PART 1 - GENERAL

1.1 QUALITY ASSURANCE

.1 Sustainability Standards Certification:
.1 Low-Emitting Materials: provide listing of sealants and coatings used in building, comply with VOC and chemical component limits or restriction requirements.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181.
.1 Primers and Coatings: in accordance with manufacturer's recommendations for surface conditions.
.2 Primer: maximum VOC limit 250 g/L.
.3 Paints: maximum VOC limit 150 g/L.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 CONNECTIONS TO EQUIPMENT

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

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

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

3.3 CLEARANCES

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

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 DRAINS

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

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

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

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

3.5 AIR VENTS

.1 Install manual air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

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

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

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

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

.7 Install concealed pipework 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.

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

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

.13 Provide for thermal expansion as indicated.

.14 Valves:
.1 Install in accessible locations.
.2 Remove interior parts before soldering.
.3 Install with stems above horizontal position unless indicated.
.4 Valves accessible for maintenance without removing adjacent piping.
.5 Install globe valves in bypass around control valves.
.6 Use ball or butterfly valves at branch take-offs for isolating purposes except where 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.

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

3.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:
.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
.2 Other floors: terminate 25 mm above finished floor.
.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

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

3.9 PREPARATION FOR FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.

.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 fires topping material or installation.

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

3.10 FLUSHING OUT OF PIPING SYSTEMS

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

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

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work, or in absence of test pressure, test to 1.5 times normal maximum operating pressure.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of 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 approval and certification 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 by Departmental Representative 10 days minimum, prior to commencement of work.

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

3.13 CLEANING

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

.2 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
- .1 ASME B40.100-05, Pressure Gauges and Gauge Attachments.
- .2 ASME B40.200-08, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB).
- .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit shop drawings and product data.

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

1.3 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

.2 Collect, separate and place in designated containers for reuse and recycling of paper, plastic, polystyrene, corrugated cardboard, Steel, Metal, and Plastic in accordance with Waste Management Plan.

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

.4 Place materials defined as hazardous or toxic waste in designated containers.

.5 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Design point to be at mid point of scale or range.

.2 Ranges: as indicated.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB 14.4 ASME B40.200.
.1 Acceptable material: Trerice AX9.
.2 Other acceptable manufacturers: Weiss, Taylor, Wekster.

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass.

2.4 PRESSURE GAUGES

.1 88 mm, dial type: to ASME B40.100, Grade 2A, bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:
.1 Snubber for pulsating operation.
.2 Diaphragm assembly for corrosive service.
.3 Bronze stop cock.
.4 Oil filled for high vibration applications.

.3 Acceptable material: Trerice AX9.

.4 Other acceptable manufacturers: Weiss, Taylor, Wekster.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

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

.2 Install in locations as indicated and on inlet and outlet of:
.1 Heat exchangers.
.2 Water heating and cooling coils.
.3 Water boilers.
.4 DHW tanks.

.3 Install wells as indicated only for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:
.1 Suction and discharge of pumps.
.2 Upstream and downstream of PRV's.
.3 Inlet and outlet of coils.
.4 Inlet and outlet of liquid side of heat exchangers.
.5 Outlet of boilers.
.6 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
.1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
.2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International
.1 ASTM A 276-08, Standard Specification for Stainless Steel Bars and Shapes.
.2 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
.3 ASTM B 283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
.4 ASTM B 505/B 505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
.1 MSS-SP-25-1998, 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Valves:
.1 Except for speciality valves, to be single manufacturer.

.2 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 to ANSI/ASME B16.18.

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

.4 Globe Valves:
.1 Requirements common to globe valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Bonnet: union with hexagonal shoulders.
.3 Connections: screwed with hexagonal shoulders.
.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
.6 Handwheel: non-ferrous.
.7 Handwheel Nut: bronze to ASTM B 62.
.2 NPS 2 and under, composition disc, Class 125:
.1 Body and bonnet: screwed bonnet.
.2 Disc and seat: renewable rotating PTFE disc, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.
.3 Operator: handwheel.

.5 Check Valves:
.1 Requirements common to check valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Connections: screwed with hexagonal shoulders.
.2 NPS 2 and under, swing type, bronze disc, Class 125:
.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
.3 Stainless steel spring, heavy duty.
.4 Seat: regrindable.

.6 Ball Valves:
.1 NPS 2 and under:
.1 Body and cap: cast high tensile bronze to ASTM B 62.
.2 Pressure rating: Class125.
.3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.
.4 Stem: tamperproof ball drive.
.5 Stem packing nut: external to body.
.6 Ball and seat: replaceable hard chrome solid ball and Teflon seats.
.7 Stem seal: TFE with external packing nut.
.8 Operator: removable lever handle.

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.

3.2 CLEANING

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

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.2 ASTM International Inc.
.1 ASTM A 126-04), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
.2 ASTM A 536-84(2004)e1, Standard Specification for Ductile Iron Castings.
.3 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
.4 ASTM B 209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate Metric.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
.1 MSS SP-67-02a, Butterfly Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit data for valves specified in this section.

1.3 CLOSEOUT SUBMITTALS

.1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

PART 2 - PRODUCTS

2.1 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG

.1 Except to speciality valves, to be of single manufacturer.

.2 To be suitable for dead-end service.

.3 Sizes:
.1 Grooved end type: NPS 2 to 12.

.4 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
.1 NPS 2 - 12: 200 psig.

.5 Minimum seat temperature ratings to 121 degrees C.

.6 Application: on-off operation.

.7 Grooved ends.

.8 Operators:
.1 NPS 2 - 8: handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel. Standard coating: black laquer.

.9 Designed to comply with MSS SP-67 and API 609.

.10 Construction:
.1 Body ductile iron.
.2 Disc: aluminum bronze or 316 SS.
.3 Seat: EPDM.
.4 Shaft: 316 stainless steel.
.5 Taper pin: 316 SS.
.6 Key: stainless.
.7 O-Ring: EPDM.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Valve and mating flange preparation.
.1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
.2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
.3 Install butterfly valves with disc in almost closed position.
.4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 INSTALLATION OF VALVES

.1 Install in accordance with manufacturer's instructions.

.2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.

.3 Verify suitability of valve for application by inspection of identification tag.

.4 Mount actuator on to valve prior to installation.

.5 Handle valve with care so as to prevent damage to disc and seat faces.

.6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.

.7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

3.3 CLEANING

.1 Clean installed products in accordance to manufacturer's recommendation.

.2 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B31.1-12, Power Piping.

.2 ASTM International
- .1 ASTM A 125-1996(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
- .2 ASTM A 307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 ASTM A 563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
- .1 MSS SP 58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .2 MSS SP 69-2003, Pipe Hangers and Supports - Selection and Application.
- .3 MSS SP 89-2009, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
- .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 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 or MSS SP 58.
.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 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 in accordance with MSS SP 58.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58. ANSI B31.1 and

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

2.3 PIPE HANGERS

.1 Finishes:
.1 Pipe hangers and supports: painted with zinc-rich paint after manufacture.
.2 Ensure steel hangers in contact with copper piping are 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: 13 mm FM approved.
.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP 58 and MSS-SP 69.

.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 to MSS SP 69.

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

.4 Upper attachment to concrete:
.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved to MSS SP 69.

