of bypass valves:
- .1 On gate valve: globe, with composition disc, trim, to Section 23 05 23 - Valves - Bronze. Pressure rating to match main valve.
 - .2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23 - Valves - Bronze. Pressure rating to match main valve.
- 2.6 VALVE OPERATORS .1 Install valve operators and handwheel on valves except as specified.
- .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms and mechanical equipment rooms.
- 2.7 CHECK VALVES .1 Swing check valves, Class 125:
- .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.
 - .1 Up to NPS 16: cast iron to ASTM A126 Class B.
 - .2 NPS 18 and over: cast iron to ASTM A126 Class C.
 - .2 Ratings:
 - .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
 - .2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.
 - .3 NPS 18 and over: 1.03 MPa CWP.
-

-
- 2.7 CHECK VALVES (Cont'd)
- .1 (Cont'd)
 - .3 Bronze Trim
 - .1 Disc: Rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B 62.
 - .2 NPS 8 and over: bronze-faced cast iron.
 - .2 Seat rings: renewable bronze to ASTM B62 screwed into body.
 - .3 Hinge pin, bushings: renewable bronze to ASTM B62.
 - .4 Iron Trim
 - .1 Disc: A126 Class B, secured to stem, rotating for extended life.
 - .2 Seat: cast iron, integral with body.
 - .3 Hinge pin: exelloy; bushings: malleable iron.
 - .5 Identification tag: fastened to cover.
 - .6 Hinge: galvanized malleable iron.
- .2 Swing check valves, NPS 2 1/2 - 8 Class 250:
- .1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
 - .2 Flanged ends: 2 mm raised face with serrated finish.
 - .3 Rating: 1.7 mPa steam; 3.4 mPa CWP.
 - .4 Disc: Rotating for extended life.
 - .1 Up to NPS 3: bronze to ASTM B61.
 - .2 NPS 4 - 8: Iron faced with ASTM B61 bronze.
 - .5 Seat rings: renewable bronze to ASTM B61, screwed into body.
 - .6 Hinge pin, bushings: renewable, bronze to ASTM B61.
 - .7 Hinge: galvanized malleable iron.
 - .8 Identification tag: fastened to cover.
- 2.8 SILENT CHECK VALVES
- .1 Body: malleable iron or ductile iron with integral seat.
 - .2 Pressure rating: Class 125, WP = 860 kPa.
 - .3 Connections: grooved ends or flanged.
 - .4 Disc: bronze or stainless steel renewable rotating disc.
 - .5 Seat: renewable, EPDM.
 - .6 Stainless steel spring, heavy duty.
-

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Install rising stem valves in upright position with stem above horizontal. Confirm there is sufficient room for valve stem in fully open position.

PART 1 - GENERAL

1.1 RELATED SECTIONS .1 Section 01 33 00 Submittal Procedures

- 1.2 REFERENCES .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME B16.5-2013, Pipe Flanges and Flanged Fittings.
 - .2 ANSI/ASME B16.10-2009, Face-to-Face and End-to-End Dimensions Valves.
 - .3 ANSI/ASME B16.25-2012, Buttwelding Ends.
 - .4 ANSI/ASME B16.34-2013, Valves Flanged, Threaded and Welding End.
- .2 American Petroleum Institute (API)
- .1 API 598-2009, Valve Inspection and Testing.
- .3 American Society for Testing and Materials (ASTM)
- .1 ASTM A49-2012, Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A193M-2012B, Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service.
 - .3 ASTM A194M-2012A, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.
 - .4 ASTM A216-2012, Specification for Steel Castings, Carbon Suitable for Fusion Welding for High Temperature Service.
 - .5 ASTM B85-2010e1, Specification for Aluminum Alloy Die Castings.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
- .1 SP25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 SP61-2013, Pressure Testing of Steel Valves.
- .5 Province of Nova Scotia
- .1 Boiler Pressure Vessel and Compressed Gas Regulations.

- 1.3 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit data for valves specified this section.
-

1.4 CLOSEOUT SUBMITTALS .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00.

1.5 EXTRA MATERIALS .1 Furnish following spare parts:
.1 Valve seats: one for every ten (10) valves each size, minimum one (1).
.2 Discs: one (1) for every ten (10) valves each size, minimum one (1).
.3 Stem packing: one (1) for every ten (10) valves, each size. Minimum one (1).
.4 Valve handles: two (2) of each size.
.5 Gaskets for flanges: one (1) for every ten (10) flanged joints.

PART 2 - PRODUCTS

2.1 GENERAL .1 Valves to be individually tested.
.2 Requirements common to valves, unless specified otherwise:
.1 Pressure-temperature ratings: to ANSI B16.34.
.2 Inspections and tests: to API 598.
.3 Pressure Testing: to MSS SP-61.
.4 Flanged valves:
.1 Face-to-face dimensions: to ANSI B16.10.
.2 Flange dimensions: to ANSI B16.5 with 1.6 mm raised face
.5 Butt-weld valves:
.1 End-to-end dimensions: to ANSI B16.10.
.2 End dimensions: to ANSI B16.25 bored for standard pipe schedule.
.6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B 85 or malleable iron to ASTM A 49.
.7 Markings: to MSS SP-25.
.8 Identification:
.1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.
.2 Body markings: manufacturer, size, primary service rating, material symbol.
.9 Canadian registration number (CRN) required for all products.

2.2 GATE VALVES .1 NPS 2 1/2 - 12, rising stem, OS&Y, solid flexible wedge disc, flanged butt-weld ends, Class150 300:
.1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A 216 WCB, with full

2.2 GATE VALVES
(Cont'd)

- .1 (Cont'd)
 - .1 (Cont'd)
length disc guides designed to ensure correct re-assembly.
 - .2 Body/bonnet joint: Flat face with corrugated metallic gasket, malefemale on Class 300.
 - .3 Bonnet studs: to ASTM A 193 Type B7.
 - .4 Bonnet nuts: to ASTM A 194 Type 2H.
 - .5 Stuffing box: including non-galling two-piece ball jointed packing gland, with swing-type eye bolts and nuts.
 - .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
 - .7 Yoke sleeve: Ni-Resist, minimum melting point above 954°C.
 - .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
 - .9 Disc: with disc stem ring to connect to stem, guided throughout its travel.
 - .1 NPS 2 1/2 - 6: Solid corrosion and heat resistant 13% chromium steel with minimum hardness of 350 HB.
 - .2 NPS 8 and larger: Carbon steel faced with corrosion and heat resistant 13 chromium steel with minimum hardness of 350 HB.
 - .10 Seat ring: seamless carbon steel with hard-faced cobalt-chromium-tungsten alloy seating surface, slipped in, seal welded, ground to match disc.
 - .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with accurately-cut precision-machined Acme or 60° V threads, top screwed for handwheel nut, T-head disc-stem connection.
 - .12 Operator: see elsewhere this section.

2.3 GLOBE VALVES

- .1 NPS 2 1/2 - 12, rising stem, OS&Y, flanged butt-weld ends, Class150 300:
 - .1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A 216 WCB.
 - .2 Body/bonnet joint: Flat Male-female face with corrugated metallic gasket.
 - .3 Bonnet studs: to ASTM A 193 Type B7.
 - .4 Bonnet nuts: to ASTM A 194 Type 2H.
 - .5 Stuffing box: including non-galling two-piece ball-jointed packing gland, with swing-type eye bolts and nuts.
 - .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
 - .7 Yoke bushing: Ni-Resist, minimum melting point above 954°C.
 - .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.

-
- 2.3 GLOBE VALVES (Cont'd)
- .1 (Cont'd)
 - .9 Disc: Plug type with 15° taper seat and bottom guide.
 - .10 Seat rings: with 1.6 mm thick cobalt-chromium-tungsten alloy facings with minimum hardness of 375 HB (cold), slipped in, seal welded, ground to match disc.
 - .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with bonnet bushing, long engagement with yoke bushing for accurate seating, accurately-cut precision-machined Acme or 60° V threads, top screwed for handwheel nut.
 - .12 Operator: see elsewhere this section.
- 2.4 VALVE OPERATORS
- .1 Handwheel: on all valves except as specified.
 - .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.
 - .3 Ball valves: NPS 36 lever handle, NPS 812 gear operator.
- 2.5 BYPASSES FOR VALVES GATE AND GLOBE
- .1 Locations: on valves as indicated.
 - .2 Position of bypass valve on main valves: stem venture or parallel position.
 - .3 Size of bypass valve:
 - .1 Main valve up to NPS 8: NPS 3/4.
 - .2 Main valve NPS 10 and over: NPS 1.
 - .4 Type of bypass valves:
 - .1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23 Valves - Bronze.
 - .2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23 - Valves - Bronze
- 2.6 CHECK VALVES
- .1 NPS 2 1/2 and over, flanged butt-weld ends, Class150 300: swing check.
 - .1 Body and multiple-bolted cap: cast steel to ASTM A 216 WCB.
 - .2 Cap studs: to ASTM A 193 Type B7.
 - .3 Cap nuts: to ASTM A 194 Type 2H.
 - .4 Body/cap joint: male-female face with corrugated metallic gasket.
 - .5 Disc: heat treated corrosion and heat resistant 13% chromium steel.
-

- 2.6 CHECK VALVES .1 (Cont'd)
(Cont'd)
- .6 Seat rings: heat treated corrosion and heat resistant 13% chromium steel, slipped in, seal welded, ground to match disc.
- .7 Hinge: ASTM A 216 WCB.
- .8 Hinge pin: 410 Stainless Steel.
-
- 2.7 BALL VALVES .1 NPS 3 and larger, flanged ends. Class 150 or 300 regular port.
- .1 One piece body: cast carbon steel to ASTM A216 WCB.
- .2 Ball: Type 304 stainless steel.
- .3 Blow out proof stem
- .4 Stem: type 304 stainless steel
- .5 Antistatic device
- .6 Seats: glass filled PTFE.
- .7 Body gasket: PTFE.
- .8 Cap /screws: ASTM A193.
- .9 Packing: graphoil
- .10 Gland: carbon steel C1018 cadmium plated.
- .11 Gland Flange: ASTM A36.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.
-
- 3.2 COMMISSIONING .1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Submittal Procedures: Section 01 33 00
	.2	Cast-in-Place Concrete: Section 03 30 00
	.3	Structural Steel: Section 05 12 23
<u>1.2 REFERENCES</u>	.1	American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
	.1	ANSI/ASME B31.1-2012, Power Piping, (SI Edition).
	.2	ANSI/ASME B31.3-2012, Process Piping.
	.3	ANSI/ASME B31.5-2013, Refrigeration Piping and Heat Transfer Components.
	.4	ANSI/ASME B31.9-2011, Building Services Piping.
	.2	American Society for Testing and Materials (ASTM)
	.1	ASTM A125-96 (R2007), Specification for Steel Springs, Helical, Heat Treated.
	.2	ASTM A307-2012, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
	.3	ASTM A563-07a, 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 SP58-2009, Pipe Hangers and Supports Materials, Design and Manufacture.
	.5	Underwriter's Laboratories of Canada (ULC).
<u>1.3 DESIGN REQUIREMENTS</u>	.1	Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
	.2	Base maximum load ratings on allowable stresses prescribed by ASME B31.1 , B31.3, B31.5, B31.9 or MSS SP58.
	.3	Do not allow that supports, guides or anchors to 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

- | | | |
|-------------------------------------|----|---|
| 1.3 DESIGN REQUIREMENTS
(Cont'd) | .4 | (Cont'd)
contraction, prevent excessive stresses from being introduced into pipework or connected equipment. |
| | .5 | Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58. |

- | | | |
|------------------------------|----|---|
| 1.4 PERFORMANCE REQUIREMENTS | .1 | Design supports, platforms, catwalks, hangers to withstand seismic events for location as per the National Building Code. |
|------------------------------|----|---|

- | | | |
|------------------------------------|----|--|
| 1.5 SHOP DRAWINGS AND PRODUCT DATA | .1 | Submit shop drawings and product data in accordance with Section 01 33 00. |
| | .2 | Submit shop drawings and product data for following items:
.1 Bases, hangers and supports.
.2 Connections to equipment and structure.
.3 Structural assemblies. |

- | | | |
|-------------------------|----|---|
| 1.6 CLOSEOUT SUBMITTALS | .1 | Provide maintenance data for incorporation into manual specified in Section 01 78 00. |
|-------------------------|----|---|

PART 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 painted with zincrich paint after manufacture.
.2 Use electroplating galvanizing process or hot dipped galvanizing process.
.3 Confirm steel hangers in contact with copper piping are copper plated or epoxy coated. |
| | .2 | Upper attachment structural: Suspension from lower flange of I-Beam. |
-

2.2 PIPE HANGERS
(Cont'd)

- .2 Upper attachment structural:(Cont'd)
 - .1 Cold piping NPS 2 maximum: Malleable iron Cclamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed, 13 mm FM approved.
 - .2 Cold piping NPS 2 1/2 or greater, 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 where required to MSS SP58.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
 - .1 Cold piping NPS 2 maximum: Ductile iron top of beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved where required to MSS SP58.
 - .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, FM approved where required.
- .4 Upper attachment to concrete:
 - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weld-less 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 FM approved where required to MSS SP58.
- .5 Shop and field fabricated assemblies:
 - .1 Trapeze hanger assemblies: MSS SP58.
 - .2 Steel brackets: MSS SP58.
 - .3 Sway braces for seismic restraint systems: to MSS SP58.
- .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 galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation saddles for hot pipework.
 - .4 Oversize pipe hangers and supports for insulated pipes.
- .8 Adjustable clevis: material to MSS SP58, UL listed FM approved, where required clevis bolt with nipple

-
- 2.2 PIPE HANGERS
(Cont'd)
- .8 Adjustable clevis:(Cont'd)
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 SP58.
 - .10 U-bolts: carbon steel to MSS SP58 with two (2) nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.
 - .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP58.
- 2.3 RISER CLAMPS
- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP58, type 42, UL listed FM approved where required.
 - .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 SP58, 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 SP58.
- 2.5 CONSTANT
SUPPORT SPRING
HANGERS
- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with \pm spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).
 - .1 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
-

2.5 CONSTANT
SUPPORT SPRING
HANGERS
(Cont'd)

- .2 Provide upper and lower factory set travel stops.
- .3 Provide load adjustment scale for field adjustments.
- .4 Total travel to be actual travel \pm 20%. Difference between total travel and actual travel 25 mm minimum.
- .5 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 precompressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring precompressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with \pm 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 Section 05121. 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 To Section 05 31 00.

2.10 HOUSEKEEPING
PADS

- .1 For basemounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: to Section 03 30 00.

2.11 OTHER EQUIPMENT.1 From structural grade steel meeting requirements of
SUPPORTS Section 05 12 23.

.2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install in accordance with manufacturer's
instructions and recommendations.

.2 Vibration Control Devices:
.1 Install on piping systems at pumps, boilers,
chillers, cooling towers, and 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 four (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 the Canadian Fire code.

.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

3.2 HANGER SPACING
(Cont'd)

- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Hydronic, steam, condensate, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

Maximum Pipe Size Copper Size: NPS	NPS Maximum Spacing:	Steel Maximum Spacing:
up to 1-1/4	2.2 m	1.8 m
1-1/2	2.1 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.1 m	3.0 m
3	3.1 m	3.0 m
3-1/2	3.1 m	3.3 m
4	4.1 m	3.6 m
5	4.1 m	
6	5.1 m	
8	5.1 m	
10	6.6 m	
12	6.9 m	

- .6 Within 300 mm of each elbow.
- .7 Pipework greater than NPS 12: to MSS SP58.

