

PART 1 - GENERAL

<u>1.1 GENERAL</u>	.1	Refer to Division 1 for the requirement for Contractor provided interference drawings. Coordinate and cooperate with the production of these interference drawings and note that the installation of mechanical systems will not commence until the interference drawings have been reviewed by the Departmental Representative.
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<u>PART 2 - PRODUCTS</u>	Not applicable
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<u>PART 3 - EXECUTION</u>	Not applicable.
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PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Section 07 84 00 - Firestopping and Smoke Seals.
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<u>1.2 REFERENCES</u>	.1	Canadian General Standards Board (CGSB) .1 CAN/CGSB1.181-99, Organic Zinc-Rich Coating.
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<u>PART 2 - PRODUCTS</u>	Not Applicable.
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PART 3 - EXECUTION

<u>3.1 CONNECTIONS TO EQUIPMENT</u>	.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 NEC.
	.5	Maintain equipment and valves a maximum of 910mm above ceilings.

<u>3.2 CLEARANCES</u>	.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 and 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.

3.5 PIPEWORK
INSTALLATION
(Cont'd)

- .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.
- .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.
- .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.

3.6 SLEEVES
(Cont'd)

- .2 Material: Schedule 40 black steel pipe (sheet metal acceptable for non-rated dry wall partitions).
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB- 1.181.
 - .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 Confirm 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.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Confirm integrity of insulation and vapour barriers.

3.9 FLUSHING OUT
OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems as specified in relevant sections of Division 21, 22 & 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 Departmental Representative 72 hours minimum prior to performance of pressure tests.
- .2 PIPework: Pressure test piping at either city mains 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 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

3.10 PRESSURE .6 Insulate or conceal work only after review of
TESTING OF tests by Departmental Representative.

EQUIPMENT
(Cont'd)

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Section 01 33 00 - Submittal Procedures
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<u>1.2 REFERENCES</u>	.1	American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
	.1	ASHRAE 90.1-2007, Energy Standard for Buildings except Low-Rise Residential Buildings.
	.2	National Electrical Manufacturers' Association (NEMA).

<u>1.3 SECTIONS INCLUDES</u>	.1	Electrical work to conform to Division 26 including the following:
	.1	Supplier and installer responsibility is indicated in Division 26 on electrical drawings and related mechanical responsibility is indicated in Divisions 21, 22 and 23, and on mechanical drawings.
	.2	Control wiring and conduit is specified in Division 26, conduit, wiring and connections below 50V which are related to control systems specified in Divisions 21, 22 and 23, are the responsibility of Divisions 21, 22 and 23 respectively except as indicated otherwise. Refer to Division 26 for quality of materials and workmanship.

<u>1.4 SHOP DRAWINGS</u>	.1	Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
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<u>1.5 CLOSEOUT SUBMITTALS</u>	.1	Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 Closeout Submittals.
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PART 2 - PRODUCTS

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| <u>2.1 GENERAL</u> | .1 | Motors to be inverter duty rated premium efficiency, in accordance with local utility company standards and the requirements of ASHRAE 90.1. |
| <u>2.2 MOTORS</u> | .1 | Provide motors for mechanical equipment as specified. |
| | .2 | If delivery of specified motor will delay delivery or installation of equipment, install motor approved by Departmental Representative for temporary use. Final acceptance of equipment will not occur until specified motor is installed. |
| | .3 | Motors under 1/2 HP: speed as indicated, continuous duty, builtin overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated. |
| | .4 | Motors 1/2 HP and larger: NEMA, Class B, squirrel cage induction, premium efficiency, speed as indicated, continuous duty, inverter rated, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 575 V, unless otherwise specified or indicated. |
| <u>2.3 TEMPORARY MOTORS</u> | .1 | If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed. |
| <u>2.4 BELT DRIVES</u> | .1 | Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets. |
| | .2 | Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified. |
| | .3 | For motors under 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% |

- 2.4 BELT DRIVES
(Cont'd)
- .3 For motors under 10 HP:(Cont'd)
range. Use midposition of range for specified
r/min.
 - .4 For motors 10 HP and over: sheave with split
tapered bushing and keyway having fixed pitch
unless specifically required for item
concerned. Provide sheave of correct size to
suit balancing.
 - .5 Correct size of sheave to be determined
during commissioning.
 - .6 Minimum drive rating: 1.5 times nameplate
rating on motor. Keep overhung loads within
manufacturer's design requirements on prime
mover shafts.
 - .7 Motor slide rail adjustment plates to allow
for centre line adjustment.
 - .8 Supply one (1) set of spare belts for each
set installed.
- 2.5 DRIVE GUARDS
- .1 Provide guards for unprotected drives.
 - .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel
frame.
 - .2 Minimum 1.2 mm thick sheet metal tops
and bottoms.
 - .3 38 mm dia holes on both shaft centres
for insertion of tachometer.
 - .4 Removeable to servicing.
 - .3 Provide means to permit lubrication and use
of test instruments with guards in place.
 - .4 Install belt guards to allow movement of
motors for adjusting belt tension.
 - .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick
galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
 - .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen,
galvanized, 19 mm mesh.
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| 2.5 DRIVE GUARDS
(Cont'd) | .6 | Unprotected fan inlets or outlets:(Cont'd) |
| | .2 | Net free area of guard: not less than 80% of fan openings. |
| | .3 | Securely fasten in place. |
| | .4 | Removable for servicing. |

PART 3 EXECUTION

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| 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. |
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| 3.2 INSTALLATION | .1 | Fasten securely in place. |
| | .2 | Make removable for servicing, easily returned into, and positively in position. |

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| 3.3 FIELD QUALITY CONTROL | .1 | Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS. |
| | .1 | As specified in other sections of this specification. |
| | .2 | Manufacturer's Field Services: |
| | .1 | Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS. |
| | .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, as directed in PART 1 - QUALITY ASSURANCE. |

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| 3.4 CLEANING | .1 | Proceed in accordance with Section 01 74 11. |
| | .2 | Upon completion and verification of performance of installation, remove surplus. |

