PART 1 - GENERAL

1.1 RELATED WORK

.1 Commissioning: Section 01 91 13

.2 Waste Management and Disposal: Section 01 74 21

.3 Mechanical General Requirements: Section 21 05 01

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Collect, separate and recycle all site generated waste materials in accordance with Section 01 74 21.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 50 00 - Temporary Facilities

1.2 USE OF SYSTEMS

.1 Use of new and/or existing permanent heating and/or ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:

.1 Entire system is complete, pressure tested, cleaned, flushed out.

.2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.

.3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dustproducing processes.

.4 There is no possibility of damage from any cause.

.5 Supply ventilation systems are protected by 60 % filters, which shall be inspected daily, changed every week or more frequently as required.

.6 Return systems have approved filters over all openings, inlets, outlets.

.7 All systems will be:

.1 operated as per manufacturer's recommendations or instructions.

.2 operated by Contractor.

.3 monitored continuously by Contractor.

.8 Warranties and guarantees are not thereby relaxed.

.9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.

.10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as new" condition, filters in air systems replaced.

.2 Filters referred to herein are over and above those specified elsewhere in this specification.

.3 Exhaust systems are not included in any approvals for temporary heating ventilation.

PART 2 - PRODUCTS Not applicable.

PART 3 - EXECUTION Not applicable.

PART 1 - GENERAL

1.1 RELATED WORK

.1 Firestopping: Section 07 84 00

.2 Cleaning and Startup of Mechanical Systems: Section 23 08 02

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB1.181-99, Organic Zinc-Rich Coating.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

.4 Maintain all minimum clearances required by the NEC.

.5 Minimum 750mm in front of VAV terminal units.

.6 Maintain equipment and valves a maximum of 900mm above ceilings.

3.2 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: NPS 3/4 ball valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

.1 Install manual air vents at high points in piping systems in areas within accessible mechanical spaces.

.2 Install automatic air vent with isolating valve at each high point in finished areas.

.3 Install drain piping on manual air vents to floor drain and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS DRAIN TO GLYCOL TANKS FOR GLYCOL SYSTEM

.1 General: Compatible with system, to suit pressure rating of system.

.2 Locations: Where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions.

.4 Over NPS 2: Isolating flanges.

3.6 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.

3.6 PIPEWORK INSTALLATION (Cont'd)

.6 Install piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion.

.14 Valves:
.1 Install in accessible locations.
.2 Remove interior parts before soldering.
.3 Install with stems above horizontal position unless otherwise indicated.
.4 Valves accessible for maintenance without removing adjacent piping.
.5 Install globe valves in bypass around control valves.
.6 Use ball or butterfly valves at branch takeoffs for isolating purposes except where otherwise specified.
.7 Install butterfly valves on chilled water and related condenser water systems only.
.8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
.9 Install plug cocks or ball valves for glycol service.
.10 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

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

.16 Install pipe straight and parallel to building lines.

3.7 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, dry-wall partitions and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe (sheet metal acceptable for non-rated dry wall partitions).

.3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.

.5 Installation:
.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
.2 Other floors: Terminate 25 mm above finished floor.
.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB- 1.181.
.4 All mechanical room walls and wet areas above ground slab.

.6 Sealing:
.1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
.4 Ensure no contact between copper pipe or tube and sleeve.

3.8 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.

3.9 PREPARATION FOR FIRESTOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00.

3.9 PREPARATION FOR FIRESTOPPING (Cont'd)

.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: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance with Section 23 08 02.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 23 08 02 supplemented as specified in relevant sections of Division 21, 22 & 23.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT

.1 Advise the Departmental Representative 72 hours minimum prior to performance of pressure tests.

.2 Pipework: pressure test all 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 Submit tests results to Departmental Representative.

.6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after review of tests by Departmental Representative.

3.12 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Departmental Representative.

.2 Request written approval ten (10) days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

.4 Ensure daily clean-up of existing areas.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Cleaning: Section 01 74 11

1.2 REFERENCES

.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).

1.3 SECTION INCLUDES

.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.

1.4 SHOP DRAWINGS

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

1.5 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 33 00.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Motors to be inverter duty rated premium efficiency, in accordance with local utility company standards and the requirements of ASHRAE 90.1.

2.2 MOTORS

.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, built-in 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.

.5 Provide ECM motors where specified.

2.3 TEMPORARY MOTORS

.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.

2.4 BELT DRIVES

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

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

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

2.4 BELT DRIVES (Cont'd)

.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 set of spare belts for each set installed in accordance with Section 21 05 01 - Mechanical General Requirements.

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 diameter holes on both shaft centres for insertion of tachometer.
.4 Removable 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.

.6 Unprotected fan inlets or outlets:
.1 Wire or expanded metal screen, galvanized, 19 mm mesh.
.2 Net free area of guard: not less than 80% of fan openings.
.3 Securely fasten in place.
.4 Removable for servicing.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Fasten securely in place.

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

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.2 Upon completion and verification of performance of installation, remove surplus.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 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.

1.3 MAINTENANCE DATA

.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

2.1 ANCHORS AND GUIDES

.1 Anchors:
.1 Provide as indicated/required.
.2 Structural steel members secured to building structure.

.2 Alignment guides:
.1 Provide as indicated to accommodate specified thickness of insulation.
.2 Carbon steel bolted spider and outer housing.
.3 Copper plated spider for copper piping.

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.

2.2 FLEXIBLE CONNECTIONS (Cont'd)

.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.

END

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Mechanical General Requirements: Section 22 05 00

1.2 REFERENCES

.1 ASME B31.1-2012, Power Piping.

.2 ANSI/ASME Boiler and Pressure Vessel Code-2010:
- .1 Section 1: Rules of Construction Power Boilers.
- .2 Section V: Nondestructive Examination.
- .3 Section IX: Welding and Brazing Qualifications.

.3 CSA W47.2-2011, Certification of Companies for Fusion Welding of Aluminum.

.4 CSA W48-06(R2011), Filler Metals and Allied Materials for Metal Arc Welding.

.5 CSA B51-09, Boiler, Pressure Vessel and Pressure Piping Code Supplement.

.6 CAN/CSA-W117.2-06(R2011), Safety in Welding, Cutting and Allied Processes.

.7 CSA W178.1-08, Certification of Welding Inspection Organizations.

.8 CSA W178.2-08, Certification of Welding Inspectors.

.9 ANSI/AWS B2.1-B2.1M-2012, Welding Procedures and Performance Qualifications.

.10 AWS C1.1-2000(R2012), Recommended Practices for Resistance Welding.

.11 ANSI/AWWA C206-2011, Field Welding of Steel Water Pipe.

.12 ASME B31.9-2011, Building Services Piping.

1.3 WELDERS QUALIFICATIONS

.1 Welding qualifications to be in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure to be performed from authority having jurisdiction.

1.3 WELDERS QUALIFICATIONS (Cont'd)

.3 Furnish welder's qualifications to Departmental Representative.

.4 Each welder to possess identification stamp issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminum to be in accordance with CSA W47.2.

1.4 INSPECTORS' QUALIFICATIONS

.1 Inspectors to be qualified to CSA W178.2.

1.5 WELDING PROCEDURES

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures to be available for inspection at all times.

.3 Safety in welding, cutting and allied processes to be in accordance with CAN/CSA-W117.2.

PART 2 - PRODUCTS

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

PART 3 - EXECUTION

3.1 WORKMANSHIP

.1 Welding to be in accordance with ANSI/ASME B31.1, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B2.1, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

3.2 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification stamp.

.2 Backing rings:
.1 Where used, fit to minimize gaps between ring and pipe bore.
.2 Do not install at orifice flanges.

3.2 INSTALLATION REQUIREMENTS (Cont'd)

.3 Fittings:
.1 NPS 2 and smaller: install welding type sockets.
.2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review all weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before any work is started.

.2 Formulate "Inspection and Test Plan" in association with Departmental Representative.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for visual inspection of all welds during early stages of welding procedures in accordance with AWS W1. Repair or replace all defects as required by codes and as specified herein.

3.4 EXAMINATIONS AND TESTS

.1 General:
.1 Perform examinations and tests by tradesmen qualified in accordance with CSA W178.1 and CSA W178.2 and approved by the Departmental Representative.
.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
.3 Inspect and test all welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.

.2 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.3 Failure of visual examinations:
.1 Upon failure of any weld by visual and/or hydrostatic examination, perform additional testing as directed by Departmental Representative.

.4 Hydrostatically test all welds to requirements of ANSI/ASME B31.1.

3.5 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

3.6 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at the Contractor's expense.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Mechanical General Requirements: Section 21 05 01

1.2 REFERENCES

.1 ASME B40.1-2005, Pressure Gauges and Gauge Attachments.

.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.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

.2 Submit manufacturer's product data for following items:
- .1 Thermometers.
- .2 Pressure gauges.
- .3 Stop cocks.
- .4 Wells.
- .5 Snubbers.

1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Thermometers and pressure gauges to operate at mid point of scale or range.

2.2 DIRECT READING THERMOMETERS

.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.
- .1 Acceptable Material: Trerice BX9; Weiss; Taylor; Baker; Winter's.

2.3 REMOTE READING HERMOMETERS

.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.
.1 Acceptable Material: Trerice M80341; Weiss; Taylor; Baker; Winter's.

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.
.1 Acceptable Material: Trerice 620B series; Weiss; Taylor, Baker; Winter's.

.2 Provide mini ball valve and:
.1 Snubber for pulsating operation.
.2 Diaphragm for corrosive service.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Provide engraved lamicoid nameplates as specified in Section 23 05 53, identifying medium.

.3 Locate between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on all piping. Provide heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:
.1 Water heating coils.
.2 3-way mixing valves.
.3 Heat exchangers supply and return piping.

3.2 THERMOMETERS (Cont'd)

.2 (Cont'd)
.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.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Health and Safety Requirements: Section 01 35 29

.2 Construction/Demolition Waste Management and Disposal: Section 01 74 21

.3 Closeout Submittals: Section 01 78 00

.4 Installation of Pipework: Section 23 05 05

1.2 REFERENCES

.1 Codes and standards referenced in this section refer to the latest edition thereof.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
.1 ANSI/ASME B1.20.1-06, Pipe Threads, General Purpose (Inch.)
.2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings

.3 American Society of Testing and Materials (ASTM(
.1 ASTM A276-10, Specification for Stainless Steel Bars and Shapes.
.2 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.
.3 ASTM B283-10, Specification for Copper and Copper Alloy Die Forgings (Hot Pressed)
.4 ASTM B505/B505M-10, 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-80-2008, Bronze Gate, Globe, Angle and Check Valves.
.3 MSS SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.
.1 Submit shop drawings and product data in accordance with Section 01 33 00.

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.

1.4 QUALITY ASSURANCE

.1 Health and Safety
.1 Do construction occupational health and safety in accordance with Section 01 35 29.

1.5 DELIVERY, STORAGE AND DISPOSAL

.1 Waste Management and Disposal
.1 Separate and recycle waste materials in accordance with Section 01 74 21.
.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.

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.

2.1 MATERIALS (Cont'd)

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

2.2 GATE VALVES

.1 Requirements common to all gate valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Bonnet: with hex. shoulders.
.3 Connections: with hex. shoulders.
.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
.5 Packing: high grade non- asbestos packing.
.6 Handwheel: non-ferrous.
.7 Handwheel Nut: bronze to ASTM B62.
.8 Glass 125, WP=860 kPa steam, 1.4 mPa WOG
.9 Class 150 WP=1.03 mPa steam, 2.07 mPa WOG.

.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125:
.1 Body: with long disc guides, screwed bonnet with stem retaining nut.
.2 Operator: Handwheel

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

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

.5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
.1 Body: with long disc guides, screwed bonnet.
.2 Operator: Handwheel

.6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
.1 Body: with long disc guides, screwed bonnet.
.2 Operator: Handwheel

2.3 GLOBE VALVES

.1 Requirements common to all globe valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Bonnet: union with hex. shoulders.
.3 Connections: screwed with hex. shoulders.
.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
.5 Packing: non-asbestos.
.6 Handwheel: non-ferrous.
.7 Handwheel Nut: bronze to ASTM B62.
.8 Glass 125, WP=860 kPa steam, 1.4 mPa WOG

.2 NPS 2 and under, composition disc, Class125:
.1 Body and bonnet: screwed bonnet.
.2 Disc and seat: renewable rotating PTFE disc regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
.3 Operator: Handwheel.

.3 NPS 2 and under, composition disc, Class 150:
.1 Body and bonnet: union bonnet.
.2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
.3 Operator: Handwheel

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

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

2.4 CHECK VALVES

.1 Requirements common to all check valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Connections: with hex agonal shoulders.
.3 Glass 125, WP=860 kPa steam, 1.4 mPa WOG
.4 Class 150 WP=1.03 mPa steam, 2.07 mPa WOG
.5 Class 200 1.4 mPa CWP

2.4 CHECK VALVES (Cont'd)

.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.

.5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
.1 Body: with integral seat, union bonnet ring with hex. shoulders, cap.
.2 Disc: renewable PTFE for steam, #6 composition rotating disc for water, oil or gas service in disc holder having guides top and bottom, of bronze to ASTM B62.

.6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
.1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

2.5 SILENT CHECK VALVES

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

2.6 BALL VALVES

.1 NPS 2 and under:
.1 Body and cap: cast high tensile bronze to ASTM B62.
.2 Pressure rating: Class 125, 860 MPa steam.
.3 Connections: Screwed ends to ANSI B1.20.1 and with hex. shoulders.

2.6 BALL VALVES (Cont'd)

.1 (Cont'd)
.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.

2.7 ACCEPTABLE PRODUCT

.1 Acceptable Product: Jenkins, Crane, Watts, Wilkins, Newman Hattersley, Milwaukee, Conbraco, Kitz, Red White, M.A. Stewart, Nibco.

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 noticeable markers on ceiling systems for all equipment located above ceiling tiles.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Health and Safety Requirements: Section 01 35 29

.3 Construction/Demolition Waste Management Disposal: Section 01 74 21

.4 Closeout Submittals: Section 01 78 00

.5 Installation of Pipework: Section 23 05 05

.6 Valves - Bronze: Section 23 05 23

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-2010, 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-70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends.
.2 MSS SP-71-2011, Grey Iron Swing Check Valves, Flanged and Threaded Ends
.3 MSS SP-85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.
.1 Submit shop drawings and product data in accordance with Section 01 33 00.
.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.

1.4 QUALITY ASSURANCE

.1 Health and Safety
.1 Do construction occupational health and safety in accordance with Section 01 35 29.

1.5 DELIVERY, STORAGE AND DISPOSAL

.1 Waste Management and Disposal:
.1 Separate and recycle waste materials in accordance with Section 01 74 21.
.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.

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 Bonnet gasket: non-asbestos.
.4 Stem: to have precision- machined Acme or 60V threads, top screwed for handwheel nut.
.5 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
.6 Gland packing: non-asbestos.
.7 Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
.8 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.

.6 Acceptable Product: Crane, Jenkins, Milwaukee, Newman Hattersley, Kitz, M.A. Stewart, NIBCO, Watts, Wilkins.

2.2 GATE VALVES

.1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze or iron trim, solid wedge disc:
.1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
.2 Bronze Trim:
.1 Disc: Solid offset taper wedge, bronze to ASTM B62.
.2 Seat rings: renewable bronze to ASTM B62, screwed into body.
.3 Stem: bronze to ASTM B62.

2.2 GATE VALVES (Cont'd)

.1 (Cont'd)
.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.
.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.

2.2 GATE VALVES (Cont'd)

.3 (Cont'd)
.3 Iron Trim:(Cont'd)
.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).
.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.

2.3 UNDERWRITERS APPROVED GATE VALVE (Cont'd)

.1 (Cont'd)
.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 2 1/2 - 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. Pressure rating to match main valve.
.2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23. Pressure rating to match main valve.

2.6 VALVE OPERATORS

.1 Install valve operators as follows:
.1 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:
- .1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
- .2 Flanged ends: 2 mm raised face with serrated finish.
- .3 Rating: 1.7 mPa steam; 3.4 mPa CWP.
- .4 Disc: Rotating for extended life.
  - .1 Up to NPS 3: bronze to ASTM B61.
  - .2 NPS 4 - 8: Iron faced with ASTM B61 bronze.
- .5 Seat rings: renewable bronze to ASTM B61, screwed into body.
- .6 Hinge pin, bushings: renewable, bronze to ASTM B61.
- .7 Hinge: galvanized malleable iron.
- .8 Identification tag: fastened to cover.

2.8 SILENT CHECK VALVES

.1 Body: malleable iron or ductile iron with integral seat.

.2 Pressure rating: Class 125, WP = 860 kPa.

.3 Connections: grooved ends or flanged.

.4 Disc: bronze or stainless steel renewable rotating disc.

.5 Seat: renewable, EPDM.

.6 Stainless steel spring, heavy duty.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal. Ensure sufficient room for valve stem in fully open position.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Closeout Submittals: Section 01 78 00

.3 Valves - Bronze: Section 23 05 23

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME B16.5-2003, Pipe Flanges and Flanged Fittings.
- .2 ANSI/ASME B16.10-2009, Face- to-Face and End-to-End Dimensions Valves.
- .3 ANSI/ASME B16.25-2007, Buttwelding Ends.
- .4 ANSI/ASME B16.34-2009, Valves Flanged, Threaded and Welding End.

.2 American Petroleum Institute (API)
- .1 API 598-2004, 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-11, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.
- .3 ASTM A194M-10, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
- .4 ASTM A216-08, Specification for Steel Castings, Carbon Suitable for Fusion Welding for High Temperature Service.
- .5 ASTM B85-10, Specification for Aluminum Alloy Die Castings.

.4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
- .1 MSS-SP25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.
- .2 MSS-SP61-2009, 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.

.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 (1) for every ten (10) valves each size, minimum one (1).
.2 Discs: one (1) for every ten (10) valves each size, minimum one (1).
.3 Stem packing: one (1) for every ten (10) valves, each size. Minimum one (1).
.4 Valve handles: two (2) of each size.
.5 Gaskets for flanges: one (1) for every ten (10) flanged joints.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Except for specialty valves, to be of single manufacturer.
.1 Acceptable manufacturers:
.1 Crane
.2 Jenkins
.3 Milwaukee
.4 Newman Hattersley
.5 Kitz
.6 M.A. Stewart
.7 NIBCO
.8 Watts
.9 Wilkins

.2 Valves to be individually tested.

.3 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

2.1 GENERAL (Cont'd)

.3 (Cont'd)
.5 Butt-weld valves:
.1 End-to-end dimensions: to ANSI B16.10.
.2 End dimensions: to ANSI B16.25 bored for standard pipe schedule.
.6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B 85 or malleable iron to ASTM A 49.
.7 Markings: to MSS SP-25.
.8 Identification:
.1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.
.2 Body markings: manufacturer, size, primary service rating, material symbol.
.9 Canadian registration number (CRN) required for all products.

2.2 GATE VALVES

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

2.2 GATE VALVES (Cont'd)

.1 (Cont'd)
.11 Stem:(Cont'd)
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.