.5 Shop and field-fabricated assemblies:
.1 Trapeze hanger assemblies: to ASME B31.3 and MSS SP 58.
.2 Steel brackets: to ASME B31.3 and MSS SP 58.

.6 Hanger rods: threaded rod material to MSS SP 58:
.1 Ensure that hanger rods are subject to tensile loading only.
.2 Provide linkages where lateral or axial movement of pipework is anticipated.
.3 Do not use 22 mm or 28 mm rod.

.7 Pipe attachments: material to MSS SP 58:
.1 Attachments for steel piping: carbon steel black.
.2 Attachments for copper piping: copper plated black steel.
.3 Use insulation shields for hot pipework.
.4 Oversize pipe hangers and supports to accommodate insulation thickness. Provide insulation shields.

.8 Adjustable clevis: material to MSS SP 69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.9 Finishes for steel pipework: black.
.1 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated or epoxy coated.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: black carbon steel to MSS SP 58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.3 Bolts: to ASTM A 307.

.4 Nuts: to ASTM A 563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:
.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A 125, 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.

2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.9 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

.2 Concrete.

2.10 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.

.2 Submit structural calculations with shop drawings.

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 Install in accordance with:
.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:
.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and 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 industry standards.
.3 Steel pipes: install below coupling or shear lugs welded to pipe.
.4 Cast iron pipes: install below joint.

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

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

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

3.3 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code.

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

.3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.4 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

.5 Pipework greater than NPS 12: to MSS SP 69.

3.4 HANGER INSTALLATION

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

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 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.

3.6 FINAL ADJUSTMENT

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

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

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

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

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

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

2.2 SYSTEM NAMEPLATES

.1 Colours:
.1 Hazardous: red letters, white background.
.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:
.1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:
.1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 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 Identification for PWGSC Preventive Maintenance Support System (PMSS):
.1 Use arrangement of Main identifier, Source identifier, Destination identifier.
.2 Equipment in Mechanical Room:
.1 Main identifier: size #9.
.2 Source and Destination identifiers: size #6.
.3 Terminal cabinets, control panels: size #5.
.3 Equipment elsewhere: sizes as appropriate.

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 IDENTIFICATION OF PIPING SYSTEMS

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

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

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

.4 Arrows showing direction of flow:
.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

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

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

.7 Colours and Legends:
.1 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:

Contents	Background colour marking	Legend
City water	Green	CITY WATER
Treated water	Green	TREATED WATER
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Make-up water	Yellow	MAKE-UP WTR
Domestic cold water supply	Green	DOM. CWS
Sanitary	Green	SAN
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS

2.5 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.6 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

.1 Provide identification only after painting has been completed.

3.3 INSTALLATION

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

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

.3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

.1 Locations:

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

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

.3 Protection:
.1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

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

.2 Adjacent to each change in direction.

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

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

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

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

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

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

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

.3 Number valves in each system consecutively.

3.7 CLEANING

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

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 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.

1.2 QUALIFICATIONS OF TAB PERSONNEL

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

.2 Provide documentation confirming qualifications, successful experience.

.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,or CAABC.
.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.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 in 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 TABB), 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 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 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 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 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 Division 23.

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 7 days prior to start of TAB.

.2 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.

.3 Ducts are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Access doors, installed, closed.

.6 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 5%. Unless noted otherwise.

.3 Chilled water chiller pumps: plus 5%, minus 0%, chilled water building pumps: plus 0% minus 5%.

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Departmental Representative list of instruments 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 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 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 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 digital copy of TAB Report to Departmental Representative for verification and approval, in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Departmental Representative.

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

.3 Number and location of verified results as directed by Departmental Representative.

.4 Pay 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. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

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

1.19 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section.

.2 Do TAB of systems, equipment, components, controls specified Division 23 following systems, equipment, components, controls:
.1 Mechanical room exhaust fan.

.3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB.

.4 Quality assurance: perform TAB under direction of supervisor qualified by to standards of CAABC or NEBB.

.5 Measurements: to include 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.

.6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 OTHER TAB REQUIREMENTS

.1 Set design flow of chilled water dedicated chiller pumps P-94, P-95, P-96 with any two pumps operating simultaneously. Run chiller pumps in all three possible combinations and make flow adjustments to minimize any difference in total flows.

.2 Set balance valve on cooling tower bypass line so that pressure drop across full bypass flow equals pressure drop across full flow cooling tower.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

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

.2 Reference Standards:
- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IESNA 90.1-10, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International Inc.
  - .1 ASTM C 335M-10e1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
  - .2 ASTM C 411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .3 ASTM C 449/C 449-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .4 ASTM C 547-12, Standard Specification for Mineral Fiber Pipe Insulation.
  - .5 ASTM C 553-11, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .6 ASTM C 612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .7 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
.4 Green Seal Environmental Standards (GSES)
.1 Standard GS-36-11, Commercial Adhesives.
.5 South Coast Air Quality Management District (SCAQMD), California State
.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
.6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
.7 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S102-07, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
.2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
.1 Description of equipment giving manufacturer's name, type, model, year and capacity.
.2 Details of operation, servicing and maintenance.
.3 Recommended spare parts list.

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:
.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 degrees C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with and without factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with and without factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
.1 Mineral fibre: to ASTM C 553.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to ASTM C 553.

2.3 JACKETS

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

.2 Lagging adhesive: compatible with insulation.
.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:
.1 Water based, fire retardant type, compatible with insulation.
.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.

.2 Indoor Vapour Retarder Finish:
.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.5 Outdoor Vapour Retarder Mastic:
.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.7 Contact adhesive: quick-setting
.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.

.8 Canvas adhesive: washable.
.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.

.9 Tie wire: 1.5 mm stainless steel.

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

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

.12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Exhaust air ducts to Outdoors	C-2	yes	25

.2 Finishes:
.1 Exposed indoors: canvas jacket.
.2 Concealed indoors: non required.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
- .1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .1 ASHRAE Standard 90.1-10, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM B 209M-10, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
- .2 ASTM C 335-10, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C 411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C 449/C 449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C 547-2012, Mineral Fiber Pipe Insulation.
- .6 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

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

.5 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2005.

.6 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.
.3 CAN/ULC-S702-2009, Thermal Insulation, Mineral Fibre, for Buildings
.4 CAN/ULC-S702.2-10, Thermal Insulation, Mineral Fibre, for buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:
.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as specified.

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

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

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

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S702.
.2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.5 TIAC Code A-6: flexible unicellular tubular elastomer.
.1 Insulation: with vapour retarder jacket.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

2.3 INSULATION SECUREMENT

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

.2 Contact adhesive: quick setting.

.3 Tie wire: 1.5 mm diameter stainless steel.

.4 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.4 CEMENT

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

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.8 JACKETS

.1 Polyvinyl Chloride (PVC):
.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
.2 Colours: to match adjacent finish paint.
.3 Minimum service temperatures: -20 degrees C.
.4 Maximum service temperature: 65 degrees C.
.5 Moisture vapour transmission: 0.02 perm.
.6 Thickness: 0.5mm.
.7 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.

.2 Aluminum:
.1 To ASTM B 209.
.2 Thickness: 0.50 mm sheet.
.3 Finish: stucco embossed.
.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

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

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

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with 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 Install hangers, supports outside vapour retarder jacket.