PART 1 - GENERAL

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| <u>1.1 RELATED SECTIONS</u> | .1 | Section 01 33 00 - Submittal Procedures |
| <u>1.2 SHOP DRAWINGS</u> | .1 | Submit shop drawings in accordance with Section 01 78 00. |
| | .2 | Indicate for each item as applicable:
.1 Manufacturer, model number, line contents, pressure and temperature rating.
.2 Movement handled; axial, lateral, angular and the amounts of each.
.3 Nominal size and dimensions including details of construction and assembly. |
| <u>1.3 MAINTENANCE DATA</u> | .1 | Provide maintenance data for incorporation into manual specified in Section 01 33 00. |
| | .2 | Data to include:
.1 Servicing requirements, including any special requirements, stuffing box packing, lubrication and recommended procedures. |

PART 2 - PRODUCTS

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| <u>2.1 ANCHORS AND GUIDES</u> | .1 | Anchors:
.1 Provide as indicated/required.
.2 Structural steel members secured to building structure. |
| | .2 | Alignment guides:
.1 Provide as indicated to accomodate specified thickness of insulation.
.2 Carbon steel bolted spider and outer housing.
.3 Copper plated spider for copper piping. |
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- 2.2 FLEXIBLE CONNECTIONS
- .1 Application: to suit motion.
 - .2 Minimum length in accordance with manufacturer's recommendations to suit offset.
 - .3 Inner hose: bronze, corrugated.
 - .4 Braided wire mesh, bronze outer jacket.
 - .5 Diameter and type of end connection: as indicated.
 - .6 Operating conditions:
 - .1 Working pressure: 1034 kPa.
 - .2 Working temperature: 93°C.
 - .3 To match system requirements.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install pipe anchors, guides and flexible pipe connections as indicated, required and in accordance with manufacturers instructions. Anchors to withstand 150% of axial thrust.
 - .2 Ensure that a minimum of one-half of the pipe alignment spider is within the guide under all conditions.
 - .3 All horizontally installed flexible loops must have 180° return bend supported.
 - .4 Provide flexible connections at all pump inlet/outlets.

PART 1 - GENERAL

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| <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

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| <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. |
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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.

3.2 THERMOMETERS .2
(Cont'd)

- (Cont'd)
- .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 Use extensions on all thermometers wells and pressure gauges to allow for insulation thickness.

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

<u>1.1 RELATED SECTIONS</u>	.1	Section 23 05 05 - Installation of Pipework
<u>1.2 REFERENCES</u>	.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.
<u>1.3 SUBMITTALS</u>	.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.

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| 1.3 SUBMITTALS
(Cont'd) | .2 | Product Data:(Cont'd)
.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 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. |
| 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 (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. |
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PART 2 - PRODUCTS

- 2.1 MATERIALS
- .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.
 - .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 Class 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
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- 2.2 GATE VALVES (Cont'd)
- .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.
 - .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 Class 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
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2.3 GLOBE VALVES
(Cont'd)

- .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.
- .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.

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| 2.4 CHECK VALVES
(Cont'd) | .5 | NPS 2 and under, horizontal lift type, composition disc, Class150:
.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.
- .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.

2.2 GATE VALVES
(Cont'd)

- .1 (Cont'd)
 - .2 Bronze Trim:(Cont'd)
 - .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.
 - .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.

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- 2.2 GATE VALVES (Cont'd)
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- .3 (Cont'd)
- .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.
- .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).
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- 2.3 UNDERWRITERS .1 (Cont'd)
- APPROVED GATE VALVE
(Cont'd)
- .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 -
-

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- 2.5 BYPASSES FOR GATE AND GLOBE VALVES (Cont'd) .4 Type of bypass valves:(Cont'd)
.2 On globe valve:(Cont'd)
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.
.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:
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|-------------------------------------|----|--|
| <u>2.7 CHECK VALVES</u>
(Cont'd) | .2 | (Cont'd)
.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. |
| <u>2.8 SILENT CHECK VALVES</u> | .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

- | | | |
|-------------------------|----|--|
| <u>3.1 INSTALLATION</u> | .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.

2.1 GENERAL(Cont'd)

.2 (Cont'd)

.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 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.
 - .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.

2.5 BYPASSES FOR
VALVES GATE AND
GLOBE
(Cont'd)

- .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.
.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

1.1 RELATED
SECTIONS

- .1 Submittal Procedures: Section 01 33 00
- .2 Cast-in-Place Concrete: Section 03 30 00
- .3 Structural Steel: Section 05 12 23
- .4 Metal Fabrications: Section 05 50 00

1.2 REFERENCES

- .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).

1.3 DESIGN
REQUIREMENTS

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

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|-------------------------------------|----|--|
| 1.3 DESIGN REQUIREMENTS
(Cont'd) | .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 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.
 - .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

2.2 PIPE HANGERS
(Cont'd)

- .4 Upper attachment to concrete:(Cont'd)
 - .1 Ceiling:(Cont'd)
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 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 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.

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| <u>2.6 VARIABLE
SUPPORT SPRING
HANGERS</u> | .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. |
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 | | |
| <u>2.7 EQUIPMENT
SUPPORTS</u> | .1 | Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05121. Submit calculations with shop drawings. |
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| <u>2.8 EQUIPMENT ANCHOR.
BOLTS AND TEMPLATES</u> | .1 | Provide templates to ensure accurate location of anchor bolts. |
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| <u>2.9 PLATFORMS AND
CATWALKS</u> | .1 | To Section 05 50 00. |
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| <u>2.10 HOUSEKEEPING
PADS</u> | .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. |
|
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| <u>2.11 OTHER EQUIPMENT.
SUPPORTS</u> | .1 | From structural grade steel meeting requirements of Section 05 12 23. |
| | .2 | Submit structural calculations with shop drawings. |
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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.

- 3.4 HORIZONTAL MOVEMENT
(Cont'd)
- .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

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|-----------------------------|----|---|
| <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. |
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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.

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| 2.2 SYSTEM
NAMEPLATES
(Cont'd) | .4 | Locations:(Cont'd) |
| | .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. |
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2.5 IDENTIFICATION .5
OF PIPING SYSTEMS
(Cont'd)

- 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 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:	

<u>Contents</u>	<u>Background colour</u>	<u>Legend</u>
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** 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

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, service, function, normal position, location of tagged item.

2.8 CONTROLS
COMPONENTS
IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this Section. If no EMCS included in project, identification as per this section.
- .2 Inscriptions to include function and (where appropriate) failsafe position, component ID name.

2.9 LANGUAGE

- .1 Identification to be in English.
- .2 Use one nameplate, label, etc. for each language.