.4 Type of bypass valves:
.1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23.
.2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.

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.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedure: Section 01 33 00

.2 Closeout Submittals: Section 01 78 00

.3 Cast-in-Place Concrete: Section 03 30 00

.4 Structural Steel for Buildings: Section 05 12 23

.5 Metal Fabrications: Section 05 50 00

1.2 REFERENCES

.1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
- .1 ANSI/ASME B31.1-2010, Power Piping, (SI Edition).
- .2 ANSI/ASME B31.3-08, Process Piping.
- .3 ANSI/ASME B31.5-2010, Refrigeration Piping and Heat Transfer Components.
- .4 ANSI/ASME B31.9-2008, Building Services Piping.

.2 American Society for Testing and Materials (ASTM)
- .1 ASTM A125-96(2007), Specification for Steel Springs, Helical, Heat Treated.
- .2 ASTM A307-10, 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, and Selection, Application and Installation.

.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.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 , B31.3, B31.5, B31.9 or MSS SP58.

1.3 DESIGN REQUIREMENTS (Cont'd)

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection 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 Submittal Procedures.

.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.

.3 Acceptable materials: Cooper B- Line, Unistrut, Thaler, or approved equivalent.

2.2 PIPE HANGERS

.1 Finishes:
.1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
.2 Use electroplating galvanizing process or hot dipped galvanizing process.
.3 Ensure 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 C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
.1 Rod: 9 mm UL listed, 13 mm FM approved.
.2 Cold piping NPS 2 1/2 or greater, 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 and MSS SP69.

.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 SP69.
.2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top of beam jaw clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.

.4 Upper attachment to concrete.
.1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weld-less forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved where required to MSS SP58.

.5 Shop and field fabricated assemblies.
.1 Trapeze hanger assemblies: MSS SP58.
.2 Steel brackets: MSS SP58.
.3 Sway braces for seismic restraint systems: to MSS SP58.

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

2.2 PIPE HANGERS (Cont'd)

.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/m| 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 ¦5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel ¦ 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring precompressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring precompressed variable spring hanger with two (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 ¦ 5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements specified in Trade Package 5. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.9 PLATFORMS AND CATWALKS

.1 Section 05 50 00.

2.10 HOUSEKEEPING PADS

.1 For base-mounted equipment: Concrete, at least 100 mm high (150mm for air handling equipment with cooling coils), 100 mm larger all around than equipment, and with chamfered edges.

.2 Concrete: in accordance with Section 03 30 00.

2.11 OTHER EQUIPMENT SUPPORTS

.1 From structural grade steel meeting requirements specified in Section 05 12 23.

.2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

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

.2 Vibration Control Devices:
.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and elsewhere as indicated.

.3 Clamps on riser piping:
.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
.2 Bolt tightening torques to be to industry standards.
.3 Steel pipes: Install below coupling or shear lugs welded to pipe.
.4 Cast iron pipes: Install below joint.

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

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

.6 Use approved constant support type hangers where:
.1 vertical movement of pipework is 13 mm or more.
.2 transfer of load to adjacent hangers or connected equipment is not permitted.

3.1 INSTALLATION (Cont'd)

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

3.2 HANGER SPACING

.1 Plumbing piping: most stringent requirements of Canadian Plumbing Code

.2 Fire protection: to applicable fire code, or as indicated below, whichever is more stringent.

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

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 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: NPS	Hanger Rod Diameter mm	Copper Maximum Spacing	Steel Maximum Spacing
up to 1-1/4	9.5	1.83 m	2.14 m
1-1/2	9.5	2.1 m	2.74 m
2	9.5	2.74 m	3.05 m
2-1/2	9.5	3.0 m	3.66 m
3	12.7	3.0 m	3.66 m
3-1/2	12.7	3.3 m	3.96 m
4	12.7	3.66 m	4.27 m
5	15.9		4.88 m
6	19		5.18 m
8	22.2		5.79 m
10	22.2		6.7 m
12	22.2		7.00 m

.6 Within 300 mm of each elbow.

.7 Pipework greater than NPS 12: to MSS SP58.

.8 Rolled groove piping: Any section 1200mm in length or longer shall have at least one (1) hanger.

3.3 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members. Comprised of angel iron or c- channel.

3.4 HORIZONTAL MOVEMENT

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

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

3.5 FINAL ADJUSTMENT

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

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

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

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

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Cast-in-Place Concrete: Section 03 30 00

.3 Testing, Adjusting and Balancing (TAB) of Mechanical Systems: Section 23 05 95

1.2 REFERENCES

.1 National Fire Protection Association (NFPA)
.1 NFPA 13-2010, Installation of Sprinkler Systems.
.2 National Building Code of Canada (NBC) - 2005.

1.3 SHOP DRAWINGS

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

.2 Provide separate shop drawings for each isolated system shop drawings complete with performance and product data.

PART 2 - PRODUCTS

2.1 GENERAL

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

.2 Acceptable product: Korfund, Mason, Vibron, Vibro-Acoustics.

2.2 ELASTROMERIC PADS

.1 Type EP1: neoprene waffle or ribbed; 9mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2: rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3: neoprene-steel- neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4: rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer

2.2 ELASTROMERIC PADS (Cont'd)

.4 Type EP4:(Cont'd)
natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTROMERIC MOUNTS

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

2.4 SPRINGS

.1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.

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

.3 Cadmium plate for outdoor, 100% relative humidity.

.4 Colour code springs.

2.5 SPRING MOUNT

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

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

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

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

.5 Type M5: enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

.6 Acceptable manufacturer: Korfund, Mason, Vibron, Vibro-Acoustics.

2.6 HANGERS

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

.2 Type H1: neoprene inshear, moulded with rod isolation bushing which passes through hanger box.

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

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

2.7 ACOUSTIC BARRIERS FOR ANCHOR AND GUIDES

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

2.8 HORIZONTAL THRUST RESTRAINT

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

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

2.9 STRUCTURAL BASES

.1 Type B1 Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; predrilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and predrilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

2.9 STRUCTURAL BASES (Cont'd)

.4 Acceptable manufacturer: Korfund, Masdom, Vibron, Vibro Acoustics.

2.10 INERTIA BASE

.1 Type B3 Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

.3 Concrete: to Section 03 30 00.

.4 Acceptable manufacturer: Korfund, Mason, Vibron, Vibro-Acoustics.

2.11 ROOF CURB ISOLATION RAILS

.1 General: complete factory assembled without need for sub-base.

.2 Lower member: continuous rectangular steel tube or extruded aluminum channel.

.3 Upper member: continuous rectangular steel tube or extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.

.4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.

.5 High frequency isolation: 6mm minimum thick continuous gasket on top and bottom of complete assembly or pads on top and bottom of each spring. Material: closed cell neoprene.

.6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: aluminum neoprene.

.7 Hardware: cadmium plated or galvanized.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Painting: Section 09 91 10

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB1.60-97, Interior Alkyd Gloss Enamel.
.2 CAN/CGSB24.3-92, Identification of Piping Systems.

.2 National Fire Protection Association
.1 NFPA 13-2010, Installation of Sprinkler Systems.
.2 NFPA 14-2010, Standpipe and Hose Systems.

1.3 PRODUCT DATA

.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.

1.4 SAMPLES

.1 Submit samples in accordance with Section 01 33 00.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal 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.

.4 Include required listings, ie. CSA, ULC, etc.

2.2 SYSTEM NAMEPLATES

.1 Colours:
.1 Hazardous: red letters, white background. /2 Elsewhere: white letters, black 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 # 8.
.2 Equipment in Mechanical Rooms: Use size # 9.
.3 Use maximum of 25 letters/numbers per line.

.5 Nameplates to be fastened securely with pop rivets or screws in conspicuous place. Where nameplates cannot be mounted, such as on cool surfaces, provide standoffs.

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 Sprinklers: to NFPA 13.
.2 Standpipe and hose systems: to NFPA 14.

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:
.1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:
.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:
.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:
.1 To full circumference of pipe or insulation.
.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:
.1 Pipes and tubing 20 mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
.2 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150C and intermittent temperature of 200C.

.7 Colours and Legends:
.1 Where not listed, obtain direction from Departmental Representative.
.2 Colours for legends, arrows, to following table: Background colour Legend, arrows Yellow BLACK Green WHITE Red WHITE

.3 Background colour marking and legends for piping systems:

2.5 IDENTIFICATION OF PIPING SYSTEMS (Cont'd)

.7 Colours and Legends:(Cont'd)
.3 (Cont'd)

Contents	Background colour	Legend
** Add design temperature ++ Add design temperature and pressured		
Chilled water supply	Green	CH. W.S
Chilled water return	Green	CH. W.R
Hot water heating supply	Yellow	HWHS
Hot water heating return	Yellow	HWHR
Glycol heating supply	Yellow	GHS
Glycol heating return	Yellow	GHR
Boiler feed water	Yellow	BLR. FEED WTR
Domestic hot water supply	Green	DHWS
Dom. HWS recirculation	Green	DHWR
Domestic cold water supply	Green	DCW
None Potable Water System	Purple	NONE POTABLE WATER (Entire pipe System shall be painted purple)
Contaminated lab waste	Yellow	CONT. LAB WASTE
Acid waste	Yellow	ACID WASTE (add source)
Storm water	Green	SS
Sanitary	Green	SAN.S.
Plumbing vent	Green	SAN. VENT
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Instrument air	Green	INSTRUMENT AIR
Control air tubing	To Section 25 05 54	
Conduit for low voltage Control wiring	To Section 23 09 00	

2.6 DUCTWORK IDENTIFICATION

.1 50 mm high stencilled letters and directional arrows 150mm 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 EF-1/2, etc.

2.7 VALVES, CONTROLLERS

.1 Brass tags 75mm 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,

2.7 VALVES, CONTROLLERS (Cont'd)

.2 (Cont'd) service, function, normal position, location of tagged item.

.3 Use the same abbreviations as noted for the pipe labeling.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in section 23 09 00 and per this section.

.2 Inscriptions to include function and (where appropriate) failsafe position, component ID name.

2.9 EQUIPMENT CONCEALED BY CEILING

.1 At valves, balancing dampers, air vents, and drains, and other similar pieces of mechanical equipment located above T-bar ceilings or access doors, install circular ¾ö diameter self adhesive identification discs on the underside of the ceiling, as close as possible to the location of the equipment.

.2 Discs shall be coloured as scheduled in this section.

.3 Where the item has a primary and secondary colour, provide a ¾ö diameter primary colour disc with a 3/8ö diameter secondary colour disc centered on the primary disc.

.4 For backflow preventers, fire dampers, air terminal units, exhaust fans, reheat coils and other similar pieces of equipment located above T-bar ceilings or access doors, provide laminated plastic plates as noted for System Nameplates. A second identical plate shall be installed on the underside of the ceiling grid or access door opening frame, as close as possible to the location of the equipment. Size tag to match width of frame with suitable text size that is visible from floor level.

2.10 LANGUAGE

.1 Identification to be in English.

.2 Use one nameplate, label, etc. for each language.

PART 3 - EXECUTION

3.1 TIMING

.1 Provide identification only after all painting specified in Section 09 91 23 has been completed.

3.2 INSTALLATION

.1 Perform work in accordance with CAN/CGS B24.3 except as specified otherwise.

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

3.3 NAMEPLATES

.1 Locations:
.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:
.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection
.1 Do not paint, insulate or cover in any way.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

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

.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.

.10 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. Secure tags with nonferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one (1) copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

END

PART 1 - GENERAL

1.1 TIMING

.1 Ducts to be tested before installation of insulation or any other form of concealments.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, gaskets, etc.

1.2 EXCLUSIONS

.1 Flexible connections to VAV boxes.

1.3 REFERENCES

.1 SMACNA HVAC Air Duct Leakage Test Manual.

1.4 TEST PROCEDURES

.1 Ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment to be pressure tested for leaks.

.2 Maximum lengths of ducts to be tested to be consistent with capacity of test equipment.

.3 Section of duct to be tested to include:
.1 Fittings, branch ducts, tapins.

.4 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

.5 Base partial system leakage calculations on Reference Standard.

.6 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

1.5 TESTING AGENCY

.1 Installing Contractor.

1.6 RELATED WORK

.1 Departmental Representative shall witness tests and to verify verify reported results.

1.6 RELATED WORK (Cont'd)

.2 To be certified by the same TAB agency approved by Departmental Representative to undertake TAB on this project.

1.7 TEST INSTRUMENTS

.1 Testing agency to provide instruments for tests.

.2 Test apparatus to include:
.1 Fan capable of producing required static pressure.
.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
.3 Flow measuring instrument compatible with the orifice plate.
.4 Calibration curves for orifice plates used.
.5 Flexible duct for connecting to ductwork under test.

.3 Smoke bombs for visual inspections.

.4 Test apparatus to be accurate to within +/3 % of flow rate and pressure.

.5 Submit details of test instruments to be used to Departmental Representative at least three months before anticipated start date.

.6 Test instruments to be calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.

.7 Instruments to be recalibrated every six months thereafter.

1.8 SYSTEM LEAKAGE TOLERANCES

.1 System leakage tolerances specified herein are stated as a percentage of total flow rate handled by the system. Therefore, when testing sections of ductwork this acceptable leakage shall be prorated to entire system. Leakage for sections of duct systems shall not exceed the total allowable leakage.

.2 Leakage tests on following systems not to exceed specified leakage rates.
.1 Small duct systems up to 250 Pa: Leakage 2%.
.2 VAV box and duct on downstream side of VAV box: Leakage 2%.
.3 Large low pressure duct systems up to 500 Pa: Leakage 2%.

1.8 SYSTEM LEAKAGE TOLERANCES (Cont'd)

.2 (Cont'd)
.4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: Leakage 1%.

.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

1.9 EQUIPMENT LEAKAGE TOLERANCES

.1 Equipment and system components such as VAV boxes, duct heating leakage: 2%.

1.10 REPORT FORMS

.1 Submit proposed report form and test report format to Departmental Representative for approval. Do not start tests until approval received in writing from Departmental Representative.

1.11 PRESSURE TEST

.1 Prepare report of results and submit to Departmental Representative within 24 hours of completion of tests. Include:
.1 Schematic of entire system.
.2 Schematic of section under test showing test site.
.3 Required and achieved static pressures.
.4 Orifice differential pressure at test sites.
.5 Permissible and actual leakage flow rate (L/s) for test sites.
.6 Witnessed certification of results.

.2 Include test reports in final TAB report for Commissioning Manual.

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

3.1 GENERAL

.1 Pressure test the washroom exhaust duct system and the supply duct systems on the fan side of chilled beams or up to terminal units on systems without chilled beams.

END

PART 1 - GENERAL

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

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

.3 TAB agency shall be present to assist the commissioning authority during the commissioning of HVAC systems. TAB agency shall be responsible for measuring entering and leaving air temperature at all coils to calibrate EMCS and for setting the DHW balancing valves.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel certified to AABC or NEBB to perform TAB to Departmental Representative within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience. TAB contractor shall have a minimum of five (5) years experience to AABC, NEBB or SMACNA.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.
.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed

1.2 QUALIFICATIONS OF TAB PERSONNEL (Cont'd)

.7 (Cont'd) in the TAB standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
.1 For systems or system components not covered in TAB standard, use TAB procedures developed by TAB Specialist.
.2 Where new procedures and requirements are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or SMACNA), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

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

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

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

1.4 EXCEPTIONS

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

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

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

1.6 PRE-TAB REVIEW

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

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

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

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in other Divisions.

1.8 OPERATION OF SYSTEMS DURING TAB

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

1.9 START OF TAB

.1 Notify Departmental Representative seven (7) days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:
.1 Installation of ceilings, doors, windows, other construction affecting TAB.
.2 Application of weatherstripping, sealing, caulking.
.3 All pressure, leakage, other tests specified elsewhere in other Divisions.
.4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
.1 Proper thermal overload protection in place for electrical equipment.
.2 Air systems:
.1 Filters in place, clean.
.2 Duct systems clean.

1.9 START OF TAB (Cont'd)

.3 (Cont'd)
.2 Air systems:(Cont'd)
.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
.4 Correct fan rotation.
.5 Fire, smoke, volume control dampers installed and open.
.6 Coil fins combed, clean.
.7 Access doors, installed, closed.
.8 Outlets installed, volume control dampers open.
.3 Liquid systems:
.1 Flushed, filled, vented.
.2 Correct pump rotation.
.3 Strainers in place, baskets clean.
.4 Isolating and balancing valves installed, open.
.5 Calibrated balancing valves installed, at factory settings.
.6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:
.1 HVAC systems: plus 5%, minus 5%.
.2 Hydronic systems: plus or minus 10%.

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within three (3) months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:
.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Departmental Representative prior to submission of formal TAB report, sample of rough TAB sheets. Include:
- .1 Details of instruments used.
- .2 Details of TAB procedures employed.
- .3 Calculations procedures.
- .4 Summaries.

1.15 TAB REPORT

.1 Format to be in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:
- .1 Project record drawings.
- .2 System schematics.

.3 Submit three (3) copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Departmental Representative.

.2 Provide manpower and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results to be at discretion of Departmental Representative.

.4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

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

1.19 AIR SYSTEMS

.1 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.

.2 Do TAB of systems, equipment, components, controls specified in other Divisions.

.3 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.

.4 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC or NEBB.

.5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross- sectional area, RPM, electrical power, voltage, noise, vibration, amperage and volts for each stage of electrical heating coils.

.6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
.2 At controllers, controlled device.

.7 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 HYDRONIC SYSTEMS

.1 Definitions: for purposes of this section, to include low pressure hot water heating, chilled water, condenser water, glycol systems.

.2 Standard: TAB to be to most stringent of TAB standards of AABC or NEBB.

.3 Do TAB of systems, equipment, components, controls specified in other Divisions.

.4 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.

.5 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC or NEBB.

.6 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: flow rate, static pressure,

1.20 HYDRONIC SYSTEMS (Cont'd)

.6 Measurements:(Cont'd)
pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power, voltage, noise, vibration.

.7 Locations of equipment measurement: to include, but not be limited to, following as appropriate:
.1 Inlet and outlet of heat exchangers (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.
.2 At controllers, controlled device.

.8 Locations of systems measurements to include, but not be limited to, following as appropriate: supply and return of primary and secondary loops (main, main branch, branch, sub-branch) of all hydronic systems, inlet connection of make-up water.

1.21 DOMESTIC WATER SYSTEMS

.1 Meet requirements as specified for hydronic systems.

.2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: inlet and outlet of heaters, tank, pump, circulator, at controllers, controlled device.

.3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

.4 Balance flow at all trap primer drains to ensure consistency.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Bases, Hangers and Supports: Section 23 05 29

.3 Interior Painting; Section 09 91 23

1.2 REFERENCES

.1 American Society for Testing and Materials International, (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 Pipe Insulation.
.3 ASTM C449-07, Standard Specification for Mineral Fiber Hydraulic Setting Thermal Insulating and Finishing Cement.
.4 ASTM C553-11, 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 S102-07, Surface Burning Characteristics of Building Materials and Assemblies.
.2 CAN/ULC S701-11, 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 (including metal baffle ceilings) and non-accessible chases and furred-in spaces.
.2 "EXPOSED" will mean "not concealed" as defined herein.