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. Comprised of angel iron or c-channel.

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

PART 1 - GENERAL

- | | | |
|-----------------------------|----|--|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
| | .2 | Interior Painting: Section 09 91 23 |
| <u>1.2 REFERENCES</u> | .1 | Canadian Gas Association (CGA)
.1 CSA/CGA B149.1-2010, Natural Gas and Propane Installation Code. |
| | .2 | Canadian General Standards Board (CGSB)
.1 CAN/CGSB1.60-97, Interior Alkyd Gloss Enamel.
.2 CAN/CGSB24.3-92, Identification of Piping Systems. |
| | .3 | National Fire Protection Association
.1 NFPA 13-2013, Installation of Sprinkler Systems.
.2 NFPA 14-2013, Standpipe and Hose Systems. |
| | .4 | CSA Z7396.1-2012, Medical Gas Piping Systems. |
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| | .2 | Product data to include paint colour chips, other products specified in this section. |
| <u>1.4 SAMPLES</u> | .1 | Submit samples in accordance with Section 01 33 00. |
| | .2 | Samples to include nameplates, labels, tags, lists of proposed legends. |
-

PART 2 - PRODUCTS

- 2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES
- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
 - .2 Lettering and numbers to be raised or recessed.
 - .3 Information to include, as appropriate:
 - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

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

#	mm	Lines	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.
 - .3 Use maximum of 25 letters/numbers per line.

2.3 EXISTING
IDENTIFICATION
SYSTEMS

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

2.4 PIPING SYSTEMS
GOVERNED BY CODES

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

2.5 IDENTIFICATION
OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and

- 2.5 IDENTIFICATION OF PIPING SYSTEMS (Cont'd)
- .6 (Cont'd)
- .2 All other pipes:(Cont'd)
continuous operating temperature of 150°C and
intermittent temperature of 200°C.
- .7 Colours and Legends:
- .1 Where not listed, obtain direction from
Departmental Representative.
- .2 Colours for legends, arrows, to following
- | <u>Background colour</u> | <u>Legend, arrows</u> |
|---|-----------------------|
| Yellow | BLACK |
| Green | WHITE |
| Red | WHITE |
| .3 Background colour marking and legends for
piping systems: | |

Contents

Background colour

Legend

** Add design temperature

++ Add design temperature and pressured

Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Heating water supply	Black	HWS
Heating water return	Black	HWR

- 2.6 DUCTWORK IDENTIFICATION
- .1 50 mm high stencilled letters and directional arrows
150 mm long x 50 mm high.
- .2 Colours: Black, or coordinated with base colour to
ensure strong contrast.
- .3 Identify system : e.g. Supply AHU1, Exhaust F7.

- 2.7 VALVES, CONTROLLERS
- .1 Brass tags 12 mm diameter with stamped
identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved
size, showing charts and schedules with
identification of each tagged item, valve type,

- | | | |
|---|----|---|
| <u>2.7 VALVES,
CONTROLLERS
(Cont'd)</u> | .2 | (Cont'd)
service, function, normal position, location of
tagged item. |
| <u>2.8 CONTROLS
COMPONENTS
IDENTIFICATION</u> | .1 | Identify all systems, equipment, components,
controls, sensors with system nameplates specified in
this Section. If no EMCS included in project,
identification as per this section. |
| | .2 | Inscriptions to include function and (where
appropriate) failsafe position, component ID name. |
| <u>2.9 LANGUAGE</u> | .1 | Identification to be in English. |
| | .2 | Use one nameplate, label, etc. for each language. |
|
<u>PART 3 - EXECUTION</u> | | |
| <u>3.1 TIMING</u> | .1 | Provide identification only after all painting
specified in Section 09 91 23 has been completed. |
| <u>3.2 INSTALLATION</u> | .1 | Perform work in accordance with CAN/CGSB 24.3 except
as specified otherwise. |
| | .2 | Provide ULC and/or CSA registration plates as
required by respective agency. |
| <u>3.3 NAMEPLATES</u> | .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 nonferrous chains or closed "S" hooks.
- .2 Install one (1) copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

PART 1 - GENERAL

- | | | |
|-----------------------------|----|---|
| <u>1.1 RELATED SECTIONS</u> | .1 | Section 01 33 00 - Submittal Procedures. |
| | .2 | Section 23 05 29 - Bases, Hangers and Supports. |
| | .3 | Section 23 05 53 - Mechanical Identification. |
-
- | | | |
|-----------------------|----|--|
| <u>1.2 REFERENCES</u> | .1 | American Society for Testing and Materials International, (ASTM) |
| | .1 | ASTM B209M-2010, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric). |
| | .2 | ASTM C335-2010e1, Test Method for Steady State Heat Transfer Properties of Pipe Insulation. |
| | .3 | ASTM C449-07(R2013), Standard Specification for Mineral Fiber Hydraulic Setting Thermal Insulating and Finishing Cement. |
| | .4 | ASTM C553-2011, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications. |
| | .5 | ASTM C612-10, Specification for Mineral Fiber Block and Board Thermal Insulation. |
| | .6 | ASTM C921-10, Standard Practice for Determining Properties of Jacketing Materials for Thermal Insulation. |
| | .2 | Canadian General Standards Board (CGSB) |
| | .1 | CGSB 51GP52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation. |
| | .3 | Thermal Insulation Association of Canada (TIAC): National Insulation Standards. |
| | .4 | Underwriters Laboratories of Canada (ULC) |
| | .1 | CAN/ULC S102-2010, Surface Burning Characteristics of Building Materials and Assemblies. |
| | .2 | CAN/ULC S701-2011, Thermal Insulation Polystyrene, Boards and Pipe Covering. |
-

- 1.3 DEFINITIONS .1 For purposes of this section:
- .1 "CONCEALED" insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" will mean "not concealed" as defined herein.
 - .3 Insulation systems insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
- .1 CRD: Commercial Round Ductwork,
 - .2 CRF: Commercial Rectangular Finish.
 - .3 CEF: Commercial Rigid Insulation External Application.
- 1.4 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.
- 1.5 SAMPLES .1 Submit samples in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.
- 1.6 MANUFACTURERS' INSTRUCTIONS .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used and installation standards achieved.
- 1.7 QUALIFICATIONS .1 Installer: specialist in performing work of this section and qualified to standards of TIAC.
-

- | | | |
|---|----|--|
| <u>1.8 DELIVERY,
STORAGE AND
HANDLING</u> | .1 | Deliver materials to site in original factory packaging, labelled 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 recommended by manufacturer. |

PART 2 - PRODUCTS

- | | | |
|--------------------------------------|----|--|
| <u>2.1 FIRE AND SMOKE
RATING</u> | .1 | In accordance with CAN/ULCS102:
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50. |
|--------------------------------------|----|--|

- | | | |
|-----------------------|----|--|
| <u>2.2 INSULATION</u> | .1 | Mineral fibre: as specified includes glass fibre, rock wool, slag wool. |
| | .2 | Thermal conductivity ("k" factor) not to exceed specified values at 24 C mean temperature when tested in accordance with ASTM C335. |
| | .3 | TIAC Code C1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51GP52Ma (as scheduled in PART 3 of this Section). |
| | .4 | TIAC Code C2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51GP52Ma (as scheduled in PART 3 of this section).
.1 Mineral fibre: to ASTM C553.
.2 Jacket: to CGSB 51GP52Ma.
.3 Maximum "k" factor: to ASTM C553. |

- | | | |
|--------------------|----|---|
| <u>2.3 JACKETS</u> | .1 | 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 | Aluminum:
.1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
.2 Thickness: 0.40 mm sheet.
.3 Finish: Stucco embossed or corrugated. |
-

-
- 2.3 JACKETS
(Cont'd)
-
- .2 Aluminum:(Cont'd)
 - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
 - .3 Stainless steel:
 - .1 Type: 304 or 316 where additional corrosion protection is required.
 - .2 Thickness: 0.25 mm sheet.
 - .3 Finish: Corrugated or stucco embossed.
 - .4 Jacket banding and mechanical seals: 12mm wide, 0.5 mm thick stainless steel.
 - .4 Self adhesive weather barrier membrane:
 - .1 Flexible SBS modified membrane impermeable to air, moisture vapour and water. UV light resistant, flame free adhesion.
- 2.4 ACCESSORIES
-
- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
 - .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
 - .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m2.
 - .5 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.
 - .6 Contact adhesive: quick-setting.
 - .7 Canvas adhesive: washable.
-

- 2.4 ACCESSORIES
(Cont'd)
- .8 Tie wire: 1.5 mm stainless steel.
 - .9 Banding: 12 mm wide, 0.5 mm thick stainless steel.
 - .10 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation.
 - .11 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips, length to suit thickness of insulation.

PART 3 - EXECUTION

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

- 3.2 INSTALLATION
- .1 Install in accordance with TIAC National Standards.
 - .2 Apply materials in accordance with manufacturer's instructions and as indicated.
 - .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
 - .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
 - .5 Supports, Hangers in accordance with Section 23 05 29 Bases, Hangers and Supports.
 - .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 .1 Insulation types and thicknesses: Conform to
INSULATION SCHEDULE following Table:

	<u>TIAC Code</u>	<u>Vapour Retarder</u>	<u>Thickness (mm)</u>
Rectangular cold and dual temperature supply air ducts (exposed)	C1	Yes	50
Round cold and dual temperature supply air ducts (concealed)	C2	Yes	50
Rectangular warm air ducts (exposed)	C1	No	25
Round warm air ducts (exposed)	C1	No	25
Rectangular cold and dual temperature supply air ducts (concealed)	C2	Yes	25
Round cold and dual temperature supply air ducts (exposed)	C1	Yes	50
Rectangular warm air ducts (concealed)	C2	No	25
Round warm air ducts (concealed)	C2	No	25
Supply, return and exhaust ducts exposed in space being served	none		
Outside air ducts to mixing Plenum	C1	Yes	50
Intake and exhaust plenums	C1	Yes	50
Exhaust duct between dampers and louvers	C1	No	50
Rectangular ducts outside	C1	special	75
Round ducts outside	C1	special	75

3.3 DUCTWORK
INSULATION SCHEDULE
(Cont'd)

- .2 Jackets: Exposed round ducts 600mm and larger, smaller sizes where subject to abuse:
 .1 Use TIAC code C1 insulation , scored to suit diameter of duct.
 .2 Finishes: Conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	None	None
Indoor, exposed within mechanical room	CRF/ Canvas	CRD/ Canvas
Indoor, exposed elsewhere	CRF/ Aluminum CRF/Self	CRD/ Aluminum CRD/Self
Outdoor, exposed	adhesive weather barrier membrane	adhesive weather barrier membrane

PART 1 - GENERAL

- | | | |
|-----------------------------|----|---|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
| | .2 | Joint Sealers: Section 07 92 00 |
| | .3 | Mechanical Identification: Section 23 05 53 |
-
- | | | |
|-----------------------|----|--|
| <u>1.2 REFERENCES</u> | .1 | American Society for Testing and Materials (ASTM) |
| | .1 | ASTM B209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric. |
| | .2 | ASTM C335-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation |
| | .3 | ASTM C449/C449M-07(R2013), Standard Specification for Mineral FibreHydraulicSetting Thermal Insulating and Finishing Cement. |
| | .4 | ASTM C533-11, Standard specification for Calcium Silicate Insulation Block and Pipe. |
| | .5 | ASTM C534-11, Standard Specification for Preformed Elastomeric Cellular Thermal Insulation in Sheet And Tubular Form. |
| | .6 | ASTM C547-11e1 Standard Specification for Mineral Fibre Pipe Insulation. |
| | .7 | ASTM C921-10, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation. |
| | .2 | Canadian General Standards Board (CGSB) |
| | .1 | CGSB 51GP52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation. |
| | .2 | CAN/CGSB51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts. |
| | .3 | Manufacturer's Trade Associations |
| | .1 | Thermal Insulation Association of Canada (TIAC): National Insulation Standards. |
| | .4 | Underwriters' Laboratories of Canada (ULC) |
| | .1 | CAN/ULCS102-10, Surface Burning Characteristics of Building Materials and Assemblies. |
| | .2 | CAN/ULCS701-11 Thermal Insulation, Polystyrene, Boards and Pipe Covering. |
| | .3 | CAN/ULCS702-09, Thermal Insulation, Mineral Fibre, for Buildings |
-

- 1.3 DEFINITIONS .1 For purposes of this section:
- .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
- .1 CPF: Commercial Piping Finish.
- 1.4 SHOP DRAWINGS .1 Shop drawings in accordance with Section 01 33 00.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.
- 1.5 SAMPLES .1 Submit samples in accordance with Section 01 33 00.
- 1.6 MANUFACTURER'S INSTRUCTIONS .1 Submit manufacturers' installation instructions in accordance with Section 01 33 00.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.
- 1.7 QUALIFICATIONS .1 Installer to be specialist in performing work of this Section and qualified to standards of TIAC.
- 1.8 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.
-

PART 2 - PRODUCTS

- 2.1 FIRE AND SMOKE RATING
- .1 In accordance with CAN/ULC S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.
- 2.2 INSULATION
- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
 - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
 - .3 TIAC Code A2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: to ASTM C533.
 - .2 Maximum "k" factor: to 0.075 W/m°C @ 500°C .
 - .3 Design to permit periodic removal and reinstallation.
 - .4 TIAC Code A3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULCS702 and ASTM C547.
 - .2 Jacket: to CGSB 51GP52Ma.
 - .3 Maximum "k" factor: to CAN/ULCS702.
 - .5 TIAC Code A6: Flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket to ASTM C534.
 - .2 Jacket: to CGSB 51GP52Ma.
 - .3 Maximum "k" factor: 0.039 W/m - °C.
 - .4 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants
 - .5 Flame spread index less than 25, and smoke developed index less than 50.
 - .6 TIAC Code C2: Mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULCS702.
 - .2 Jacket: to CGSB 51GP52Ma.
 - .3 Maximum "k" factor: to CAN/ULCS702.
-

- | | | |
|---|----|---|
| <u>2.3 INSULATION
SECRETMENT</u> | .1 | Tape: Selfadhesive, aluminum, plain reinforced, 50 mm wide minimum. |
| | .2 | Contact adhesive: Quick setting. |
| | .3 | Canvas adhesive: Washable. |
| | .4 | Tie wire: 1.5 mm diameter stainless steel. |
| | .5 | Bands: Stainless steel, 19 mm wide, 0.5 mm thick. |
| <u>2.4 CEMENT</u> | .1 | Thermal insulating and finishing cement:
.1 Hydraulic setting or air drying on mineral wool, to ASTM C449/C449M. |
| <u>2.5 VAPOUR
RETARDER LAP
ADHESIVE</u> | .1 | Water based, fire retardant type, compatible with insulation. |
| | .2 | For Type A6 insulation to manufacturer's recommendation. |
| <u>2.6 INDOOR VAPOUR
RETARDER FINISH</u> | .1 | Vinyl emulsion type acrylic, compatible with insulation. |
| | .2 | For Type A6 insulation to manufacturer's recommendation. |
| <u>2.7 OUTDOOR VAPOUR
RETARDER FINISH</u> | .1 | Vinyl emulsion type acrylic, compatible with insulation. |
| | .2 | For Type A6 insulation to manufacturer's recommendation. |
| | .3 | Reinforcing fabric: Fibrous glass, untreated 305 g/m2. |
| <u>2.8 JACKETS</u> | .1 | Polyvinyl Chloride (PVC):
.1 Onepiece moulded type and sheet to CAN/CGSB51.53 with preformed shapes as required.
.2 Colours: to Section 23 05 53.
.3 Minimum service temperatures: 20 degrees C.
.4 Maximum service temperature: 65 degrees C.
.5 Moisture vapour transmission: 0.02 perm.
.6 Thicknes: 1.0 mm. |
-

- 2.8 JACKETS (Cont'd)
- .1 (Cont'd)
- .7 Fastenings:
- .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
- .2 Tacks.
- .3 Pressure sensitive vinyl tape of matching colour.
- .8 Special requirements:
- .1 Indoor: flame spread rating 25, smoke developed rating 50.
- .2 Outdoor: UV rated material at least 1.0 mm thick.
- .2 Canvas:
- .1 220gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: Compatible with insulation.
- .3 Aluminum:
- .1 To ASTM B209.
- .2 Thickness: 0.40 mm sheet.
- .3 Finish: Stucco embossed or corrugated.
- .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
- .5 Fittings: 0.5 mm thick dieshaped fitting covers with factoryattached protective liner.
- .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .4 Stainless steel:
- .1 Type: 304 or type 316 where additional corrosion protection is required.
- .2 Thickness: 0.25 mm.
- .3 Finish: Smooth corrugated or stucco embossed.
- .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
- .5 Fittings: 0.5 mm thick dieshaped fitting covers with factoryattached protective liner.
- .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- 2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS
- .1 Caulking: to Section 07 92 00.