PART 3 - EXECUTION

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| <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. |
| <u>3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS</u> | .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. |

3.4 LOCATION OF
IDENTIFICATION ON
PIPING AND DUCTWORK
SYSTEMS
(Cont'd)

- .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

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| 1.1 RELATED SECTIONS | .1 | Section 01 33 00 - Submittal Procedures. |
| | .2 | Section 23 05 29 - Bases, Hangers and Supports. |
| | .3 | Section 23 05 53 - Mechanical Identification. |
| 1.2 REFERENCES | .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.
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| <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

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| <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. |
|--------------------------------------|----|--|

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| <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. |

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| <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. |
|--------------------|----|--|
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2.3 JACKETS
(Cont'd)

- .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.
 - .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.

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| <u>2.4 ACCESSORIES</u>
(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

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| <u>3.1 PREINSTALLATION REQUIREMENTS</u> | .1 | Pressure testing of ductwork systems complete, witnessed and certified. |
| | .2 | Surfaces clean, dry, free from foreign material. |
| <u>3.2 INSTALLATION</u> | .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 .2
INSULATION SCHEDULE
(Cont'd)

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.

<u>1.2 REFERENCES</u> (Cont'd)	.4	(Cont'd) .3 CAN/ULCS702-09, Thermal Insulation, Mineral Fibre, for Buildings
<u>1.3 DEFINITIONS</u>	.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.
<u>1.4 SHOP DRAWINGS</u>	.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.
<u>1.5 SAMPLES</u>	.1	Submit samples in accordance with Section 01 33 00.
<u>1.6 MANUFACTURER'S INSTRUCTIONS</u>	.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.
<u>1.7 QUALIFICATIONS</u>	.1	Installer to be specialist in performing work of this Section and qualified to standards of TIAC.

- | | |
|---|---|
| <u>1.8 DELIVERY,
STORAGE AND
HANDLING</u> | <ul style="list-style-type: none">.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

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|--------------------------------------|--|
| <u>2.1 FIRE AND SMOKE
RATING</u> | <ul style="list-style-type: none">.1 In accordance with CAN/ULC S102.<ul style="list-style-type: none">.1 Maximum flame spread rating: 25..2 Maximum smoke developed rating: 50. |
| <u>2.2 INSULATION</u> | <ul style="list-style-type: none">.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.<ul style="list-style-type: none">.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.<ul style="list-style-type: none">.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.<ul style="list-style-type: none">.1 Insulation: with vapour retarder jacket to ASTM C534..2 Jacket: to CGSB 51GP52Ma..3 Maximum "k" factor: 0.039 W/m - °C. |

2.2 INSULATION (Cont'd)	.5	TIAC Code A6:(Cont'd)
	.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.
2.3 INSULATION SECRETMENT	.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.
2.4 CEMENT	.1	Thermal insulating and finishing cement:
	.1	Hydraulic setting or air drying on mineral wool, to ASTM C449/C449M.
2.5 VAPOUR RETARDER LAP ADHESIVE	.1	Water based, fire retardant type, compatible with insulation.
	.2	For Type A6 insulation to manufacturer's recommendation.
2.6 INDOOR VAPOUR RETARDER FINISH	.1	Vinyl emulsion type acrylic, compatible with insulation.
	.2	For Type A6 insulation to manufacturer's recommendation.

2.7 OUTDOOR VAPOUR RETARDER FINISH .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.

2.8 JACKETS

.1 Polyvinyl Chloride (PVC):
.1 One-piece 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 Thickness: 1.0 mm.
.7 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.
.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 factory attached protective liner.

- 2.8 JACKETS (Cont'd)
- .2 Canvas:(Cont'd)
- .3 Aluminum:(Cont'd)
- .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 dished fitting covers with factory attached protective liner.
- .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

- 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.

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|---|----|--|
| 3.2 <u>INSTALLATION
(Cont'd)</u> | .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 <u>REMOVABLE,
PRE-FABRICATED,
INSULATION AND
ENCLOSURES</u> | .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 <u>INSTALLATION
OF ELASTOMERIC
INSULATION</u> | .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 <u>PIPING
INSTALLATION
SCHEDULES</u> | .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. |
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- 3.5 PIPING
INSTALLATION
SCHEDULES
(Cont'd)
-
- .3 TIAC Code: (Cont'd)
 - .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.
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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
RWL and RWP		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

<u>1.1 RELATED SECTIONS</u>	.1	Submittal Procedures: Section 01 33 00.
<u>1.2 REFERENCES</u>	.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.
<u>1.3 SHOP DRAWINGS</u>	.1	Submit shop drawings in accordance with Section 01 33 00.
	.2	Indicate on manufacturers catalogue literature the following: valves.
<u>1.4 MAINTENANCE DATA</u>	.1	Provide maintenance data for incorporation into manual specified in Section 01 78 00.

PART 2 - PRODUCTS

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|-------------------------------|----|---|
| <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. |
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PART 3 - EXECUTION

3.1 GENERAL .1 Refer to Section 23 21 13.

PART 1 - GENERAL

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|--------------------------|-----|---|
| <u>1.1 REFERENCES</u> | .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. |
| <u>1.2 SHOP DRAWINGS</u> | .1 | Submit shop drawings in accordance with Section 01 33 00. |

<u>1.2 SHOP DRAWINGS</u> (Cont'd)	.2	Indicate on manufacturers catalogue literature the following:
	.1	Valves.
	.2	Grooved fittings.

<u>1.3 MAINTENANCE DATA</u>	.1	Provide maintenance data for incorporation into manual specified in Section 01 78 00.
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PART 2 - PRODUCTS

<u>2.1 PIPE</u>	.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.

<u>2.2 PIPE JOINTS</u>	.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.
 - .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
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- 3.1 PIPING
INSTALLATION
(Cont'd)
- .8 (Cont'd)
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.
- .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

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|-----------------------------|----|--|
| <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 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 tapings 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 REFERENCES</u> | .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). |
| <u>1.2 ACTION AND INFORMATIONAL SUBMITTALS</u> | .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. |

1.2 ACTION AND
INFORMATIONAL
SUBMITTALS
(Cont'd)

- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 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.
 - .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.