1.3 DEFINITIONS (Cont'd)

.1 (Cont'd)
.3 "Outside" shall include unheated sections of the parking garage.
.4 Insulation systems includes 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.

.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.

.2 Installation instructions to include procedures used and installation standards achieved.

1.7 QUALIFICATIONS

.1 Installer: specialist in performing work of this section, and have at least 5 years successful experience in this size and type of project, qualified to standards of TIAC.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather and construction traffic.

1.8 DELIVERY, STORAGE AND HANDLING (Cont'd)

.3 Protect against damage from any source.

.4 Store at temperatures and conditions recommended by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULCS102:
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.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 Maximum conductivity: 0.23 w/m*°C@24°C mean

.4 Minimum 3 PCF density.

.5 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).

.6 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.

2.3 JACKETS

.1 Canvas:
.1 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.2 Lagging adhesive: Compatible with insulation.

.2 Aluminum:
.1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
.2 Thickness: 0.40 mm sheet.
.3 Finish: Stucco embossed or corrugated.
.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.3 JACKETS (Cont'd)

.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 Bakor Foilskin, or approved equivalent.

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.

.8 Tie wire: 1.5 mm stainless steel.

.9 Banding: 12 mm wide, 0.5 mm thick stainless steel.

.10 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation.

.11 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips, length to suit thickness of insulation.

PART 3 - EXECUTION

3.1 PREINSTALLATION REQUIREMENTS

.1 Pressure testing of ductwork systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and as indicated.

.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with Section 23 05 29.
.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

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

3.3 DUCTWORK INSULATION SCHEDULE (Cont'd) .1 (Cont'd)

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular supply air (exposed and in vertical shafts)	C1	Yes	50
Round supply air ducts (concealed)	C2	Yes	25
Rectangular supply air ducts (concealed)	C2	Yes	25
Round supply air ducts (exposed and in vertical shafts)	C1	Yes	50
Supply, return and exhaust ducts exposed in space being served	none (unless indicated on the plans)		
Outside air ducts to mixing Plenum	C1	Yes	50
Intake and exhaust plenums	C1	Yes	50
Exhaust duct between dampers and louvers	C1	Yes	50
Rectangular ducts outside	C1	special	75
Round ducts outside	C1	special	75

.2 Jackets: Exposed round ducts 600 mm 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:

3.3 DUCTWORK INSULATION SCHEDULE (Cont'd)

.2 Jackets:(Cont'd)

.2 Finishes:(Cont'd)

	TIAC Code Rectangular	Round
Indoor, concealed	None	None
Indoor, exposed Within mechanical Room	CRF/ Canvas	CRD/ Canvas
Indoor, exposed elsewhere	Aluminum CRF/Self	CRF/CRD/ Aluminum CRD/Self
Outdoor, exposed to precipitation	adhesive weather barrier membrane	adhesive weather barrier membrane

END

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Bases, Hangers and Supports: Section 23 05 29

.2 Mechanical Identification: Section 23 05 53

1.2 REFERENCE

.1 American Society for Testing and Materials (ASTM International)
.1 ASTM B209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate.
.2 ASTM C335-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
.3 ASTM C449/C449M-07(R2013), Specification for Mineral Fiber Hydraulic Setting Thermal Insulating and Finishing Cement.
.4 ASTM C533-11, Specification for Calcium Silicate Block and Pipe Thermal Insulation.
.5 ASTM C534-08, Standard Specification for Preformed Flexible Cellular Thermal Insulation In Sheet And Tubular Form.
.6 ASTM C547-11, Specification for Mineral Fiber Pipe Insulation.
.7 ASTM C553-11, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
.8 ASTM C612-10, Specification for Mineral Fiber Block and Board Thermal Insulation.
.9 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.

.3 Thermal Insulation Association of Canada (TIAC)
.1 National Insulation Standards.

.4 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 PRODUCT DATA

.1 Submit samples in accordance with Section 01 33 00.

1.4 SAMPLES

.1 Submit samples in accordance with Section 01 33 00.

.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.

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with Section 01 33 00.

.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.6 QUALIFICATIONS

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

1.7 DELIVERY, STORAGE AND HANDLING

.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

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.2 Maximum flame spread rating: 25.
.1 Maximum smoke developed rating: 50.

.3 Acceptable product: Manson, Knauf, Owens Corning.

2.2 INSULATION

.1 Mineral fibre: includes glass fibre, rock wool, slag wool.

2.2 INSULATION (Cont'd)

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.
.1 Mineral fibre: ASTM C 547.
.2 Maximum "k" factor: ASTM C 547.

.4 TIAC Code A2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
.1 Insulation: ASTM C533.
.2 Maximum "k" factor: ASTM C533.
.3 Design to permit periodic removal and reinstallation.

.5 TIAC Code A3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.4 Mineral fibre:
.1 Mineral fibre: ASTM C547.
.2 Jacket: to CGSB 51GP52Ma.
.3 Maximum "k" factor: ASTM C547.

.6 TIAC Code A6: Flexible unicellular tubular elastomer 4 Mineral fibre: ASTM C 612.
.1 Insulation: with vapour retarder jacket to ASTM C534.
.2 Jacket: to CGSB 51GP52Ma.
.3 Maximum "k" factor: C534.
.4 Certified by manufacturer free of potential stress corrosion cracking corrodants.
.5 Flame spread index less than 25, and smoke developed index less than 50.

.7 TIAC Code C1: Rigid mineral fibre board, un-faced.
.1 Mineral fibre: ASTM C612.
.2 Maximum "k" factor: ASTM C612.

.8 TIAC Code C2: Mineral fibre blanket un-faced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
.1 Mineral fibre: ASTM C553.
.2 Jacket: to CGSB 51GP52Ma.
.3 Maximum "k" factor: ASTM C553.

.9 TIAC Code C4: Rigid mineral fibre board faced with factory applied vapour retarder jacket.
.1 Mineral fibre: ASTM C612.
.2 Jacket: to CGSB 51GP52Ma.
.3 Maximum "k" factor: ASTM C612.

.10 Provide removable pre-fabricated insulation pads for valves.

2.3 CEMENT

.1 Thermal insulating and finish
.1 To: ASTM C449/C449M.
.2 Hydraulic setting or air drying on mineral wool, to ASTM C449.

2.4 JACKETS

.1 Canvas:
.1 220 gm/m¦ cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.2 Lagging adhesive: Compatible with insulation.

.2 Aluminum:
.1 To ASTM B 209.
.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: 0.25 mm thick dieshaped 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.

2.5 INSULATION SECUREMENTS

.1 Tape: Self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: Quick setting.

.3 Canvas adhesive: Washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

.6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation.

.7 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER LAP ADHESIVE

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

2.7 INDOOR RETARDER FINISH

.1 Type A6 to manufacturer's recommendation.

2.8 OUTDOOR VAPOUR RETARDER MASTIC

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m¦.

.3 Type A6 to manufacturer's recommendation..

PART 3 - EXECUTION

3.1 PRE-INSULATION

.1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards
.1 Hot equipment: To TIAC code 1503-H.
.2 Cold equipment: to TIAC code 1503-C or 1503CA.

.2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.

.3 Provide vapour retarder as recommended by manufacturer.

.4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

.5 Use two (2) layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Hangers, supports outside vapour retarder jacket.

.7 Supports, Hangers:
.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED INSULATION AND ENCLOSURES

.1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

.2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.4 EQUIPMENT INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 Hot Equipment:
.1 TIAC code A1 or C1 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.

.3 Thicknesses:
.1 Heat Exchanger 50mm
.2 Air separators 50mm
.3 Expansion tanks 50mm.

.4 Finishes:
.1 Equipment in mechanical rooms: TIAC code CEF/1 with jacket.
.2 Equipment elsewhere: TIAC code CEF/2 with 13mm cement jacket.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Joint Sealing: Section 07 92 00

1.2 REFERENCES

.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, Standard Specification for Mineral Fibre Hydraulic Setting Thermal Insulating and Finishing Cement.
- .4 ASTM C533-11, Standard specification for Calium Silicate Insulation Block and Pipe.
- .5 ASTM C534-11, Standard Specification for Preformed Elastomeric Cellular Thermal Insulation in Sheet And Tubular Form.
- .6 ASTM C547-11, Standard Specification for Mineral Fibre Pipe Insulation.
- .7 ASTM C921-10, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 51GP52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .2 CAN/CGSB51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts.

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

.4 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULCS102-10, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULCS701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULCS702-09, Thermal Insulation, Mineral Fibre, for Buildings

1.3 DEFINITIONS

.1 For purposes of this section:
.1 "CONCEALED" - insulated mechanical services in suspended ceilings (including metal baffle ceilings) and non- accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as specified.
.3 "OUTSIDE" shall include unheated portions of the parking garage.

.2 TIAC ss:
.1 CPF: Commercial Piping Finish.

1.4 SHOP DRAWINGS

.1 Shop drawings in accordance with Section 01 33 00.

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.5 SAMPLES

.1 Submit samples in accordance with Section 01 33 00.

1.6 MANUFACTURER'S INSTRUCTIONS

.1 Submit manufacturers' installation instructions in accordance with Section 01 33 00.

.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.7 QUALIFICATIONS

.1 Installer to be specialist in performing work of this Section, and have at least five (5) years successful experience in this size and type of project, qualified to standards of TIAC.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather, construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions required by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULCS102.
- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
- .1 Mineral fibre: to CAN/ULC S702 and ASTM C547.
- .2 Jacket: to CGSB 51GP52Ma.
- .3 Maximum "k" factor: to CAN/ULCS702.

.4 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.

.5 Acceptable product: Manson, Knauf, Owens Corning.

2.3 INSULATION SECRETMENT

.1 Tape: Self adhesive, 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.

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m2.

2.8 JACKETS

.1 Canvas:
.1 220gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.2 Lagging adhesive: Compatible with insulation.

.2 Aluminum:
.1 To ASTM B209.
.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 die shaped fitting covers with factory attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.3 Stainless steel:
.1 Type: 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 die shaped fitting covers with factory attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.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 Bakor Foilskin, or approved equivalent.

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, and free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers:
.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

.2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:
.1 Insulation, fastenings and finishes: same as system.
.2 Jacket: Aluminum, SS, PVC high temperature fabric.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry at all times. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSTALLATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A3.
.1 Securements: Tape at 300 mm oc.
.2 Seals: VR lap seal adhesive, VR lagging adhesive.
.3 Installation: TIAC Code: 1501C.

.3 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.

.4 Thickness of insulation to be as listed in following table.

3.5 PIPING INSTALLATION SCHEDULES (Cont'd)

.4 (Cont'd)

.1 Do not insulate exposed run outs to plumbing fixtures, chrome plated piping, valves, fittings.

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
Hot Water Heating	60-94	A-3	30	64	64	76	89	89
Hot Water Heating	up to 59	A-3	30	64	64	76	89	89
Glycol Heating	60-94	A-3	30	64	64	76	89	89
Glycol Heating	up to 59	A-3	30	64	64	76	89	89
Chilled Water or Glycol	4-13	A-3	25	25	38	38	38	38
Chilled Water or Glycol	below 4	A-3	25	25	38	38	38	38
Humidifer Steam & Condensate		A-3	30	30	30	30		
Chilled Water or Glycol Pump Casing and Tanks		A-3	25	25	25	25	25	25
Domestic Potable and Non-Potable CWS		A-3	25	25	25	25	25	25
Domestic HWS and Pre-Heated Hot water		A3	25	25	25	38	38	38
RWL and RWP		A-3	25	25	25	25	25	25
Cooling Coil cond. Drain		A-3	25	25	25	25	25	25

3.5 PIPING INSTALLATION SCHEDULES (Cont'd)

.4 (Cont'd)

.1 (Cont'd)

Application	Temp	TIAC	Pipe sizes (NPS) and insulation thickness (mm)					
Roof Drain Body		C-2	25	25	25	25	25	25
Sprinkler Pipe	40	A-3	50	----------50----------				
Outside (Where trace heated)								
Sanitary Drainage Outside		A-3	50	----------50----------				
Hot Water Heating Outside	64	A-3	50	----------50----------				
Domestic Potable Non-Potable, Hot and Cold Water, Outside	40	A-3	50	----------50----------				

.5 Rain water pipes from the south plaza shall not be insulated. With the exception of the running trap.

.6 All trace heated piping shall be insulated.

.7 Finishes:

.1 Exposed indoors: aluminum jacket or canvas.

.2 Exposed in mechanical rooms: aluminum jacket or canvas.

.3 Concealed, indoors: canvas on valves, fittings. All service jacket elsewhere.

.4 Use vapour retarder jacket on TIAC code A3 insulation compatible with insulation.

.5 Outdoors: self adhesive weather barrier membrane and aluminum jacket Weather barrier not required in the parking garage.

3.5 PIPING INSTALLATION SCHEDULES (Cont'd)

.7 Finishes:(Cont'd)
.6 Finish attachments: SS screws or bands, at 150 mm oc. or to manufacturers recommendations.
.7 Seals: wing or closed.
.8 Installation: To appropriate TIAC code CPF/1 through CPF/5.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 08 02 - Cleanup and Startup of Mechanical Systems.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
.1 ASTM E 202-2012, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

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

1.5 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:
.1 TAB has been completed
.2 Verification of operating, limit, safety controls.
.3 Verification of primary and secondary pump flow rates.
.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test:
.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
.1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
.2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
.2 Test procedures:
.1 Open fully heat exchanger, heating coil and radiation control valves.
.2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
.3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

.7 Chilled water system capacity test:
.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
.1 Adding heat from building heating system or;
.2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum

1.5 HYDRONIC SYSTEM CAPACITY TEST (Cont'd)

.7 Chilled water system capacity test:(Cont'd)
.1 (Cont'd)
.2 (Cont'd)
outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater that OAT. RAT to be at least 23 degrees C minimum.
.2 Test procedures:
.1 Open fully cooling coil control valves.
.2 Set thermostats on associated AHU's for maximum cooling.
.3 Set AHU's for design maximum air flow rates.
.4 Set load or demand limiters on chillers to 100%.
.5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.

1.6 GLYCOL SYSTEMS

.1 Test to prove concentration will prevent freezing to minus [40] degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E 202.

1.7 POTABLE WATER SYSTEMS

.1 When cleaning is completed and system filled:
.1 Verify performance of equipment and systems as specified elsewhere in Division 23.
.2 Check for proper operation of water hammer arrestors. Run one (1) outlet for ten (10) seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
.3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

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

.1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23.

.2 Verification of controls, detection devices, alarm devices is specified Division 26.

.3 Demonstrate that fire hose will reach to most remote location regardless of partitions, and obstructions.

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

1.9 SANITARY AND STORM DRAINAGE SYSTEMS

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

.2 Ensure that traps are fully and permanently primed.

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

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

.5 Cleanouts: refer to Section 22 42 00 - Plumbing Fixtures.

.6 Roof drains:
.1 Refer to Section 22 42 00 - Plumbing Fixtures.
.2 Remove caps as required.

1.10 REPORTS

.1 In accordance with Sections 01 79 00 - Demonstration and Trainng and 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

1.11 TRAINING

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified herein.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

Not applicable.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials
.1 ASTM E202-09, Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

PART 2 - PRODUCTS

2.1 CLEANING SOLUTIONS

.1 Low foaming detergent at all temperatures.

.2 No pH neutralization required.

.3 Designed for use on most metals including aluminum.

.4 Biodegradable.

.5 Phosphate Free.

.6 Nitrite Free.

PART 3 - EXECUTION

3.1 CLEANING HYDRONIC AND STEAM SYSTEMS

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

.2 Cleaning Agency:
.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:
.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
.1 Cleaning procedures, flow rates, elapsed time.
.2 Chemicals and concentrations to be used.
.3 Inhibitors and concentrations.
.4 Specific requirements for completion of work.

3.1 CLEANING HYDRONIC AND STEAM SYSTEMS (Cont'd)

.4 Cleaning procedures:(Cont'd)
.1 (Cont'd)
.5 Special precautions for protecting piping system materials and components.
.6 Complete analysis of water used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:
.1 Systems: free from construction debris, dirt and other foreign material.
.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
.3 Strainers: clean prior to initial fill.
.4 Install temporary filters on pumps not equipped with permanent filters.
.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning:
.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:
.1 Flush system thoroughly with water, back flush pump, strainers, blow down drain valves and risers to remove all loose debris. Remove accumulated sludge in boilers if necessary.
.2 Then add 2% solution on low foaming detergent to the system through a bypass feeder or another feeding device.
.3 Circulate for 36 hours at 82C. For chilled systems, circulate at least 48 hours at ambient temperature.
.4 During recirculation, back flush strainers, drain valves and risers at their lowest point once every 8 hours.
.5 Drain cleaning water completely.
.6 Then fill and drain system several times. Circulate 30 minutes every time the system is refilled.
.7 Bleed system at several points until water is clear and nonfoaming. Clean pup strainers.
.8 Draw a water sample from the system and sent it to out laboratory for analysis.
.9 If the laboratory report is satisfactory, the system must then be treated with the appropriate formula.

.8 Glycol Systems:
.1 In addition to procedures specified above perform procedures specified herein.

3.1 CLEANING HYDRONIC AND STEAM SYSTEMS (Cont'd)

.9 Test to prove concentration will prevent freezing to minus 40 C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

3.2 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.
.2 Ensure air is removed.
.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets.
.5 Clean out strainers repeatedly until system is clean.
.6 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
.7 Repeat with water at design temperature.
.8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
.9 Bring system up to design temperature and pressure slowly over a 48 hour period.
.10 Perform TAB as specified in Section 23 05 95 Testing, Adjusting and Balancing (TAB).
.11 Adjust pipe supports, hangers, springs as necessary.
.12 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
.13 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, realign, repeat startup procedures.
.14 Retighten bolts, etc. using torque wrench, to compensate for heat- caused relaxation. Repeat several times during commissioning.
.15 Check operation of drain valves.
.16 Adjust valve stem packings as systems settle down.
.17 Prior to balancing, fully open all balancing valves (except those that are factoryset).
.18 Check operation of over- temperature protection devices on circulating pumps.
.19 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 The Work specified in this Section consists of the supply and installation of pre-insulated piping, fittings and valves, leak detection system, flushing and testing of mechanical systems as detailed in this Section and/or on the Drawings. The work includes, but is not limited to: the supply of all labour, supervision, consumables, tools, construction equipment, and all incidental material and expenses in connection with the installation, erection in place and testing, in accordance with this Specification, of all systems described in Clause 1.3, Description of Work. Handling and storage of all material, job site cleanup and removal of construction wastes is also included.

.2 Allow for field joints as indicated on drawings.

.3 Provide all pipe and materials. Purchase the main materials for pre-insulated piping and joints from the specified supplier listed in paragraph 2.1 of this section.