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

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, 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.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

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

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

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

.2 TIAC Code: A-1.
.1 Securements: Tape at 300 mm on centre.
.2 Seals: lap seal adhesive, lagging adhesive.
.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.
.1 Securements: Tape at 300 mm on centre.
.2 Seals: VR lap seal adhesive, VR lagging adhesive.
.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.
.1 Insulation securements: Tape or as per manufacturer.
.2 Seals: lap seal adhesive, lagging adhesive.

.5 Thickness of insulation as listed in following table.
.1 Run-outs to individual units and equipment not exceeding 4000 mm long.
.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp degrees 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			
Chilled Water	4 - 13	A-3	25	25	25	25	25	25
Condenser Water		None						
Outdoors Condenser Water		A-3	25	25	25	25	25	25
Indoors Domestic CWS		A-3	25	25	25	25	25	25
Refrigerant hot gas liquid suction	below 4	A-6	25	25	38	38	38	38

.6 Finishes:

.1 Exposed in mechanical rooms: PVC jacket.
.2 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
.3 Outdoors: water-proof aluminum jacket.
.4 Finish attachments: SS bands, at 150 mm on centre. Seals: wing closed.
.5 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

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

END OF SECTION

PART 1 - GENERAL

1.1 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

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

1.2 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 Chiller operation.
.3 Maximum cooling demand.
.4 Chiller failure.
.5 Cooling tower fan failure.
.6 Condenser fan failure.

1.3 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 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 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.

1.4 CONDENSER WATER SYSTEMS

.1 In addition to procedures specified above, perform following:
.1 Add chemicals twice per week as required.
.2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.
.4 Inject inhibitor into cooling tower sump.

.5 Adjust pressure regulating valve on fill line to ensure:
.1 Water level automatically fills in the case check valve after condenser water pumps leaks.
.2 Water does not overfill resulting in overflow of tower sump.
.6 Stroke 3-way bypass valve under load stable operation throughout.

1.5 EMERGENCY POWER .1 Simulate a power outage scenario and ensure that both data centre chiller systems automatically start-up under emergency power.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

PART 2 - PRODUCTS

2.1 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

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 CLEANING HYDRONIC AND STEAM SYSTEMS

.1 Timing: systems 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 used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

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

.6 Complete analysis of water 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 Fill system with water, ensure air is vented from system.

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

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

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

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

.6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
.7 Add chemical solution to system.
.8 Establish circulation, raise temperature slowly to maximum design. Circulate for 12 h, ensuring flow in all circuits. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.3 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:
.1 Establish circulation and expansion tank level, set pressure controls.
.2 Ensure air is removed.
.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
.5 Clean out strainers repeatedly until system is clean.
.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.
.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
.8 Repeat with water at design temperature.
.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
.10 Bring system up to design temperature and pressure slowly.
.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.12 Adjust pipe supports, hangers, springs as necessary.
.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
.15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
.16 Check operation of drain valves.
.17 Adjust valve stem packings as systems settle down.
.18 Fully open balancing valves (except those that are factory-set).
.19 Check operation of over-temperature protection devices on circulating pumps.
.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 CLEANING

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

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
.1 ASME B16.1-2010,Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
.2 ASME B16.3-2011, Malleable Iron Threaded Fittings: Classes 150 and 300.
.3 ASME B16.5-2009, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
.4 ASME B16.9-2012, Factory-Made Wrought Buttwelding Fittings.
.5 ASME B18.2.1-2010, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
.6 ASME B18.2.2-2010, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.2 ASTM International
.1 ASTM A 47/A 47M-(2009), Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
.3 ASTM A 536-84(2009), Standard Specification for Ductile Iron Castings.
.4 ASTM B 61-08, Standard Specification for Steam or Valve Bronze Castings.
.5 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 CSA International
.1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
.2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

.4 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
.1 MSS-SP-67-2002a, Butterfly Valves.
.2 MSS-SP-70-2011, Gray Iron Gate Valves, Flanged and Threaded Ends.
.3 MSS-SP-71-2011, Gray Iron Swing Check Valves Flanged and Threaded Ends.

.4 MSS-SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
.5 MSS-SP-85-2002, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
.1 Include special servicing requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect hydronic systems from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.2 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

PART 2 - PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A 53/A 53M, Grade B, as follows:
.1 To NPS 12: Schedule 40.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 Roll grooved: standard rigid coupling to CSA B242.

.1 Make and manufacture to match roll grooved joints used in existing system.

.3 Flanges: plain or raised face, weld neck to ANSI/AWWA C111/ A21.11.

.4 Orifice flanges: slip-on raised face, 2100 kPa.

.5 Flange gaskets: to ANSI/AWWA C111/ A21.11.

.6 Pipe thread: taper.

.7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.8 Roll grooved coupling gaskets: type EPDM.
.1 -34 degrees C to +110 degrees C at continuous operation.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:
.1 Cast iron: to ASME B16.1, Class 125.
.2 Steel: to ASME B16.5.

.3 Unions: malleable iron, to ASTM A 47/A 47M and ASME B16.3.

.4 Fittings for roll grooved piping: ductile iron to ASTM A 536.

2.4 VALVES

.1 Connections:
.1 NPS 2 and smaller: screwed ends.
.2 NPS 2-1/2 and larger: flanged or grooved ends.

.2 Butterfly valves: to MSS-SP-67 application: isolating cells or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):
.1 NPS 2-1/2 and over: grooved ends.

.3 Globe valves: to MSS-SP- 80 85 application: throttling, flow control.
.1 NPS 2 and under:
.1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.

.4 Balancing, for TAB:
.1 Sizes: calibrated balancing valves, as specified this section.
.2 NPS 2 1/2 and over:
.1 Grooved on flanged ends.
.2 'Y' pattern, globe style to provide flow measurement, flow balancing and shut off capability.
.3 Handwheel indicator and memory feature.
.4 Self sealing EPDM measurement points and EPDM seat.
.5 Ductile iron body.
.6 Rate -20 degrees C to 110 degrees C.
.7 Acceptable product Tour & Anderson #789.
.8 Other acceptable products: Armstrong, B+G, Taco.

.5 Drain valves: Ball as specified in Section 23 05 23.01 - Bronze Valves.

.6 Swing check valves: to MSS-SP-71.
.1 NPS 2 and under:
.1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.

.7 Ball valves:
.1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic systems installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

3.3 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and when TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.4 CLEANING, FLUSHING AND START-UP

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

3.5 TESTING

.1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.

3.6 BALANCING

.1 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.7 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems.

3.8 CLEANING

.1 Clean in accordance with Section 23 08 02 - Cleaning any Start up of Mechanical Piping Systems.
.1 Leave Work area clean at end of each day.

3.9 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
.1 ASME-04(2013), Boiler and Pressure Vessel Code.

.2 ASTM International Inc.
.1 ASTM A 47/A 47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A 278/A 278M-01(2011), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
.3 ASTM A 516/A 516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
.4 ASTM A 536-84(2009), Standard Specification for Ductile Iron Castings.
.5 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International)
.1 CSA B51-2004, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Provide manufacturer's printed product literature and datasheets for air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials.

PART 2 - PRODUCTS

2.1 AUTOMATIC AIR VENT

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

.2 Float: solid material suitable for 115 degrees C working temperature.

.3 Acceptable products: Flofab MV15.