PART 3 - EXECUTION

- 3.1 PRE-INSTALLATION REQUIREMENT
- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
 - .2 Surfaces clean, dry, free from foreign material.
- 3.2 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.
- 3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES
- .1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
 - .2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
 - .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: Aluminum, SS, PVC high temperature fabric.
- 3.4 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.
-

3.5 PIPING
INSTALLATION
SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A2.
 - .1 Insulation securements: 18 ga SS wire or 12 mm x 0.51 mm SS bands at 300 mm oc.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501H.
- .3 TIAC Code: A3.
 - .1 Securements: Tape at 300 mm oc.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501C.
- .4 TIAC Code: A6.
 - .1 Insulation securements: as per manufacturer's recommendation.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501CA.
- .5 TIAC Code: C2 with vapour retarder jacket.
 - .1 Insulation securements: 18 ga SS wire or 12 mm x 05 mm ss bands at 300 mm oc.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501C.
- .6 Have thickness of insulation listed in the following table:
 - .1 Runouts to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

3.5 PIPING
INSTALLATION
SCHEDULES
(Cont'd)

.6 (Cont'd)
.2 (Cont'd)

Application	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness(mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8&over
Roof Drain Body		C2	25	25	25	25	25	25
Domestic HWS		A-3	25	25	25	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
Refrigerant Hot Gas, Liquid, Suction	4-13	A-6	25	25	25	25	25	25
Refrigerant Hot Gas, Liquid, Suction	below 4	A-6	25	25	25	25	25	25
Cooling Coil cond. Drain		A-3	25	25	25	25	25	25
HWS and HWR		A-3	25	25	25	25	25	25

.7 Finishes:

- .1 Exposed indoors: PVC jacket.
- .2 Exposed in mechanical rooms: PVC jacket.
- .3 Concealed, indoors: canvas on valves, fittings.
No further finish.
- .4 Use vapour retarder jacket on TIAC code A3
insulation compatible with insulation.
- .5 Outdoors: Waterproof Aluminum or SS jacket.
- .6 Finish attachments: SS screws or bands, at 150
mm oc. Seals: wing or closed.
- .7 Installation: To appropriate TIAC code CPF/1
through CPF/5.

PART 1 - GENERAL

- 1.1 REFERENCES .1 American Society for Testing and Materials
.1 ASTM E202-2012, Test Methods for Analysis of
Ethylene Glycols and Propylene Glycols.

PART 2 - PRODUCTS

- 2.1 CLEANING SOLUTIONS .1 Low foaming detergent at all temperatures.
.2 No pH neutralization required.
.3 Designed for use on most metals including aluminium.
.4 Biodegradable.
.5 Phosphate Free.
.6 Nitrite Free.

- PART 3 - EXECUTION Not applicable.

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
.1 Materials and installation for piping, valves and fittings for gas fired equipment.
- 1.2 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures.
.2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
.3 Section 01 78 00 - Closeout Submittals.
.4 Section 01 45 00 - Quality Control
.5 Section 01 91 13 - General Commissioning (Cx) Requirements.
.6 Section 23 05 05 - Installation of Pipework.
.7 Section 23 08 01 - Performance Verification Mechanical Piping Systems
.8 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- 1.3 REFERENCES .1 American Society of Mechanical Engineers (ASME)
.1 ASME B16.5-2013, Pipe Flanges and Flanged Fittings
.2 ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings
.3 ASME B16.22-2013, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
.4 ASME B18.2.1-2012, Square and Hex Bolts and Screws Inch Series.
.2 American Society for Testing and Materials International (ASTM)
.1 ASTM A 47/A47M-99 (R2014), Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A 53/A53M-2012, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
.3 ASTM B 75M-2011, Standard Specification for Seamless Copper Tube (Metric).
.4 ASTM B 837-2010, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
-

- 1.5 QUALITY ASSURANCE (Cont'd)
- .1 (Cont'd)
 - .1 (Cont'd)
 - .4 Review manufacturer's installation instructions and warranty requirements.
 - .2 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
 - .3 Trades people to have journey person qualifications.

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

PART 2 - PRODUCTS

- 2.1 PIPE
- .1 Steel pipe: to ASTM A 53/A53M, Schedule 40, seamless as follows:
 - .1 NPS ½ to 2, screwed.
 - .2 NPS 2 ½ and over, plain end.
 - .2 Copper pipe: to ASTM B 75M.
- 2.2 JOINTING MATERIAL
- .1 Screwed fittings: pulverized lead paste
 - .2 Welded fittings: to CSA W47.1.
 - .3 Flange gaskets: non-metallic flat.
 - .4 Brazing: to ASTM B 75M.

- 2.3 FITTINGS
- .1 Steel pipe fittings, screwed:
 - .1 Malleable iron: screwed to ANSI B16.3, Class 150 for service pressures up to and including 861 kPa.
 - .2 Unions: malleable iron, brass to iron, ground seat, to ASTM A47M.
 - .3 Nipples: schedule 40, to ASTM A53.
 - .2 Copper tube fittings:
 - .1 Service line riser and transition fittings.
 - .1 Wrought copper and copper alloy, solder type 1 to ANSI/ASME B16.22.
- 2.4 MANUAL SHUT-OFF VALVES
- .1 NPS 4 and under, full port, forged brass ball valve for two piece body construction complete with the following:
 - .1 Blowout-proof stem.
 - .2 Adjustable packing gland.
 - .3 Chrome-plated ball.
 - .4 Class 150 WSP, 600 WOG.
 - .5 CGA 3.16 approved.
 - .6 Provide complete with CRN.
 - .7 Lever handle.
 - .8 ANSI B1.20.1 NPT end connections.

PART 3 -EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS
- .1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheet.
- 3.2 PIPING
- .1 Install piping in accordance Section 23 05 05 - Installation of Pipework, applicable Provincial Codes, CAN/CSA-B149.1, supplemented as specified.
 - .2 Slope piping down in direction to flow to low points.
 - .3 Install drip points:
 - .1 At low points in piping system and where indicated.
 - .2 Provide complete with blowdown valve i.e. manual shut-off valve as specified above.
 - .3 Minimum 75 mm in length from tee connection in riser to top of valve. Size to be minimum NPS =. Provide complete with threaded end cap.
-

- 3.2 PIPING (Cont'd)
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage.
 - .5 Provide clearance for access and for maintenance.
 - .6 Ream pipes, clean scale and dirt, inside and out.
 - .7 Install piping to minimize pipe dismantling for equipment removal.
 - .8 Field ending of piping to be prohibited.
 - .9 Nesting of bushings to be prohibited. Utilize properly sized reducing fittings.
 - .10 Do not utilize propane piping as an electrical ground.
- 3.3 VALVES
- .1 Install valves with stems upright or horizontal unless approved otherwise by Departmental Representative.
 - .2 Install valves as indicated.
- 3.4 FIELD QUALITY CONTROL
- .1 Site Tests/Inspection:
 - .1 Test system in accordance with CAN/CSA B149.1 and CAN/CSAB149.2 and requirements of authorities having jurisdiction.
 - .2 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with contract.
 - .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of work at 25% and 60% complete.
 - .3 Upon completion of work, after cleaning is carried out.
-

- 3.4 FIELD QUALITY CONTROL
(Cont'd)
- .3 Obtain reports within 3 days of review and submit immediately to Departmental Representative.
 - .4 Performance Verification:
 - .1 Refer to Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
 - .5 PV procedures:
 - .1 Test performance of components.
- 3.5 ADJUSTING
- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1 and CAN/CSA B149.2.
 - .2 Pre-Start-Up Inspections:
 - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
 - .2 Check gas trains, entire installation is approved by authority having jurisdiction.
- 3.6 CLEANING
- .1 Cleaning: in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems, CAN/CSA B149.1, CAN/CSA B149.2, supplemented as specified.
 - .2 Perform cleaning operations as specified in Section 01 74 11 - Cleaning, and in accordance with manufacturer's recommendations.
 - .3 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- 3.7 PURGING
- .1 Purge after pressure test in accordance with CSA-B149.1.
- 3.8 IDENTIFICATION
- .1 Identify new propane piping systems in accordance with requirements for CSA-B149.1.
 - .2 Above ground propane piping to be primed and painted yellow along its entire length. All below ground propane piping to be covered with plastic yellow
-

- 3.8 IDENTIFICATION (Cont'd) .2 (Cont'd)
identification marker tape suitable for direct burial.
- .3 Supply and install "Propane Gas" pipe identification markers along length of propane piping installation in accordance with CSA-B149.1 and Section 23 05 53 - Mechanical Identification. Maximum spacing along straight length of pipe to be 6 m.
- .4 Maintain minimum depth of burial of underground propane piping of 600 mm, unless otherwise noted.
- 3.9 STORAGE CYLINDERS .1 Propane storage cylinder will be supplied and installed by the Owner. This tank shall not be considered part of this contract.
- .2 The responsibility for connection of the propane storage cylinder to the propane distribution piping will be borne by the Owner.

PART 1 - GENERAL

1.1 RELATED SECTIONS .1 Submittal Procedures: Section 01 33 00.

1.2 REFERENCES .1 ASME B16.4-2011, Gray-Iron Threaded Fittings, Class 125 and 250.

.2 ASME B16.15-2011, Cast Bronze Threaded Fittings, Classes 125 and 250.

.3 ANSI B16.18-2012, Cast Copper Alloy, Solder Joint Pressure Fittings.

.4 ASME B16.22-2012, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.5 ASTM B 32-08, Specification for Solder Metal.

.6 ASTM B 88-09, Specification for Seamless Copper Water Tube.

.7 AWS A5.8/A5.8M-2011, Filler Metals for Brazing and Braze Welding.

1.3 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 33 00.

.2 Indicate on manufacturers catalogue literature the following: valves.

1.4 MAINTENANCE DATA .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

PART 2 - PRODUCTS

- | | | |
|-------------------------------|----|---|
| <u>2.1 PIPING</u> | .1 | Type "L" hard drawn copper tubing: to ASTM B88M. |
| | .2 | Roll grooved copper piping may be used but products must be of one manufacturer throughout. |
| <u>2.2 FITTINGS</u> | .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. |
| | .5 | Roll grooved fittings: with rigid joints. |
| <u>2.3 JOINTS</u> | .1 | Solder, tin-antimony, 95:5: to ASTM B32. |
| | .2 | Silver solder BCUP: to ANSI/AWS A5.8. |
| | .3 | Brazing: as indicated. |
| | .4 | No lead solder permitted on this site. |
| <u>2.4 VALVES - ALL TYPES</u> | .1 | See Sections 23 05 23, 23 05 24 and 23 05 25. |

PART 3 - EXECUTION

- | | | |
|--------------------|----|----------------------------|
| <u>3.1 GENERAL</u> | .1 | Refer to Section 23 21 13. |
|--------------------|----|----------------------------|

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 ASME B16.1-2010, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125 and 250.
 - .2 ASME B16.3-2006, Malleable-Iron Threaded Fittings, Classes 150 and 300.
 - .3 ASME B16.5-2013, Pipe Flanges and Flanged Fittings: CPS 1/2 through NPS 24 Metric/Inch Standard.
 - .4 ASME B16.9-2012, Factory-Made Wrought Steel Butt-Welding Fittings.
 - .5 ANSI B18.2.1-2012, Square and Hex Bolts and Screws, Inch Series.
 - .6 ASME B18.2.2-2012, Square and Hex Nuts.
 - .7 ANSI/AWWA C111/A21.11-2012, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
 - .8 ASTM A47/A47M-99(2009), Specification for Ferritic Malleable Iron Castings.
 - .9 ASTM A 53/A 53M-2012, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - .10 ASTM A536-84(2009), Specification for Ductile Iron Castings.
 - .11 ASTM B 62-09, Specification for Composition Bronze or Ounce Metal Castings.
 - .12 CSA-B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
 - .13 CSA-W47.1-09, Certification of Companies for Fusion Welding of Steel.
- 1.2 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Indicate on manufacturers catalogue literature the following:
 - .1 Valves.
 - .2 Grooved fittings.
-

1.3 MAINTENANCE DATA .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

PART 2 - PRODUCTS

2.1 PIPE .1 Steel pipe: to ASTM A53, Grade B, as follows:
.1 To NPS 6, Schedule 40 (Hydronic Systems).
.2 NPS 8 and over, Schedule 30.
.3 Chemical pot feeder piping, Schedule 80.

2.2 PIPE JOINTS .1 NPS 2 and under: screwed fittings with teflon tape.
.2 NPS 2-1/2 and over: welded fittings and flanges to CSA W47.1.
.3 Roll grooved: rigid coupling to CSA B242, except for first three (3) couplings next to circulating pumps which are to be flexible pattern, minimum pressure rating 2069 kPa.
.4 Flanges: plain, slip-on or weld neck.
.5 Orifice flanges: slip-on raised face, 2069 kPa.
.6 Flange gaskets: to ANSI/AWWA C111/A21.11. 3 mm, red rubber impregnated cloth to ANSI B2.1.
.7 Pipe thread: taper.
.8 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.
.9 Roll grooved coupling gaskets: grade E, type EPDM. All grooved products to be of one manufacturer.

2.3 FITTINGS .1 NPS 2 and smaller 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 NPS 2.5 and larger butt-welding fittings: steel, to ANSI/ASME B16.9.
.4 Unions: malleable iron, to ASTM A47M and ANSI/ASME B16.3.

2.3 FITTINGS (Cont'd)

- .5 Fittings for roll grooved piping: ductile iron to ASTM A536. All grooved products to be of one (1) manufacturer.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- .1 Connect to equipment in accordance with equipment 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 wherever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers pipe size changes, installed to provide positive drainage or positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves, fittings.
- .6 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.
- .7 Assemble piping using fittings manufactured to ANSI standards.
- .8 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .9 Install circuit balancing valves complete with flow measuring fittings for all coils, air handling units, unit heaters, force flow heaters, perimeter radiation, ceiling radiant panels and heat exchangers.