.4 Contractor is responsible for receiving and off-loading pre-insulated piping.

1.2 RELATED WORK

.1 Excavating, Trenching and Backfilling: Section 31 23 10

.2 Cast-in-place concrete: Section 03 30 00

1.3 REFERENCE STANDARDS

.1 Carry out the Work in accordance with all applicable Federal, Provincial, Municipal and other laws ordinances and regulations and with the latest edition of the following standards which shall be deemed to be and form part of this Specification.

.1 Government of the Province of Nova Scotia. Steam Boiler Pressure Vessel, and Refrigeration Plant Inspection Act and Regulations.

.2 CSA B51-09, Boiler, Pressure Vessel and Pressure Piping Code.

.3 CSA W48-06(R2011) Series, Filler Metals and Materials for Metal Arc Welding.

.4 ANSI/ASME Boiler and Pressure Vessel Code-2007.

.1 Section V: Nondestructive Examination.

.2 Section IX: Welding and Brazing Qualifications.

1.3 REFERENCE STANDARDS (Cont'd)

.1 (Cont'd)

.5 CAN/CSA-W117.2-12, Safety in Welding, Cutting and Allied Processes.

.6 CSAW 178.1-08(R2013), Certification of Welding Inspection Organizations.

.7 Canadian General Standards Board (CGSB) CGSB 48.2-92 Spot Radiography of Welded Butt Joints in Ferrous Materials; CGSB 48.4-92 Certification of Non-destructive Testing Personnel (Industrial Radiography Method); CAN/CGSB-51.2-95 Thermal Insulation, Calcium Silicate for Piping, Machinery and Boilers.

.8 ASTM A53-2012, Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.9 ASTM A105/A105M-2012, Forgings, Carbon Steel, for Piping Components.

.10 ASTM A106-2011, Seamless Carbon Steel Pipe for High Temperature Service.

.11 ASTM A108-2007, Steel Bars, Carbon, Cold-Finished, Standard Quality.

.12 ASTM A181/A181M-2012, Forgings, Carbon Steel, for General-Purpose Piping.

.13 ASTM A193/A193M-2012, Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

.14 ASTM A194/A194M-2012, Carbon and Alloy Steel Nuts for High-Pressure and High Temperature Service.

.15 ASTM A216/A216M-2012, Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service.

.16 ASTM A234/A234M-2011, Piping Fittings of Wrought Carbon and Alloy Steel for Moderate and Elevated Temperatures.

.17 ANSI/ASME B31.1-2012, Power Piping.

.18 ANSI/ASME 16.5-2013, Pipe Flanges and Flanged Fittings.

.19 ANSI/ASME 16.25-2012, Buttwelding Ends.

.20 ANSI/MSS SP-58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.

.21 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/ Industrial Type.

.22 DIN 10217-1-2005, Welded Steel Tubes for Pressure Purposes.

.23 DIN 10204-2005, Metallic Product Types of Inspection Documents.

.24 EN 253-2013, District Heating Pipes - Preinsjlated Bonded Pipe Systems for Directly Biried Hot Water Networks: Pipe Assembly of Steel Service Pipe.

1.4 CERTIFICATES AND REGISTRATIONS

.1 Obtain, at own expense, all approvals and all relevant certificates for the Work and material which may be required by the authorities named above, Department of Labour, Province of Nova Scotia.

.2 Applicable mill test reports and certificates must accompany all deliveries.

.3 Confirm all documentation, including Canadian Registration No. (C.R.N.) and heat number where required accompanies all pipe shipped. Liaise with the Boilers and Pressure Vessel Inspection Division of the Department of Labour and Advanced Education of Nova Scotia and confirm all identifying marks and corresponding affidavits for pre-insulated pipe are witnessed by the Department of Labour Inspection prior to identifying marks being covered or otherwise obscured. Obtain written approval from any deviation from the procedure.

1.5 TEST AND INITIAL OPERATIONS

.1 Carry out tests specified by the Departmental Representative to determine the quality of the workmanship and the condition of materials and equipment. Tests to include witnessed hydrostatic and flushing tests of piping systems. Furnish at no additional expense to the Contract all materials equipment and labour for and shall facilitate in every way all tests required by the Departmental Representative. No separate payment will be made for such tests.

.2 The Departmental Representative will at their discretion carry out such additional tests as may be necessary to determine that every section of the Works will perform and operate satisfactorily and efficiently.

.3 Test each part of the Works as soon as possible after its installation.

.4 When installation is complete including the tests specified herein, start-up and conduct the initial operation of each system under the Departmental Representative's supervision. Provide tradesmen and equipment as may be required by the Departmental Representative for start-up.

.5 If the tests prove satisfactory, then the equipment or system will be accepted by the Departmental Representative.

1.5 TEST AND INITIAL OPERATIONS (Cont'd)

.6 If a malfunction is discovered and repairs and/or adjustments are necessary, return the equipment or system for remedial action at no extra cost to the Contract. After successful completion of repairs, testing or start-up will continue.

1.6 RECORD DRAWINGS

.1 Provide record drawings indicating the actual "as-built" data for the following:
.1 elevations
.2 inverts
.3 location of piping
.4 location of welds
.5 location of expansion joints
.6 location of all existing services uncovered during excavation

.2 In general, provide marked up drawings to the Departmental Representative indicating all differences in as-built and existing conditions from the information shown on drawings.

1.7 DELIVERY AND STORAGE

.1 Schedule material purchases, purchased material shipping, delivery, unloading, storing and transport to actual job site of all materials.

1.8 WARRANTY

.1 The warranty will be for five (5) years commencing on the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIAL SUPPLIED BY THE CONTRACTOR

.1 Supply all pre-insulated piping components and appurtenances. The material includes, but is not limited to: all straight pipe, valves, fittings and insulating, jacketing and jacket jointing systems.

.2 Supply sufficient material for installation of the systems outlined on the Drawings, when installed in an economical way.

.3 Any left-over material will be the property of the Owner.

2.2 PRE-INSULATED DISTRICT HEATING PIPING

.1 General:
.1 The prefabricated pipes will be made of a steel pipe, polyurethane foam insulation with integral copper alarm wires and an outer casing of polyethylene. The materials will be bonded together to form a solid unit with shear strength between the steel pipe and outer casing of a min. of 0.12 N/mm^2 in the axial and min. of 0.2 N/mm^2 in the tangential direction.
.2 In order to ensure uniform shear strength, grit blast the steel pipe to minimum preparation conforming to SSPC-SP6 immediately before foaming.

.2 Steel pipes:
.1 The dimensions of the steel pipes are to be in accordance with ISO 4200. The pipes will be delivered as welded pipes in steel quality St. 37.0 according to DIN 1626 or a corresponding standard. Welding factor v = 1.0.
.2 The pipes must conform to the technical requirements laid down in DIN 10217-1, and the quality must be documented in a Works certificate according to DIN 10204 or ASTM A53, Schedule 40.
.3 The Proponent will be responsible for obtaining Mill Test Certificates for all piping. Manufacturers name or trademark shall appear on all fittings and on each length of pressure pipe.

.3 Form insulation:
.1 The molded polyurethane foam must consist of minimum 88% closed cells and shall have the following properties:
.1 Average density over the entire pipe length: 80 kg/m^3.
.2 Core density: Min. 60 kg/m^3.
.3 Compressive strength: 0.4-0.6 N/mm^2.
.4 Continuous temperature load: Straight pipes 140°C, for 30 years.
.5 Thermal conductivity: 0.027 W/mK at 50° (before aging).

.4 Outer casing:
.1 Polyethylene:
.1 HDPE (Minimum PE 80, ISO 12162).
.2 Properties: Minimum as required in EN253.
.3 All parts are fully weldable within the melt flow index.
.4 MFR variation less than or equal to 0.5 g/10 min.
.2 Thermal Stability:
.1 Calculated continuous surface temperature greater than or equal to 50°C for 30 years.
.2 Oxidation induction timer (OIT): >30 min. at 210°C.

2.2 PRE-INSULATED DISTRICT HEATING PIPING (Cont'd)

.4 Outer casing:(Cont'd)
.3 Resistance against cracking formation:
.1 Slow crack formation (notch sensitivity) >3000 h (notch, 4 MPa, 80°, ISO 13479).
.2 Quick crack propagation (cold sensitivity) >5 bar (0°C, ISO 13377).
.4 Internal surface treatment:
.1 All outer casings are corona-treated during production. This ensures an optimum adhesion between outer casing and insulation.

.5 Alarm wire for leak detection system:
.1 Copper wires molded into the insulation must be able to:
.1 Detect moisture occurring in the foam insulation by a measurement between copper wire and steel pipe. Detection must occur before damage leads to corrosion of the steel pipe.
.2 Locate a break of the measuring wire.
.3 Be part a central surveillance by a combination of the integral copper wires and other system components.
.2 Crimp and solder wire joints. Provide crimp connectors and all tools necessary to ensure proper jointing of the wires.
.3 Place hygroscopic material around the wires joints.

2.3 JOINTS

.1 General:
.1 After welding and pressure testing of a steel pipes, seal the joints with muffs and insulate.
.2 Deliver the jointing material individually wrapped.
.3 The joint types applied to be power transmitting and be possible to have them pressure tested for tightness before they are installed.

.2 Joints for outer casing:
.1 A joint type must be either welded or heat shrunk together with the outer casing of the preinsulated pipe to form an unbreakable unit.
.2 After pressure testing the joint, it shall be possible to repair any leaks by a welding process, without having to demount the joint.
.3 A non-destructive inspection of the welds and the quality of the foam insulation shall be possible.

.3 Insulation of joints:
.1 Insulation of joints to be from two (2) factory-made pre-fabricated insulation shells.

2.4 FITTINGS

.1 Bends and curved pipe elements to be delivered as system solutions, which - after their installation - appear in the same quality as all other system parts.

.2 To the extent possible, directional changes in the dimension diameter of 88.9/160 mm or smaller will be affected by curving the pipes on site (using special tools as specified by the manufacturer) .

.3 To the extent possible, directional changes in the dimension diameter of 114.3/200 mm or larger will be effected by using pipes curved in the factory according to the indicated curving angle.

.4 For the curving of pipes on site as well as in the factory, use techniques and equipment which ensure that sporadic overloading of the materials used is avoided.

.5 Depending on the position of the mitering and pipe dimension, the manufacturer will provide the necessary instructions for size and execution.

2.5 ISOLATION VALVES

.1 Maintenance-free ball valve with an all-welded valve body and a stainless polished valve ball placed in a spring-loaded Teflon seats. Pre-insulated units. Provide T-keys for valve operation.

.2 Mark isolation valves permanently with closed and open position and so it is possible to effect replacement of stop and stem seals without having to remove casing and insulation material.

.3 Design valve arrangements such that a problem-free operation is ensured regardless of their position in a pre-stressed pipe system.

.4 Valves will be shipped to site after having been pressure tested and flushed clean by the Manufacturer. Valve ends will be factory sealed prior to shipment to prevent the entrance of foreign matter into the valves during shipment, storage and installation.

2.6 WELDING ELECTRODES

.1 Do welding only with electrodes certified to the requirements of the appropriate CSA W48 Standard, or other compatible or acceptable standard.

.2 Use electrodes listed in the Contractor's approved welding procedures.

PART 3 - EXECUTION

3.1 CLEANING AND PROTECTION OF PIPING AND EQUIPMENT

.1 Keep all piping and equipment clean and protected from damage, corrosion, contamination, distortion, ingress of dirt and foreign material.

.2 Immediately upon receipt at storage area, inspect all piping and equipment for damage. Store piping and equipment after being identified as specified and properly protected.

.3 Remove loose mill scale, sand and dirt from the inside and outside of all piping.

.4 Confirm all piping systems are free from foreign material. Flush each system with suitable fluids and supply, install and remove such temporary piping, screens, and fluids required to flush out the systems. Give the Departmental Representative not less than twenty-four (24) hours notice before such flushing is performed in each system or part of a system.

3.2 PRE-INSULATED DISTRICT HEATING PIPING

.1 Fabrication:
.1 Codes and procedures: piping fabrication to ANSI B31.1.
.2 Screwed fabrication is not allowed on this project.
.3 Welded metal joints:
.1 Welding to be in accordance with Clause 3.3.
.2 Prepare field bevels and shop bevels by mechanical means or flame cutting in conformance with ANSI Standard B31.1. Clean bevels of scale and oxidation just prior to welding.
.3 Provide full penetration welds. Use butt welding only on all district heating piping. Socket welding will be permitted for piping sizes N.P.S.2 (50 mm and less).

.2 DH pipework installation:
.1 Install the system in accordance with the pipe manufacturer's recommendations.
.2 Install the District Heating System in accordance with the pipe supplier's design criteria.
.3 The installation method will be determined upon the piping manufacturer submitting the design shop drawings.
.4 Install pre-insulated piping in trenches as indicated on the drawings. The vertical tolerance

3.2 PRE-INSULATED DISTRICT HEATING PIPING (Cont'd)

.2 DH pipework installation:(Cont'd)
.4 (Cont'd)
will be + 25 mm in locations where 0% slope is indicated.
.5 Weld with the piping laying on the boards above ground near the trench, or laying on wood supports in or over the trench or laying on sandbedding in the trench with excavations under every joint. Temporary board supports must be removed before backfilling.
.6 Protect open pipe ends from dirt and sand. Keep enclosed plastic caps on pipe ends until welding starts.
.7 Use piping in economic way by planning all cuts. Cut the jacket so that no indentations or fractures arise. Remove all insulation from the steel pipe before welding is started.
.8 If the District Heating piping has to be cut, cut the pipe leaving a 220 mm free steel pipe end left for joining.
.9 Keep exposed insulation dry during installation.

.3 Joints: install the system in accordance with manufacturer's recommendations.
.1 Use jointing kits supplied by the pipe supplier.
.2 Train personnel designated by the Contractor to work with foaming and jointing and use experienced personnel in this Work.

.4 Retain the service of the pre-insulated piping Technical Representative to supervise completion of the first joint as a minimum at no additional cost to the Contract. Retain further service of the pre-insulated piping Technical Representative as necessary to ensure installation in compliance with these specifications to the manufacturer's satisfaction at no additional cost to the Contract.

3.3 WELDING

.1 Reference standards: carry out all welding in accordance with the requirements of ANSI/ASME B31.1 and ANSI/ASME BPVC Section IX for piping system welds. In the case of piping systems welds, the use of backing rings is not permitted. At all times the requirements of the Boiler Inspection Branch, Department of Labour and Advanced Education, Government of the Province of Nova Scotia must be rigidly adhered to.

.2 Handling of welding electrodes: store all welding electrodes in their original sealed packaging in a warm dry area until immediately before the time that

3.3 WELDING (Cont'd)

.2 Handling of welding electrodes:(Cont'd)
they are used. Discard containers that show signs of damage. Store opened containers in heated ovens. A method of keeping electrodes warm and moisture free will be available with each welder.

.3 Workmanship:
.1 IT IS ABSOLUTELY IMPERATIVE THAT VALVES WELDED INTO THE SYSTEM MUST BE OPEN AS THE WELDING IS CARRIED OUT.
.2 Pipe welders must hold current certificates of qualifications registered in the Province of Nova Scotia for the class of work in which they are employed. Before commencing any welding on piping, retest each welder at the site in the relevant class of welding as provided in the Nova Scotia Boiler and Pressure Vessels Act and Regulations therein and Part A, Section IX, of the ASME Boiler and Pressure Vessel Code.
.3 Do welding in accordance with the Contractor's Welding Procedures and relevant standards. Submit to the Departmental Representative for acceptance complete approved written details of welding procedures which he proposes to adopt prior to the commencement of any welding. Do not deviate from the approved procedures. Make available at the work site at all times a copy of the approved welding procedure.
.4 Gas Tungsten Arc Welding (G.T.A.W.) Welding: G.T.A.W. is not required for welding of Carbon Steel materials unless otherwise specified. Where specified, perform G.T.A.W. root pass welding but with succeeding passes done by the shielded metal arc process.

.4 Radiographic and Visual Inspection of Pipe Welds:
.1 Carry out radiographic inspection of the total circumference of 100% of completed butt welded joints in welded ferrous piping. Payment for the x-ray services will be paid for by the Contractor at no additional cost to the Contract. Payment for the radiographic inspection of the pre-qualification test welds will also be at not additional cost to the Contract. The radiography will be gamma-ray type and performed by an independent testing agency specializing in this type of testing in accordance with Section V of the ASME Boiler and Pressure Vessel Code and CAN/CGSB-48.2. This Agency must be certified in accordance with CSA W178.1.
.2 Leave pipe joints uncovered until they have been inspected, tested and accepted by the Departmental Representative and/or Provincial Authority.

3.3 WELDING (Cont'd)

.4 (Cont'd)

.3 Each welder must identify his welded joint by painted initials and sequentially numbering his welded joints as the joints are completed. Sequential numbering will be cross referenced by the Contractor to the numbering system used for the leak detection system leak locations.

.4 Welders must be withdrawn from pipework welding and be submitted for requalification tests in the event of three (3) consecutive welds being rejected.

.5 If a radiograph indicates a weld not in accordance with this Specification, the Contractor, at no additional cost to the Contract, will repair the weld within thirty six (36) hours and provide such additional radiographs as may be required by the Departmental Representative to satisfy him regarding the quality of the remainder of the Work.

.6 Submit all radiographic film for approval within twenty-four (24) hours of the radiograph being completed. Identify all welds and the appropriate identification, together with the welder's designated number or letter must be permanently shown on each radiographic film.

.7 The following defects would be cause of weld rejection as determined by the Departmental Representative:

.1 As described in ANSI/ASME B31.1.

.2 Welding performed by unqualified personnel.

.3 Welds not reasonably uniform in appearance.

.4 Evidence of peening.

.5 Cracks

.6 Oxidation of Welds

.7 Lack of fusion

.8 Welds lacking welder's identification.

.8 Technique and requirements for the radiographic examination of welds:

.1 Radiographic technique to be in accordance with ANSI/ASME B31.1 and ANSI/ASME BPVC, Section V.

.2 Use the latest type ASME Penetrameters.

.3 Where double wall radiography using an external radioactive source is impracticable, radiograph the welds with the unshrouded source located inside the piping (centre shot), and emitting full intensity in all directions. To facilitate centre shots, a boss shall be located 150 mm from the weld centreline. Exposures shall be made on films placed on the outer surface of the pipe around the whole circumference of the weld.

.4 Use industrial X-ray film of the medium speed, fine grain, high contrast type.

3.3 WELDING (Cont'd)

.4 (Cont'd)

.9 Interpretation of radiographs: to ANSI/ASME B31.1. In cases of dispute, the decision of the Departmental Representative is final.

.10 Acceptance, ownership and handling of radiographs:

.1 The Departmental Representative reserves the right to reject any or all radiographic films which contain excessive mechanical, chemical, or other processing defects that could interfere with proper interpretation of the radiograph. In the event of a rejection, re-radiograph the joint at no additional cost to the Contract. Catalogue and file all radiographs in a manner acceptable to the Departmental Representative.