.4 Other acceptable manufacturers: Maid-o-Mist,Taco, B&G.

2.2 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B 62, screwed connections, Y pattern.

.2 NPS 2 1/2 to 12: cast steel body to ASTM A 278/A 278M, Class 30, flanged connections.

.3 Blowdown connection: NPS 1.

.4 Screen: stainless steel with 1.19 mm perforations.

.5 Working pressure: 860 kPa.

2.3 SUCTION DIFFUSER

.1 Body: cast iron with flanged connections.

.2 Strainer: with built-in, stainless 3mm mesh, low pressure drop screen and NPS 1 blowdown connection, and NPT 1/4" gauge tapping.

.3 Permanent magnet particle trap.

.4 Full length straightening vanes.

.5 Adjustable support leg.

.6 Acceptable product indicated in schedule on drawings.

.7 Other acceptable manufacturers: Flofab, Taco,B&G.

2.4 TRIPLE DUTY VALVE

.1 Incorporate shut off valve, spring closure non slam check valve and throttling with flow measurement capability.

.2 Cast iron body, flanged connections.

.3 Acceptable product: As indicated in pump schedule on drawing.

.4 Other acceptable manufacturers: B&G, FloFab, Taco.

2.5 PRESSURE RELIEF VALVE

.1 Application chilled water closed loops.

.2 Bronze body, handwheel adjustment, 7-2070 kPa, -50 degrees C to 200 degrees C, threaded connections.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 GENERAL

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

.2 Maintain adequate clearance to permit service and maintenance.

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

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

3.3 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

3.4 AIR VENTS

.1 Install at high points of systems.

.2 Install ball valve on automatic air vent inlet.

3.5 PRESSURE SAFETY RELIEF VALVES

.1 If pressure safety relief valve for chilled water system has been demolished as part of this project, then contractor to install new replacement valve.

.2 Run discharge pipe to terminate above nearest drain.

3.6 SUCTION DIFFUSERS

.1 Install on inlet to pumps having suction size greater than 50 75.

3.7 CLEANING

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

.2 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
.1 Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC)

.3 Canadian Standards Association (CSA International)
.1 CSA-B214-12, Installation Code for Hydronic Heating Systems.

.4 National Electrical Manufacturers' Association (NEMA)
.1 NEMA MG 1-2011, Motors and Generators.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:
.1 Provide manufacturer's printed product literature and datasheets for pump, circulator, and equipment, and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

.3 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.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and operation data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 MAINTENANCE

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Size and select components to: CSA-B214.

2.2 VERTICAL IN-LINE CIRCULATORS

.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, fully closed, dynamically balanced.

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

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

.5 Coupling: rigid self-aligning.

.6 Motor: to NEMA MG 1 resilient mounted, drip proof, sleeve bearing.

.7 Capacity: as indicated on drawings.

.8 Design pressure: 1200 kPa.

.9 Provide integrated controller where indicated:
.1 UL Type 12 enclosure, integrated mounting on pump, orientation to be field adjustable, c/w fused disconnect switch, and D/C link reactor for harmonic suppression.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install hydronic pumps to: CSA-B214.

.2 In line circulators: install as indicated by flow arrows.
.1 Support at inlet and outlet flanges or unions.
.2 Install with bearing lubrication points accessible.

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

.4 Install volute venting pet cock in accessible location.

.5 Check rotation prior to start-up.

.6 Install pressure gauge test cocks as indicated.

3.3 START-UP

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

.2 Procedures:
.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
.2 After starting pump, check for proper, safe operation.
.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
.4 Check base for free-floating, no obstructions under base.
.5 Run-in pumps for 12 continuous hours minimum.
.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.

.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 Replace seals if pump used to degrease system or if pump used for temporary heat.
.15 Verify lubricating oil levels.

3.4 PERFORMANCE VERIFICATION (PV)

.1 Verify that manufacturer's performance curves are accurate.

.2 Ensure valves on pump suction and discharge provide tight shut-off.

.3 Net Positive Suction Head (NPSH):
.1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
.2 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.

.4 Multiple Pump Installations - Series and Parallel:
.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.6 Commissioning Reports: Reports to include:
.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
.2 Pump performance curves (family of curves).

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B16.22-12, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
- .2 ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
- .3 ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.
- .4 ASME B31.5-10, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A 307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 ASTM B 280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)
- .1 CSA B52-05(R2009), Mechanical Refrigeration Code.

.4 Environment Canada (EC)
- .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 TUBING

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

2.2 FITTINGS

.1 Service: design pressure 2070 kPa and temperature 121 degrees C.

.2 Brazed:

.1 Fittings: wrought copper to ASME B16.22.
.2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.3 Flanged:
.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
.2 Gaskets: suitable for service.
.3 Bolts, nuts and washers: to ASTM A 307, heavy series.

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

2.3 PIPE SLEEVES

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

2.4 VALVES

.1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

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

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

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

3.3 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

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

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

3.4 PIPING INSTALLATION

.1 General:
.1 Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Hot gas lines:
.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
.2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
.3 Provide inverted deep trap at top of risers.
.4 Provide double risers for compressors having capacity modulation.
.1 Large riser: install traps as specified.
.2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.
.5 Install to manufacturers recommendations.

3.5 PRESSURE AND LEAK TESTING

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

.2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.

.3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:
.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
.1 Twice to 14 Pa absolute and hold for 4 h.
.2 Break vacuum with refrigerant to 14 kPa.
.3 Final to 5 Pa absolute and hold for at least 12 h.
.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
.5 Submit test results to Departmental Representative.

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

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

.9 Manufacturer's Field Services:
.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
.3 Schedule site visits, to review Work, at stages listed:
.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
.2 During progress of work.
.3 Upon completion of the Work, after cleaning is carried out.
.4 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.

3.7 DEMONSTRATION .1 Instructions:
.1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

3.8 CLEANING .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
.1 Materials, components, equipment and chemicals for installation of complete HVAC water treatment system.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
.1 ASME Boiler and Pressure Vessel Code, Section VII-2004.

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Closeout Submittals:
.1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
.2 Include following:
.1 Log sheets as recommended by manufacturer.

1.4 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURER

.1 Equipment selection and installation to be coordinated with and approved by the current supplier with existing valid contract with PWGSC.

.2 Current supplier in place at the Joseph Ghiz Building is Millennium Water.

2.2 POT FEEDER-CHILLED WATER

.1 Welded steel, pressure rating 1200 kPa. Temperature rating: 90 degrees C.

.2 7.6 litre capacity body.

.3 Acceptable material: Neptune VTF.

.4 Other applicable manufacturers: JL Wingent and American Wheatley.

.5 Provide stainless steel filter cartridge housing rated for 2000 kPa, temperature rating 90 degrees C, 250 mm cartridge length with 5 micron cartridge.

.6 Provide (6) sets of filter cartridges for each type of filter.

2.3 BROMINE POT FEEDER-CONDENSER WATER

.1 Clear PVC body 860 kPa pressure rating, 38 degrees C, temperature rating, 42 litre capacity.

.2 Furnished with pressure relief valve, 860 kPa rating.

.3 Acceptable material: Neptune CLR-25. Other acceptable manufacturers: General Electric, GTP.