3.2 FLUSHING, CLEANING AND FILLING

- .1 Flush after pressure test for minimum of 4 hrs.
- .2 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for 3 hrs. minimum.
- .3 Drain and flush for 4 hrs. Remove strainer screen/basket and clean.

- | | | |
|--|----|---|
| 3.2 FLUSHING,
CLEANING AND
FILLING
(Cont'd) | .4 | Refill system with clean water. Circulate for 2 hrs. minimum. |
| | .5 | Drain and flush for 2 hrs. Remove strainer screen/basket and clean. Re-install after obtaining approval of Departmental Representative. |
| | .6 | Refill with clean water, adding water treatment as specified. |
| 3.3 FILLING OF
SYSTEM | .1 | Refill system with clean water adding water treatment as specified. |
| | .2 | Vent all air from the system. |
| 3.4 TESTING | .1 | Test system in accordance with Section 23 05 05 |

PART 1 - GENERAL

- | | | |
|-----------------------------|----|--|
| <u>1.1 RELATED SECTIONS</u> | .1 | Section 01 33 00 Submittal Procedures. |
| | .2 | Section 01 78 00 Closeout Submittals. |
| | .3 | Section 23 05 05 Installation of Pipework. |

- | | | |
|-----------------------|----|--|
| <u>1.2 REFERENCES</u> | .1 | American Society of Mechanical Engineers (ASME)
.1 ANSI/ASME, Boiler and Pressure Vessels Code (BPVC), Section VIII and IX. |
| | .2 | American Society for Testing and Materials (ASTM)
.1 ASTM A47/A47M-99-(R2009), Specification for Ferritic Malleable Iron Castings.
.2 ASTM A248/A278M-01(R2011), Specification for Gray Iron Castings for PressureContaining Parts for Temperatures up to 560°F (350°C).
.3 ASTM A516/A516M-2010, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate and Lower Temperature Service.
.4 ASTM A536-84(2009), Specification for Ductile Iron Castings.
.5 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings. |
| | .3 | Canadian Standards Association (CSA)
.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code. |
| | .4 | Provincial Boiler, Pressure Vessel and Compressed Gas Regulations. |

- | | | |
|-------------------------|----|---|
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00 Submittal Procedures. |
| | .2 | Indicate on product data expansion tanks, air vents, separators, valves, strainers. |

- | | | |
|--------------------------|----|--|
| <u>1.4 SHOP DRAWINGS</u> | .1 | Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures. |
|--------------------------|----|--|
-

PART 2 - PRODUCTS

2.1 CANADIAN
REGISTRATION
NUMBERS (CRN)

- .1 Required on all products as per Provincial Regulations and CSA B51.

2.2 AUTOMATIC AIR
VENTS

- .1 Industrial float vent: cast iron body and NPS ½ connection and rated at 1034 kPa working pressure.
- .2 Float: solid material suitable for 116°C working temperature.
- .3 Manual and automatic vent connection on each device.
- .4 Acceptable material: Watts, Amtrol, Armstrong, Braukmann.

2.3 PIPE LINE
STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B 62, solder end screwed connections, Y pattern.
- .2 NPS 2 1/2 to 12: cast steel body to ASTM A 278M, Class 30, cast iron body to ASTM, Class 30 flanged connections.
- .3 NPS 2 to 12: T type with ductile iron body to ASTM A 536 malleable iron body to ASTM A 47M, grooved ends.
- .4 Blowdown connection: NPS 1 complete with ball valve and plug.
- .5 Screen: stainless steel brass with 1.19 mm perforations.
- .6 Working pressure: 1034 kPa.
- .7 "Y" pattern, NPS 2 and smaller threaded, NPS 2.5 and larger flanged.

2.4 CIRCUIT
BALANCING VALVES

- .1 Valves sizes 13mm to 50mm:
 - .1 Bronze valve body with ultra-high strength engineered resin plug, threaded ends, brass metering ports, drain plugs, Y pattern design, multi-turn 360 degree. Adjustment with micrometer type indicator on valve handwheel and built-in memory. Pre-formed removable PVC insulation jacket to be included.

2.4 CIRCUIT
BALANCING VALVES
(Cont'd)

- .2 Valve sizes 62mm to 300mm
 - .1 Ductile iron valve body with industrial grooved ends. Bronze valve stem and plug disc with ergonomically designed handwheel with multi-turn adjustments. Features to be the same as the smaller valve.

PART 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 Departmental Representative'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 pump.
- .4 Install ahead of each automatic control valve larger than NPS 1 and radiation except at radiation and as directed.

3.3 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet.
- .3 In mechanical rooms, use manual air vents and run discharge to nearest drain or service sink. On Glycol systems, drain to Glycol tank.
- .4 In public areas, use automatic air vents.

3.4 CIRCUIT
BALANCING VALVES

- .1 Install with flow in the direction of the arrow on the valve body at least five pipe diameters downstream from any fitting and ten pipe diameters downstream from a pump. Maintain easy and unobstructed access to valves.
- .2 Refer to controls section for combination flow limiter and control valves.

3.5 CLEANING

- .1 Clean in accordance with Section 01 78 00.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

PART 1 - GENERAL

- | | | |
|-----------------------------|----|--|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
| | .2 | Commissioning: Section 01 91 00 |
| | .3 | Thermometers and Pressure Gauges - Piping Systems: Section 23 05 20 |
| <u>1.2 SHOP DRAWINGS</u> | .1 | Submit shop drawings in accordance with Section 01 33 00. |
| | .2 | Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers. |
| | .3 | Submit shop drawings of pump curves for review showing point of operation. |
| | .4 | Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly. |
| <u>1.3 MAINTENANCE DATA</u> | .1 | Provide maintenance data for incorporation into manual specified in Section 01 78 00. |

PART 2 - PRODUCTS

- | | | |
|--|----|---|
| <u>2.1 IN-LINE COMMERCIAL DUTY CIRCULATING PUMPS</u> | .1 | Volute: cast iron radially split, with screwed or flanged design suction and discharge connections. |
| | .2 | Impeller: corrosion resistant alloy steel or cast iron. |
| | .3 | Shaft: stainless steel with bronze sleeve bearing, integral thrust collar. |
| | .4 | Seal assembly: mechanical for service to 135°C. |
| | .5 | Coupling: flexible self-aligning. |
| | .6 | Motor: (1750 rpm maximum) resilient mounted open, drip proof, sleeve bearing, high efficiency. |
-

2.1 IN-LINE
COMMERCIAL DUTY
CIRCULATING PUMPS
(Cont'd)

- .7 Motors must be non-overloading over the published performance curve.
- .8 Capacities: as indicated on the Project Drawings.
- .9 Design pressure: 862 kPa.
- .10 Tapped openings in volute and flanges for draining and gauge connections.
- .11 Performance: refer to pumps schedule on mechanical drawings.
- .12 Acceptable Manufacturers: ITT Bell & Gossett; Taco; Armstrong.

2.2 VERTICAL
IN-LINE
CIRCULATING PUMPS

- .1 Volute: cast iron, radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: bronze.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135°C.
- .5 Coupling: rigid self-aligning.
- .6 Motor: (1750 rpm maximum) resilient mounted, open, drip proof, stainless steel or bronze sleeve bearing.
- .7 Motors shall be non-overloading over the published performance curve.
- .8 Capacities: as indicated on the Project Drawings.
- .9 Design pressure: 862 kPa.
- .10 Performance: refer to pumps schedule on mechanical drawings.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible. Do not support motor. Provide 12 mm thick neoprene pads below pipe supports for vertical in-line pumps.
 - .2 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
 - .3 Pipe drain tapping to floor drain.
 - .4 Install volute venting pet cock in accessible location.
 - .5 Check rotation prior to start-up.
 - .6 Install pressure gauges and test cocks. Refer also to Section 23 05 20.
- 3.2 START-UP
- .1 General:
 - .1 In accordance with manufacturer's recommendations.
 - .2 Procedures:
 - .1 Before starting pump, check that over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .4 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 12 continuous hours.
 - .6 Verify operation of over-temperature and other protective devices under low and no-flow condition.
 - .7 Eliminate air from scroll casing.
 - .8 Adjust water flow rate through water-cooled bearings.
 - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
 - .10 Adjust alignment of piping and conduit to ensure true flexibility at all times.
 - .11 Eliminate cavitation, flashing and air entrainment.

- 3.2 START-UP
(Cont'd)
- .2 Procedures:(Cont'd)
.12 Adjust pump shaft seals, stuffing boxes, glands.
.13 Measure pressure drop across strainer when clean and with flow rates as finally set.
.14 Replace seals if pump used to degrease system or if pump used for temporary heat.
.15 Verify lubricating oil levels.
- 3.3 PERFORMANCE
VERIFICATION (PV)
- .1 General:
.1 In accordance with manufacturer's recommendations.
- .2 Exclusions:
.1 This paragraph does not apply to small in-line circulators.
- .3 Assumptions: These PV procedures assume that:
.1 Manufacturer's performance curves are accurate.
.2 Valves on pump suction and discharge provide tight shut-off.
- .4 Multiple Pump Installations - Series and Parallel:
.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .6 Commissioning Reports: In accordance with Section 01 91 00 reports supplemented as specified herein. Reports to include:
.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
.2 Report forms as acceptable to Departmental Representative.
.3 Pump performance curves (family of curves).

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.22-2012, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-2007, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-2006, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-2013, Refrigeration Piping and Heat Transfer Components.
 - .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 307-2012, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B 280-2013, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - .3 Canadian Standards Association (CSA International)
 - .1 CSA B52-05 (R2009), Mechanical Refrigeration Code.
 - .4 Environment Canada (EC)
 - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
 - .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Submit WHMIS MSDS in accordance with Section 01 33 00. Indicate VOC's for adhesive and solvents during application and curing.
 - .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

1.2 ACTION AND
INFORMATIONAL
SUBMITTALS
(Cont'd)

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 DELIVERY,
STORAGE AND
HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling.
 - .4 Separate for reuse and recycling and place in designated containers.
 - .5 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B 280, type B.
 - .2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
- .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
- .3 Flanged:
 - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.

- | | | |
|--|----|---|
| <u>2.2 FITTINGS
(Cont'd)</u> | .3 | Flanged:(Cont'd)
.2 Gaskets: suitable for service.
.3 Bolts, nuts and washers: to ASTM A 307, heavy series. |
| | .4 | Flared:
.1 Bronze or brass, for refrigeration, to ASME B16.26. |
| <u>2.3 PIPE SLEEVES</u> | .1 | Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation. |
| <u>2.4 VALVES</u> | .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. |
|
<u>PART 3 - EXECUTION</u> | | |
| <u>3.1 MANUFACTURER'S INSTRUCTIONS</u> | .1 | Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet. |
| <u>3.2 GENERAL</u> | .1 | Install in accordance with CSA B52, EPS1/RA/1, ASME B31.5 and Section 23 05 05 - Installation of Pipework. |
| <u>3.3 BRAZING PROCEDURES</u> | .1 | Bleed inert gas into pipe during brazing. |
| | .2 | Remove valve internal parts, solenoid valve coils, sight glass. |
| | .3 | Do not apply heat near expansion valve and bulb. |

3.4 PIPING
INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constriction. Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND
LEAK TESTING

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

3.6 FIELD QUALITY
CONTROL

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

- 3.6 FIELD QUALITY CONTROL
(Cont'd)
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
- .1 Twice to 14 Pa absolute and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to Departmental Representative.
- .7 Charging:
- .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
- .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to Departmental Representative.
- 3.7 CLEANING
- .1 Perform cleaning operations in accordance with manufacturer's recommendations.
 - .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 RELATED SECTIONS .1 Submittal Procedures: Section 01 33 00

1.2 REFERENCES .1 ANSI/ASME Boiler and Pressure Vessel Code, Section VII-2013.

1.3 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 33 00.

1.4 OPERATION AND MAINTENANCE DATA .1 Provide operation and maintenance data for water treatment equipment for incorporation into manual specified in Section 01 33 00.
 .2 Include following: pot feeder, chemicals, MSDS information sheets.
 .3 Provide operation and maintenance demonstration and training.

PART 2 - PRODUCTS

2.1 MANUFACTURER .1 Equipment, chemicals and service by one manufacturer.
 .2 Acceptable Material: Nalco Canada; Drew Chemical Limited; Betz; Bird Archer, Dearborn; Magnor; Mogul; Industrial Boiler- Tech; Eclipse Chemical.

2.2 BY-PASS POT FEEDER .1 Welded steel. Pressure rating: 200 psig. Temperature rating: 194°F.

2.3 CHEMICAL FEED PIPING .1 Schedule 80, black steel pipe and fittings with threaded crosses at all changes in direction and plugs in unconnected ports.

2.4 CLOSED HOT WATER HEATING SYSTEM .1 Pot feeder: capacity five (5) US gallons minimum to control sludge, scale and corrosion.

.2 Provide phosphate polymer for scale control and catalyzed sodium sulphite for oxygen removal.

2.5 SUPPLY OF CHEMICALS .1 Provide a one (1) year supply. Chemicals must be compatible with piping system materials.

2.6 TEST EQUIPMENT .1 Provide, for each type of system specified herein, one set of basic test equipment complete with carrying case and reagents for chemicals supplied. Include required specialized or supplementary equipment.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Perform HVAC water treatment in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction together with additional specified requirements by the manufacturer.

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

3.2 WATER TREATMENT SERVICES .1 Provide water treatment monitoring and consulting services for a 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, one (1) day minimum.

.4 Visit site every 90 days during period of operation or as required until the 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.

3.2 WATER TREATMENT .7 Instructions and advice to operating staff to be
SERVICES clear and concise and in writing.
(Cont'd)

- 3.3 CLEANING OF .1 Provide copy of recommended cleaning procedures and
SYSTEM chemicals for approval by Departmental
Representative.
- .2 Thoroughly flush the heating system piping 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 the low
pressure systems with clean water treated to prevent
scale and corrosion during system operation.