.2 The radiographs, filing containers and catalogues become the property of the Owner and must be forwarded to the Departmental Representative on completion of each system prior to the hydrostatic test.

.11 Radiography personnel: radiographers must be certified by the Canadian Government Specification Board, under Standard 48-GP-4. All radiography must be carried out under the supervision of a radiographer who holds the qualifications of Senior Radiographer in accordance with CGSB Standard 48-GP-4.

.12 Radiography safety requirements: the safety requirements of the following codes shall be rigidly adhered to:

.1 Dept. of National Health & Welfare - RPO-S-1.

.2 Atomic Energy Control Board - AECL Bulletin

3.4 PREPARATION

.1 Lay out work in accordance with lines and grades as indicated.

.2 Verify trench profiles, grades, lines, levels, dimensions as indicated against established benchmarks. Report discrepancies to Departmental Representative and obtain written instruction.

.3 When required by Departmental Representative, provide drawings showing relative locations of various services.

3.5 INSTALLATION OF PIPING

.1 Maintain clearances between pipes as indicated.

.2 Maintain clearance between pipes and structures for O&M as indicated, as directed and according to manufacturer's recommendations.

.3 Provide manual air vents and drains as specified and as indicated.

.4 Seal piping passing through walls as indicated on the design drawings and the piping supplier's shop drawings.

.5 Provide for pipe movement as indicated.

.6 Use eccentric reducers in horizontal piping to prevent accumulation of pockets of air or condensate.

.7 Weld couplings for drains into piping to ANSI/ASME B31.1.

.8 Cap open ends of piping during installation. Remove all foreign material from inside piping.

.9 Remove all burrs from piping.

.10 Grade nominally horizontal piping as indicated to low point for drainage.

.11 Flanges: Tighten bolts evenly with torque wrench. Retighten bolts with torque wrench after system is in operation.

.12 Revisions to location of piping require written approval of Departmental Representative.

3.6 VALVES

.1 Install isolating valves at all branch take-offs, at each piece of equipment and elsewhere as indicated.

.2 Install in accordance with manufacturer's recommendations.

.3 Install in accessible locations with stem vertical where possible where indicated, but horizontal or above as a minimum.

.4 Flanged valves to be accessible for maintenance without removing adjacent piping.

3.7 VALVED DRAINS

.1 Locations:
.1 At bottom of risers.
.2 At low points in mains and branches.
.3 Elsewhere as indicated.

.2 Discharge:
.1 Provide hose adapter on drain valves where discharge piping cannot conveniently be carried to floor drains drainage trench.

.3 Check operation after system is in use and under full pressure.

3.8 AIR VENTS

.1 Install at high points and elsewhere as indicated on hydrotest only. Seal weld vents after successful hydrotest.

3.9 INSPECTIONS

.1 Leave all joints in piping systems uncovered until all tests are completed and system inspected and approved by Departmental Representative.

3.10 LEAKAGE TESTING AND FLUSHING PIPING

.1 Leak testing:
.1 For steel district heating piping, perform full hydrostatic test in accordance with Chapter VI Article 137 of B31.1 and using only clean potable water. Give Departmental Representative one (1) day prior notice. The test pressure to be 125 psig for six (6) hours duration. Supply and install pressure relieving devices to prevent over-pressurizing of pipe.
.2 After testing, completely drain all water from piping.
.3 Install and remove temporary piping and supports to release air in piping being tested. Adjacent system piping may be operational while testing is underway.
.4 Carry out all leak testing in accordance with the Boiler and Pressure Vessel Inspection, Inspection Services Division, Department of Labour and Advanced Education, Government of the Province of Nova Scotia.

.2 Flushing:
.1 Remove all foreign material from the inside of the piping as the work progresses and at the direction of the Departmental Representative.
.2 Perform flushing after leak testing is completed.

3.10 LEAKAGE TESTING AND FLUSHING PIPING (Cont'd)

.2 Flushing:(Cont'd)

.3 Flushing flows must be a minimum of 1.5 metres/sec.

.4 Notify the Departmental Representative two (2) days in advance of flushing.

.5 Install and remove temporary piping and supports to supply and carry the flushing water away to a safe discharge point.

.6 Install barriers at all flushing discharge points and keep unauthorized personnel away from discharge point.

.7 Flush using potable water for a period of 10 minutes. When all piping has been flushed it is to be completely dried.

3.11 FINAL CONNECTIONS

.1 Provide blind flange and gate valve for future connection to hot water supply heating system. Connections to the heating system shall be done by others. Provide blind flanges and gate valves for final connections.

.2 Charge the district piping system with nitrogen to 125 psig after completion of all other testing and flushing specified eslewhere in this section. Provide pressure gauges on both ends of supply and return piping to facilitate the monitoring of pre-insulated piping system throughout all construction.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00.

.2 Closeout Submittals: Section 01 78 00

.3 Domestic Water Supply Piping - Copper: Section 22 11 18

.4 Valves - Bronze: Section 23 05 23

.5 Valves - Cast Iron: Section 23 05 24

.6 Valves - Cast Steel: Section 23 05 25

.7 Steel Pipe and Fittings - Hydronic Systems: Section 23 21 13

1.2 REFERENCES

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

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

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

.4 ASME B16.22-2001, 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-04, Filler Metals for Brazing and Braze Welding.

1.3 SHOP DRAWINGS

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

.2 Indicate on manufacturer's catalogue literature the following: valves.

1.4 MAINTENANCE DATA

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

PART 2 - PRODUCTS

2.1 PIPING

.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.

2.2 FITTINGS

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.

.3 Cast iron threaded fittings: to ANSI/ASME B16.4.

.4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

.5 Roll grooved fittings: with rigid joints.

2.3 JOINTS

.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.

2.4 VALVES - ALL TYPES

.1 See Section 22 11 18, 23 05 23m 23 05 24 and 23 05 25.

PART 3 - EXECUTION

3.1 GENERAL

.1 Refer to Section 22 11 18 and 23 21 13.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Mechanical General Requirements: Section 21 05 01

1.2 REFERENCES

.1 ANSI B18.2.1-2010, Square and Hex Bolts and Screws, Inch Series.

.2 ANSI/AWWA C111/A21.11-07, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.

.3 ASME B16.1-2010, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125 and 250.

.4 ASME B16.3-2011, Malleable-Iron Threaded Fittings, Classes 150 and 300.

.5 ASME B16.5-2009, Pipe Flanges and Flanged Fittings: CPS 1/2 through NPS 24 Metric/Inch Standard.

.6 ASME B16.9-2007, Factory-Made Wrought Steel Butt-Welding Fittings.

.7 ASME B18.2.2-2010, Square and Hex Nuts.

.8 ASTM A47/A47M-99(2009), Specification for Ferritic Malleable Iron Castings.

.9 ASTM A 53/A 53M-10, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc- Coated, Welded and Seamless.

.10 ASTM A536-84(2009), Specification for Ductile Iron Castings.

.11 ASTM B 62-09, Specification for Composition Bronze or Ounce Metal Castings.

.12 CSA-B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.

.13 CSA-W47.1-09, Certification of Companies for Fusion Welding of Steel.

1.3 SHOP DRAWINGS

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

.2 Indicate on manufacturers catalogue literature the following:
.1 Valves.
.2 Grooved fittings.

1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00.

PART 2 PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A53, Grade B, as follows:
.1 To NPS 6, Schedule 40 (Hydronic Systems).
.2 NPS 8 and over, Schedule 30.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with teflon tape.

.2 NPS 2-1/2 and over: welded fittings and flanges to CSA W47.1.

.3 Roll grooved: rigid coupling to CSA B242, except for first 3 couplings next to circulating pumps which are to be flexible pattern, minimum pressure rating 2069 kPa. Victaulic or approved equivalent. (Note: This is in addition to flexible connections specified elsewhere).

.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.
.1 Acceptable Material: Victaulic Style 07 Rigid Couplings; Victaulic Style 77 Flexible Couplings.

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 manufacturer.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

.1 Connect to equipment in accordance with equipment manufacturer's instruction and the specified requirements unless otherwise indicated.

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

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

.4 Use eccentric reducers pipe size changes, installed to provide positive drainage or positive venting.

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

.6 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.

.7 Assemble piping using fittings manufactured to ANSI standards.

.8 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

3.1 PIPING INSTALLATION (Cont'd)

.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 Ensure all air is vented from the system.

3.4 TESTING

.1 Test system in accordance with Section 21 05 01.

END

PART 3 - GENERAL

3.1 RELATED WORK

.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

3.2 REFERENCES

.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- 2009(R2009), Specification for Ferritic Malleable Iron Castings.
.2 ASTM A248/A278M-01(R2011), Specification for Gray Iron Castings for Pressure-Containing 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 CAN/CSA C22.2 No. 68-09, Motor Operated Appliances.
.2 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

.4 Provincial Boiler, Pressure Vessel and Compressed Gas Regulations.

3.3 PRODUCT DATA

.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.

3.4 SHOP DRAWINGS

.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 DIAPHRAGM TYPE EXPANSION TANK

.1 Horizontal or vertical as indicated steel pressurized diaphragm type expansion tank.
- .1 Initial temperature: as indicated.
- .2 Final temperature: as indicated.
- .3 Minimum operating pressure: as indicated.
- .4 Maximum operating Pressure as indicated.

.2 Capacity: as indicated
- .1 Acceptance volume: as indicated.

.3 Size: length and diameter as indicated.

.4 Diaphragm sealed in elastomer or EPDM suitable for 115 C operating temperature.

.5 Working pressure: 860 kPa with ASME stamp and certification.

.6 Air precharged to 84 kPa plus residual static pressure (initial fill pressure of system) or as indicated.

.7 Saddles for horizontal installation, base mount for vertical installation.

.8 Supports: Provide supports with hold down bolts and installation templates.

.9 Renewable diaphragm.

2.3 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.

2.4 AIR SEPARATOR - EXPANSION TANK FITTING

.1 Complete with adjustable vent tube and built-in manual vent valve.

.2 Working pressure: 1034 kPa.

2.5 AIR SEPARATOR - IN-LINE

.1 Working pressure: 1034 kPa.

.2 Size: for 0.15 m/s

.3 Shell: steel to ASME BPVC Section VIII.

.4 Removable stainless steel collection tube.

2.6 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

.1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing or as indicated.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.7 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.

2.8 SUCTION DIFFUSER

.1 Body: cast iron with flanged or grooved ductile iron connections 2.1 MPa.

2.8 SUCTION DIFFUSER (Cont'd)

.2 Strainer: with builtin, disposable 1.19 mm mesh, startup strainer, low pressure drop screen and NPS 1 blowdown connection.

.3 Permanent magnet particle trap.

.4 Full length straightening vanes.

.5 Pressure gauge tappings.

.6 Adjustable support leg.

2.9 GLYCOL MAKEUP PACKAGE

.1 See equipment schedule on Drawings for more information.

.2 12mm (1/2 FNPT) system valve.

.3 Lift with recovery line from system relief valve.

.4 Storage/mixing tank with cover; pump suction hose with inlet strainer; pressure pump with thermal cut-out; integral pressure switch; integral check valve; cord and plug; pre-charged accumulator tank with EPDM diaphragm; manual diverter valve for for purging air and agitating contents of storage tank; pressure regulating valve adjustable (35- 380 KPa; 5-55 psig) complete with pressure gauge; integral replaceable strainer; built- in check valve; union connection; 12mm x 900mm long flexible connection hose with check valve; low level pump cut-out. Pressure pump shall be capable of running dry without damage. Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No. 68.

.5 Accessories: Low level alarm panel complete with remote monitoring dry contacts and selectable audible alarm.

.6 Acceptable Manufacturer: Axiom, Exponflex, Armstrong or approved equivalent.

2.10 CIRCUIT BALANCING VALVES

.1 Valves sizes 13mm to 50mm.
.1 Valve body to be bronze 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.

2.10 CIRCUIT BALANCING VALVES (Cont'd)

.2 Valve sizes 62mm to 300mm

.1 Valve body to be ductile iron with industrial grooved ends. Valve stem and plug disc to be bronze with ergonomically designed handwheel with multi-turn adjustments. Features to be the same as the smaller valve.

.3 Acceptable: Armstrong CBV Type, tour & Anderson, or equal.

2.11 COMBINATION AUTOMATIC FLOW LIMITER AND CONTROL VALVE

.1 Used for all final coil/heater connections.

.2 Refer to Section 23 09 00 for specification.

2.12 PREMIXED GLYCOL SOLUTION

.1 42% Propylene Glycol with dye and corrosion inhibitor.

.2 Acceptable products: Dowfrost or approved equivalent.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines and blow off connections to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

3.2 STRAINERS (Cont'd)

.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 EXPANSION TANKS

.1 Adjust expansion tank pressure as indicated to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

3.5 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain. Provide union near connection to the valve.

3.6 SUCTION DIFFUSERS

.1 Install on inlet to pumps having suction size greater than 50.

3.7 GLYCOL MAKEUP PACKAGE

.1 Fill entire system with propylene glycol. Leave the glycol tank 50% full. Refer to drawings for glycol systems which include but are not limited to: The chilled water system, heating hot water at AHU coils and solar hot water heating system.

3.8 CIRCUIT BALANCING VALVES

.1 Install with flow in the direction of the arrow on the valve body at least five pipe diameters downstream form any fitting and ten pipe diameters downstream from a pump. Easy and unobstructed access to valves to be maintained.

.2 Refer to controls section for combination flow limiter and control valves.

3.9 CLEANING

.1 Clean in accordance with Section 01 78 00.

.2 Remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Closeout Submittals: Section 01 78 00

.3 Steel Piping & Fittings - Hydronic Systems: Section 23 05 13

.4 Thermometers and Pressure Gauges - Piping Systems: Section 23 05 20

1.2 SHOP DRAWINGS

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

.2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

.3 Submit shop drawings of pump curves for review showing point of operation.

.4 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

1.3 MAINTENANCE DATA

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

.2 Data to include:
.1 Manufacturers name, type, model year, capacity and serial number.
.2 Details of operation, servicing and maintenance.
.3 Recommended spare parts list with names and addresses.

1.4 WARRANTY

.1 Provide five (5) year parts and labour warranty from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 IN-LINE COMMERCIAL DUTY CIRCULATION PUMPS

.1 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.

.2 Impeller: corrosion resistant alloy steel or cast iron.

.3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical for service to 135 C.

.5 Motor: (1750 rpm maximum) resilient mounted open, drip proof, sleeve bearing, premium efficiency, refer also to Section 23 05 13.

.6 Motors shall be non-overloading over the published performance curve. Motors shall be high efficiency inverter duty.

.7 Capacities: as indicated on the Drawings.

.8 Design pressure: 1034 kPa.

.9 Tapped openings in volute and flanges for draining and gauge connections.

.10 Performance: refer to pumps schedule on mechanical drawings.

.11 Acceptable product: ITT Bell & Gossett; Grundfos/Paco; Armstrong.

2.2 VERTICAL IN-LINE AND END SUCTION COMMERCIAL DUTY CIRCULATION PUMPS

.1 Volute: cast iron, radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.

.2 Impeller: bronze.

.3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical for service to 135 C.

.5 Coupling: rigid self-aligning.

.6 Motor: (1750 rpm maximum) resilient mounted, open, drip proof, stainless steel or bronze sleeve bearing.

2.2 VERTICAL IN-LINE AND END SUCTION COMMERCIAL DUTY CIRCULATION PUMPS (Cont'd)

.7 Motors shall be non-over-loading over the published performance curve. Motors shall be high efficiency inverter duty.

.8 Capacities: as indicated on the drawings.

.9 Design pressure: 1034 kPa.

.10 Performance: refer to pumps schedule on mechanical drawings.

.11 Acceptable product: Armstrong; ITT Bell & Gossett; Grundfos/Paco.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible. Do not support motor. Provide 12 mm thick neoprene pads below pipe supports for vertical in-line pumps.

.2 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.3 Pipe drain tapping to floor drain.

.4 Install volute venting pet cock in accessible location.

.5 Check rotation prior to start-up.

.6 Install pressure gauges and test cocks. Refer also to Section 23 05 20.

3.2 START-UP

.1 General:
.1 In accordance with manufacturer's recommendations.

.2 Procedures:
.1 Before starting pump, check that over-temperature and other protective devices are installed and operative.
.2 After starting pump, check for proper, safe operation.

3.2 START-UP (Cont'd)

.2 Procedures:(Cont'd)

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free- floating, no obstructions under base.

.5 Run pumps for 12 continuous hours.

.6 Verify operation of over- temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Verify lubricating oil levels.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
.1 ASME B16.22-2001, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
.2 ASME B16.24-2011, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
.3 ASME B16.26-2011, Cast Copper Alloy Fittings for Flared Copper Tubes.
.4 ASME B31.5-2010, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials (ASTM)
.1 ASTM A 307-2012, Specification for Carbon Steel Bolts and Studs, 414 MPa Tensile Strength.
.2 ASTM B 280-08, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA)
.1 CSA B52-2005(R2009), Mechanical Refrigeration Code.

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

PART 2 - PRODUCTS

2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
.1 Hard copper: to ASTM B 280, type ACR 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 2068 kPa and temperature 121 C.

.2 Brazed:
.1 Fittings: wrought copper to ASME B16.22.
.2 Joints: silver solder, 45% Ag-15% Cu or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

2.2 FITTINGS (Cont'd)

.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 22mm and under: Class 500, 3495 kPa, 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 22mm: Class 375, 2502 kPa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

PART 3 - EXECUTION

3.1 GENERAL

.1 Work to be performed by licensed (certified) refrigeration personnel.

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

3.2 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.3 PIPING INSTALLATION

.1 General:
.1 Soft annealed copper tubing: bend without crimping or constriction Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Suction lines:
.1 Pitch at least 12 mm per 3 m away from the evaporator.
.2 Provide trap at base of risers.
.3 Provide double risers for compressors having capacity modulation.
.4 Large riser: install traps as specified above.
.5 Small riser: size for 5m/s at minimum load. Connect upstream of traps on large riser.

3.4 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 1999 kPa and 1000 kPa on high and low sides respectively.

.3 Test Procedure: Build pressure up to 34 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.5 DEHYDRATION AND CHARGING

.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 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 96 kPa vacuum and hold for 4 h.
.2 Break vacuum with refrigerant to 14 kPa.
.3 Final to absolute and hold for at least 12 h.

3.5 DEHYDRATION AND CHARGING (Cont'd)

.6 (Cont'd)
.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
.5 Submit test results to the Departmental Representative.

.7 Charging:
.1 Charge system through filter- drier and charging valve on high side. Low side charging not permitted.
.2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
.3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:
.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
.2 Record and report measurements to the Departmental Representative.