2.4 PACKAGED CHEMICAL HEADER

.1 Wall mounted prefabricated system complete with:

- .1 Basket strainer
- .2 Conductivity probe
- .3 Test coupon
- .4 Three injection tees
- .5 Isolation valves

.2 NPT 3/4" PVC construction, rated for 860 kPa pressure and 40 degrees C temperature.

.3 Acceptable material: Advantage WM-100-B3. Other acceptable manufacturers: General Electric, JL Wingert, Buckman.

2.5 CHEMICAL FEED PIPING

.1 Resistant to chemicals employed. Pressure rating: 860 kPa.

2.6 CHEMICAL FEED PUMPS

.1 Top-mounted electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting.

.2 4-20 mA control input.

.3 120 VAC power plug.

2.7 SHIPPING/ FEEDING CHEMICAL CONTAINERS

.1 High density moulded polyethylene, with liquid level graduations, cover.

.2 Pail sized with connection on top for feed pump suction hose.

2.8 CONTROLLER

.1 Fully transistorized, suitable for wall or mounting, linear over full measuring range of 0-5000 micromhs.

.2 Insensitive to phase angle shifts, capable of operating on 95-240 Volts without affecting accuracy, power, bleedoff status lights.

.3 Microprocessor controller capable of controlling four systems with LCD display graphic.

.4 Timer outputs for feed pumps, conductivity control, make-up water control.

.5 Provide BACNET IP port for tie into building automation system.

.6 Acceptable material: Advantage Megatron. Other acceptable manufacturers: GE, Buckman,JL Wingert.

2.9 WATER METER

.1 Positive displacement type meter, bronze casing, rubber piston, pressure range 200 to 1000 kPa, temperature range 1 degree C to 40 degrees C, accuracy of +/- 1.5%.

.2 Meter sized for 0.946 L/s continuous flow and capable of flow range of 0.0315 to 1.89 L/s.

.3 Acceptable product: Carlon JSJ 075. Other acceptable manufacturers: Neptune, GE.

2.10 BLOW DOWN SOLENOID

.1 Brass or bronze body, rated for max 860 kPa operating pressure, max temperature rating 82 degrees C, normally closed with 120 VAC operator, NPT 3/4" threaded connections.

2.11 CHEMICALS

.1 Provide 1 months supply.

.2 Obtain chemicals from manufacturer with existing valid contract with PWGSC.

2.12 TEST EQUIPMENT

.1 Provide one set of test equipment for each system to verify performance.

.2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

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

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

3.3 CHEMICAL FEED PIPING

.1 Install crosses at changes in direction. Install plugs in unused connections.

3.4 CLEANING OF MECHANICAL SYSTEM

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

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

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

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

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

3.5 WATER TREATMENT SERVICES

.1 Provide water treatment monitoring and consulting services for period of one month after system start-up. Service to include:
.1 Initial water analysis and treatment recommendations.
.2 System start-up assistance.
.3 Operating staff training.
.4 Visit plant during period of operation and as required until system stabilizes, and advise on treatment system performance.

.5 Provide necessary recording charts and log sheets for one year operation.
.6 Provide necessary laboratory and technical assistance.
.7 Provide clear, concise, written instructions and advice to operating staff.

3.6 FIELD QUALITY CONTROL

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

.2 Commissioning:
.1 Commissioning Agency: to be holder of service contract.
.2 Timing:
.1 After start-up deficiencies rectified.
.2 After start-up and before TAB of connected systems.
.3 Pre-commissioning Inspections: verify:
.1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.
.2 Suitability of log book.
.3 Currency and accuracy of initial water analysis.
.4 Required quality of treated water.
.4 Commissioning procedures - applicable to Water Treatment Systems:
.1 Establish, adjust as necessary and record automatic controls and chemical feed rates.
.2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
.3 Establish test intervals, regeneration intervals.
.4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
.5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.

.6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).

.7 Advise Departmental Representative in writing on matters regarding installed water treatment systems.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
.1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).
.1 ASTM A 480/A 480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
.2 ASTM A 635/A 635M-096, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
.3 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Department of Justice Canada (Jus).
.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .

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

.5 National Fire Protection Association (NFPA).
.1 NFPA 90A-2012, Standard for the Installation of Air-Conditioning and Ventilating Systems.
.2 NFPA 90B-2012, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible,2005.
.2 IAQ Guideline for Occupied Buildings Under Construction 2007, 2nd Edition.

.7 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

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

.2 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

PART 2 - PRODUCTS

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and resources.

2.2 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

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

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.
.3 Class C: transverse joints and connections made air tight with gaskets sealant tape or combination thereof. Longitudinal seams unsealed.
.4 Unsealed seams and joints.

2.3 SEALANT

.1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.4 TAPE

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

2.5 DUCT LEAKAGE

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

2.6 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.
.1 Rectangular: standard radius Centreline radius: 1.5 times width of duct.
.2 Round: smooth radius 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 45 degrees entry on branch.
.2 Round main and branch: enter main duct at 45 degrees with conical connection.
.3 Provide volume control damper in branch duct near connection to main duct.
.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.
.2 Converging: 30degrees maximum included angle.

.6 Offsets:
.1 Full radiused elbows as indicated.

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

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.8 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
.1 Maximum size duct supported by strap hanger: 500.
.2 Hanger configuration: to ASHRAE and SMACNA.
.3 Hangers: black steel angle with black steel rods to following table:

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

.4 Upper hanger attachments:
.1 For concrete: manufactured concrete inserts.
.2 For steel joist:manufactured joist clampsteel plate washer.

.3 For steel beams: manufactured beam clamps:

PART 3 - EXECUTION

3.1 GENERAL

.1 Do work in accordance with SMACNA as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.
.1 Insulate strap hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

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

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

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

3.3 SEALING AND TAPING

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

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Air-Conditioning and Refrigeration Institute (ARI)
- .1 ARI 550/590-2011, Water-Chilling Packages Using the Vapor Compression Cycle.

.2 American Society for Testing and Materials International, (ASTM)
- .1 ASTM C 547-12, Specification for Mineral Fiber Pipe Insulation.

.3 Canadian Standards Association (CSA International)
- .1 CSA B52-13, Mechanical Refrigeration Code.

.4 Environment Canada/Environmental Protection Services (EPS)
- .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

1.2 SHOP DRAWINGS

.1 Indicate:
- .1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
- .2 Wiring as assembled and schematically.
- .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
- .4 Space requirements for operation and maintenance.
- .5 Type of refrigerant used.

1.3 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Data to include:
- .1 Description of equipment giving manufacturers name, type, model year, capacity and serial numbers.
- .2 Provide part load performance curves.
- .3 Details on operation servicing and maintenance.

.4 Recommended spare parts list.
.5 Factory startup and test report.
.6 Seasonal commissioning report.

1.4 QUALITY ASSURANCE

.1 Manufacturer must demonstrate with shop drawings submittal that local representative can service chillers and be able to respond to maintenance request within 24 hours.

.2 Have access to local supply of essential parts and provide 7 year guarantee of availability of spare parts after absolescence.

.3 12 month parts and labour warranty.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Each chiller shall include: two (x2) centrifugal compressors; 2-pass evaporator; 2-pass water cooled condenser; motor starters; controls; control centre; piping; wiring; refrigeration charge; mounted on isolated steel base ready for connection to system chilled water piping; external control circuitry and electrical power source.

.2 Standard two (x2) individual refrigeration circuits.