2.3 PIPE SLEEVES

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

2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 GENERAL .1 Install in accordance with CSA B52, EPS1/RA/1, ASME B31.5 and Section 23 05 05 - Installation of Pipework.
- 3.3 BRAZING PROCEDURES .1 Bleed inert gas into pipe during brazing.
.2 Remove valve internal parts, solenoid valve coils, sight glass.
.3 Do not apply heat near expansion valve and bulb.
- 3.4 PIPING INSTALLATION .1 General:
.1 Soft annealed copper tubing: bend without crimping or constriction. 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.
- .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:

3.6 FIELD QUALITY CONTROL
(Cont'd)

- .7 Charging:(Cont'd)
- .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

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| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
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| <u>1.2 REFERENCES</u> | .1 | American Society for Testing and Materials (ASTM) <ul style="list-style-type: none">.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) <ul style="list-style-type: none">.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) <ul style="list-style-type: none">.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible..2 SMACNA HVAC Duct Leakage Test Manual. |
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| <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: <ul style="list-style-type: none">.1 Sealants..2 Tape..3 Proprietary Joints. |
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<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.
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<u>1.5 WASTE MANAGEMENT AND DISPOSAL</u>	.1	Separate and recycle waste materials in accordance with municipal regulations and Section 01 74 21.
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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.
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<u>2.3 TAPE</u>	.1	Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
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<u>2.4 DUCT LEAKAGE</u>	.1	In accordance with SMACNA HVAC Duct Leakage Test Manual.
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<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.

<u>2.5 FITTINGS (Cont'd)</u>	.2	Radiused elbows:(Cont'd) .2 Round: smooth radius or five piece. Centreline radius: 1.5 times diameter.
	.3	Mitred elbows, rectangular: .1 To 400 mm: with single thickness turning vanes. .2 Over 400 mm: with double thickness turning vanes.
	.4	Branches: .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 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.
<u>2.6 FIRE STOPPING</u>	.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.
<u>2.7 GALVANIZED STEEL</u>	.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:
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2.11 HANGERS AND .3 Hangers:(Cont'd)
SUPPORTS
(Cont'd)

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

- .4 Upper hanger attachments:
- .1 For 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.
 - .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.

- 3.5 LEAKAGE TESTS
(Cont'd)
- .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

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|-------------------------------------|----|---|
| <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

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|---------------------------------|----|--|
| <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. |
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<u>2.3 ACCESS DOORS IN DUCTS</u>	<ul style="list-style-type: none">.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:<ul style="list-style-type: none">.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.
<u>2.4 TURNING VANES</u>	<ul style="list-style-type: none">.1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.
<u>2.5 INSTRUMENT TEST PORTS</u>	<ul style="list-style-type: none">.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.
<u>2.6 SPIN-IN COLLARS</u>	<ul style="list-style-type: none">.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.

3.1 INSTALLATION .3 (Cont'd)
(Cont'd) .4 (Cont'd)

- .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.
 - .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

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| <u>1.1 RELATED SECTIONS</u> | .1 | Submittal Procedures: Section 01 33 00 |
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| <u>1.2 REFERENCES</u> | .1 | Sheet Metal and Air Conditioning National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible. |
|
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| <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

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|---------------------------------|----|--|
| <u>2.1 GENERAL</u> | .1 | Manufacture to SMACNA standards. |
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| <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. |
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2.3 MULTI-BLADED
DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .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

2.1 MULTI-LEAF DAMPERS	<ul style="list-style-type: none">.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..5 Performance:<ul style="list-style-type: none">.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:<ul style="list-style-type: none">.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	<ul style="list-style-type: none">.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.

2.2 DISC TYPE .6 Performance:
DAMPERS
(Cont'd)

.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 .1 Automatic gravity operated, multi leaf,
DAMPERS 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.
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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

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|--|----|--|
| 2.2 SMOKE DAMPERS
(Cont'd) | .3 | Normally open smoke/seal (S/DSSSD):(Cont'd)
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. |
| | .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.
 - .7 Install break-away joints of approved design on each side of fire separation.

PART 1 - GENERAL

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|-------------------------------------|----|---|
| <u>1.1 REFERENCES</u> | .1 | Section 01 33 00 Submittal Procedures. |
| <u>1.2 REFERENCES</u> | .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. |
| <u>1.3 PRODUCT DATA</u> | .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. |
| <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. |
| <u>1.5 SAMPLES</u> | .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.

3.1 DUCT INSTALLATION (Cont'd)	.4 Flexible duct shall have no more than a 15 offset and shall have a minimum of two hangers (per DTIR requirements).
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PART 1 - GENERAL

- 1.1 WARRANTY .1 Provide 48 months extended warranty for refrigeration compressors.
- 1.2 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.
- 1.3 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.
-

1.4 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 shall be unfolded and page size papers shall be unperforated at the binding edge if possible.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Precision environmental control system designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.
- .2 System type:
 - .1 Air flow arrangement: upflow.
 - .2 Cooling: direct expansion.
 - .3 Condensing: direct expansion.
- .3 Cooling and dehumidifying capacity, with fan heat extracted: based on computer room environment of 22C dry bulb and 50% RH (plus or minus 1C and 5% RH) with minimum supply air temperature of 14C and minimum control dead-band of 3% RH separating humidification and dehumidification.

2.1 GENERAL
(Cont'd)

.4 Unit controls must not permit dehumidification and humidification to occur simultaneously.

.5 Unit capacity as shown.

2.2 CABINET

.1 Frame:
.1 Construct of MIG welded, formed sheet metal.
.2 Paint using the autophoretic coating process for maximum corrosion protection.
.3 Capable of being separated into three parts in the field to accommodate rigging through small spaces.

.2 The exterior panels insulated with a minimum 25mm of 0.68 kg density fiber insulation.

.3 Main front panel with captive 1/4 turn fasteners.

.4 Color to match existing units. Z-430 IBM off-white.

.5 Upflow air supply exit from the top of the unit with the air scrolled towards the front of the unit. Three (3)-way air discharge plenum.

.6 Cabinet to house: cooling coil, reheat coil, compressors, fans, filters, humidifier, unit environmental control system, motor starters or contactors and electrical disconnect switch.

.7 Provide adequate access to components for servicing.

2.3 FILTER CHAMBER

.1 Integral part of the system, located within the cabinet serviceable from the end of the unit or the top of the unit.

.2 The filters rated not less than 60% efficiency (based on ASHRAE 52).

.3 Located within the cabinet

.4 Arranged in a V-bank configuration to minimize air pressure drop.

2.3 FILTER CHAMBER .5 Deep pleated 100mm filters with an MERVI 11
(Cont'd) rating (60-65% ASHRAE 52.1).

2.4 FAN .1 DWDI centrifugal, statically and dynamically
balanced, V-belt drive

.2 Heavy duty steel shaft with self-aligning,
permanently sealed, pillow block bearings with
a minimum L3 life of 200,000 hours.