PART 1 - GENERAL

- | | | |
|-----------------------------|----|--|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
|-----------------------------|----|--|
-
- | | | |
|-----------------------|----|--|
| <u>1.2 REFERENCES</u> | .1 | American Society for Testing and Materials (ASTM)
.1 ASTM A480/A480M-11b, Specification for General Requirements for FlatRolled Stainless and HeatResisting Steel Plate, Sheet and Strip.
.2 ASTM A635/A635M-09b, Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Carbon, Hot Rolled.
.3 A653/A653M-11, Specification for Steel Sheet, Zinc Coated (Galvanized) or ZincIron Alloy Coated (Galvannealed) by the HotDip Process. |
| | .2 | National Fire Protection Agency (NFPA)
.1 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.
.2 NFPA 90B-2012, Installation of Warm Air Heating and Air Conditioning Systems.
.3 NFPA 91-2011, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particle Solids.
.4 NFPA 96-2011, 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.
.2 SMACNA HVAC Duct Leakage Test Manual. |
-
- | | | |
|---|----|--|
| <u>1.3 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data in accordance with Section 01 33 00. |
| | .2 | Indicate following:
.1 Sealants.
.2 Tape.
.3 Proprietary Joints. |
-
- | | | |
|-----------------------------------|----|--|
| <u>1.4 CERTIFICATE OF RATINGS</u> | .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. |
|-----------------------------------|----|--|
-

- | | | |
|--|----|---|
| <u>1.5 WASTE
MANAGEMENT AND
DISPOSAL</u> | .1 | Separate and recycle waste materials in accordance with municipal regulations and Section 01 74 21. |
|--|----|---|

PART 2 - PRODUCTS

- | | | |
|------------------------------------|----|---|
| <u>2.1 SEAL
CLASSIFICATION</u> | .1 | Classification as follows: |
| | .2 | Seal classification: <ul style="list-style-type: none">.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape..2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof..3 Class C: transverse joints and connections made air tight with gaskets sealant tape or combination thereof. Longitudinal seams unsealed. |

- | | | |
|--------------------|----|--|
| <u>2.2 SEALANT</u> | .1 | Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C. |
|--------------------|----|--|

- | | | |
|-----------------|----|--|
| <u>2.3 TAPE</u> | .1 | Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide. |
|-----------------|----|--|

- | | | |
|-------------------------|----|--|
| <u>2.4 DUCT LEAKAGE</u> | .1 | In accordance with SMACNA HVAC Duct Leakage Test Manual. |
|-------------------------|----|--|

- | | | |
|---------------------|----|--|
| <u>2.5 FITTINGS</u> | .1 | Fabrication: to SMACNA. |
| | .2 | Radiused elbows: <ul style="list-style-type: none">.1 Rectangular: Centreline radius: 1.5 times width of duct..2 Round: smooth radius or five piece. Centreline radius: 1.5 times diameter. |
| | .3 | Mitred elbows, rectangular: <ul style="list-style-type: none">.1 To 400 mm: with single thickness turning vanes..2 Over 400 mm: with double thickness turning vanes. |
-

- 2.5 FITTINGS
(Cont'd)
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct or 450 entry on branch.
 - .2 Round main and branch: enter main duct at 450 with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with volume control damper.
 - .5 Transitions:
 - .1 Diverging: 200 maximum included angle.
 - .2 Converging: 300 maximum included angle.
 - .6 Offsets:
 - .1 Full short radiused elbows as indicated.
 - .7 Obstruction deflectors: maintain full crosssectional area. Maximum included angles: as for transitions.
- 2.6 FIRE STOPPING
- .1 Retaining angles around duct, on both sides of fire separation only if required by authority having jurisdiction.
 - .2 Firestopping material and installation must not distort duct.
- 2.7 GALVANIZED STEEL
- .1 Lock forming quality: to ASTM A653, G90 zinc coating.
 - .2 Thickness, fabrication and reinforcement: to SMACNA.
 - .3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.
- 2.8 STAINLESS STEEL
- .1 To ASTM A480/A480M, Type 304.
 - .2 Finish: No 4. finish on exposed side of duct in finished area's, No. 3 finish or lower where concealed.
 - .3 Thickness, fabrication and reinforcement: to SMACNA.
 - .4 Joints: to SMACNA and be continuous inert gas welded.
-

- 2.9 ALUMINUM
- .1 To SMACNA. Aluminum type: 3003H14.
 - .2 Thickness, fabrication and reinforcement: to SMACNA.
 - .3 Joints: to SMACNA and be continuous weld.
- 2.10 BLACK STEEL
- .1 To ASTM A635/A635M.
 - .2 Thickness: 1.2 mm
 - .3 Fabrication: ducts and fittings or SMACNA.
 - .4 Reinforcement: to SMACNA.
 - .5 Joints: continuous weld.
- 2.11 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 SMACNA.
 - .3 Hangers: galvanized steel angle with black steel rods to ASHRAE or SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10
 - .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .1 Acceptable manufacturers Myatt, Grinnell, Hunt.
 - .2 For steel joist: manufactured joist clamp steel plate washer.
 - .1 Acceptable manufacturers Myatt, Grinnell, Hunt.
 - .3 For steel beams: manufactured beam clamps:
 - .1 Acceptable manufacturers Myatt, Grinnell, Hunt.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, and 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. Do not place fire stopping material in expansion space between damper sleeve and fire partition.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 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 or as follows:

Duct Size	Spacing
(mm)	(mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intake.
 - .2 Minimum 3000 mm from duct mounted humidifier in all directions.
 - .3 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards fume hoods served. Slope header ducts down toward risers.

- 3.3 WATERTIGHT DUCT (Cont'd) .4 Fit base of riser with 150 mm deep drain sump and NPS 1 ½ drain connected, with deep seal trap and valve and discharging to open funnel drain or service sink or as approved by Departmental Representative.
- 3.4 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. Sealant and tape to be applied to full perimeter of duct.
- 3.5 LEAKAGE TESTS .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Do leakage tests in sections.
- .3 Make trial leakage tests as instructed to demonstrate workmanship.
- .4 Install no additional ductwork until trial test has been passed.
- .5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degree elbows.
- .6 Complete test before insulation or concealment.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-2011, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM C423-09a, Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .3 ASTM E90-09, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - .4 ASTM E477-06a, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
 - .3 National Building Code of Canada (NBC), 2010.
 - .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
- 1.2 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Provide separate shop drawings for each piece of attenuation equipment complete with product data.
- 1.3 PERFORMANCE RATING DATA
- .1 Provide performance rating data, certified by a professional engineer or accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:
 - .1 Silencer: insertion loss, pressure drop at design conditions, generated noise level.
 - .2 Acoustic plenums: transmission loss and acoustical absorption.
 - .3 Acoustical performance measurements to be made in accordance with ASTM E477, ASTM E90 and ASTM C423, except where specified otherwise.

PART 2 - PRODUCTS

- 2.1 ABSORPTION AND INSULATING MEDIA
- .1 Acoustic quality, glass fibre, free of shot and odour; bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements or requirements of authority having jurisdiction for duct lining.
- 2.2 SILENCERS
- .1 Factory manufactured of prime coated or galvanized steel, compatible with ductwork specified elsewhere and to ASHRAE and SMACNA standards.
- .2 Outer casing and galvanized steel inner casing with clean cut circular perforations to enclose acoustic media. Inner casing to have halfsplitters running full length of silencer where any cross sectional dimension exceeds 450 mm. Protect media from erosion with tedlar or mylar between media and perforated metal.
- .3 Performance: see silencer schedule.
- 2.3 ACOUSTIC PLENUMS
- .1 Panels: tongue and groove connection type, designed for individual panel removal for equipment access without major dismantling of plenum.
- .1 Outer sheet: 1.3 mm thick galvanized steel to ASTM A653/A653M, with coating designation G90 (Exposed to outside air).
- .2 Inner sheet: 0.85 mm thick galvanized steel to ASTM A653/A653M, with coating designation G90 with 2 mm diameter clean cut perforations on 5 mm staggered centres.
- .3 Fully framed with 1.3 mm thick galvanized steel channels.
- .4 Horizontal stiffeners: 0.85 mm minimum galvanized steel on 800 mm centres to control media settlement.
- .5 Access panels: sized for equipment removal; two handles per panel; screw at 100 mm maximum centres; perimeter neoprene sponge gasket; materials same as standard panel.
- .6 Deflection: not to exceed 1/240 of unsupported panel span at design pressure differential of 500 Pa.
- .7 Connections: acoustically sealed.

2.3 ACOUSTIC
PLENUMS
(Cont'd)

- .2 Doors: access doors with minimum 510 x 1375 mm opening.
 - .1 Construction same as standard panel except interiors to be solid.
 - .2 Two butt-type nylon bushed hinges, two cam-type latches with inside and outside handles.
 - .3 Neoprene gasket seal.
 - .4 Zinc plated hardware.
 - .5 Open against air pressure.
- .3 Windows: inspection windows, 305 x 305 mm, double glazed with 6 mm wire reinforced glass mounted in neoprene "U" channels.
- .4 Assembly: base sections and flashings 1.3 mm minimum galvanized steel.
 - .1 Panel and flashing joints externally sealed with 5 mm diameter bead of non sag, non hardening sealant. Floor channel to floor connection sealed with 3 x 13 mm monolastomeric tape.
 - .2 Factory cut and frame openings where greatest dimension exceeds 300 mm. Smaller panel openings, to be site located and cut 50 mm larger in diameter, sleeved with 0.75 mm minimum galvanized steel.
 - .3 Fill space between pipe or conduit and sleeve with acoustic media, covered and mastic sealed in accordance with manufacturer's instructions.
 - .4 No sensory leakage at design pressure differential of 500 Pa.
 - .5 Assembly RSI not less than 1.2 (m².oC)/W at 10°C.
 - .6 Certified acoustical performance:
 - .1 Transmission loss to ASTM E90.
 - .2 Acoustical absorption to ASTM C423.

2.3 ACOUSTIC
PLENUMS
(Cont'd)

.4 Assembly:(Cont'd)
.6 (Cont'd)
.2 (Cont'd)

Octave bands, (Hz)	125	250	500	1000	2000	4000
Transmission loss, dB	21	28	39	50	53	56
Absorption coefficient	0.7	0.9	0.99	0.99	0.9	0.9

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Noise flanking: where indicated, install in wall sleeve with uniform clearance around to ensure no contact of silencer with wall sleeve. Pack with flexible, non hardening caulking on both sides of sleeves.

.3 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.

.4 Suspension: to manufacturer's instructions.

3.2 SITE VISIT

.1 Supplier of equipment will visit site to confirm installation is in accordance with manufacturer's instructions and submit report to the Departmental Representative.

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

.3 Provide Departmental Representative with notice 24 h in advance of visit.

3.3 TESTING / COMMISSIONING

.1 Experienced and competent sound and vibration testing professional consultant will take sound measurement after start up and testing, adjusting and balancing of systems to Section 23 05 93 Testing Adjusting and Balancing (TAB) of Mechanical Systems.

3.3 TESTING /
COMMISSIONING
(Cont'd)

- .2 Sound measurements to extend over frequency range of 125 to 4000 Hz and to be taken:
 - .1 Upstream and downstream of each silencer and plenum.
 - .2 In areas adjacent to mechanical equipment rooms, duct and pipe shafts.
 - .3 At 1800 mm above floor adjacent to first air terminal.
 - .4 At following critical locations: air handling units, chillers, pumps, fans, air compressors, refrigeration compressors.
- .3 Provide Departmental Representative with notice 24 h in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation, acceptability of noise levels in occupied areas, other conditions affecting acoustics and, where appropriate, recommendation for remedial measures and costs.
- .5 Submit complete report of test results including sound curves, include in Commissioning Manual.

PART 1 - GENERAL

- | | | |
|-------------------------------------|----|---|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
| <u>1.2 REFERENCES</u> | .1 | Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards Metal and Flexible. |
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| | .2 | Indicate the following:
.1 Flexible connections.
.2 Duct access doors.
.3 Turning vanes.
.4 Instrument test ports. |
| <u>1.4 CERTIFICATION OF RATINGS</u> | .1 | Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards. |

PART 2 - PRODUCTS

- | | | |
|---------------------------------|----|--|
| <u>2.1 GENERAL</u> | .1 | Manufacture in accordance with SMACNA - HVAC Duct Construction Standards. |
| <u>2.2 FLEXIBLE CONNECTIONS</u> | .1 | Frame: galvanized sheet metal frame 0.66 mm thick with fabric clenched by means of double locked seams. |
| | .2 | Material:
.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 400C to plus 900 degrees C, density of 1.3 kg/m2. |
-

2.3 ACCESS DOORS
IN DUCTS

- .1 Noninsulated ducts: sandwich construction of same material as duct, one (1) 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 mm x 300 mm: two (2) sash locks complete with safety chain.
 - .2 301 mm to 450 mm: four (4) sash locks complete with safety chain.
 - .3 451 mm to 1000 mm: piano hinge and minimum two (2) sash locks.
 - .4 Doors over 1000 mm: piano hinge and two (2) handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 mm x 300 mm glass viewing panels.

2.4 TURNING VANES

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

2.5 INSTRUMENT
TEST PORTS

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

2.6 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.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Allow for slack material in flexible connection.
 - .2 Access doors and viewing panels:
 - .1 Size:
 - .1 600 mm x 600 mm for person size entry.
 - .2 450 mm x 450 mm for servicing entry.
 - .3 300 mm 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 submain ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.

3.1 INSTALLATION .3 (Cont'd)

(Cont'd) .4 (Cont'd)

.2 In mixed air applications in locations as approved by Department Representative.

.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.

PART 1 - GENERAL

- | | | |
|-----------------------------|----|---|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
| <u>1.2 REFERENCES</u> | .1 | Sheet Metal and Air Conditioning National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible. |
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| | .2 | Indicate the following: dimensions, materials. |

PART 2 - PRODUCTS

- | | | |
|---------------------------------|----|--|
| <u>2.1 GENERAL</u> | .1 | Manufacture to SMACNA standards. |
| <u>2.2 SINGLE BLADE DAMPERS</u> | .1 | Of same material as duct, 0.8 mm up to 450 mm wide, 1.6 mm maximum up to 1200 mm wide, 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 or bronze end bearings. |
| | .5 | Channel frame of same material as adjacent duct, complete with angle stop. |
| <u>2.3 MULTI-BLADED DAMPERS</u> | .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. |

- 2.3 MULTI-BLADED DAMPERS
(Cont'd)
- .4 Bearings: pin in bronze bushings or selflubricating nylon.
 - .5 Linkage: shaft extension with locking quadrant.
 - .6 Channel frame of same material as adjacent duct, complete with angle stop.
 - .7 Maximum leakage: 2 % at 500 Pa.

PART 3 - EXECUTION

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

PART 1 - GENERAL

- | | | |
|-------------------------------------|----|--|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
| | .2 | Closeout Submittals: Section 01 78 00 |
| | .3 | Duct Accessories: Section 23 33 00 |
| | | |
| <u>1.2 REFERENCES</u> | .1 | American Society for Testing and Materials (ASTM)
.1 ASTM A653M-11, Standard Specification for Steel Sheet, ZincCoated (Galvanized) or ZincIron AlloyCoated (Galvannealed) by HotDip Process. |
| | | |
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| | .2 | Indicate the following:
.1 Performance data.
.2 Specifications. |
| | | |
| <u>1.4 CLOSEOUT SUBMITTALS</u> | .1 | Provide maintenance data for incorporation into manual specified in Section 01 78 00. |
| | | |
| <u>1.5 CERTIFICATION OF RATINGS</u> | .1 | Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency. |

PART 2 - PRODUCTS

- | | | |
|-------------------------------|----|---|
| <u>2.1 MULTI-LEAF DAMPERS</u> | .1 | Opposed or parallel blade type as indicated. |
| | .2 | Structurally formed steel or extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel or extruded aluminum frame. |
| | .3 | Pressure fit selflubricated bronze bearings. |
| | .4 | Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod. |

2.1 MULTI-LEAF
DAMPERS
(Cont'd)

- .5 Performance:
 - .1 Leakage: in closed position to be less than 2% of rated air flow at 500 Pa differential across damper.
 - .2 Pressure drop: at full open position to be less than 25 Pa differential across damper at 10 m/s.
- .6 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI factor of 5.0.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI factor of 5.0.

2.2 DISC TYPE
DAMPERS

- .1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A 653M.
- .2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A 653M.
- .3 Gasket: extruded neoprene, field replaceable, with ten (10) year warranty.
- .4 Bearings: roller self lubricated and sealed.
- .5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zincaluminum foundry alloy casting cam follower.
- .6 Performance:
 - .1 Leakage: in closed position to be less than 2 % of rated air flow at 500 Pa pressure differential across damper.
 - .2 Pressure drop: at full open position to be less than 25 Pa differential across damper at 10 m/s.

2.3 BACK DRAFT
DAMPERS

- .1 Automatic gravity operated, multi leaf, aluminum or steel construction with nylon bearings, centre pivoted, spring assisted or counterweighted.

2.4 RELIEF DAMPERS

- .1 Automatic multileaf steel or aluminum dampers with ball bearing centre pivoted and Counterweights set to open as indicated.