3.6 INSTRUCTIONS

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

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM A480/A480M-2013, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .2 ASTM A635/A635M-09b, Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Alloy, Carbon, Structural, High- Strength Low- Alloy and High-Strength Low-Alloy with Improved Formability.
- .3 A653/A653M-2011, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.2 National Fire Protection Agency (NFPA)
- .1 NFPA 90A-12, Installation of Air Conditioning and Ventilating Systems.
- .2 NFPA 90B-12, Installation of Warm Air Heating and Air Conditioning Systems.
- .3 NFPA 91-10, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Non-combustible Particle Solids.
- .4 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .2 SMACNA HVAC Duct Leakage Test Manual.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

.2 Indicate following:
- .1 Sealants.
- .2 Tape.
- .3 Proprietary Joints.

1.3 CERTIFICATE OF RATINGS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with municipal regulations.

PART 2 - PRODUCTS

2.1 SEAL CLASSIFICATION

.1 Classification to SMACNA Seal Class A.

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

2.2 SEALANT

.1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 300 C to plus 930 C.

2.3 TAPE

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

2.4 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:
.1 Rectangular: Centreline radius: 1.5 times width of duct.
.2 Round: smooth radius or five piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:
.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 45° entry on branch.
.2 Round main and branch: enter main duct at 45° with conical connection.
.3 Provide volume control damper in branch duct near connection to main duct.
.4 Main duct branches: with volume control damper.

2.4 FITTINGS (Cont'd)

.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 cross-sectional area. Maximum included angles: as for transitions.

2.5 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation only if required by authority having jurisdiction.

.2 Firestopping material and installation must not distort duct.

2.6 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653, G90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA. Less than 24 gauge is not permitted.

.3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.7 STAINLESS STEEL

.1 To ASTM A480/A480M, Type 316, 18 gauge minimum.

.2 Finish: No 4. finish on exposed side of duct in finished areas, No. 3 finish or lower where concealed.

.3 Thickness, fabrication and reinforcement: to SMACNA.

.4 Joints: to SMACNA and be continuous inert gas welded. Lateral seam orientated at the top of the duct.

2.8 HANGERS AND SUPPORTS

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.

.2 Hanger configuration: to SMACNA.

2.8 HANGERS AND SUPPORTS (Cont'd)

.3 Hangers: galvanized steel angle with black steel rods to ASHRAE or SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
051 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.

.5 Duct shaft supports:
.1 Design with steel angles to rigidly support ductwork within the shaft opening. Use SMACNA standard details where possible. Submit shop Drawing with supported weights for installations outside SMACNA guidelines.
.2 Steel angle shall never be smaller than 38mm x 38mm x 7mm for shaft supports.

PART 3 - EXECUTION

3.1 DUCT SYSTEMS

.1 Exhaust ducts TO be galvanized steel except where indicated on the plans to be stainless steel. All stainless steel duct systems TO be fully welded, i.e. transverse and longitudinal seams.

.2 Supply ducts TO be galvanized steel except 1.5m of acoustic flex duct for ceiling diffusers and flexible connections at equipment.

3.2 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.

.7 Protect all ductwork from dirt and weather during transportation, prior to and during installation. Use enclosed trailers and store material indoors in a covered and protected area.

3.3 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 (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.4 WATERTIGHT DUCT

.1 Provide watertight duct for:
.1 Fresh air intake and exhaust plenums.
.2 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 Fit base of riser with 150 mm deep drain sump and NPS 1½ drain connected, with deep seal trap and valve

3.4 WATERTIGHT DUCT (Cont'd)

.3 (Cont'd)
and discharging to open funnel drain or service sink or as approved by Departmental Representative.

3.5 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 (1) coat of sealant to manufacturers recommendations. Sealant and tape to be applied to full perimeter of duct.

3.6 LEAKAGE TESTS

.1 Perform duct leakage on all fume exhaust ductwork in accordance with SMACNA HVAC Duct Leakage Test Manual.

.2 Do leakage tests in sections.

.3 Make trial leakage tests as instructed to demonstrate workmanship.

.4 Install no additional ductwork until trial test has been passed.

.5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 elbows.

.6 Complete test before insulation or concealment.

3.7 BRANCH CONNECTIONS AND TEES

.1 Use low loss fittings with conical tee's at round branch ducts.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
.1 SMACNA 1966-HVAC Duct Construction Standards Metal and Flexible, 2005.

1.3 PRODUCT DATA

.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.

1.4 CERTIFICATION OF RATING

.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

2.1 GENERAL

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

2.2 FLEXIBLE CONNECTIONS

.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 400 C to plus 900 C, density of 1.3 kg/m¦.

2.3 ACCESS DOORS IN DUCTS

.1 Non-insulated 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 (1) sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

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

2.4 TURNING VANES

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

2.5 INSTRUMENT TEST PORTS

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 BRANCH CONNECTIONS

.1 Conial galvanized sheet metal with lockable butterfly damper.

.2 Sheet metal thickness to co- responding round duct standards.

.3 Use only low loss fittings. For round branches with a diameter of 100mm or less smaller than the main, use regular to round low loss fittings.

2.6 BRANCH CONNECTIONS (Cont'd)

.4 No branch fittings at the same size as the branch duct will be permitted. Use conical or square-to-round only.

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 Ensure slack material in flexible connection.

.2 Access doors and viewing panels:
- .1 Size:
  - .1 600 x 600 mm for person size entry.
  - .2 450 x 450 mm for servicing entry.
  - .3 300 x 300 mm for viewing.
  - .4 As indicated.
- .2 Locations:
  - .1 Fire and smoke dampers.
  - .2 Control dampers.
  - .3 Devices requiring maintenance.
  - .4 Required by code.
  - .5 Reheat coils.
  - .6 Intake and exhaust plenums.
  - .7 Turning vanes.
  - .8 As required for duct cleaning (minimum 30 ft apart and at all changes in direction)
  - .9 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.

3.1 INSTALLATION (Cont'd)

.3 (Cont'd)
.1 General:(Cont'd)
.4 Locations.
.1 For traverse readings:
.1 Ducted inlets to roof and wall exhausters.
.2 Inlets and outlets of other fan systems.
.3 Main and submain ducts.
.4 And as indicated.
.2 For temperature readings:
.1 At outside air intakes.
.2 In mixed air applications in locations as approved by Departmental 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.
.2 At all right angle bonds whether indicated on the drawings or not.

PART 1 - GENERAL

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

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

1.3 PRODUCT DATA
.1 Submit product data in accordance with Section 01 33 00.

.2 Indicate the following: dimensions, materials.

PART 2 - PRODUCTS

2.1 GENERAL
.1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS
.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.

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.

2.3 MULTI-BLADED DAMPERS (Cont'd)

.4 Bearings: pin in bronze bushings or self-lubricating 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 in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Provide for supply, return and exhaust systems and locate balancing dampers in each branch duct.

.3 Provide for runouts to registers and diffusers: located as close as possible to main ducts.

.4 All dampers to be vibration free.

.5 Ensure damper operators are observable and accessible.

.6 Provide where indicated on the plans.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Closeout Submittals: Section 01 78 00

.3 Duct Accessories: Section 23 33 00

.4 Field Control Devices: Section 25 30 02

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)
.1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

.2 Indicate the following:
.1 Performance data.
.2 Specifications.

1.4 CLOSEOUT SUBMITTALS

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

1.5 CERTIFICATION OF RATINGS

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

PART 2 - PRODUCTS

2.1 MULTI-LEAF DAMPERS

.1 Opposed or parallel blade type as indicated, or opposed blades for modulating control functions, parallel for two position operation.

.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.

2.1 MULTI-LEAF DAMPERS (Cont'd)

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Operator: to Section 25 30 02.

.6 Performance:
.1 Leakage: in closed position to be less than 2% of rated air flow at 500 Pa differential across damper.
.2 Pressure drop: at full open position to be less than 25 Pa differential across damper at 10 m/s.

.7 Insulated aluminum dampers:
.1 Extruded aluminum (6063T5) damper frame is not less than 2.03mm in thickness. Damper frame is 100mm deep and is insulated with polystyrene on four sides if type.
.2 Flanged to Duct Type.
.3 Blades are extruded aluminum (6063T5) profiles, internally insulated with expanded polyurethane foam and thermally broken. Complete blade has an insulating factor of R 2.29 and a temperature index of 55.
.4 Blade seals are extruded EPDM. Frame seals are extruded silicone. Seals are secured in an integral slot within the aluminum extrusions.
.5 Bearings are composed of a Celcon inner bearing fixed to a 7/16" aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
.6 Linkage hardware is installed in frame side and constructed of aluminum and corrosion resistant, zinc- plated steel, complete with cup-point trunnion screws for a slip-proof grip.
.7 Dampers are designed for operation in temperatures ranging between - 40 C and 85 C.
.8 Dampers are parallel blade action.
.9 Leakage does not exceed 15.2 l/s/m¦ against.25 kPa w.g. differential static pressure.
.10 Pressure drop of a fully open 1219mm x 1219mm damper does not exceed .007kPa w.g. at 5.08 l/s.
.11 Dampers are made to size required without blanking off free area.
.12 Installation of dampers must be in accordance with current manufacturer's installation guidelines provided with each shipment of dampers.
.13 Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width.

2.1 MULTI-LEAF DAMPERS (Cont'd)

.7 Insulated aluminum dampers:(Cont'd)
.14 Acceptable material: Tamco Series 9000, Nailor, E. H. Price, Honeywell, Johnson.

2.2 DISC TYPE DAMPERS

.1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A 653M.

.2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A 653M.

.3 Gasket: extruded neoprene, field replaceable, with ten (10) year warranty.

.4 Bearings: roller self lubricated and sealed.

.5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.

.6 Performance:
.1 Leakage: in closed position to be less than 2 % of rated air flow at 500 Pa pressure differential across damper.
.2 Pressure drop: at full open position to be less than 25 Pa differential across damper at 10 m/s.

2.3 BACK DRAFT DAMPERS (BDD)

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

2.4 RELIEF DAMPERS

.1 Automatic multi-leaf 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 Ensure dampers are observable and accessible.

.6 Provide motorized insulated dampers at each duct connected to the out doors.

END

PART 1 - GENERAL

1.1 RELATED WORK

.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-11, Installation of Air Conditioning and Ventilating Systems.

.2 Underwriters Laboratories of Canada (ULC)
.1 ULCS112-07, Fire Test of Fire Damper Assemblies.
.2 ULCS112.2-M84, Fire Test of Ceiling Firestop Flap Assemblies.
.3 ULCS505-74, Fusible Links for Fire Protection Service.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Provide following:
.1 Six (6) fusible links of each type.

1.6 CERTIFICATE OF RATINGS

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

PART 1 - PRODUCTS

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type B or C, blades out of air stream listed and bear label of latest edition ULCS112, meet requirements of provincial fire authority and ANSI/NFPA 90A. Fire damper assemblies to be fire tested in accordance with ULC4S112. Minimum rating 1‖ hours, dynamically rated. Static dampers are not permitted.

.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; multi-blade 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 negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow. Fusible link shall activate at 165‖F.

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

.6 Equip fire dampers with steel sleeve or frame installed to prevent disruption of ductwork or impair damper operation.

.7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the

2.1 FIRE DAMPERS (Cont'd)

.9 (Cont'd)
centerline of the wall, partition or floor slab depth or thickness.

.10 Unless otherwise indicated, the installation details given in SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC and in manufacturer's instructions for fire dampers shall be followed.

.11 Dampers shall be rated for dynamic closure at minimum 2000 FPM and 4 inches w.g. static pressure with airflow in either direction.

.12 Dampers shall be certain type, Ruskin Model DIBD2, or equal.

2.2 SMOKE DAMPERS

.1 To be 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 (2) flexible stainless steel blade edge seals to provide required constant sealing pressure.

.3 Normally open smoke/seal (S/DSSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units mounted horizontally in vertical ducts.

.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 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 ULCS505 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.

.5 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.

3.2 COMMISSIONING

.1 Commission in accordance with Contractor's Commissioning Plan.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

1.2 REFERENCES

.1 National Fire Protection Association (NFPA)
.1 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.
.2 NFPA 90B-2012, Installation of Warm Air Heating and Air Conditioning Systems.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
.1 SMACNA-1966 HVAC Duct Construction Standards Metal and Flexible, 2006.

.3 Underwriters' Laboratories of Canada (ULC)
.1 CAN/ULCS110-2007, Fire Tests for Air Ducts.
.2 UL 181-2005, Factory Made Air Ducts and Connectors.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

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

1.4 CERTIFICATION OF RATINGS

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

1.5 SAMPLES

.1 Submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00.

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

.2 Performance:
.1 Factory tested to 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.(mm)					
100	0.6	3	12	27	0
150	1.2	3	12	22	27
200	2.0	5	12	19	20
300	2.4	5	12	16	15

.3 Flexible duct work installed above metal baffle ceilings shall be black.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

.1 Install in accordance with: NFPA 90A and NFPA 90B SMACNA.

.2 Do trial test to demonstrate workmanship.

.3 Use for minimum 0.9m and maximum 1.5m between ceiling mounted diffusers and branch ducts on supply duct systems only. Do not use for exhaust air duct systems.

.4 Flexible duct shall have no more than a 15 offset and shall have a minimum of two hangers.

END

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 23 05 13 Motors, Drives and Guards.

.2 Section 23 05 48 Vibration Isolation and Seismic Control.

.3 Section 23 33 00 Duct Accessories.

1.2 REFERENCES

.1 AMCA 99-07, Standards Handbook.

.2 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Rating.

.3 AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.

.4 AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.5 CGSB 1.181-99, Ready Mixed Organic Zinc-Rich Coating.

.6 NEMA ICS 7.1-06 Safety Standard for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

.7 American Bearing Manufacturers Association (ABMA).

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data showing:
.1 Fan performance curves showing point of operation, BHP and efficiency.
.2 Sound rating data at point of operation.
.3 Dimensional data.
.4 Installation procedures.

.2 Indicate:
.1 Motors, sheaves, bearings, shaft details.
.2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate, dimensions, installation procedure.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into operation and maintenance manual.

1.5 EXTRA MATERIALS

.1 Spare parts to include:
.1 Matched sets of belts.
.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.6 MANUFACTURED ITEMS

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

1.7 WARRANTY

.1 Provide extended warranty for parts and labour for five (5) years following project substantial completion.

PART 2 PRODUCTS

2.1 FANS GENERAL

.1 Accesories and hardware: matched sets of Vbelt drives, adjustable slide rail motor bases, belt guards, coupling guards, fan inlet and/or outlet safety screens as indicated and as specified in Section 23 05 13 Motors, Drives and Guards, inlet or outlet dampers and vanes as indicated.

.2 Factory primed before assembly in colour standard to manufacturer.

.3 Scroll casing drains: as indicated.

.4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.5 Vibration isolation: to Section 23 05 48 Vibration Isolation and Seismic Control.

.6 Flexible connections: to Section 23 33 00 Duct Accessories.

2.2 CENTRIFUGAL FANS

.1 Fan wheels:
.1 Welded steel or aluminum construction.
.2 Maximum operation speed of centrifugal fans not more than 40% of first critical speed.
.3 Air foil or backward inclined blades, as indicated.
.4 Bearings: air handling quality, heavy duty, split pillowblock, flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life to ABMA L10 of 100,000 hours. Shaft seals on laboratory fume hood and biological safety cabinet exhaust fans:
.5 Single disc or stuffing box seals.

.2 Housings:
.1 Volute with inlet cones: fabricated steel for wheels 12" or greater, cast iron, or steel, for smaller wheels, braced, and with welded supports.
.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with with gaskets of nonoxidizing nonflammable material.
.3 Provide bolted latched airtight access doors with handles.
.4 Spark resistant construction Type B minimum where indicated.

PART 3 EXECUTION

3.1 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Sectin 23 05 48 Vibration Isolation and Seismic Control, flexible electrical leads and flexible connections in accordance with Section 23 33 00 Duct Accessories.

.2 Provide sheaves and belts required for final balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

.5 Installation shall be in strict accordance with manufacturers recommendations.

.6 Grease fan bearing prior to operation.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Closeout Submittals: Section 01 78 00

.3 Acoustic Panel Ceilings: Section 09 51 13

.4 Linear Metal Baffle Ceiling: Section 09 54 23

1.2 REFERENCES

.1 American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE).
.1 ASHRAE 70-2006(RA2011), Method of Testing the Performance of Air Outlets.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00 Submittal Procedures.

.2 Indicate the following:
.1 Capacity.
.2 Throw and terminal velocity.
.3 Noise criteria.
.4 Pressure drop.
.5 Neck velocity.

1.4 SAMPLES

.1 Submit samples in accordance with Section 01 33 00 Submittal Procedures.

1.5 CERTIFICATIONS

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

1.6 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Include:
.1 Keys for volume control adjustment.
.2 Keys for air flow pattern adjustment.

PART 2 - PRODUCTS

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.

.2 Frames:
.1 Full perimeter gaskets.
.2 Plaster frames where set into plaster or gypsum board.
.3 Concealed fasteners.

.3 Concealed manual volume control damper operators as indicated.

.4 Colour: standard except Bone White PSP4186J in areas with metal baffle ceilings, to match ceiling colour, chilled beams and lights, or as directed by Departmental Representative.

.5 Acceptable manufacturers: E. H. Price, Titus, Nailor, Carnes, Airvector, Anemostat.

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 SUPPLY GRILLES AND REGISTERS

.1 Refer to Schedule on drawings.

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 Return to schedule on drawings.

2.5 DIFFUSERS

.1 Refer to Schedule on drawings.

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 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.

.4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere.

.5 Coordinate clips and fasteners to match architectural ceiling types. Refer to architectural Drawings.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

1.2 REFERENCES

.1 ANSI/ASME Boiler and Pressure Vessel Code, Section VIII for Unified Pressure Vessels, Latest Edition.

.2 CSA-B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 SHOP DRAWINGS

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

1.4 MAINTENANCE MATERIALS

.1 Supply the following spare parts:
.1 Head gaskets.

1.5 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual.

PART 2 - PRODUCTS

2.1 PLATE HEAT EXCHANGER

.1 Design:
.1 The plate heat exchanger shall consist of a pack of corrugated metal plates with portholes for the passage of the two fluids between which heat transfer will take place.

.2 The plate shall be assembled between a fix frame plate and a movable pressure plate and compressed by tightening bolts. The plates shall be fitted with a gasket which seals the interpolate channel and directs the fluids into alternate channels. The number of plates is determined by the flow rate, physical properties of the fluids, pressure drop and temperature program. The plate corrugations shall promote fluid turbulence and support the plates against differential pressure. The plate and the pressure plate shall be suspended from an upper carrying bar and located by a lower guiding bar, both of which are fixed to a support column. Connections shall be located in the frame plate or, if either or

2.1 PLATE HEAT EXCHANGER (Cont'd)

.2 (Cont'd)
both fluids make more than a single pass within the unit, in the frame and pressure plates.

.3 Frame Plate: Mild steel, epoxy painted.

.4 Nozzles: Metal lined stainless steel.

.5 Plates: Stainless steel Alloy 316.

.6 Gaskets: Clip-on, EPDM.

.7 Pressure Rating: ASME 150 psig@356°F.

.8 Pipe Connections: Grooved or NPT to suite pipe system.

.9 Fluid capacity & Performance: See equipment schedules.

