PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

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

.2 National Fire Code of Canada (NFCC 2005)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

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 and National Fire Code of Canada.

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

3.4 DRAINS

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

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

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

3.5 AIR VENTS

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

.2 Install isolating valve at each automatic air valve.

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, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

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

3.7 PIPEWORK INSTALLATION (Cont'd)

.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 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.
- .6 Install butterfly valves between weld neck flanges to ensure full compression of liner.
- .7 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

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 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.
- .1 Chrome or nickel plated brass or type 302 stainless steel..

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

3.10 PREPARATION FOR FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

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

3.11 FLUSHING OUT OF PIPING SYSTEMS

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

3.12 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.

.3 Maintain test pressure of 862 kPa 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.

3.13 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.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B31.1-2014, Power Piping.
- .2 ASME B31.3-2014, Process Piping.
- .3 ASME Boiler and Pressure Vessel Code-2007:
  - .1 BPVC 2015 Section I: Power Boilers.
  - .2 BPVC 2015 Section V: Nondestructive Examination.
  - .3 BPVC 2015 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
- .1 ANSI/AWWA C206-11, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)
- .1 AWS C1.1M/C1.1-2000(R2012), Recommended Practices for Resistance Welding.

.4 Canadian Standards Association (CSA International)
- .1 CSA W47.2-11, Certification of Companies for Fusion Welding of Aluminum.
- .2 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
- .3 CSA B51-14, Boiler, Pressure Vessel and Pressure Piping Code.
- .4 CSA W117.2-12, Safety in Welding, Cutting and Allied Processes.
- .5 CSA W178.1-14, Certification of Welding Inspection Organizations.
- .6 CSA W178.2-14, Certification of Welding Inspectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

.1 Qualifications:
- .1 Welders:
  - .1 Welding qualifications in accordance with CSA B51.
  - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
  - .3 Submit welder's qualifications to Departmental Representative.
  - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
  - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
- .2 Inspectors:
  - .1 Inspectors qualified to CSA W178.2.
- .3 Certifications:
  - .1 Registration of welding procedures in accordance with CSA B51.
  - .2 Copy of welding procedures available for inspection.
  - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

PART 2 - PRODUCTS

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

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 QUALITY OF WORK

.1 Welding: in accordance with ASME B31.1 & ASME B31.3, ASME Boiler and Pressure Vessel Code, Sections I and IX and AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, applicable requirements of provincial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

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

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

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

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

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

.2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.

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

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

.1 General:
- .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative DCC Representative Consultant.
- .2 To ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

3.5 SPECIALIST EXAMINATIONS AND TESTS (Cont'd)

.1 General:(Cont'd)
  .3 Inspect and test 10% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and full gamma ray radiographic (hereinafter referred to as "radiography") tests.

.2 Hydrostatically test welds to ASME B31.1.

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

.4 Failure of visual examinations:
  .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 20% of welds, selected at random by Departmental Representative by radiographic particle tests.

3.6 DEFECTS CAUSING REJECTION

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

.2 In addition, chilled water systems below 1034 kPa:
  .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.
  .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.
  .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.
  .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.
  .5 Repair cracks and defects in excess of 0.8 mm in depth.
  .6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic tests.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

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

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
  .1 ASME B40.100-2013, Pressure Gauges and Gauge Attachments.
  .2 ASME B40.200-2008, 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.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to CAN/CGSB-14.4 & ASME B40.200.
  .1 Resistance to shock and vibration.

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.4 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel or phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:
  .1 Snubber for pulsating operation.
  .2 Gasketted pressure relief back with solid front.
  .3 Isolating ball valve.

PART 3 - EXECUTION

3.1 GENERAL

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

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

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

.2 Install in locations as indicated and on inlet and outlet of:
   - .1 Water cooling coils.

.3 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in locations as follows:
   - .1 Inlet and outlet of coils.
   - .2 In other locations as indicated.