.3 Factory installed flow switch for chilled water and condenser water.

.4 Compressors shipped separate to chiller as required for transporting chillers throughout building and into boiler room. Field installation of compressors on site including connection and refrigerant charging

.5 All cold equipment to be factory insulated.

.6 The chiller unit compressors shall be designed for mechanical and electrical isolation to facilitate service and removal.

2.2 CAPACITY (PER EACH CHILLER)

.1 Certified ratings based on ARI 550:
.1 Capacity indicated on drawings.

2.3 COMPRESSOR(S)

.1 Hermetic centrifugal compressor statically and dynamically balanced, motor-gear-compressor assembly balanced to vibration levels less than one mil at operating speed.

.2 Two stage direct drive designed for no-load start, automatic capacity control through variable frequency drive and motor, providing modulation capability from 10 to 100% of full load as per ARI 550.

.3 Magnetic bearings to provide levitated rotation of rotor shafts and impellors. No oil is used for lubrication.

.4 When not powered, the rotor is supported by carbon composite touchdown bearings.

.5 Each compressor shall include individual suction, discharge and motor cooling refrigerant isolation valves to allow for removal of compressor during chiller operation.

2.4 SHELL & TUBE EVAPORATOR AND CONDENSER

.1 Labelling: to CSA B52 and provincial requirements.

.2 Horizontal steel shell and finned copper tubes with steel intermediate supports and tube sheets.
.1 Removable water boxes permitting individual tube cleaning and removal.

.3 Distribution and baffles arranged to prevent direct high velocity impingement on tubes and uniform heat exchange through whole of heat exchanger surface.

.4 Evaporator condenser and water boxes shall be designed for 1 1/2 times working pressure but not less than 1 MPa on water side.
.1 Design refrigerant side for working pressure suitable for refrigerant used and leak tested using refrigerant trace gas.

.5 Dual pressure relief valves mounted on evaporator and condenser per each refrigerant circuit. Connected by common manifold with change over valve.

.6 Grooved pipe connections.

.7 Factory insulated.

2.5 REFRIGERANT PIPING

.1 Refrigerant piping, valves, fittings and related parts: to CSA B52 include:
.1 Electronic expansion valve.
.2 Solenoid stop valves.
.3 Liquid sight glasses complete with moisture indicator.
.4 Mechanical high pressure/low pressure switch for each circuit.
.5 Refrigerant electronic level sensor for each circuit.

.2 Suction line insulation: flexible elastomeric, unicellar insulation to ASTM C 547.

.3 Comply with requirements of EPS 1/RA/2.

2.6 CONTROL PANEL

.1 To EEMAC standard and include:
.1 Safety controls with cutout, indicator lights and manual reset and contacts for an alarm to include:
.1 High condenser pressure.
.2 High hermetic motor temperature.
.3 High discharge temperature.
.4 Motor over current.
.5 Low evaporator temperature.
.2 Operating controls to include:
.1 Start-stop switch.
.2 In/out chilled and condensor water temperature sensing.
.3 Low chilled water temperature cutout and automatic reset.
.4 Excess purge signal light and reset switch.
.5 Chilled water flow interruption light metre to indicate number of compressor starts and elapsed running time.
.6 Display of compressor operating information.

.7 Stepper motor controls for electronic refrigerant expansion valves.
.8 Adjustable water temperature set point on controller.
.9 Demand limit switch permitting selection of maximum motor load between 10 and 100% of full load.
.10 Interlock terminals.
.11 Other points as indicated on drawing.

.3 Alarm for refrigerant leakage.

.4 Data on main display screen shall include:

.1 Entering and leaving chilled water temperatures
.2 Entering and leaving condenser water temperatures.
.3 Current operating state of chiller.
.4 Active timers
.5 Chiller enable status.
.6 Chiller water flow proof status
.7 Condenser water flow proof status.
.8 Indicator of compressor readiness
.9 Indication of clearance to run.
.10 Chiller set point
.11 Total chiller kW
.12 Total chiller current input
.13 Three pages of data trends with zoom functionality.
.14 Graphical dial indicators that clearly indicate safe and unsafe operating values.
.15 Graphical representation of evaporator and condenser showing gas movement when chiller is running.
.16 Current alarms (announce and manual reset provision)
.17 Compressor actual rpm, maximum rpm, minimum rpm.
.18 Compressor alarm description and fault description.
.19 Compressor percentage motor demand.
.20 Compressor safety interlock status.
.21 Compressor modbus communication health status.
.22 Compressor suction and discharge pressures.
.23 Compressor suction and discharge temperatures.

.24 Compressor internal cooling system temperatures and status.
.25 Compressor motor kW and amps.
.26 Compressor pressure ratio.

.5 Bridge connection for direct tie into existing building Siemens automation system. Writable points to include chiller enable/disable and supply water temperature set point.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Provide appropriate protection apparatus.

.2 Install unit as indicated, to manufacturer's recommendations, and in accordance with EPS1/RA/2.

.3 Ensure adequate clearances for servicing and maintenance.

.4 Manufacturer to:
.1 Include one site visit during installation.
.2 Include one site visit for startup/ training
.3 Provide seasonal commissioning services(cooling season) when cooling towers are seasonally commissioned.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Air-Conditioning and Refrigeration Institute (ARI)
- .1 ARI 550/590-2011, Water-Chilling Packages Using the Vapor Compression Cycle.

.2 American Society for Testing and Materials International, (ASTM)
- .1 ASTM C 547-12, Specification for Mineral Fiber Pipe Insulation.

.3 Canadian Standards Association (CSA International)
- .1 CSA B52-13, Mechanical Refrigeration Code.

.4 Environment Canada/Environmental Protection Services (EPS)
- .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

1.2 SHOP DRAWINGS

.1 Indicate:
- .1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
- .2 Wiring as assembled and schematically.
- .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
- .4 Space requirements for operation and maintenance.
- .5 Type of refrigerant used.

1.3 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Data to include:
- .1 Description of equipment giving manufacturers name, type, model year, capacity and serial numbers.
- .2 Provide part load performance curves.
- .3 Details on operation servicing and maintenance.

.4 Recommended spare parts list.
.5 Factory startup and test report.
.6 Seasonal commissioning report.

1.4 QUALITY ASSURANCE

.1 Manufacturer must demonstrate with shop drawings submittal that local representative can service chillers and be able to respond to maintenance request within 24 hours.

.2 Have access to local supply of essential parts and provide 7 year guarantee of availability of spare parts after absolescence.

.3 12 month parts and labour warranty.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Each chiller shall include: one (x1) centrifugal compressors; 4-pass evaporator; motor starters; controls; control centre; piping; wiring; refrigeration charge; mounted on isolated steel base ready for connection to system chilled water piping; external control circuitry and electrical power source.

.2 Factory installed flow switch for chilled water.

.3 Compressors shipped separate to chiller as required for transporting chillers throughout building and into boiler room. Field installation of compressors on site including connection and refrigerant charging

.4 All cold equipment to be factory insulated.

.5 The chiller unit compressors shall be designed for mechanical and electrical isolation to facilitate service and removal.

.6 Chiller and remote air cooled condenser to be selected together to operate as one unit.

.7 Free Cooling Mode: System shall operate at outdoor temperatures down to minus 28.8 degrees C. Low ambient operation achieved by refrigerant bypassing the compressors and refrigerant flow driven by gravitational forces on liquid refrigerant. Compressors shall not operate when unit is in free cooling mode.