.10 Designed, constructed and tested in accordance with ANSI/ASME Boiler and Pressure Vessel Code, Section VIII, CSA B51 and Provincial Pressure Vessel Regulations.

.11 Supports: As required to suit equipment and rigidly fasten to the base.

.12 Provide pressure relied valve on the heating side of heat exchanger.

.13 Acceptable Material: Alfa Laval, Bell & Gossett, Armstrong.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.

3.2 APPURTENANCES

.1 Install with safety relief valve piped to the nearest funnel floor drain.

.2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary sides of all heat exchangers.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Closeout Submittals: Section 01 78 00

.3 Commissioning: Section 01 91 13

.4 Painting: Section 09 91 13

.5 Vibration Isolation and Seismic Control Measures: Section 23 05 48

.6 Motors, Drives and Guards for Mechanical System: Section 23 05 13

.7 Thermal Insulation for Equipment: Section 23 07 16

.8 Duct Accessories: Section 23 33 00

.9 Commercial Fans: Section 23 34 00

1.2 REFERENCES

.1 ANSI/NFPA
.1 ANSI/NFPA90A-2011, Standard for the Installation of Air Conditioning and Ventilating Systems.

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

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

.4 Canadian Standards Association
.1 CSA B52-05(R2009) Package, Mechanical Refrigeration Code

.5 American Bearing Manufacturer's Association
.1 ANSI/ABMA 9-08, Load Ratings and Fatique Life for Ball Bearings
.2 ANSI/ABMA 11-08, Load Ratings and Fatique Life for Roller Bearings.

.6 Air Movement and Control Association
.1 AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.

1.2 REFERENCES (Cont'd)

.7 American Society of Heating Refrigeration and Air-Conditioning Engineers.
.1 ASHRAE 15-2010, Safety Standard for Refrigeration Systems.
.2 ASHRAE 51-2007, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
.3 ASHRAE 68-1997, Laboratory Method of Testing to Determine the Sound Power in a Duct.
.4 ASHRAE 522-2012, Method of Test for General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.8 National Electrical Manufacturer's Association
.1 NEMA MG1-09, Motors and Generators
.2 NEMA ICS 7.1-06, Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

.9 Provincial Boiler Pressure Vessel and Compressed Gas Regulations.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

.2 Indicate following:
.1 Construction specifications, dimensions, weights, fans, motors, vibration isolation, coils, capacities, curves, filter housings, filters, mixing boxes, dampers. Controls actuators, accessories installation procedures, and control wiring diagrams.

1.4 CLOSEOUT SUBMITTALS

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

1.5 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

.3 One (1) set of filters for start up, one set for commissioning, one spare set of filters for each unit. One spare actuator for dampers in unit energy recovery section.

1.6 WARRANTY

.1 Provide extended parts and labour warranty for five (5) years from the Substantial Performance Completion date.

PART 2 PRODUCTS

2.1 GENERAL

.1 Factory assembled components to form units supplying air at design conditions as indicated.

2.2 MANUFACTURED ITEMS

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

.2 Acceptable manufacturers: Renewaire, or equal.

2.3 UNIT CONSTRUCTION

.1 Unit casing to be of minimum 16 gauge (1.6mm) satin coat galvanized sheet metal. Clean surfaces with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat to be a 2 part epoxy c/w acrylic UV top coat to all exposed surfaces. All unprotected metal and welds shall be factory coated. volume measurement.

.2 All walls, roofs and floors to be of formed construction, with at least two (2) breaks at each joint. Secure joints by sheet metal screws or pop rivets. Break in wall and floor joints and break out all outdoor units roof joints for rigidity. All joints shall be caulked with a water resistant sealant.

.3 Support casing on a structural "C" channel base frame, designed and welded for low deflection. Provide structural steel supports for mounting of internal components such as fans, coils, etc. Using unit floor to support such components is unacceptable.

.4 Provide the entire unit interior including piping vestibule with a 22 gauge (.85mm) solid, G90 galvanized metal liner over all insulated areas.

.5 Install the liner to allow wipe down of the unit interior without risk of wetting the internal insulation. Liner to overlap with seams caulked &

2.3 UNIT CONSTRUCTION (Cont'd)

.5 (Cont'd)
screwed. Solid liner shall be broken over 2" (51mm) drain pan upturn to allow water to shear into pan (see floor as drain pan).

.6 Provide units with access doors to the following components: fans and motors, filters, dampers and operators, access and supply plenums , electrical control panels. Access doors must be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.7 Provide units with hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles, operable from both sides for all units. Hinged access doors open outwards on all sections for outdoors units. Doors located on sections with positive pressure to have a clear warning label and a safety device must be affixed.

.8 Access doors to fan sections shall incorporate 10" x 10" (254 mm x 254 mm) double pane wire reinforced tempered glass viewing window.

.9 Provide marine lights with Lexan bulb covers in each fan section . Lights shall be wired in EMT conduit to a switch with pilot light. 120 volt power supply from unit single point power supply complete with convenience circuit non fused disconnect.

.10 Insulate units with 2"(51mm) thick nominal 3 lb./cu.ft. (48 kg./cu.m.) density acoustic insulation.

.11 3 lb./cu.ft. (48 kg/cu.m.) insulation is secured with steel angles. Cover all longitudinal insulation joints and butt ends by a sheet metal break to prevent erosion of exposed edges. Insulate drain pans and all floor areas on the underside.

.12 The floor is to act as drain pan (Wipe down interior) complete with 2" (51mm) upturn standing seams around perimeter (or 2" (51mm) perimeter collar continuously welded to the unit base) and welded corners to ensure the floor is watertight. Alternately screwing down, tack welding and caulking of this collar is not acceptable. Provide 1 ½" (38mm) drain connections for complete drainability of the base pan.

.13 Provide stainless steel drain pans on unit inlet and on exhaust leaving side of heat pipe. Extend heat pipe drain to the piping vestibule for connection to building drain.

2.3 UNIT CONSTRUCTION (Cont'd)

.14 In air-to-air heat reclaim units, the exhaust section drain pans will be an integral part of the floor paneling, a minimum of 2" (51 mm) deep, with welded corners. Extend drain pans over the full exhaust fan plenum andbe connect with a 1½"(38 mm) M.P.T. drain connection.

.15 Air handling units to be weatherproofed and equipped for installation outdoors. This includes the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 25mm galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 51mm with three (3) break interlocking design; outer wall panels extend a minimum of 6mm below the floor panel; drain trap(s) connections for field supply and installation of drain traps. Mount units on roof curbs incorporate welded floor to base construction. Floors are of three break upstanding design with welded corners and free of penetrations. Caulk unit underside joints.

.16 Provide full perimeter roof mounting curb of heavy gauge sheet metal, minimum of 305mm high, and complete with wood nailer, neoprene sealing strip, and fully welded "Z" bar with 25mm upturn on inner perimeter, to provide a complete seal against the elements. Provide external (internal) insulation and flashing of the roof-mounting curb.

.17 Provide integral piping vestibule to accommodate the heating coil piping and drain. Vestibule to be of same construction as the unit c/w hinged access doors and lever handles.

.18 Provide a louver & vertical hood combination on the unit inlet.

.19 Provide expanded metal grating over return air opening.

2.4 FANS

.1 Centrifugal fans to be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer must be a member of AMCA. All fans and fan assemblies to be dynamically balanced during factory test run. Select fan shafts for stable operation at least 20% below the first critical RPM. Provide fan shafts with a rust inhibiting coating.

2.4 FANS (Cont'd)

.2 All forward curved fan assemblies shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame.

.3 Drives to be adjustable on fans with motors 7 1/2 HP (5.6 kW) or smaller. On fans with larger motors, provide fixed drives. Provide all drives with a rust inhibiting coating. Provide the air balancer for drive changes (if required) during the air balance procedure.

.4 Provide standard belt guards on all fans.

.5 Provide fan-motor assemblies with vibration isolators. Isolators to be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. Isolators to be neoprene-in-shear type for single 230mm to 380mm diameters forward curve fans. All other fans to incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 25mm static deflection designed to achieve high isolation efficiency. Attach fans to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

.6 Fans to be epoxy coated for corrosion resistance.

.7 Fan motors to be ODP (open drip proof) Super-E high efficiency type.

2.5 COILS

.1 Coils to be 5/8" O.D. and/or 1/2" O.D. as manufactured by Engineered Air, constructed of Copper tube, aluminum fin, and copper headers with schedule 40 steel pipe connectors and stainless steel casing.

.2 Fins constructed of aluminum or copper to be rippled for maximum heat transfer and be mechanically bonded to the tubes by mechanical expansion of the tubes. Coils to have a galvanized steel casing. Factory test all coils with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.

.3 Headers with schedule 40 steel pipe connections utilize grooved connections.

.4 Headers to be outside the air-handling unit for maximum serviceability except for blow through applications where headers are internal. Fully conceal the non-headered end of the coil. Provide

2.5 COILS (Cont'd)

.4 (Cont'd) auxiliary drain pan complete with 13mm MPT drain connection at headered end of cooling coils.

.5 Coils to be removable from the unit at the header end, unless shown otherwise on the drawings. Equip water coils with a capped vent tapping at the top of the return header or connection, and a capped drain tapping at the bottom of the supply header or connection.

.6 Water and glycol coils to be circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable.

.7 5/8" O.D. tube diameter water coils shall be ARI Certified.

.8 Provide Heresite P-413, a pure phenolic thermosetting resinous coating to protect heating coil and heat pipe against exposure to corrosive atmospheres. Accomplish process by a multiple coat application of degreasing and etching, dipping and baking (four times), resulting in complete coating coverage of the fins, tubes, headers and casing.

2.6 FILTERS

.1 Provide filter sections with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.

.2 For units with filter banks up to 1825mm high, the filter modules will be designed to slide out of the unit. Side removal 50mm filters will slide into a formed metal track, sealing against metal spacers at each end of the track.

.3 50mm Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Permanent re-usable metal enclosing frame. For intake filters. The filter media shall have a minimum efficiency of 30-35% on ASHRAE Standard 52.1, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.

.4 Filter media shall meet UL Class 2 standards.

.5 Provide filter bank with "Dwyer 2000 magnehelic" air filter gauge complete with static pressure tips and

2.6 FILTERS (Cont'd)

.5 (Cont'd) aluminum tubing all factory installed. Filter gauge to have a range of 0 to 2" (0-500 Pa). Where two or more filter banks are connected to a single gauge, provide a multiple gauge kit with manual shut-off cocks in the air tubing.

.6 Where the filter gauges are provided on outdoor units mount on inside of a weatherproof enclosure with viewing window.

2.7 DAMPERS

.1 Dampers to be low leak dampers with blade ends sealed with an adhesive backed foamed polyurethane gasketting. Interlocking blade edges to include an all weather PVC seal fastened with a positive lock grip and pliable overlap edges on both the entering and leaving air sides.

.2 Extruded aluminum, low leak, thermally broken, insulated blade Tamco Series 9000 for outside and exhaust air dampers.

.3 Two position inlet dampers to be parallel blade type.

.4 Face and bypass dampers to be opposed blade type.

2.8 QDT HEAT PIPE WITH INTEGRATED TILT PACKAGE (ITP)

.1 Provide an air-to-air heat pipe exchanger with performance as shown in the schedule, to be QDT as manufactured and supplied by Engineered Air. Alternative heat pipe manufacturers to provide, at the Departmental REpresentative's request, samples of tubes with the internal wick before and after expansion of the tubes.

.2 Heat exchanger core to be of 5/8" (16 mm) or 1" (25 mm), as required, seamless aluminum tubing permanently expanded into fins. Each tube to be an individually sealed heat pipe filled with a working fluid conforming to the Mechanical Refrigeration Code, CSA Standard B52, ANSI/ASHRAE 15. Tubes to include flow separators whenever vapour and condensate streams interact limiting the heat transfer capacity of the pipe.

.3 Secondary surface to be continuous plate aluminum fins of corrugated design to produce maximum heat transfer efficiency. Spiral fins are not acceptable.

2.8 QDT HEAT PIPE WITH INTEGRATED TILT PACKAGE (ITP) (Cont'd)

.4 The capillary wick of each heat pipe to be an integral part of the inner wall of the tube to provide a completely wetted surface for maximum heat pipe capacity with minimum heat transfer resistance. Heat pipes manufactured without capillary wick, or where the wick is not acceptable to the Departmental Representative, have a minimum of 20% additional rows than that shown in the schedule. Where additional rows are provided, increase the heat pipe in face area to provide a pressure drop equal or less than that shown in the schedule.

.5 TRU:

.1 Mount the TRU on a cradle with accompanying linkage, fulcrum, control actuator and Q-TRAC solid state dedicated operating controller. These will effectively tilt the unit to achieve the following:

.1 Accurate supply air temperature control.

.2 Summer/Winter operation changeover.

.3 Frost prevention on the exhaust leaving side of the TRU.

.2 In conditions when the exhaust air could provide more heat than is required, the tilt angle of the heat pipe is varied by the Q-TRAC to limit heat transfer and maintain supply air set point.

.3 When the exhaust temperature is below the supply air set point, the tilt angle is reversed in order to cause heat transfer from supply air to exhaust air and pre-cool the supply air.

.4 When the outside air is cold enough to extract heat from the exhaust air to the point where frost will form on the exhaust side of the heat pipe, the Q-TRAC will reduce the tilt angle to limit heat transfer and keep the exhaust air above the frost threshold.

.5 Provide an enhanced recovery feature. Maximum heat recovery is obtained by first allowing frost to form on the exhaust side of the coil and using a pressure differential switch to sense when the frost forms. Just prior to frost forming, maximum heat recovery occurs. When frost is detected, the frost control set point is reset upwards, and the heat pipe is sent to defrost mode. Recovery is still achieved but at a lower level until the heat pipe is clear of frost.

.6 Install vinyl coated flexible connectors to permit the necessary tilting movement of the reclaim coil. Provide three (3) flex connectors, one for each face of the heat pipe exchanger except the exhaust leaving face. Provide four (4) flex connectors, one for each face of the heat pipe exchanger on applications where the exhaust is blow through.

.7 The flex material is to weigh a minimum of ±13 ½ ounces per square yard with a flexible operating

2.8 QDT HEAT PIPE WITH INTEGRATED TILT PACKAGE (ITP) (Cont'd)

.5 TRU:(Cont'd)
.7 (Cont'd)
range of -65°F to 150°F. Fabric to be polyester (BHT) with polyvinyl chloride coating that contains an anti-fungal, anti-bacterial treatment. Flex material is to be resistant to abrasion, weathering, oil and other hydrocarbons.
.8 Tilt mechanism to incorporate a low friction pivoting base with self aligning ball or roller bearings.

2.9 FACTORY SUPPLIED CONTROL/ WIRING

.1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays for single point power connection.

.2 Fire alarm circuits (where required) will be powered from a relay in unit circuitry.

.3 Factory wire unit to accept a single point power connection with two (2) non fused disconnects: one for unit power and one for convenience circuit.

.4 Factory installed and wired non-fused disconnect switch in CEMA/NEMA 3 weatherproof configuration.

.5 House automatic controls in a control panel mounted in or on the air handling unit, which will meet that standard of the specific installation.

PART 3 - EXECUTION

3.1 INSTALLATION

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

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

3.2 COMMISSIONING

.1 Manufacturer's representative to provide one day on site per unit for start- up and one (1) day for commissioning to Section 01 91 13.

END

PART 1 - GENERAL

1.1 WORK INCLUDED

.1 This section specifies the requirements for the supply, installation, testing and commissioning of the split system air conditioning unit system.

1.2 REFERENCES

.1 Air-Conditioning and Refrigeration Institute (ARI)
.1 ANSI/ARI 210/240-2008, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.

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.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Split system air conditioners complete with heat pump or cooling only system including, indoor fan coil unit, outdoor heat pump units and controllers.

.2 Unit shall bear ARI label, CSA and CETL.

.3 Condensing unit shall be charged with R410A refrigerant suitable for 50 meters of refrigerant piping.

.4 Acceptable material: Mitsubishi or approved equivalent.

2.2 INDOOR UNIT FAN COIL

.1 General: factory assembled, wired and run tested complete with factory wiring, piping, control circuit board motor.

.2 Fan: statically and dynamically balanced, permanently lubricated motor bearing, multi-speed motors.

2.2 INDOOR UNIT FAN COIL (Cont'd)

.3 Coil: non ferrous construction with plate fins on copper tubing, silver alloy brazing. Coil to be factory pressure tested. Coil to be complete with condensate pan and drain.

.4 Electrical and controls: as indicated.

.5 Configuration: as indicated:

2.3 OUTDOOR UNIT

.1 General: factory assembled wired, pipe and run tested air cooled condenser. Performance to suit indoor unit.

.2 Construction: sheet metal construction, steel louvre coil guard, color matched, ceramic coated cabinet screws, baked on powder paint.

.3 Unit shall be complete with front seating service valves, scroll compressor, internal pressure relief valve, internal thermal overload, high pressure switch, loss of charge switch, filter drier.

.4 Electrical and controls: as indicated.

.5 Acceptable material: Mitsubishi.

2.4 CONTROLLER

.1 Units shall be provided with remote controllers with auto or cooling/heating options.

.2 Controllers to include wall mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install where indicated and in accordance with manufacturer's instruction.

.2 Install indoor unit in horizontal orientation.

.3 Mount outdoor unit on wall where indicated on the drawings.

.4 Make all piping connections.

.5 Ensure that ready access is available to all components to allow servicing in-situ or removal of components for servicing.

3.2 DRAIN PANS

.1 Install so that no water can accumulate and arrange so as to be easily accessible for cleaning.

3.3 START-UP AND COMMISSIONING

.1 In accordance to Section 01 91 13.

.2 Manufacturer to certify installation.

.3 Manufacturer to test and start up units and certify performance.

.4 Manufacturer to provide verbal, and written instructions to operating personnel.

.5 Submit written report to Departmental Representative.

END

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Submittal Procedures: Section 01 33 00

1.2 SHOP DRAWINGS

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

.2 Indicate:
.1 Equipment, capacity, piping, and connections.
.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
.3 Special enclosures.

1.3 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00.

PART 2 - PRODUCTS

2.1 CAPACITY

.1 As indicated on drawings, based on 88°C entering water temperature, 11.1°C temperature drop and 18°C E.A.T.

2.2 COMMERCIAL FINNED TUBE RADIATION

.1 Heating elements: NPS 1-1/4 seamless copper tubing, mechanically expanded into flanged collars of evenly spaced aluminum fins, 100mm x 100mm nominal, 1 or 2 row as indicated on the drawings.

.2 Element hangers: ball bearings or plastic lined cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm centres maximum.

.3 Standard enclosures: 1.214mm (18 ga.) steel complete with components for wall-to-wall or complete with die formed end caps having no knock-outs, with inside corners, outside corners, as indicated. Provide full length channel and sealer strip at top of wall edge. Height as indicated. Joints and filler pieces to be flush with cabinet. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces to

2.2 COMMERCIAL FINNED TUBE RADIATION (Cont'd)

.3 Standard enclosures:(Cont'd)
be clear of grilles and located to provide easy access to valves and vents. Provide access doors for valves and vents. Finish cabinet with factory applied baked on paint (color by Departmental Representative).