PART 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 Section 23 33 00.
 - .5 Confirm dampers are observable and accessible.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Submittal Procedures: Section 01 33 00
 - .2 Closeout Submittals: Section 01 78 00
 - .3 Duct Accessories: Section 23 33 00
- 1.2 REFERENCES
- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.
 - .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S112-10, Fire Test of Fire Damper Assemblies.
 - .2 CAN/ULC S112.2-07, Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC S505-1974, Fusible Links for Fire Protection Service.
- 1.3 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00
 - .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Fire stop flaps.
 - .4 Operators.
 - .5 Fusible links.
 - .6 Design details of breakaway joints.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.5 EXTRA MATERIALS
- .1 Provide maintenance materials in accordance with Section 01 78 00.
 - .2 Provide following:
 - .1 Six (6) fusible links of each type.
-

1.6 CERTIFICATE OF RATINGS

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

PART 2 - PRODUCTS

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B or C, blades out of air stream listed and bear label of ULC, meet requirements of provincial fire authority and ANSI/NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN/ULC S112. Minimum rating 1 ½ hours, dynamically rated.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: offset, round or square; multiblade hinged or interlocking type; roll door type; or guillotine type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negatorspringclosing operator for multileaf type or roll door type in horizontal position with vertical air flow.
- .5 Retaining angle iron frame, 40 mm x 40 mm x 3 mm, on full perimeter of fire damper, on bothsides of fire separation being pierced.

2.2 SMOKE DAMPERS

- .1 ULC or UL listed and labelled.
- .2 Normally closed reverse action smoke vent (S/DRASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signalling device actuated by an electro thermal link. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.
- .3 Normally open smoke/seal (S/DSSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units mounted horizontally in vertical ducts.

- 2.2 SMOKE DAMPERS (Cont'd)
- .4 Motorized (S/DM): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.
 - .5 Electro thermal link (S/DETL): dual responsive fusible link which melts when subjected to local heat of 74 EC and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.
- 2.3 COMBINATION FIRE AND SMOKE DAMPERS
- .1 Damper: similar to smoke dampers specified above.
 - .2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.
- 2.4 FIRE STOP FLAPS
- .1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.2.
 - .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
 - .3 Flaps to be held open with fusible link conforming to ULC S505V and close at 74 EC.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
 - .2 Maintain integrity of fire separation.
 - .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
 - .4 Install access door adjacent to each damper. See Section 23 33 00.
 - .5 Co-ordinate with installer of firestopping.
 - .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

3.1 INSTALLATION (Cont'd)	.7	Install break-away joints of approved design on each side of fire separation.
------------------------------	----	---

PART 1 - GENERAL

- 1.1 REFERENCES .1 Section 01 33 00 Submittal Procedures.
- 1.2 REFERENCES .1 National Fire Protection Association (NFPA)
.1 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.
.2 NFPA 90B-2012, 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.
- .3 Underwriter's Laboratories of Canada (ULC)
.1 CAN/ULCS110, Fire Tests for Air Ducts.
.2 UL 181-2013, Factory Made Air Ducts and Connectors.
- 1.3 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00 Submittal Procedures.
- .2 Indicate the following:
.1 Thermal properties.
.2 Friction loss.
.3 Acoustical loss.
.4 Leakage.
.5 Fire rating.
- 1.4 CERTIFICATION OF RATINGS .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- 1.5 SAMPLES .1 Submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00 Submittal Procedures.
-

PART 2 - PRODUCTS

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

- 2.2 METALLIC - ACOUSTIC INSULATED
- .1 Noncollapsible, 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 3 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Acoustical performance: Minimum attenuation (dB/m) to following table:

		Frequency (Hz)				
		125	250	500	1000	2000
Duct	Diam.					
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	

PART 3 - EXECUTION

- 3.1 DUCT INSTALLATION
- .1 Install in accordance with: NFPA 90A and NFPA 90B SMACNA.
 - .2 Do trial test to demonstrate workmanship.
 - .3 Use for minimum 0.9m and maximum 1.5m between ceiling mounted diffusers and branch ducts on supply duct systems only. Do not use for exhaust air duct systems.
 - .4 Flexible duct shall have no more than a 15 offset and shall have a minimum of two hangers (per DTIR requirements).

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Commissioning: Section 01 91 00
	.2	Duct Accessories: Section 23 33 00
<u>1.2 REFERENCES</u>	.1	AMCA 99-2010, Standards Handbook.
	.2	ANSI/AMCA 210/ASHRAE 51-2007, Laboratory Methods of Testing Fans for Rating.
	.3	ANSI/AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
	.4	ANSI/AMCA 301-2014, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
	.5	CGSB 1.181M-99, Coating, Zinc Rich, Organic, Ready Mixed.
	.6	NEMA ICS 7.1-2006, Safety Standard for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
	.7	American Bearing Manufacturers Association (ABMA).
<u>1.3 SHOP DRAWINGS AND PRODUCT DATA</u>	.1	Submit shop drawings and product data in accordance with Section 01 33 00.
	.2	Provide: .1 Fan performance curves showing point of operation, BHP and efficiency. .2 Sound rating data at point of operation. .3 Dimensional data. .4 Installation procedures.
	.3	Indicate: .1 Motors, sheaves, bearings, shaft details. .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate, dimensions, installation procedure.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.1	Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.

- 1.5 EXTRA MATERIALS .1 Provide maintenance materials in accordance with Section 01 33 00.
- .1 Spare parts to include:
- .1 Matched sets of belts.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- 1.6 MANUFACTURED ITEMS .1 Catalogued or published ratings must be those obtained from tests carried out by manufacturer or from independent testing agency signifying adherence to codes and standards in force.
- 1.7 WARRANTY .1 Provide warranty for parts and labour for one (1) year following project Substantial Completion.

PART 2 - PRODUCTS

- 2.1 FANS GENERAL .1 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
- .2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit must bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
- .5 Open drip proof outside of air stream.
- .6 Motors:
- .1 In accordance with Section 23 05 13 Motors, Drives and Guards supplemented as specified herein.
- .2 Sizes as specified.
- .7 Accessories and hardware: matched sets of Vbelt drives, adjustable slide rail motor bases, belt

2.1 FANS GENERAL
(Cont'd)

- .7 Accessories and hardware:(Cont'd)
guards, coupling guards, fan inlet and/or outlet
safety screens as indicated and as specified in
Section 23 05 13 Motors, Drives and Guards, inlet or
outlet dampers and vanes and as indicated.
- .8 Factory primed before assembly in colour standard to
manufacturer.
- .9 Scroll casing drains: as indicated.
- .10 Bearing lubrication systems plus extension
lubrication tubes where bearings are not easily
accessible.
- .11 Vibration isolation: to Section 23 05 48 Vibration
Isolation and Seismic Control.
- .12 Flexible connections: to Section 23 33 00 Duct
Accessories.

2.2 CENTRIFUGAL
FANS

- .1 Fan wheels:
 - .1 Welded steel or aluminum construction.
 - .2 Maximum operating speed of centrifugal fans not
more than 40 % of first critical speed.
 - .3 Air foil or backward inclined blades, as
indicated.
- .2 Bearings: air handling quality, heavy duty, split
pillow block, flange mounted grease lubricated ball
or roller self aligning type with oil retaining, dust
excluding seals and a certified minimum rated life to
ABMA L10 of 100,000 hours.
- .3 Housings:
 - .1 Volute with inlet cones: fabricated steel for
wheels 300 mm or greater, cast iron, or steel, for
smaller wheels, braced, and with welded supports.
 - .2 For horizontally and vertically split housings
provide flanges on each section for bolting together,
with gaskets of non-oxidizing nonflammable material.
 - .3 Provide bolted latched airtight access doors
with handles.

PART 3 - EXECUTION

3.1 FAN
INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 Vibration Isolation and Seismic Control, flexible electrical leads and flexible connections in accordance with Section 23 33 00 Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.
- .5 Provide installation in strict accordance with manufacturer's recommendations.
- .6 Grease fan bearing prior to operation.

3.2 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 - Commissioning.

PART 1 - GENERAL

- | | | |
|---|----|---|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
| | .2 | Quality Control: Section 01 45 00 |
| | .3 | Closeout Submittals: Section 01 78 00 |
| | .4 | Commissioning: Section 01 91 13 |
| | .5 | Sound Attenuation: Section 23 32 48 |
| | .6 | Control System: Division 25 |
| <u>1.2 REFERENCES</u> | .1 | American National Standards Institute (ANSI)
.1 ANSI/ASHRAE 51/AMCA 210-2007, Laboratory Methods of Testing Fans for Rating.
.2 ANSI/NFPA 90A-2015, Installation of Air Conditioning and Ventilating Systems. |
| | .2 | International Organization of Standardization (ISO)
.1 ISO 3741-2010, Acoustics Determination of Sound Power Levels of Noise Sources Using Sound Pressure Precision Methods for Reverberation Rooms. |
| | .3 | Underwriter's Laboratories (UL)
.1 UL 181-2005, Factory-Made Air Ducts and Air Connectors. |
| <u>1.3 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data in accordance with Section 01 33 00. |
| | .2 | Indicate the following:
.1 Capacity.
.2 Pressure drop.
.3 Noise rating.
.4 Leakage.
.5 Dimensions. |
| <u>1.4 SAMPLES AND MOCK-UPS</u> | .1 | Submit samples and mockups in accordance with Section 01 33 00. |
| | .2 | Submit mockups in accordance with Section 01 45 00. |
-

- 1.5 TEST REPORTS .1 To ANSI/ASHRAE 51/AMCA 210. Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity. Sound power level with minimum inlet pressure of 0.25 kPa in accordance with ISO 3741 for 2nd through 7th octave band, by independent testing agency. Pressure loss through silencer must not exceed 60% of inlet velocity pressure maximum.
- 1.6 CLOSEOUT SUBMITTALS .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.7 CERTIFICATION .1 Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered by him from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.
- 1.8 EXTRA MATERIALS .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

PART 2 - PRODUCTS

- 2.1 MANUFACTURED UNITS .1 Terminal units of the same type to be product of one (1) manufacturer.
- 2.2 VARIABLE VOLUME BOXES .1 Pressure independent factory reset to air flow between minimum and maximum air volume.
- .2 Sizes, capacities, differential pressures and sound ratings: as indicated in schedule.
- .3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.

2.2 VARIABLE
VOLUME BOXES
(Cont'd)

- .4 Sound ratings of assembly not to exceed 35 NC at 750 Pa. Use sound attenuator if necessary to achieve rating.
- .5 Complete with:
 - .1 Operator and controller: as specified under Division 25.
 - .2 Multiport outlet adapter: as indicated.
 - .3 Reheat coil: as indicated.
- .6 Minimum 35 kPa reset span for pneumatic controllers.
- .7 Adjustable reset start point.
- .8 Operator to be factory or field mounted and calibrated where indicated.
 - .1 Gauge taps for balancing with standard pressure gauge.
 - .2 Controller to have adjustable flow settings.
- .9 Casing: constructed of 0.75 mm thick galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.
- .10 Damper: galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install a minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.

3.2 COMMISSIONING

- .1 Do commission in accordance with Section 01 91 00.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Submittal Procedures: Section 01 33 00
 - .2 Closeout Submittals: Section 01 78 00
- 1.2 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00.
 - .2 Indicate the following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
- 1.3 SAMPLES
- .1 Submit samples in accordance with Section 01 33 00.
- 1.4 CERTIFICATIONS
- .1 Catalogued or published ratings must be those obtained from tests carried out by manufacturer or from independent testing agency signifying adherence to codes and standards.
- 1.5 EXTRA MATERIALS
- .1 Provide maintenance materials in accordance with Section 01 78 00.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

PART 2 - PRODUCTS

- 2.1 GENERAL
- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.
 - .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board.
 - .3 Concealed fasteners.
-

<u>2.1 GENERAL</u> (Cont'd)	.3	Concealed manual volume control damper operators as indicated.
	.4	Colour: standard or as directed by Departmental Representative.

<u>2.2 MANUFACTURED UNITS</u>	.1	Grilles, registers and diffusers of same generic type, products of one manufacturer.
-------------------------------	----	--

<u>2.3 SUPPLY GRILLES AND REGISTERS</u>	.1	See Schedule.
---	----	---------------

<u>2.4 RETURN AND EXHAUST GRILLES AND REGISTERS</u>	.1	See Schedule.
---	----	---------------

<u>2.5 DIFFUSERS</u>	.1	See Schedule.
----------------------	----	---------------

<u>2.6 LINEAR GRILLES</u>	.1	See Schedule.
---------------------------	----	---------------

PART 3 - EXECUTION

<u>3.1 INSTALLATION</u>	.1	Install in accordance with manufacturers instructions.
	.2	Install with flat head stainless steel or cadmium plated screws in countersunk holes where fastenings are visible.
	.3	Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere.

PART 1 - GENERAL

- | | | |
|---|----|--|
| <u>1.1 SHOP DRAWINGS
AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data in accordance with Section 01 33 00. |
| | .2 | Indicate the following: construction, ASHRAE test efficiency, clean and maximum recommended pressure drop, gauges and accessories. |
| | | |
| <u>1.2 MAINTENANCE
DATA</u> | .1 | Provide maintenance data for incorporation into manual specified in Section 01 78 00. |
| | | |
| <u>1.3 CERTIFICATION
OF RATINGS</u> | .1 | Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards. |

PART 2 - PRODUCTS

- | | | |
|------------------------|----|---|
| <u>2.1 GENERAL</u> | .1 | Filters: suitable for non- condensing air at 100% RH and air temperatures between -40°C and +40°C. |
| | .2 | Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated. |
| | | |
| <u>2.2 ACCESSORIES</u> | .1 | Holding frames: "T" section or channel section construction of stainless steel. |
| | .2 | Seals: to ensure leak-proof operation. |
| | .3 | Blank-off plates: as required, to fit all openings and of same material as holding frames. |
| | .4 | Access and servicing: through doors on each side of air handling unit cabinet. |
| | .1 | Prefilters: through doors on each side of AHU. |
| | .2 | Final Filters: face loading from within AHU. |
-

- | | |
|----------------------------------|--|
| <u>2.3 AIR FILTER
GAUGES</u> | <ul style="list-style-type: none">.1 Dial type: diaphragm actuated, direct reading..2 Range: 0 to 750 Pa..3 One (1) for each bank of filters as indicated on the drawings..4 Permanent pointer set for manufacturer's recommended final pressure drop..5 Acceptable Material: Magnehelic 2000 series diaphragm actuated direct reading, dial type. |
|----------------------------------|--|

PART 3 - EXECUTION

- | | |
|-------------------------------------|--|
| <u>3.1 INSTALLATION
GENERAL</u> | <ul style="list-style-type: none">.1 Install in accordance with manufacturers recommendations. |
| <u>3.2 REPLACEMENT
MEDIA</u> | <ul style="list-style-type: none">.1 Provide three (3) complete sets of filters for each AHU, not including those used during commissioning..2 Replace all temporary media with new prior to air balance testing..3 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance. |

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Submittal Procedures: Section 01 33 00
- .2 Closeout Submittals: Section 01 78 00
- .3 Commissioning: Section 01 91 13
- .4 Vibration Isolation and Seismic Control Measures:
Section 23 05 48
- .5 Duct Accessories: Section 23 33 00
- .6 Dampers Operating: Section 23 33 15
- .7 Commercial Fans: Section 23 34 00
- .8 Filters and Filter Gauges: Section 23 44 00
- .9 Heat Exchangers: Section 23 57 00