.3 7.5 hp, 1750 RPM fan motor and mounted on an
adjustable slide base. The drive package shall
be multi-belt variable speed, sized for 200%
of the fan motor horsepower.

.4 Fan motor mounted to an automatic,
spring-tensioning base.

.5 Fan motor removable from the front of the
cabinet.

.6 Fan motor Open Drip-Proof, Premium efficiency
and meet NEMA Premium standard.

.7 The motor sheave and fan pulley shall be
double-width fixed pitch.

.8 Two belts, sized for 200% of the fan motor -
horsepower provided with the drive package.

.9 Auto-tension system provide constant tension
on the belts. Belts, shaft, blower bearings,
sheave and pulley warranted for five years
(parts only).

2.5 COMPRESSORS .1 Refrigeration system to consist of a high
efficiency digital scroll compressor, pressure
safety switches, externally equalized
expansion valve, filter drier, refrigerant
sight glass, moisture indicator and R407C
refrigerant.

.2 The compressor will be scroll-type with a
variable capacity operation capability.
Compressor solenoid valve will unload the
compressor and allow for variable capacity
operation. Compressor will be suction
gas-cooled motor, vibration isolators, thermal
overloads, automatic reset high pressure

- 2.5 COMPRESSORS (Cont'd) .2 (Cont'd)
switch with lockout after three failures, rotalock service valves, pump down low pressure transducer, suction line strainer, and a maximum operating speed of 3500 RPM. Consult factory for 575V availability.
- .3 Provide a liquid line solenoid valve for pump down control.
- .4 Provide a crankcase heater for additional system protection from refrigerant migration during off cycles.
- 2.6 COOLING COIL .1 Direct expansion.
- .2 A-Frame or V-frame design with offset orientation to ensure proper condensate drainage.
- .3 Constructed of copper tubes and aluminum fins and have maximum face velocity of 2.3 m per second at rated airflow.
- .4 Refrigerant of each system distributed throughout the entire coil face area.
- .5 A stainless steel condensate drain pan designed to avoid any standing water, to be easily cleaned or removable for cleaning.
- 2.7 REFRIGERANT .1 R-407C refrigerant, which meets the EPA clean air act for phase-out of HCFC refrigerants.
- 2.8 ELECTRIC REHEAT COIL .1 Low watt density, 304/304 stainless steel fin tubular construction, protected by thermal safety switches, controlled in three stages.
- .2 Removable from the front of the cabinet.
- 2.9 HUMIDIFIER .1 Infrared type consisting of high intensity quartz lamps mounted above and out of the water supply.
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|----------------------------|----|--|
| 2.9 HUMIDIFIER
(Cont'd) | .2 | Stainless steel evaporator pan arranged to be serviceable without disconnecting high voltage electrical connections. Removable from the front of the unit. |
| | .3 | Pre-piped ready for final connection. |
| | .4 | Use bypass air to prevent over-humidification of the computer room. |
| | .5 | Equipped with an automatic water supply system. Factory provided air-gap to prevent backflow of humidifier supply water. |
| | .6 | Adjustable water-overfeed to prevent mineral precipitation. |
| | .7 | High water detector to shut down humidifier to prevent overflowing. |
| 2.10 CONDENSER | .1 | Condenser to consist of microchannel condenser coil(s), propeller fan(s) direct-driven by individual fan motor(s), electrical controls, housing and mounting legs. Air-cooled condenser will provide positive refrigerant head pressure control to the Precision Cooling indoor unit by adjusting heat rejection capacity. Microchannel coils will provide superior heat transfer, reduce air-side pressure drop, increase energy efficiency and significantly reduce the system refrigerant volume required. EC fans and fan operating techniques to provide reduced maximum sound levels. Make various methods available to match indoor unit type, maximum outdoor design ambient and maximum sound requirements. |
| | .2 | Microchannel coils will be constructed of aluminum microchannel tubes, fins and manifolds. Tubes to be flat and contain multiple, parallel flow microchannels and span between aluminum headers. Full-depth louvered aluminum fins to fill spaces between the tubes. Tubes, fins and aluminum headers to be oven brazed to form a complete refrigerant-to-air heat exchanger coil. Copper stub pipes must be electric resistance welded to aluminum coils and joints protected with polyolefin to seal joints from corrosive environmental elements. Coil assemblies shall |

2.10 CONDENSER
(Cont'd)

- .2 (Cont'd)
be factory leak-tested at a minimum of 300 psig (2068kPag). Hot gas and liquid lines to be copper and brazed using nitrogen gas flow to the stub pipes with spun closed ends for customer piping connections. Complete coil/piping assembly will be then filled and sealed with an inert gas holding charge for shipment. E-coat provides a flexible epoxy coating to all coil surface areas without material bridging between fins. E-coat increases coil corrosion protection and reduces heat rejection capacity degradation to less than 10% after a severe 2000 hour 5% neutral salt spray test (ref. ASTM B117). The coating process accomplishes complete coil encapsulation. Color will be black.
- .3 Fan motor/blade assembly to have an external rotor motor, fan blades and fan/finger guard. Fan blades will be constructed of cast aluminum or glass-reinforced polymeric material. Fan guards to be heavy gauge, close meshed steel wire, coated with a black corrosion resistant finish. Locate fan terminal blocks in an IP54 enclosure located on the top of the fan motor. Fan assemblies will be factory-balanced, tested before shipment and mounted securely to the condenser structure. EC Fan motors will be electronically commutated for variable speed operation and have ball bearings. EC fans will provide internal overload protection through built-in electronics. Each EC fan motor must have a built-in controller and communication module, linked via RS485 communication wire to each fan and the Premium Control Board, allowing each fan to receive and respond to precise fan speed inputs from the Premium Control Board.
- .4 Provide electrical controls and service connection terminals and factory wire inside the attached control panel section. A locking disconnect switch will be factory-mounted and wired to the electrical panel and controlled via an externally mounted locking and lockable door handle. Provide high-voltage supply wiring and low voltage indoor unit communication/interlock wiring. The EC Fan/Premium Control System includes an electronic control board, EC fan motor(s) with internal overload protection, refrigerant and