2.2 CAPACITY (PER EACH CHILLER)

.1 Certified ratings based on ARI 550:
.1 Capacity indicated on drawings.

2.3 COMPRESSOR(S)

.1 Hermetic centrifugal compressor statically and dynamically balanced, motor-gear-compressor assembly balanced to vibration levels less than one mil at operating speed.

.2 Two stage direct drive designed for no-load start, automatic capacity control through variable frequency drive and motor, providing modulation capability from 10 to 100% of full load as per ARI 550.

.3 Magnetic bearings to provide levitated rotation of rotor shafts and impellors. No oil is used for lubrication.

.4 When not powered, the rotor is supported by carbon composite touchdown bearings.

.5 Compressor shall include individual suction, discharge and motor cooling refrigerant isolation valves to allow for removal of compressor during chiller operation.

2.4 SHELL & TUBE EVAPORATOR

.1 Labelling: to CSA B52 and provincial requirements.

.2 Horizontal steel shell and finned copper tubes with steel intermediate supports and tube sheets.
.1 Removable water boxes permitting individual tube cleaning and removal.

.3 Distribution and baffles arranged to prevent direct high velocity impingement on tubes and uniform heat exchange through whole of heat exchanger surface.

.4 Evaporator water boxes shall be designed for 1 1/2 times working pressure but not less than 1 MPa on water side.
.1 Design refrigerant side for working pressure suitable for refrigerant used and leak tested using refrigerant trace gas.

.5 Dual pressure relief valves mounted on evaporator per each refrigerant circuit. Connected by common manifold with change over valve.

.6 Grooved pipe connections.

.7 Factory insulated, 19 mm thick.

2.5 REFRIGERANT PIPING

.1 Refrigerant piping, valves, fittings and related parts: to CSA B52 include:
.1 Electronic expansion valve.
.2 Solenoid stop valves.
.3 Liquid sight glasses complete with moisture indicator.
.4 Mechanical high pressure/low pressure switch for each circuit.
.5 Refrigerant electronic level sensor for each circuit.

.2 Suction line insulation: flexible elastomeric, unicellar insulation to ASTM C 547.

.3 Heated receiver for low ambient operation.

.4 Comply with requirements of EPS 1/RA/2.

2.6 REMOTE CONDENSER

.1 Air cooled: Performance as indicated on drawings.

.2 Tube bundle: Copper with aluminum fin. Anticorrosive paint coatings on fins to pass 1000 hour salt spray test in accordance with ASTM B117. Factory test to 2.4 mPa under water.

.3 Condenser sheet metal housing coating rated for 1500 salt spray test in accordance with ASTM B117.

2.7 CONTROL PANEL .1 To EEMAC standard and include:

.1 Safety controls with cutout, indicator lights and manual reset and contacts for an alarm to include:

.1 High condenser pressure.
.2 High hermetic motor temperature.
.3 High discharge temperature.
.4 Motor over current.
.5 Low evaporator temperature.

.2 Operating controls to include:

.1 Start-stop switch.
.2 In/out chilled water temperature sensing.
.3 Low chilled water temperature cutout and automatic reset.
.4 Excess purge signal light and reset switch.
.5 Chilled water flow interruption light metre to indicate number of compressor starts and elapsed running time.
.6 Display of compressor operating information.
.7 Stepper motor controls for electronic refrigerant expansion valves.
.8 Adjustable water temperature set point on controller.
.9 Demand limit switch permitting selection of maximum motor load between 10 and 100% of full load.
.10 Interlock terminals.
.11 Toggle between free-cooling mode and normal (compressor) mode.
.12 Other points as indicated on drawing.

.3 Alarm for refrigerant leakage.

.4 Data on main display screen shall include:

.1 Entering and leaving chilled water temperatures
.2 Current operating state of chiller.
.3 Active timers
.4 Chiller enable status.
.5 Chiller water flow proof status
.6 Condenser water flow proof status.
.7 Indicator of compressor readiness

.8 Indication of clearance to run.
.9 Chiller set point
.10 Total chiller kW
.11 Total chiller current input
.12 Data trends with zoom functionality.
.13 Graphical dial indicators that clearly indicate safe and unsafe operating values.
.14 Graphical representation of evaporator and condenser showing gas movement when chiller is running.
.15 Current alarms (announce and manual reset provision)
.16 Compressor actual rpm, maximum rpm, minimum rpm.
.17 Compressor alarm description and fault description.
.18 Compressor percentage motor demand.
.19 Compressor safety interlock status.
.20 Compressor BAS communication health status.
.21 Compressor suction and discharge pressures.
.22 Compressor suction and discharge temperatures.
.23 Compressor internal cooling system temperatures and status.
.24 Compressor motor kW and amps.
.25 Compressor pressure ratio.

.5 Bridge connection for direct tie into existing building Siemens automation system. Writable points to include chiller enable/disable and supply water temperature set point.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Provide appropriate protection apparatus.

.2 Install unit as indicated, to manufacturer's recommendations, and in accordance with EPS1/RA/2.

.3 Ensure adequate clearances for servicing and maintenance.

.4 Manufacturer to:

.1 Include one site visit during installation.
.2 Include one site visit for startup/ training
.3 Provide winter time commissioning support including verification of low ambient operation.
.4 Provide summertime seasonal commissioning.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
.1 Materials, components, framing, installation and testing for an evaporative cooling tower.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
.1 ASTM A 48/A 48M-2012, Standard Specification for Gray Iron Castings.
.2 ASTM A 123/A/123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
.3 ASTM A 153/A 153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
.4 ASTM B 117-11, Standard Practice for Operating Salt Spray (Fog) Apparatus.
.5 ASTM D 520-2011, Standard Specification for Zinc Dust Pigment.

.2 Cooling Technology Institute (CTI)
.1 CTI-ATC-105-2000, Acceptance Test Code.
.2 CTI-STD-201-2013, Standard for the Certification of Commercial Water Cooling Tower Thermal Performance.

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

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

.5 National Electrical Manufacturers Association (NEMA)
.1 NEMA MG 1-2011, Motors and Generators.

.6 ASHRAE Energy Standard for buildings except low-rise residential buildings, ASHRAE 90.1 (2013).

1.3 PERFORMANCE REQUIREMENTS

.1 Performance certified in accordance with CTI-STD-201, and meet energy efficiency requirements of ASHRAE 90.1.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:
.1 Indicate:
.1 Connections, piping, fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
.2 Wiring as assembled and schematically.
.3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
.4 Vibration and seismic control measures.
.5 Manufacturers recommended clearances.
.6 Performance.
.2 Test reports:
.1 Submit certified test reports for cooling towers from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.4 Instructions: submit manufacturer's installation instructions.
.5 Manufacturer's Field Reports: manufacturer's field reports specified.

.3 Closeout Submittals:
.1 Provide operation and maintenance data for incorporation into manual.
.2 Include:
.1 Description of equipment giving manufacturers name, type, model year, capacity.
.2 Start-up and commissioning procedures.
.3 Details of operation, servicing and maintenance.
.4 Recommended spare parts list.

1.5 QUALITY ASSURANCE

.1 Qualifications:
.1 Installer: company or person specializing in cooling towers installations with 5 -years documented experience.