1.2 REFERENCES

- .1 (ANSI/NFPA)
 - .1 ANSI/NFPA90A-2015, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 1.181-99, Ready Mixed Organic Zinc Rich Coating.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .4 Canadian Standards Association
 - .1 CSA B52-13 Package, Mechanical Refrigeration Code
 - .5 American Bearing Manufacturer's Association
 - .1 ANSI/ABMA 9-08, Load Ratings and Fatigue Life for Ball Bearings
 - .2 ANSI/ABMA 11-08, Load Ratings and Fatigue Life for Roller Bearings.
 - .6 Air Movement and Control Association
 - .1 AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
 - .7 American Society of Heating Refrigeration and Air Conditioning Engineers.
 - .1 ASHRAE 68-1997, Laboratory Method of Testing to Determine the Sound Power in a Duct.
-

- 1.2 REFERENCES (Cont'd)
- .8 National Electrical Manufacturer's Association
 - .1 NEMA MG1-2014, Motors and Generators
 - .2 NEMA ICS 7.1-06, Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
 - .9 Provincial Boiler Pressure Vessel and Compressed Gas Regulations.
- 1.3 SHOP DRAWINGS AND PRODUCT DATA
- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
 - .2 Indicate following:
 - .1 Construction specifications, dimensions, weights, fans, motors, vibration isolation, coils, capacities, curves, filter housings, filters, mixing boxes, dampers. Controls actuators, accessories installation procedures, and control wiring diagrams.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.5 EXTRA MATERIALS
- .1 Provide maintenance materials in accordance with Section 01 78 00.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
 - .3 Provide one (1) set of filters for start up, one (1) set for commissioning, one (1) spare set of filters for each unit.
-

PART 2 - PRODUCTS

- | | | |
|-------------------------------|----|--|
| <u>2.1 GENERAL</u> | .1 | Factory assembled components to form units supplying air at design conditions as indicated. |
| | .2 | Components and configuration: as indicated. |
| <u>2.2 MANUFACTURED ITEMS</u> | .1 | Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force. |
| | .2 | Acceptable manufacturers: Engineered Air, Hanon, Venmar, AAON. |
| <u>2.3 FANS</u> | .1 | To Section 23 34 00. |
| | .2 | Fans to be double width double inlet(DWDI) airfoil or backward inclined or forward curve blades. Fans and shafts to be dynamically balanced for fixed or variable speed drive operation prior to installation into air handling unit, then the entire fan assembly statically and dynamically balanced at the factory after it has been installed in the air handling unit. Fans mounted on steel shafts accurately ground and finished. Furnish fans and scrolls with rust resistant enamel coating. |
| | .3 | Seal fan bearings against dust and dirt and precision self-aligning ball or roller type. Bearing life to be L10 rated at not less than 100,000 hours minimum as defined by ABMA 9 and ABMA 11. Bearings permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Bearings supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Bearings may not be fastened directly to the unit sheet metal casing. |
| | .4 | Fans driven by a unit mounted or a floor mounted motor connected to fans with V-belt drive complete with belt guard for externally mounted motors. Belt guards as per Section 23 05 13. Motors for V-belt drives shall be provided with adjustable bases. Fan motors shall have totally enclosed enclosures (TEFC). |
| | .5 | Unit fan or fans selected to produce the required capacity at the fan static pressure. Sound power |
-

- 2.3 FANS (Cont'd)
- .5 (Cont'd)
level as indicated. The sound power level valves obtained according to AMCA 300 or ASHRAE 68.
- .6 Motors controlled by variable frequency drives (VFD's) must be suitable for this application, and be inverter duty rated to NEMA MG1 Part 31 and NEMA ICS 7.1. All motors to be TEFC type, NEMA type B with 1.15 service factor at 40°C. All motors operated by VFD to include grounding rings.
- 2.4 CASING
- .1 General:
- .1 Factory manufactured galvanized or phosphate treated steel casing minimum thickness of 1.3 mm thick steel outer casing reinforced and braced for rigidity and flanged for bolted subassemblies, to withstand a pressure differential as indicated.
- .2 Provide walk-in access doors to allow access to internal parts and component removal.
- .1 Walk-in access doors: insulated sandwich panel construction of same material and thickness as casing, 600 mm wide full height of casing and complete with 3 hinges or piano hinges, two-way latches, neoprene gaskets and 200 x 200 mm Georgian wire glass ports or 200 mm diameter polycarbonate double port hole in fan section access. Hinge doors to open against air pressure complete with hold open devices.
- .3 Paint over steel, where steel is not galvanized, or where galvanized steel sheet is cut, with corrosion resistant paint to CGSB 1.181.
- .1 Finish exterior of unit with 2 part epoxy complete with polyurethane UV top coat.
- .4 Internally insulate top, bottom and sides of casing with 50 mm thick, 72 kg/m3 density, mineral wool fiber insulation made from Basalt Rocks Lag Roxul mineral wool is a water repellent yet vapour permeable material with metal nosings at edges, pinned and cement in place. Cover insulation with 0.85 mm (22 gauge) thick type 304 stainless steel solid liner. Wipe down unit interior with screwed and caulked liner to eliminate possible wetting of insulation. Solid liner to be broken. Provide a cleat over the 2" drain pan upturn to allow water to shear into drain pan. The floor will act as drain pan. Floor to be 18 gauge 304 stainless steel.
- .5 Weatherproof sheet metal casings:
- .1 Design for maximum wind velocity of 160 km/h, snow load Ss 5.7 kPa, S r 0.4 kPa, seismic factor of 0.10.
- .2 Finish outside with rust resistant epoxy to Section 09 91 13.

- 2.4 CASING
(Cont'd)
- .1 General:(Cont'd)
- .5 (Cont'd)
- .3 Insulation: K= 0.0337 W/m°C @ 24°C, 50 mm.
See Section 23 07 16.
- .6 Openings and bolted sections gasketted.
- .7 Provide one (1) duplex receptacle and vapour tight marine fluorescent lights complete with gaskets and cast aluminum guards in each fan section. Conduit and Wiring to Division 26 Requirements.
- .8 Floor panels minimum 1.3 mm thick, stainless steel Type 304.
- .9 Provide steel channel around perimeter unit with intermediate supports and minimum of four lifting lugs.
- .2 Acoustic panels:
- .1 Factory manufactured with Sound Transmission Coefficients and Acoustical Absorption Coefficients as indicated.
- .2 Cut and frame openings or panel penetrations greater than 150 mm (diameter or length and width) at factory. Openings or penetrations less than 150 mm (pipe, conduit and instrument holes) may be field cut. Installer to provide filler sheets between equipment and casing.
- 2.5 COILS
- .1 General:
- .1 Cleanable tube type: steel or cast iron headers and straight tubes.
- .2 Plate fin type: tubes mechanically bonded to fins. Spiral wound fin type: mechanically bonded to tubes.
- .3 Non-ferrous tubes and headers: brazed assembly.
- .4 Maximum tube length: 3.6 m unless specified otherwise.
- .5 Factory tested with air under water.
- .6 Provide Heresite P-413 pure phenolic coating to give corrosion resistance to all coils including condensor, evaporator coils. Repeat the process dipping and baking four (4) times so it will result in complete coating of the entire coil.
- .2 Capacities: as indicated.
- .3 Ratings: ARI Certified. Submit with shop drawings actual cooling and heating fluid entering and leaving conditions for stated air side requirements.
- .1 Unless otherwise indicated, dehumidifying coils rated for 2.5 m/s face velocity.
- .2 Unless otherwise indicated, preheat coils rated for 3.5 m/s.
- .3 Pressure drop through heating coils: 30 kPa maximum.
-

- 2.5 COILS
(Cont'd)
- .3 Ratings:(Cont'd)
- .4 Pressure drop through cooling coils: 60 kPa maximum.
- .5 Water velocity: 1.2 m/s maximum. Under 0.6 m/s, turbulators may be used if manufacturer's standard practice.
- .4 Coil casings:
- .1 Mounting: designed for bolting to other sections.
- .2 Steel: die formed 1.6 mm thick galvanized steel sheet, except Type 304 stainless steel for cooling coils and condensor coil.
- .3 Copper at spray washers as indicated: 1.6 mm thick cornice temper copper.
- .4 Tube supports: allow for expansion and contraction.
- .5 Supports: steel channel or double angle frames or other approved support. Provide brass supports for copper coils.
- .6 Blank-off plates: of similar material as casing to prevent air bypass. Seal openings where pipes pass through casing using methods recommended by SMACNA.
- .5 Direct expansion refrigerant coils:
- .1 Serpentine type, arranged to prevent trapping of oil.
- .1 Liquid distributors to ensure even distribution of liquid refrigerant to circuits.
- .2 Silver solder or braze joints in refrigerant tubing.
- .3 Evacuate and charge coil with nitrogen and seal before sending to site.
- .2 Tubes: copper.
- .3 Fins: aluminum plate or spiral wound.
- .4 Headers: copper.
- .5 Pressure tests: to CSA B52 and carry a Canadian registration number. Sealed with nitrogen charge.
- .6 Type of Refrigerant: R410A.
- 2.6 DRAIN PANS
- .1 Construction: stainless steel or plastic or FRP. Rounded corners.
- .2 Insulation: extruded foam type, minimum 13 mm thick.
- .3 Drain connection: in bottom at low point.
- .4 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.
- .5 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil or
-

- 2.6 DRAIN PANS (Cont'd) .5 Dimensions:(Cont'd)
eliminator and to include all return bends and headers.
- 2.7 MIXING BOX SECTION .1 Provide as indicated.
.2 Material: to match casing.
.3 Design: provide internal baffles and other devices, as required, to produce mixed air temperature to within plus or minus 3°C of design across face of outlet.
.4 Factory manufactured assembly to include frame, dampers, operating linkages, drive shafts of minimum 12 mm diameter carbon steel and access door on each side.
.5 Dampers for mixing boxes: to Section 23 33 15.
- 2.8 FILTER BOX .1 Material to match casing complete with filter arrangement as indicated using disposable type filters. Provide access to filter through hinged door.
.2 Filters: to Section 23 44 00.
.3 Provide blank off plates to ensure zero bypass around filters.
.4 Fabricated frames from minimum 1.6 mm stainless steel. Equip each holding frame with suitable filter holding devices. Provide gasketed holding frame seats. Make all joints airtight.
- 2.9 VIBRATION ISOLATION .1 Flexible connections to Section 23 33 00 Duct Accessories.
.2 Vibration isolators on each fan section to Section 23 05 48 Vibration Isolation and Seismic Control.
.3 Each fan to have 50mm spring isolators.
-

- 2.10 COMPRESS
CONDENSER
- .1 Conform to CSA B52 and ANSI/UL 465 requirements.
 - .2 Compressor/condenser section:
 - .1 Hermetic compressors, vibration isolated with flexible suction and discharge connections, oil sight glass, oil pressure switch, crankcase heater, and automatic pump down system with control to liquid line solenoid valve.
 - .2 Fans: propeller type with single piece spun venturi outlets and zinc plated guards. Motors shall be sequenced for head pressure control.
 - .3 Electrical system shall have operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof, rain tight disconnect.
 - .4 Include refrigerant piping with, sight glass, filter drier and valves.
 - .5 Condenser: staggered copper tube, aluminum fin coil assembly with sub-cooling rows to provide 6 OC sub-cooling.
 - .6 Refrigerant: R 410a.
 - .3 Evaporator:
 - .1 Rated to ANSI/ARI 210/240.
 - .2 Thermostatic expansion valve, with adjustable super heat and external equalizer.
 - .3 Coil and drain pan as described above.
- 2.11 GAS HEATING
- .1 Gas furnace to have an indirect gas heating section complete with drum and tube heat exchanger and single burner combustion system. The Heating system will provide a minimum of 80% thermal efficiency throughout entire firing ranges. Equip all units for use with natural gas. Primary heat exchanger must be stainless steel. The secondary heat exchanger must be of aluminum alloy.
 - .2 Equip the furnace with all required safety elements including flue high temperature switch, condensate drain, condensate drain blockage shutdown switch and heat exchanger high temperature shutdown.
 - .3 Unit to have vent cap and vent must be extended as required by code to give clearances to building openings. Unit to have factory installed shut off valve and union. Furnace operation will be controlled through an integrated circuit board. The circuit board will monitor heater operation and have LED diagnostic indicator lights to identify abnormalities in control functions. The circuit board shall monitor flame failure, failed ignition, airflow and low gas pressure. Unit to have a minimum 15:1 modulating control.
-

2.11 GAS HEATING .4 The unit shall have BacNet communications capability
(Cont'd)

2.12 FACTORY .1 Provide a system of motor control, including all
SUPPLIED CONTROL/
WIRING necessary terminal blocks, motor contactors, motor
overload protection, overcurrent protection,
grounding lugs, control transformers, auxiliary
contactors and terminals for the connection of
external control devices or relays.

.2 Power fire alarm circuits from a relay in unit
circuitry.

.3 Factory installed and wired main non-fused
disconnect switches in CEMA/NEMA 4 weatherproof
configuration for single point power connections to
supply fan, return fan and 120V circuit for a total
of three (3). 120V circuit to provide power to the
following:
.1 Lights.
.2 Fused convenience outlet.

.4 Provide air flow measurement station at outside air
inlet, where indicated in AHU schedule, for
connection by EMCS.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Fabricate to provide smooth air flow through all
components. Limit air leakage to 1 % of rated air
flow at 2.5 kPa suction pressure.

.2 Apply sealer into all seams prior to assembly.
Secure toe angles continuous along entire length of
assembly.

.3 Provide deep seal traps complete with priming.

3.2 COMMISSIONING .1 Manufacturer's representative to provide one (1) day
on site per unit for startup and one (1) day for
commissioning to Section 01 91 13.

PART 1 - GENERAL

- 1.1 SCOPE OF WORK .1 This section specifies the work associated with the supply and installation of self, contained, factory assembled computer room air conditioning unit complete with all associated fitting and appurtenances.
- 1.2 REFERENCES .1 ASHRAE 52.2-2012, Method of Testing General Ventilation Air - Cleaning Devices for Removal Efficiency by Particle Size.
- 1.3 SHOP DRAWINGS .1 Submit shop detail or working drawings and manufacturer's data for computer room A/C Unit to the Departmental Representative for review before any such items or equipment are incorporated into the Works. This review of Shop Drawings by Departmental Representative is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Departmental Representative approves the detailed design inherent in the Shop Drawings, responsibility for which shall remain with the Contractor submitting them, and such review shall not relieve the Contractor of responsibility for errors or omissions in Shop Drawings or of responsibility for meeting all requirements of the Construction and Contract Documents.
- .2 Submit information that clearly shows the dimensions, materials or construction, performance, finish, service and installation requirements and other characteristics in sufficient detail to permit the Departmental Representative to evaluate the suitability of the articles for the use intended.
- .3 Make corrections required by the Departmental Representative as noted, and resubmit to the Departmental Representative for review before fabrication.
- 1.4 HANDLING OF MATERIALS .1 Load and unload the computer room A/C units so as to avoid shock or damage or dropping. If, however, any material is damaged, repair or replace in a manner approved by the Departmental Representative, at no additional cost to the Contract.