- 2.10 CONDENSER
(Cont'd)
- .4 (Cont'd)
ambient temperature thermistors and refrigerant pressure transducers. The control board receives an indoor unit run signal via field-supplied low voltage interlock wires to the compressor side switch, via field-supplied CANbus communication wires from the indoor unit's control board (future feature) or via both. The control board uses sensor and communication inputs to maintain refrigerant pressure by controlling each EC fan on the same refrigerant circuit to the same speed.
- .5 The condenser cabinet will be constructed of bright aluminum sheet and divided into individual fan sections by full width baffles. Internal structural support members, including coil support frame, will be galvanized steel for strength and corrosion resistance. Provide panel doors on two (2) sides of each coil/fan section to permit coil cleaning. An electrical panel will be contained inside a factory mounted, NEMA 3R weatherproof electrical enclosure.
- .6 Condensers will be shipped with mounting legs with stabilization bracing. Legs, bracing and hardware shall be galvanized steel. Height in accordance with schedule.
- .7 Receiver Kit contains an insulated, heated receiver tank with sight glasses, mounting plate, mounting hardware, pressure relief valve, rotalock valve for refrigerant charge isolation and piping assembly with head pressure operated 3-way valve and check valve. Field assemble components to the condenser. The three (3)-way valve will sense refrigerant head pressure and adjust the flooding charge in the condenser coil to adjust the condenser heat rejection capacity. Heater to be 300W, include an integral thermostat to maintain refrigerant temperature at a minimum of 85°F (29°C) and require a separate power supply of 120-1-60 volt. Kit to function with MC variable speed fan motors and electronic controls that lower fan speed in lower outdoor ambient temperatures for maximum energy efficiency. System to allow system startup and positive head pressure control with ambient temperatures as low as -30°F (-34.4°C).

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- 2.11 DISCONNECT SWITCH (LOCKING TYPE)
- .1 Indoor unit:
 - .1 Manual disconnect switch mounted in the high voltage section of the electric panel.
 - .2 Accessible from the outside of the unit with the door closed, and prevent access to the high voltage electrical components until switched to the "OFF" position.
 - .2 Outdoor condensing unit:
 - .1 Manual disconnect switch mounted in the high voltage section of the electric panel.
- 2.12 MICRO-PROCESSOR CONTROL WITH LARGE GRAPHIC DISPLAY
- .1 Factory-set for Intelligent Control which uses "fuzzy logic" and "expert systems" methods. Proportional and Tunable PID will also be user selectable options. Internal unit component control include the following:
 - .1 Compressor Short Cycle Control - Prevents compressor short-cycling and needless compressor wear.
 - .2 System Auto Restart - The auto restart feature will automatically restart the system after a power failure. Time delay is programmable.
 - .3 Sequential Load Activation - On initial startup or restart after power failure, each operational load is sequenced with a minimum of one second delay to minimize total inrush current.
 - .4 Predictive Humidity Control - calculates the moisture content in the room and prevents unnecessary humidification and dehumidification cycles by responding to changes in dew point temperature.
 - .2 320 x 240 dot matrix graphic front monitor display and control keys for user inputs mounted in an ergonomic, aesthetically pleasing housing.
 - .1 The display & housing viewable while the unit panels are open or closed.
 - .2 Menu driven.
 - .3 Organized into three main sections:
 - .1 User Menus for: active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts.
-

2.12 MICRO-
PROCESSOR CONTROL
WITH LARGE GRAPHIC
DISPLAY
(Cont'd)

- .2 (Cont'd)
 - .3 (Cont'd)
 - .2 Service Menus: Password required to make system changes. Setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode.
 - .3 Advanced Menus: Password required to access the advance menus which include the factory settings and password menus.
 - .3 User Menus as follows:
 - .1 Active Alarms: Hold the 200 most recent alarms with time and date stamp for each alarm in unit memory.
 - .2 Event Log: hold the 400 most recent events with id number, time and date stamp for each event in unit memory.
 - .3 Graphic Data View: Eight graphic records: return air temperature, return air humidity, supply air temperature, outdoor temperature and four custom graphs.
 - .4 Unit View - Status Overview: Simple or Graphical "Unit View" summary displays include temperature and humidity values, active functions (and percent of operation) and any alarms of the host unit.
 - .5 Total Run Hours: Display accumulative component operating hours for major components including compressors, fan motor, humidifier and reheat.
 - .6 Various Sensors: Allow setup and display of custom sensors. Control to include four (4) customer accessible analog inputs for sensors provided by others. The analog inputs accept a 4 to 20 mA signal. The user must be able to change the input to 0 to 5VDC or 0 to 10VDC if desired. The gains for each analog input programmable from the front display. The analog inputs able to be monitored from the front display.
 - .7 Display Setup: English display languages
 - .8 Service Contacts: Display of local service contact name and phone number.
- .4 Service Menus as follows:
 - .1 Setpoints: menu to allow setpoints within the following ranges:
 - .1 Temperature Setpoint 65-85°F (18-29C)

2.12 MICRO-
PROCESSOR CONTROL
WITH LARGE GRAPHIC
DISPLAY
(Cont'd)

- .4 Service Menus as follows:(Cont'd)
 - .1 Setpoints:(Cont'd)
 - .2 Temperature Sensitivity +1-10°F (0.6-5.6°C)
 - .3 Humidity Setpoint 20-80% RH*
 - .4 Humidity Sensitivity 1-30% RH
 - .5 High Temperature Alarm 35-90°F (2 - 32°C)
 - .6 Low Temperature Alarm 35-90°F (2 - 32°C)
 - .7 High Humidity Alarm 15-85% RH
 - .8 Low Humidity Alarm 15-85% RH
 - .2 Standby Settings/Lead-Lag: Allow planned rotation or emergency rotation of operating and standby units.
 - .3 Timers/Sleep Mode: Allow various customer settings for turning on/off unit.
 - .4 Alarm Setup: Menu shall allow customer settings for alarm notification (audible/local/remote). The following alarms shall be available:
 - .1 High Temperature
 - .2 Low Temperature
 - .3 High Humidity
 - .4 Low Humidity
 - .5 Compressor Overload
 - .6 Main Fan Overload
 - .7 Humidifier Problem
 - .8 High Head Pressure
 - .9 Change Filter
 - .10 Fan Failure
 - .11 Low Suction Pressure
 - .12 Unit Off
 - .5 Audible Alarm: annunciate any alarm that is enabled by the operator.
 - .6 Programmable Common Alarm: Provided to Interface user selected alarms with a remote alarm device.
 - .7 Remote Monitoring: alarms to communicate to the monitoring system with the following information: Date and time of occurrence, unit number and present temperature and humidity.
 - .8 Sensor Calibration: Allow unit sensors to be calibrated with external sensors.
 - .9 Maintenance/Wellness Settings: Allow reporting of potential component problems before they occur.
 - .10 Options Setup: Provide operation settings for the installed components.
 - .11 System/Network Setup: Allow Unit-to-Unit (U2U) communication and setup for teamwork modes of operation (up to 32 units).