.4 Dimensions for enclosures: measure site conditions. Do not scale from Drawing.

.5 Provide for noiseless expansion of all components.

.6 Acceptable Manufacturers: Trane; Engineered Air; Modine; Rosemex, Sigma Corp.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

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

.3 Provide for pipe movement during normal operation.

.4 Maintain sufficient clearance to permit performance of service maintenance.

.5 Check final location with the Departmental Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.

.6 Valves
.1 Install valves with stems upright or horizontal unless approved otherwise.
.2 Install isolating ball valve on inlet and circuit balancing valve on outlet of each unit.

.7 Venting:
.1 Install standard automatic air vent with mini ball valve on continuous finned tube radiation.

.8 Clean finned tubes and comb straight.

.9 Flush, clean and drain interconnecting piping before connecting radiation to system. Provide temporary by-pass loops to ensure thorough cleaning of run-outs.

END

PART 1 - GENERAL

1.1 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Closeout Submittals: Section 01 78 00

.3 Commissioning: Section 01 91 13

1.2 SHOP DRAWINGS

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

.2 Indicate:
.1 Equipment, capacity, piping, and connections.
.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.3 MAINTENANCE

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

PART 2 - PRODUCTS

2.1 FORCE FLOW HEATERS (F.F.) AND CABINET HEATERS

.1 Cabinet: type semi-recessed or recessed as indicated, nominal 16 gauge steel with rounded exposed corners and edges, removable panels, glass fiber insulation and integral air outlet and inlet.

.2 Finish with factory applied primer coat. Finish painted on site by Contractor.

.3 Coils: aluminum fins mechanically bonded to copper tubes. Hydrostatically test to 150 psig.

.4 Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted.

.5 Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.

.6 Filters: removable thick permanent washable type.

2.1 FORCE FLOW HEATERS (F.F.) AND CABINET HEATERS (Cont'd)

.7 Capacities: as indicated on the drawings.

.8 Control:
.1 Multi-speed and off switch with integral thermal overloads accessible through a tamper proof access door in the front cover of cabinet.
.2 Controlled by building management system.

.9 Acceptable Material: Trane; Dunham- Bush; Engineered Air; Mark Hot; Modine, Rosemex; Sigma Corp.

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

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

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

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

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

.5 Air outlet: two-way adjustable louvres.

.6 Capacities: as indicated on the drawings.

.7 Controlled by building management system.

.8 Acceptable Material: Trane; Dunham- Bush; Engineered Air; Mark Hot; Modine; Rosemex; Sigma Corp.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

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

.3 Provide double swing pipe joints at each unit.

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

3.1 INSTALLATION (Cont'd)

.4 (Cont'd)
clearances arise, request and follow Departmental Representative's directive.

.5 Hot water units: for each unit, install isolating valve on inlet and circuit balancing valve on outlet. Install drain valve at low point. Install manual air vent at high point.

.6 Clean finned tubes and comb straight.

.7 Provide supplementary suspension steel as required.

.8 Thermostats on outside walls (where applicable): mount on insulated backplates.

.9 Before acceptance, set discharge patterns and fan speeds for proper distribution of heat.

.10 Provide vibration isolation spring hangers for suspended horizontal unit heaters.

PART 1 - GENERAL

1.1 SUMMARY

.1 Radiant heating systems, where shown on the Drawings and Schedules, shall be hydronic, and shall include the following:
.1 Crosslinked polyethylene (PEXa) piping.
.2 Distribution manifold(s) with balancing and flow control valves where required.
.3 Pipe-to-manifold compression nut fittings.
.4 Cold-expansion and compression-sleeve fittings.
.5 Supervision and field engineering required for the complete and proper function of the system.

1.2 RELATED WORK

.1 Submittal Procedures: Section 01 33 00

.2 Commissioning: Section 01 91 13

1.3 REFERENCES

.1 Publications listed here are part of this specification to the extent they are referenced. Where no specific edition of the standard or publication is identified, the current edition shall apply.

.2 American Society for Testing and Materials
.1 ASTM E84-10, Standard Test Method for Surface Burning Characteristics of Building Materials
.2 ASTM F876-10el, Standard Specification for Crosslinked Polyethylene (PEX) Tubing
.3 ASTM F877-11a, Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
.4 ASTM F2014-00(R2006), Standard Specification for Non-Reinforced Extruded Tee Connections for Piping Applications
.5 ASTM F2080-09, Standard Specification for Cold-Expansion Fittings With Metal Compression-Sleeves for Cross- Linked Polyethylene (PEX) Pipe

.3 Canadian Standards Association
.1 CSA B137 Series-09, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications
.2 CSA B214-07, Installation Code for Hydronic Heating Systems

.4 Underwriters' Laboratories of Canada

1.3 REFERENCES (Cont'd)

.4 (Cont'd)
.1 CAN/ULC S102.2-10, Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials

.5 Plastic Pipe Institute
.1 PPI TR-3 / 2007, Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

1.4 DEFINITIONS

.1 Crosslinked polyethylene, commonly abbreviated PEX, is made from high density polyethylene (HDPE). Crosslinking is accomplished during manufacturing. Crosslinking enhances the physical & mechanical properties of the polymer. The high-temperature properties are improved. Chemical resistance is enhanced by resisting dissolution. Low temperature properties are also improved; its impact and tensile strength, scratch resistance, and resistance to brittle fracture are enhanced. The required degree of crosslinking, according to ASTM Standard F876, is between 70-89%. This specification requires PEX to be designated as PEXa and be manufactured by the high-pressure peroxide method.

1.5 SUBMITTALS

.1 Comply with Section 01 33 00, Submittal Procedures. Approval and/or acceptance of all submittals is required prior to fabrication.

.2 Product Data: Submit manufacturer's Technical Manual, submittal forms, catalog cuts, brochures, specifications, and installation instructions. Submit data in sufficient detail to indicate compliance with the contract documents.
.1 Submit manufacturer's instructions for installation.
.2 Submit data for equipment, fittings, fasteners and associated items necessary for the installation of the piping and manifolds.

.3 Submit computer-generated radiant heating system design indicating heat flux, pipe sizing, spacing, flow rates and temperatures. Design calculations shall be performed on pipe manufacturer's software or equivalent.

1.5 SUBMITTALS (Cont'd)

.4 Shop Drawings: Provide plans drawn to scale for all installation areas.
.1 Indicate dimensions, descriptions of materials, general construction, component connections, anchorage methods and installation procedures.
.2 Indicate design, schematic layout of system, including equipment, critical dimensions and piping/slab penetration details as well as details for protecting exposed PEX piping.

.5 Certification:
.1 Submit independent certification results for the piping systems from an accredited independent testing laboratory.
.2 Fittings shall be third- party certified to applicable referenced standards as part of the manufacturer's PEX piping system, with independent listings from NSF, CSA and ICC, as applicable.
.3 Fittings embedded within the thermal mass or encased behind walls or ceilings shall be certified to ASTM F2080.

.6 Maintenance Instructions: Submit instructions for any maintenance required or recommended by manufacturer

1.6 QUALITY ASSURANCE

.1 Manufacturer: Must be a company specializing in the Work of this Section with a minimum of five (5) years documented experience.:

.2 All components shall be supplied by one manufacturer.

.3 Cross-linked polyethylene (PEXa) pipe shall conform and be certified to ASTM F876, F877 and CSA B137. Fittings shall conform and be certified to ASTM F877 or F2080, and CSA B137. Pipes with an oxygen diffusion barrier shall conform to the requirements for oxygen permeability DIN 4726 and shall also have the PPI TR-3 listing.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store piping and equipment in shipping containers with labeling in place.
.1 Pipe shall be kept in original shipping boxes until required for installation.

.2 Store piping and equipment in a safe place, dry, enclosed, under cover, in a well-ventilated area.
.1 Do not expose pipe to ultraviolet light beyond exposure limits recommended by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING (Cont'd)

.2 (Cont'd)

.2 Protect piping and manifolds from entry of contaminating materials. Install suitable plugs in open pipe ends until installation.

.3 Where possible, connect pipes to assembled manifolds to eliminate possibility of contaminants and cross- connections.

.4 Piping shall not be dragged across the ground or other surfaces, and shall be stored on a flat surface with no sharp edges.

.3 Protect materials from damage by other trades.

.4 Pipe shall be protected from oil, grease, paint, direct sunlight and other elements as recommended by manufacturer.

1.8 WARRANTY

.1 Provide manufacturer's standard written warranty.

.1 The warranty shall include as a minimum, provisions to repair defects from faulty materials or workmanship developed during the guarantee period, or provide for replacement with new materials, at no additional expense to Contract.

.2 The radiant heating pipe manufacturer shall warrant the cross-linked polyethylene piping to be free from defects in material and workmanship for a period of twenty-five (25) years

.3 Cold-expansion compression- sleeve fittings shall be warranted to be free from defects in material and workmanship for a period of twenty-five (25) years.

.4 All manifolds, distribution headers, thermostats and actuators shall be warranted to be free from defects in material and workmanship for a period of one (1) years starting at completion of successful pressurized water tests immediately following system installation.

.2 Provide installer's guarantee as appropriate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers: REHAV WIRSBO, Heatlink.

2.2 PIPING

.1 All radiant heating pipe shall be high-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876, ASTM F877 and CSA B137.

.2 Pipe shall be rated for continuous operation of 100 psi gauge pressure at 690 kPa @ 82 C, and gauge pressure at 550 kPa @ 93 C.

.3 When required, pipe shall have a co-extruded oxygen diffusion barrier capable of limiting oxygen diffusion through the pipe to less than 0.32 mg/(m2/d) @ 40 C water temperature, in accordance with DIN 4726.

.4 Bend Radius:
.1 The minimum bend radius for cold bending of the pipe shall be not less than five (5) times the outside diameter.
.2 Bends with a radius less than this shall require the use of a bending template as supplied by the pipe manufacturer, and/or hot air.

.5 Pipe to have a Flame Spread Index of less than 25, and a Smoke Developed Index of less than 50 when tested in accordance with ASTM E84 (in U.S.) or CAN/ULC S102.2 (in Canada). In any case where the pipe does not conform to these standards, appropriate piping insulation shall be installed in order to meet the standard.

2.3 FITTINGS

.1 Fittings shall be third-party certified to applicable standards ASTM F877, ASTM F2080 and CSA B137 as part of the manufacturer's PEX piping system, with independent listings from IAPMO, NSF, CSA and ICC, as applicable.

.2 Compression nut manifold fittings shall be manufactured of corrosion- resistant brass with a barbed insert and a reusable split compression ring.

2.3 FITTINGS (Cont'd)

.3 Compression-sleeve fittings shall be manufactured of brass and shall be supplied by the piping manufacturer as part of a proven cataloged system.

.4 Fittings embedded within the thermal mass or encased behind walls or ceilings shall be cold-expansion compression-sleeve fittings certified to ASTM F2080. Where required by the manufacturer, fittings shall be protected from external environmental conditions.

2.4 MANIFOLDS

.1 Material: Distribution manifolds shall be manufactured of brass or copper and be supplied by the piping manufacturer as a proven cataloged part of the manufacturer's system.

.2 Brass manifolds shall be produced from extruded brass round pipe with tapped holes for connections, and be pre-assembled by the manufacturer. 100% of manifolds used shall have been air tested by the manufacturer with no indication of leaks.

.3 Balancing Manifolds:
.1 Where required by design, brass balancing manifolds shall be equipped with integral visual flow gauges, circuit balancing and flow control valves, isolation valves with integral thermometer housings, and air vent/fill ports.
.2 Each circuit valve shall be supplied with a manual actuating handle for filling/purging operation.

.4 Copper Manifolds:
.1 Copper manifolds shall be manufactured from Type L copper.
.2 Copper and/or brass outlets shall be high-temperature brazed (lead- free) into headers.
.3 Outlets in copper headers shall be made using the T-drill process according to ASTM F2014.

.5 Manifolds shall be provided by the in-floor heating system supplier, not field fabricated.

2.5 CONTROLS

.1 Circuit actuators shall be low- voltage thermo-electric design for actuation of valves on manifold with visual indication of position, and built-in end switches, and shall be supplied by the pipe manufacturer as part of a proven catalogued system.

2.5 CONTROLS (Cont'd)

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

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

.1 Installation shall be performed by qualified laborers trained by the manufacturer in the procedures of PEX radiant heating systems and they shall be appropriately licensed for the jurisdiction where the installation will take place.

3.2 EXAMINATION

.1 Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

.2 Beginning of installation means acceptance of existing conditions.

3.3 PREPARATION

.1 Coordinate with related trades and manufacturer's recommendations with regard to installation in conjunction with:
.1 Reinforcing wire mesh or rebar.
.2 Preparation of space for manifold installation.

.2 Prepare the installation site as appropriate:
.1 For Concrete Slab-on-Grade: Sub-grade should be compacted, flat and smooth to prevent damage to pipe or insulation. Approved vapor barrier material should be installed. Approved thermal insulation, according to the design, shall be installed. Reinforcing wire mesh, if required by structural design, must be flat and level, with all sharp ends pointing down. Finished grade of the thermal mass must be a minimum of 3/4 inch (19 mm) above the top of PEX heating pipes.
.2 For Precast Concrete Sub- floor: Sub-floor must be clean and free from all construction debris which could potentially damage the pipe. Finished grade of the thermal mass overpour must be a minimum of 3/4 inch (19 mm) above the top of PEX heating pipes.

.3 Preparation of wall cavity for Manifold installation: See drawings to determine the width of the wall cabinet (if required) and required wall opening dimensions. Mount the manifold cabinet allowing space for the screed to fill up the front of the pipe opening. If a cabinet is not used, prepare a

3.3 PREPARATION (Cont'd)

.3 (Cont'd)
suitable cavity for the manifold, with a secure mounting plate that will secure the manifold at least 30 inches (75 cm) above floor level. Manifold must be installed in an area that will allow easy access for supply/return piping as well as future access maintenance.

3.4 INSTALLATION

.1 Install in accordance with manufacturer's published installation manual and/or published guidelines and final shop drawings.

.2 Mount manifolds in the locations previously prepared or in previously installed cabinets, if used. Manifolds shall be mounted as level as possible.

.3 Route piping in an orderly manner, according to layout and spacing shown in final shop drawings. All installation notes shown on the drawings shall be followed.

.4 At connections and fittings, use a plastic pipe cutter to ensure square and clean cuts, and join pipes immediately or cap ends of pipe to seal from contaminants. Where fittings are installed within the thermal mass, they shall be wrapped in non- adhesive waterproof silicone tape or sealed within a heat-shrink material approved by the manufacturer.

.5 Pipe shall be dispensed using a suitable uncoiling device. Remove twists prior to securing pipe. Pipe shall lie flat on an even plane. Finished grade of a thermal mass shall be a minimum of 19 mm above the top of PEX heating pipes. Fasten piping at no more than 90 cm intervals, being careful not to twist the pipe. In thin concrete slabs, secure piping every 60 cm. Use only fasteners supplied or approved by the manufacturer of the PEX pipe.

.6 Piping that passes through expansion joints shall be covered in protective polyethylene convoluted sleeving (flexible conduit) extending 38 cm on each side of the joint. Sleeving shall be secured on pipe to prevent movement during installation of thermal mass.

.7 Where piping exits the thermal mass, a protective conduit shall be placed around the pipe, with the conduit extending a minimum of 15 cm into the floor and exiting by a minimum of 15 cm. For penetrations at manifolds, use rigid PVC bend guides secured in place to prevent movement.

3.4 INSTALLATION (Cont'd)

.8 At the time of installation of each circuit of pipe, connect the pipe to the correct manifold outlet and record pipe length for balancing. If manifold is not installed, cap the end of the pipe and label the pipe's circuit numbers along with S for supply and R for return. Connect pipes to manifold as soon as possible and record circuit lengths. All circuits shall be labeled to indicate circuit length and serviced area.

.9 The following precautions shall be taken in areas intended for carpet:
.1 Notify carpet installer that radiant heating pipes have been installed.
.2 Keep pipes 15 cm from all wall baseplates.
.3 Install metal guards where pipe will pass through wall baseplates and where carpet tack strips will be installed.

.10 The following precautions shall be taken in areas intended for hardwood flooring:
.1 Ensure that nailing areas for hardwood flooring, if nailing is required, are clearly marked and known for hardwood installers.

.11 If the radiant heating system substrate material (thermal mass) requires curing and/or has other limitations which can be influenced by the radiant heating system while in operation, then the radiant heating system shall not be put into operation until such time that the substrate material has fully cured or set according to the material requirements of the substrate manufacturer.

.12 The installer shall confirm minimum and maximum exposure temperatures for the substrate material (thermal mass) and shall ensure proper radiant heating operating temperatures.

3.5 FIELD QUALITY CONTROL

.1 Filling, Testing & Balancing: Tests of hydronic heating systems shall comply with authorities having jurisdiction, and, where required, shall be witnessed by the building official.

.2 Pressure gauges used in testing and balancing shall show pressure increments of 1 psig and shall be located at or near the lowest points in the distribution system.

.3 Air Test:
.1 Charge the completed, yet unconcealed pipes with air at a minimum of 40 psig.

3.5 FIELD QUALITY CONTROL (Cont'd)

.3 Air Test:(Cont'd)
.2 Do not exceed 150 psig.
.3 Use liquid gas detector or soap solution to check for leakage at manifold connections.

.4 Water Test:
.1 Purge air from pipes.
.2 Charge the completed, yet unconcealed pipes with water.
.3 Take necessary precautions to prevent water from freezing.
.4 Check the system for leakage, especially at all pipe joints.

.5 Perform a preliminary pressure test pressurizing the system to the greater of 1.5 times the maximum operating pressure or 100 psig for 30 minutes
.1 As the piping expands, restore pressure, first at 10 minutes into the test and again at 20 minutes.
.2 At the end of the 30-minute preliminary test, pressure shall not fall by more than 8 psig from the maximum, and there shall be no leakage.

.6 After successfully performing the preliminary pressure test, perform the main pressure test immediately.
.1 The test pressure shall be restored and continued as the main test for 2 hours.
.2 The main test pressure shall not fall more than 3 psig after 2 hours.
.3 No leakage shall be detected.

.7 Pressure shall be maintained and monitored during installation of the thermal mass.
.1 If any leak is detected during installation of thermal mass, leak shall be found immediately and the area cleared for repair using manufacturer's approved repair coupling.
.2 Retest before covering repair.

.8 Complete inspection and furnish test reports supplied by the manufacturer of the system.

.9 A qualified installer shall be on site at all times when concrete is being poured over the pipe system and shall monitor pipe pressure and address problems if they occur.

3.6 CLEANING

.1 Clean exposed surfaces upon completion of installation using clean, damp cloth. No cleaning agents are allowed.

3.6 CLEANING (Cont'd)

.2 Comply with manufacturer's recommendations.

3.7 PROTECTION

.1 Protect installation throughout construction process until date of final completion.

.2 Replace components that cannot be repaired.

END