1.5 OPERATIONS AND
MAINTENANCE MANUALS

- .1 Provide a Manual of Operations and Maintenance. It will include details of all proprietary equipment incorporated into the Works.
- .2 Provide three (3) copies of all manufacturer's literature pertaining to such equipment and which shall include descriptions, drawings, specifications, assembly, wiring or other diagrams, material lists, parts lists, installation, operating and maintenance instructions, names and addresses of the manufacturer's local or nearest agency, and like information. Bind information and organize neatly. Submission of individual or loose information packages will not be accepted.
- .3 In addition to the above requirement for general manufacturer's literature, provide five (5) copies of full service equipment manuals.
- .4 All such material must be new material. Photocopies will not be accepted. Drawings must be unfolded and page size papers unperforated at the binding edge if possible.

1.6 EXTENDED
COMPRESSOR WARRANTY

- .1 Provide an extended compressor warranty that expressly states all repair or replacement parts are covered for a period of 18 months in addition to the standard warranty.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Provide the environmental control, Computer Room Air Conditioning units complete with a high sensible cooling system, self-contained, factory assembled, piped, wired, and factory tested prior to shipment. Provide units complete with an enclosure/cabinet assembly, fan section, filter section, cooling coil, controls, and interconnecting piping internal to unit.
- .2 The total cooling capacity is as detailed on the project plans and schedule
- .3 Provide quantities and configurations as shown on the project drawings.
- .4 Safety Certification: Units to be ETL or UL listed.

2.2 CABINET AND
FRAME

- .1 Constructed of 18 gauge welded tubular steel and be coated with a heavy corrosion inhibiting finish for long life. The side panels are to be constructed of galvanized steel. Provide cabinet with 6mm thick closed cell insulation. The unit must be serviceable through the removable side panels.
- .2 Provide unit in vertical or horizontal air flow direction. Ceiling mount the vertical air flow unit and size to fit a standard 2ft x 4ft T-bar ceiling grid opening. Ceiling hang the horizontal supply/return air unit with duct work attached to supply and return openings.
- .3 Removal of the unit from the ceiling space must not be required for access.

2.3 REFRIGERATION
CIRCUIT

- .1 Air Cooled Packaged: refrigeration system must be self-contained, factory assembled, charged and tested package. No additional refrigerant piping connections must be required. Unit to contain an indoor evaporator and air-cooled indoor condensing section. Assemble both sections within one cabinet and frame assembly. Mount units in the ceiling space with ducted supply and return air as required on the project drawings.
 - .1 Evaporator section to include a cooling coil constructed with copper tubes and aluminum fins for maximum heat transfer. A single refrigeration circuit will contain an expansion valve with external equalization, filter drier and sight-glass. See BLOWER ASSEMBLY subsection herein for evaporator blower details.
 - .2 Air-cooled condensing section includes the condenser coil which is constructed with copper tubes and aluminum fins for maximum heat transfer. A single refrigeration circuit includes a scroll compressor with a crankcase heater and high and low safety pressure switches. The scroll type compressor must have internal overload protection. The high and low pressure safety switches are connected to the refrigerant system with a Schrader fitting that allows replacement without affecting the refrigerant charge, making recovery unnecessary. Units with capillary tube metering devices will not be acceptable. Condenser fan assembly to be direct drive, double inlet, double width centrifugal fan configuration. Statically and dynamically balance the fan at the factory as a complete assembly to minimize vibration level of two mils in any plane. Locate the fan to draw air over the coil to provide even air

-
- 2.3 REFRIGERATION .1 (Cont'd)
CIRCUIT .2 (Cont'd)
(Cont'd)
-
- distribution over the entire face of the coil for maximum coil performance.
- .1 Provide both the evaporator and condenser sections with a condensate drain pan constructed of stainless steel and provide a positive drain to prevent standing water in the condensate pan.
- 2.4 BLOWER ASSEMBLY .1 Evaporator blower assembly to be a double width, double inlet, blower with belt drive and variable pitch sheave and self-aligning ball bearings rated for an average life of 100,000 hours.
- .2 Design the system for draw through air arrangement to insure even air distribution over the entire face of the coil.
- .3 Air delivery as detailed on the project plans and schedule.
- .4 Capacity as indicated.
- 2.5 FILTER .1 Provide a two (2") inch, MERV 8, based on ASHRAE Std. 52.2, disposable filter of 20" square (20" x 20").
- .2 Locate the filter behind and accessible through the hinged return air grille on units with vertical air discharge unit.
- 2.6 ELECTRICAL .1 Pre-wire all electrical components, including capacitors, contactors, relays and control transformers and contain in a hinged electrical box that swings out for easy access and servicing.
- .2 Control circuit voltage is 24 volts.
- .3 Input electrical power as indicated.
- .4 A factory installed micro-switch will disable the unit prior to condensate pan overflow should the drain become plugged with debris.
-

-
- 2.7 CONTROL SYSTEM .1 Precise temperature regulation will be provided by a low profile programmable thermostat which provides 5/2 day temperature programming for cooling only (no reheat).
- .2 Full function LCD providing 12 or 24 hour clock display.
- 2.8 WALL MOUNT CONTROLLER .1 The controller system is comprised of three (3) components: a wall mount display module, a combination remote wall mount temperature and humidity sensor and a unit mounted control module. The wall mount display module includes a backlit liquid crystal display (LCD) with six keys (buttons) for easy programming. All settings and alarm conditions will be displayed on the display module in easy read verbiage. Mount the control module on the unit and connect to the display module via a special "telephone like" cable which is included with the system. A remote mounted temperature and humidity sensor separately at the location in the controlled space as shown on the Project Drawings. Also include the combination temperature and humidity sensor connected to the control module via separate wiring.
- .2 The Wall-Mount display module will allow recall and display of the high and low temperature and high and low humidity for the last 24 hours; current percent of capacity and average percent of capacity for the last hour of operation for cool 1, cool 2, component runtimes for fan motor and cooling stages. Programming will have multi-level password and is accomplished entirely from the front of the wall mount display module. Programmable functions will be entered on flash memory to ensure program retention should power fail. The historical database will be maintained by rechargeable battery backup. Multiple messages will be displayed by automatically by scrolling from each message to the next. Alarm conditions must be displayed by automatically scrolling from each message to the next. Alarm conditions, in addition to being displayed, will enunciate an audible alarm. A programmable summary contact will be available for remote alarm monitoring. Additional test or service terminal shall not be required for any functions. The control includes temperature anticipation, moisture level humidity control.
- .3 An alarm condition will continue to be displayed until the malfunction is corrected. Multiple alarms will be displayed sequentially in order of occurrence and only those alarms, which have not been
-

2.8 WALL MOUNT CONTROLLER (Cont'd)	.3	(Cont'd) acknowledged, will continue to sound an audible alarm. A user accessible diagnostic program will aid in system component trouble shooting by displaying on the unit LCD screen the name of the controlled item, output number, terminal plug or pin number for each controlled item.
	.4	In addition, the control panel must support the following network protocols for integration with a Building Management System (BMS) for Computer Room Air Conditioning (CRAC) system monitoring and control: Modbus RTU, Modbus TCP/IP, SNMPv1/v2, BACnet IP or BACnet MS/TP and LonTalks. Unit(s) shall be furnished with an optional interface card to communicate directly with the Building Automation System (BAS) through a RS-485, Ethernet or LonTalks port. Make available through the BAS all alarms, set points, and operating parameters that are accessible from the unit mounted control panel.
2.9 DISCONNECT SWITCH	.1	Have the disconnect switch with 1/4 turn latch factory installed and wired. The switch must be in the "OFF" position to remove panel and access electrical compartment.
2.10 CONDENSATE PUMP	.1	Provide a condensate pump with the unit and shall have a capacity of 60 GPH at 8 feet of head. Ship the pump loose for field mounting and installation. Pump voltage to be 120 V.
2.11 BOTTOM SUPPLY AND RETURN AIR	.1	Supply and return air must be on bottom of cabinet complete with grilles. Refer to the project drawings.
2.12 CONDENSER AIR	.1	Condenser air will be drawn from and discharge to the ceiling plenum. Refer to the project drawings.

PART 3 - EXECUTION

- | | |
|---|--|
| <u>3.1 GENERAL</u> | <ul style="list-style-type: none">.1 Install in accordance with manufacturer's recommendations..2 Manufacturer to certify installation..3 Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances..4 Test controls and demonstrate compliance with requirements..5 Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted..6 Install and connect devices furnished by manufacturer but not specified to be factory-mounted. |
| <u>3.2 FIELD QUALITY CONTROL</u> | <ul style="list-style-type: none">.1 Start up cooling units in accordance with Quality Control manufacturer's startup instructions. Test controls and demonstrate compliance with requirements. These specifications describe requirements for a computer room environmental control system. |
| <u>3.3 EQUIPMENT PREPARATION AND START-UP</u> | <ul style="list-style-type: none">.1 Provide services of manufacturer's field engineer to Preparation and set and adjust equipment for operation as specified..2 Have start up of unit performed by a factory authorized and trained mechanics..3 In the presence of and in cooperation with the RA/C unit manufacturer's representative, start-up the RA/C unit, and ensure that RA/C unit is capable of performing all steps in the sequence of operation..4 Submit start-up report including the following information:<ul style="list-style-type: none">.1 Complete unit description..2 Voltage each phase..3 Current draw by each piece of equipment..4 All equipment set points which are field adjustable..5 Refrigeration circuits operating conditions..6 All information on manufacturer's startup report. |

PART 1 - GENERAL

- | | | |
|------------------------------|----|--|
| <u>1.1 QUALITY ASSURANCE</u> | .1 | Panels to be manufactured by a company regularly engaged in the manufacture of radiant panels having catalogue performance data and certified test data. |
| | | |
| <u>1.2 SUBMITTALS</u> | .1 | Manufacturer to submit complete scale shop drawings showing layouts and complete details of all areas where radiant panels are indicated. Coordinate these drawings with and clear interference with other trades. |
| | .2 | Shop drawings to all indicate location of supply and return hook-ups in addition to interconnection details for each zone. |

PART 2 - PRODUCTS

- | | | |
|--|----|---|
| <u>2.1 LINEAR RADIANT CEILING PANELS</u> | .1 | Refer to architectural reflected ceiling plans and room finish schedule in addition to mechanical drawings to determine location, quantity and finish of radiant panels. |
| | .2 | Refer to the contract drawings for details and dimensions. Run panels continuously from wall to wall and specified widths are minimum allowable. Determine actual wall-to-wall dimensions and provide appropriate lengths. |
| | .3 | Radiant ceiling extrusions to consist of extruded aluminum with copper tubing of 0.504in. (12.8mm) I.D. mechanically attached to the aluminum face plate. Hold the copper tube in place by an aluminum saddle, which will extend more than half way around the diameter of the tube. Place a non-hardening heat conductive paste between the copper tubing and the aluminum face plate. Panels shall weigh no more than 2.15 lb/ft ² (10.5 kg/m ²) when operating. The use of adhesive and/or clips to attach the copper tube to the extrusion will not be acceptable. |
| | .4 | Panels to be finished in the manufacturer's standard white colour. |

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Co-operate with other trades working in the ceiling to achieve a neat, well co-ordinated overall installation. Refer to Architectural and Mechanical Details for installation requirements.
- .2 All interconnecting of radiant panels by the mechanical contractor shall consist of 0.5in. (12.8mm) O.D. soft copper tubing or accessories as recommended by manufacturer, i.e. factory supplied 360 deg. Interconnecting loops and 180 deg. return U-bends. Supply first to panel tubing pass closest to perimeter wall. Multiple panels shall be circuited to ensure serpentine flow over complete length of zone. Individual serpentine panel coils connected in series is unacceptable for multiple panel zones.
- .3 Provide all radiant panels continuously from wall-to-wall and around columns and shall be field trimmed to length ensuring adequate expansion allowance while maintaining panel end coverage by architectural mouldings. Inactive filler panels will be permitted only where indicated on drawings.
- .4 Supply and install ceiling support mouldings for Radiant Panels. Confirm ceiling openings and wall mouldings are installed as per radiant panel shop drawings.
- .5 Install all radiant panels by personnel wearing clean white gloves, to avoid soiling of panel face. Hanger wires for safety and seismic restraint shall be installed at 4ft. (1200mm) o.c. or as recommended by the manufacturer.
- .6 Thoroughly clean all system piping. Flush, drain and refill before radiant panels are connected into the system.
- .7 Each group or zone of coils will be given a pressure test in accordance with procedures specified elsewhere.
- .8 No installation of finished radiant panels will begin until all glazing has been completed and all exterior openings closed in.
- .9 Cover all active panels with a minimum of 1in. (25mm) thick batt insulation.

PART 1 - GENERAL

- | | | |
|-----------------------------|----|--|
| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
| | .2 | Closeout Submittals: Section 01 78 00 |
| | .3 | Commissioning: Section 01 91 13 |
-
- | | | |
|--------------------------|----|---|
| <u>1.2 SHOP DRAWINGS</u> | .1 | Submit shop drawings in accordance with Section 01 33 00. |
| | .2 | Indicate:
.1 Equipment, capacity, piping, and connections.
.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes. |
-
- | | | |
|------------------------|----|---|
| <u>1.3 MAINTENANCE</u> | .1 | Provide maintenance data for incorporation into manual specified in Section 01 78 00. |
|------------------------|----|---|

PART 2 - PRODUCTS

- | | | |
|--|----|--|
| <u>2.1 FORCE FLOW HEATERS (F.F.) AND CABINET HEATERS</u> | .1 | Cabinet: type semi-recessed or recessed as indicated, nominal 16 gauge steel with rounded exposed corners and edges, removable panels, glass fiber insulation and integral air outlet and inlet. |
| | .2 | Finish with factory applied primer coat. Provide and apply finish painted on site. |
| | .3 | Coils: aluminum fins mechanically bonded to copper tubes. Hydrostatically test to 150 psig. |
| | .4 | Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted. |
| | .5 | Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting. |
-

.6 Filters: removable thick permanent washable type.

.7 Capacities: as indicated on the drawings.

.8 Control:

.1 Multi-speed and off switch with integral thermal overloads accessible through a tamper proof access door in the front cover of cabinet.

.2 Controlled by building management system.

2.2 HORIZONTAL AND
VERTICAL UNIT
HEATERS(H.U.H. &
V.U.H.)

.1 Casing: nominal 16 ga. thick cold rolled steel, gloss enamel finish, with threaded connections for hanger rods.

.2 Coils: seamless copper tubing, silver brazed to steel headers with evenly spaced aluminum fins mechanically bonded to tubing. Hydrostatically test to 150 psig.

.2 Fan: direct drive propeller type, factory balanced, with anti-corrosive finish and fan inlet guard.

.3 Motor: speed as indicated, direct drive continuous duty, built-in overload protection, and resilient motor supports.

.4 Air outlet: two-way adjustable louvres.

.5 Capacities: as indicated on the drawings.

.6 Controlled by building management system.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Install in accordance with piping layout and reviewed shop drawings.

.3 Provide double swing pipe joints at each unit.

.4 Check final location with the Departmental Representative if different from that indicated prior to installation. Should deviations beyond allowable

- 3.1 INSTALLATION
(Cont'd)
- .4 (Cont'd)
clearances arise, request and follow the Departmental Representative's directive.
 - .5 Hot water units: for each unit, install isolating valve on inlet and circuit balancing valve on outlet. Install drain valve at low point. Install manual air vent at high point.
 - .6 Clean finned tubes and comb straight.
 - .7 Provide supplementary suspension steel as required.
 - .6 Thermostats on outside walls (where applicable):
mount on insulated backplates.
 - .7 Before acceptance, set discharge patterns and fan speeds for proper distribution of heat.
 - .8 Provide vibration isolation spring hangers for suspended horizontal unit heaters.