2.12 MICRO-
PROCESSOR CONTROL
WITH LARGE GRAPHIC
DISPLAY
(Cont'd)

- .4 Service Menus as follows:(Cont'd)
 - .12 Teamwork Modes of Operation: Saves energy by preventing operation of units in opposite modes multiple units.
 - .13 Auxiliary Boards: Allow setup of optional expansion boards.
 - .14 Diagnostics/Service Mode: Provided with self-diagnostics to aid in troubleshooting. Diagnosed and reported as pass/not pass. Control inputs indicated as on or off at the front display. Control outputs able to be turned on or off from the front display without using jumpers or a service terminal. Each control output indicated by an LED on a circuit board.
- .5 Advanced Menus as follows:
 - .1 Factory Settings: Configuration settings factory-set based on the pre-defined component operation.
 - .2 Change Passwords: Allow new passwords to be set or changed.
- .6 System View - Status Overview: "System View" to display a summary of operation for the total number of operating units within a Unit-to-Unit (U2U) configuration.
- .7 Spare Parts List: menu to include a list of critical spare parts, their quantity and part numbers.
- .8 Unit Diary: menu to include a free field area within the unit memory where unit history may be stored for reference.
- .9 One network switch required to connect all new units to existing wall mounted microprocessor.

2.13 REMOTE
COMMUNICATION

- .1 Remote monitoring of alarms and operation of each AC unit.
- .2 Provision for e-mail alert and auto dialer to notify personnel of alarm.
- .3 Provision to access unit(s) status from a remote location.

- | | | |
|--|----|---|
| 2.13 REMOTE
COMMUNICATION
(Cont'd) | .4 | Components |
| | .1 | "Webcards" as required in the AC units. |
| | .2 | Software are required. A license version is required to monitor multiple units. |
| | .5 | SNMP based and alarms can trigger e-mail alerts or a external script with a model can do auto dialer "pager" alarm. |
| | .6 | Remote access by entering the equipment IP address over the internet. |
| | .1 | IP address for each AC unit. |
| | .2 | Password protected. |

PART 3 - EXECUTION

- | | | |
|------------------------------|----|---|
| 3.1 GENERAL | .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. |
| 3.2 FIELD
QUALITY CONTROL | .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. |
-

- 3.3 EQUIPMENT
PREPARATION AND
START-UP
-
- .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 train ed mechanics.
 - .3 In the presence of and in cooperation with the RA/C unit manufacturer's representative, start-up the RA/C uni, 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:
 - .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

- 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

<u>2.1 GENERAL</u>	.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.
	.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

- 3.1 INSTALLATION
- .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 RELATED SECTIONS</u> | .1 | Section 01 33 00 Submittal Procedures. |
| <u>1.2 REFERENCES</u> | .1 | American National Standards Institute (ANSI)/
National Fire Protection Association (NFPA)
.1 ANSI/NFPA 96-2011, Standard for
Ventilation Control and Fire Protection of
Commercial Cooking Operations. |
| | .2 | American Society for Testing and Materials
(ASTM)
.1 ASTM E90-09, Method for Laboratory
Measurement of Airborne Sound Transmission
Loss of Building Partitions and Elements. |
| | .3 | Sheet Metal and Air Conditioning Contractors'
National Association (SMACNA) |
| | .4 | Society of Automotive Engineers (SAE) |
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with
Section 01 33 00 Submittal Procedures. |
| | .2 | Indicate the following:
.1 Pressure drop.
.2 Face area.
.3 Free area.
.4 Dimensions. |
| <u>1.4 TEST REPORTS</u> | .1 | Submit certified data from independent
laboratory substantiating acoustic and
aerodynamic performance to ASTM E90. |
| <u>1.5 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 |

PART 2 - PRODUCTS

2.1 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS	.1	Factory manufactured aluminum hinged at curb line.
	.1	Complete with integral birdscreen of 2.7 mm diam 12 mm mesh aluminum wire.
	.2	Vertical or horizontal backdraft dampers on four faces.
	.3	Maximum throat velocity: 3.3 m/s intake.
	.4	Maximum loss through unit: 15 Pa exhaust static pressure.
	.5	Maximum velocity through damper area: 1.5 m/s.
	.6	Shape: as indicated.
2.2 FIXED LOUVRES - ALUMINUM	.1	Construction: welded with exposed joints ground flush and smooth.
	.2	Material: extruded aluminum alloy 6063T5.
	.3	Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500mm. Drainable blades.
	.4	Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit. Flanged frame or flush frame as indicated.
	.5	Mullions: at 1500 mm maximum centres.
	.6	Fastenings: stainless steel with nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
	.7	Screen: 12 mm on exhaust and intake mesh, 2 mm diam wire aluminum birdscreen on inside face of louvres in formed Uframe.
	.8	Finish: factory applied enamel, or anodized as indicated. Colour: to Departmental Representative's approval.

PART 3 - EXECUTION

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

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Submittal Procedures: Section 01 33 00
	.2	Construction/Demolition Waste Management and Disposal: Section 01 74 21
	.3	Closeout Submittals: Section 01 78 00
	.4	General Commissioning (Cx) Requirements: Section 01 91 13
<u>1.2 REFERENCES</u>	.1	Canadian Standards Association, (CSA International)
	.2	National Fire Protection Association (NFPA) .1 NFPA 96-2014, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
	.3	Underwriter's Laboratories of Canada (ULC)
<u>1.3 SHOP DRAWINGS</u>	.1	Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Indicate following: dimensions, capacities, hanging methods, installation procedures.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.1	Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
<u>1.5 CERTIFICATION OF RATINGS</u>	.1	Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards.

1.6 EXTRA MATERIALS .1 Provide one complete set of filters for each filter unit or filter bank in accordance with Section 01 78 00 - Closeout Submittals.