.2 Regulatory Requirements: work to be performed in compliance with applicable Provincial /Territorial regulations.

.3 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with manufacturer's written instructions.

.2 Storage and Protection:
.1 Store materials in dry location.
.2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

.3 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.7 MAINTENANCE

.1 Extra Materials:
.1 Furnish following spare parts: .
.2 Furnish spare parts data for each different item of equipment specified, after approval of detail drawings and not later than months prior to date of occupancy.
.3 Include with data complete list of parts and supplies, , source of supply, recommended spare parts list for 1 year of operation, and list of parts recommended by manufacturer to be replaced on routine basis.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Performance and acceptable manufacturers listed on drawings.

.2 Factory assembled induced draft counterflow vertical discharge cooling tower.

.3 Ensure major equipment including cooling towers, cooling tower fan drive assemblies, fans, and motors have manufacturer's name, address, style, model serial number, on plate secured to item of equipment.

.4 Plates: durable and legible throughout equipment life and made of stainless steel.

.5 Fix plates in prominent locations with nonferrous screws or bolts.

2.2 MATERIALS

.1 Steel: components fabricated of hot dipped galvanized steel not lighter than 1.5 mm thick steel, protected against corrosion by zinc coating.
.1 Zinc coating: to ASTM A 153/A 153M and ASTM A 123/A 123M, with extra heavy coating of not less than 0.76 kg per square meter of surface.
.2 Coat galvanized surfaces damaged due to welding with zinc rich coating conforming to ASTM D 520, Type 1.

.2 Fibre glass reinforced plastic, (FRP) components: inert, corrosion resistant, and fire-retardant with thickness of 3.66 kg/square meter.

.3 Polyvinyl chloride, (PVC) with flame spread rating of 10, smoke developed of 25, to CAN/ULC-S102.

.4 Stainless steel: type 304.

.5 Plastic: polypropylene.

.6 Hardware: zinc-coated steel or Type 304 stainless steel.
.1 Bolts: provided with neoprene washers under heads.

.2 Hardware: meet salt-spray fog test as defined by ASTM B 117.

2.3 CASING AND FRAMEWORK

.1 Materials: galvanized steel sheet, angles and channels.

.2 Structure: designed for wind loads of 1.45 kN/m^2 on projected area and transmission of loads to anchorage.
.1 Include 15 % increased loading for ice or snow load.

.3 Access doors panels: on both end walls for servicing and maintenance. Access to middle cell through cell on either end.

.4 Access to spray nozzles: permanent galvanized steel ladder and access platforms.

.5 Provide straight-rung ladders of standard design, starting at ground level and extending as high as required to gain access to fan decks and water distribution systems.
.1 Stairways and ladders: hot-dip, zinc-coated steel.
.2 Equip ladders higher than 3.66m with safety cage.

.6 Provide steel hand railings minimum 1067 mm high around exterior of each working surface that is 1.0m or more above ground, roof, or other supporting construction.
.1 Railings: minimum 32mm zinc-coated steel pipe with standard zinc-coated steel railing.

.7 All components inside unit to be fully accessible. Provide ladders, safety rails, platforms as required.

2.4 COLD WATER BASIN

.1 Construct basin watertight from , Type 304 stainless steel.

.2 Construct and install basin to ensure that air will not entrained in outlets when operating and no water will overflow on shutdown.

.3 Provide individual sump with individual outlet.

.4 Equip outlets with stainless steel strainger with anti-vortexing baffles.

.5 Equip basins with:
.1 Overflow and valved drain connections.
.2 Electric makeup water system, controllers, sensors, valves as indicated.

.6 Makeup water: discharge not less than 50 mm or two pipe diameters, whichever is greater, above top of basin.

2.5 HOT WATER DISTRIBUTION

.1 Construct basin watertight from type 304 stainless steel.

.2 Water distribution: gravity-flow type system which distributes waters evenly over entire fill surface.

.3 Design tower cells so that water flow of 140 % capacity will not cause overflowing or splashing.

.4 Ensure distribution system is self-draining and non-clogging.

.5 Gravity-Flow System: provided with open basins which include splash box baffles to minimize splashing of incoming hot water and holes that evenly distribute water over entire decking area.
.1 Equip water basin holes with polypropylene orifice inserts.

.6 Provide hot water distribution basins with tower manufacturer's standard removable, stainless steel, covers to prevent airborne debris from entering basin.

2.6 FILL, ELIMINATORS AND LOUVRES

.1 Tower fill: splash or film, type.
.1 Fill material: free to expand or contract without warping or cracking
.2 Do not use plasticized wood cellulose for fill material.
.3 Ensure fill is removable or otherwise made accessible for cleaning.

.4 Space supports: corrosion resistant, designed to prevent warping, sagging, misalignment, or vibration of fill material.
.5 Design fill material and supports to provide for even mixing of air and water.
.6 Construct fill material of PVC formed sheets, in pattern, and of sufficient height to meet performance specifications.
.7 Design lintels with safety factor of 2 minimum.

.2 Provide eliminators in tower outlet to limit drift loss to not over 0.005 % of circulating water rate.
.1 Construct eliminators of polyvinyl chloride (PVC).
.2 Eliminators: multi-pass zigzag type, assembled into sections making strong, stable unit.

.3 Provide air inlets for each cooling tower with individually removable louvers arranged to prevent escape of water. Louvers: zinc-coated steel.
.1 Provide compatible materials casings and louvers.
.2 One material not to produce stains on other materials.
.3 Provide air intakes with 25 mm zinc-coated steel mesh.

2.7 FAN

.1 Fan: axial statically and dynamically balanced, low noise.

.2 Fan drive: V-belt designed for minimum 150% of motor nameplate ratings.

.3 Motor: single speed, totally enclosed, insulation Class B, continuous-rated type which conforms to NEMA MG 1, inverter duty.
.1 Mount motors in accordance with manufacturer's recommendations.

.4 Drives, fans, and moving parts: protected by galvanized wire guards.

.5 Provide extended bearing lubrication lines accessible from the access door.

2.8 ACCESSORIES

.1 Vibration cut out switches mechanically tripped with a frequency range of 0 to 3600 RPM and trip point of 0.2 to 2.0 g's, switch mounted on outside of unit.

.2 Provide control panel C/W VFU's for tower fans and allow for tie in of water level controller and vibration cut out switch.
.1 Indoor - Floor mounted with stand.
.2 Switches and operating lights.
.3 Hard wire points for tie into B.A.S.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

.1 Mount on structural supports as indicated and to manufacturer's recommendations.

.2 Ensure clearance for servicing and maintenance as recommended by manufacturer.

.3 Manufacturers field service representative to approve installation, to supervise start up and to instruct operators.

.4 Provide seasonal commissioning of system including water balancing, and 3-way valve adjustments.

3.3 FIELD QUALITY CONTROL

.1 Site Tests:
.1 Test under actual operating conditions in accordance with CTI-ATC-105 to verify specified performance.

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

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 ADJUSTING

.1 Lubricate bearings with oil or grease as recommended by manufacturer.

.2 Tighten belts to manufacturer's specified tension.

3.5 CLEANING

.1 Wipe equipment clean, and remove traces of oil, dust, dirt, or paint spots.

.2 Maintain system in clean condition until final acceptance.

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

END OF SECTION