1.7 WASTE MANAGEMENT AND DISPOSAL .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of corrugated cardboard, polystyrene, plastic, packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 - PRODUCTS

2.1 RANGE HOOD - DOMESTIC .1 Complete system including:

.1 750 or 900 mm hood as indicated.

.2 Lifetime washable aluminum filter.

.3 Light unit with bulb.

.4 Centrifugal, twin blower and two speed motor.

.5 Fan and light switches.

.6 Colored to be selected by Departmental Representative.

.2 Roof or wall outlet complete with backdraft damper as indicated.

.3 Capacity: see schedule on drawings.

.4 Noise rating:

.1 vertical discharge max 6 sones.

.2 horizontal discharge max 7 sones.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install hoods in accordance with manufacturer's instructions.
 - .2 Install filter/filter media prior to acceptance.

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Submittal Procedures: Section 01 33 00
	.2	Waste Management and Disposal: Section 01 74 21
	.3	Refrigerant Piping: Section 23 23 00
	.4	HVAC Controls: Field Installation: Section 25 05 60
	.5	HVAC Controls: Field Control Devices: Section 25 30 02
<u>1.2 REFERENCES</u>	.1	Air-Conditioning and Refrigeration Institute (ARI)
	.1	ARI 210/240-2008, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.
	.2	ARI 325-98, Standard for Ground Water - Source Heat Pumps.
	.2	American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
	.1	ANSI/ARI 320-98, Standard for Water-Source Heat Pumps.
	.3	American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
	.1	ANSI/NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.
	.4	American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
	.1	ASHRAE Standard 15-2010, Safety Standard for Refrigeration Systems.
	.5	Canadian Standards Association (CSA International)
	.1	CAN/CSA-C13256-2-01 (R2010), Performance of Ground and Water Source Heat Pumps.
	.2	CAN/CSA-C656-05(R2010), Performance Standard for Single Package Central Air Conditioners and Heat Pumps.

1.2 REFERENCES (Cont'd)	.6	Environment Canada, (EC)/Environmental Protection Services (EPS) .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems. .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.
1.3 SHOP DRAWINGS AND PRODUCT DATA	.1	Submit shop drawings in accordance with Sections 01 33 00.
	.2	Indicate: .1 Capacities. .2 ARI Ratings. .3 Sound Power levels. .4 Installation instructions. .5 Start-up Instructions. .6 O&M, Instructions.
1.4 WASTE MANAGEMENT AND DISPOSAL	.1	Separate and recycle waste materials in accordance with Section 01 74 21.
	.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.
	.4	Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
1.5 WARRANTY	.1	For heat pumps, the 12 months warranty period but compressors warranty is extended to six (6) years.

PART 2 - PRODUCTS

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| <u>2.1 GENERAL</u> | .1 | Heat pumps/AC units: CSA approved and carry ARI or CSA certification seal. |
| | .2 | Provide any additional accessories and controls required for a complete working system as indicated on drawings. |
| <u>2.2 REFRIGERANTS</u> | .1 | Type of Refrigerant: R410A. |
| <u>2.3 DRAIN PANS</u> | .1 | Design and construct condensate drain pans under indoor coils so that no water can accumulate and install to allow for easy cleaning. |
| | .2 | Include condensate pumps as required. |
| <u>2.4 AIR-SOURCE
HEAT PUMP/AC</u> | .1 | As per schedules. |
| <u>2.5 CENTRAL
CONTROLLER</u> | .1 | Wall-mounted touch screen LCD controller, capable of controlling all indoor units and outdoor units from one central location. |
| | .2 | Capable of controlling external devices such as fans, pumps, HRVs, etc. |
| | .3 | Capable of providing occupied/unoccupied schedules to indoor units and external devices. |
| <u>2.6 ZONE
CONTROLLERS</u> | .1 | As indicated on drawings and Section 25 30 02. |

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated and in accordance with manufacturer's instructions.
- .2 Install outdoor units in accordance with manufacturer's instructions.
- .3 Secure with hold-down bolts.
- .4 Make duct connections through flexible connections.
- .5 Level unit with fans running. Align ductwork. flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.
- .6 Make piping connections.
- .7 Nothing to obstruct ready access to components or to prevent removal of components for servicing.
- .8 System installer is to provide complete controls for this system as specified in this Section and Division 25.

3.2 DRAIN PANS

- .1 Install so that no water can accumulate and arrange for easy access for cleaning.

3.3 CONTROLS

- .1 Provide wiring and programming as required for a complete working system.
 - .2 Central controller to work with local zone controllers as indicated on controls drawings to provide full control to the heat pump system, as well as auxiliary electric heaters.
 - .3 Central controller to provide control to auxiliary equipment (fans, pumps, HRVs, etc.) as indicated on controls drawings.
 - .4 Field installation in accordance with 25 05 60.
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| 3.4 <u>START-UP AND COMMISSIONING</u> | .1 | Manufacturer to certify installation and performance. Submit written report to Departmental Representative. |
| | .2 | Demonstrate to Departmental Representative operation of system, including sequences of operation, startup, shutdown, schedules, etc. |
| | .3 | Allow one (1) day on site to demonstrate system to Departmental Representative. |
| | .4 | As per 01 91 13 |
| 3.5 <u>TRAINING</u> | .1 | Provide one (1) day of training to pertinent building staff in operation, maintenance, safety requirements of installed system. |
| | .2 | Provide training summary and signed attendance sheet to Departmental Representative. |
| | .3 | As per 01 91 13 |
| 3.6 <u>MAINTENANCE SERVICE DURING WARRANTY PERIOD</u> | .1 | Provide services, materials, and equipment to maintain HVAC controls system for warranty period of one (1) year after date of substantial completion. Provide detailed preventative maintenance schedule for system components as described in Submittal article. |
| | .2 | Emergency Service Calls: <ul style="list-style-type: none"> .1 Initiate service calls when controls system is not functioning correctly. .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost. .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time. .4 Service personnel to be on site ready to service system after receiving request for service. .5 Perform work continuously until system restored to reliable operating condition. |
| | .3 | Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of system based on |

- 3.6 MAINTENANCE .3 Operation:(Cont'd)
SERVICE DURING original design conditions and as recommended
WARRANTY PERIOD by manufacturer.
(Cont'd)
- .4 Work requests: record each service call
request, when received separately on approved
form and include:
- .1 Serial number identifying component
involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
- .1 No system modification, including
operating parameters and control settings, to
be made without prior written approval of
Departmental Representative.