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

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
  .1 ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch).

.2 ASTM International
  .1 ASTM B62-15, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Valves:
  .1 Except for specialty valves, to be single manufacturer.
  .2 Products to have CRN registration numbers.

.2 Ball Valves:
  .1 NPS 2 and under:
    .1 Body and cap: cast high tensile bronze to ASTM B62.
    .2 Pressure rating: Class 125.
    .3 Connections: screwed ends to ASME B1.20.1 and with hexagonal shoulders and solder ends to ASME.
    .4 Stem: tamperproof ball drive.
    .5 Stem packing nut: external to body.
    .6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
    .7 Stem seal: TFE with external packing nut.
    .8 Operator: removable lever handle.

.3 Butterfly Valves:
  .1 NPS 2-1/2 through NPS 6, 2068 kPa with grooved ends.
    .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
    .2 Disc: elastomer coated ductile iron with integrally cast stem.
    .3 Operator: lever.

2.2 Circuit Balancing Valves (CBV)

.1 General:
  .1 Y style globe valve, designed to provide precise flow measurement and control, with valved ports for connection to differential pressure meter.

.2 Accuracy:
  .1 Readout to be within plus or minus 2% of actual flow at design flow rate.

2.2 Circuit Balancing Valves (CBV) (Cont'd)

.3 Pressure die-cast dezincification resistant copper alloy construction, Teflon disc, screw-in bonnet.
   .1 Flow control: At least four 4 full turns of handwheel with digital handwheel and tamperproof concealed mechanical memory.

.4 Insulation:
   .1 Use prefabricated shipping packaging of 5.4 R polyurethane as insulation.

.5 Drain connection:
   .1 NPS 3/4 valved and capped, suitable for hose socket.
   .2 Incorporated into valve body or provided as separate item.

.6 Size:
   .1 Valve to be sized for a minimum pressure drop of 6 kPa at design flow at mid range. Provide pipe reducers as required.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Remove internal parts before soldering.

.2 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

END

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 American Petroleum Institute (API)
   .1 API Std. 609, Butterfly Valves: Double-flanged, Lug- and Wafer-type, Seventh Edition.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
   .1 MSS SP-67-2011, Butterfly Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG

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

.2 To be suitable for dead-end service.

.3 CRN registration number required for products.

.4 Sizes:
   .1 Lug type: NPS 2 to 30.

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

.6 Minimum seat temperature ratings to 121 degrees C.

.7 Application: on-off operation.

.8 Full lug body (threaded).

.9 Operators:
   .1 NPS 2 - 6: 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.
   .2 NPS 8 - 30: manual enclosed gear operator or electric actuators as specified elsewhere in this section.

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

.11 Compatible with ASME Class 125/Class 150 flanges.

2.1 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG (Cont'd)

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

2.2 MOUNTING flanges. FLANGES

.1 Class 125 cast iron to ASME B16.1 or Class 150 steel to B16.5 pipe

2.3 ELECTRIC ACTUATORS

.1 Operation: designed to provide precise quarter turn electric operation.
- .1 Torque range: up to 1.130 N-m and speed ranges from 10 seconds to 30 seconds to move from fully open to fully closed.
- .2 Gear train within actuator to provide smooth continuous rotary power stroke for accurate automatic valve positioning. Factory-set, field adjustable cam-actuated travel limit switches to provide precise control of shaft rotation.

.2 Construction:
- .1 Castings: heavy duty industrial grade for rugged use.
- .2 Actuators: continuous duty with high efficiency single phase reversing capacitor motor with thermal overload protection.
- .3 Gears and pinions constructed from hardened steel.
- .4 Gear train to be permanently lubricated.
- .5 Mechanical brake to ensure that gear is locked in precise position.

.3 Electrical:
- .1 Control options: 4-20 Ma DC or 0-10 V DC.
- .2 CSA approved.
- .3 Electrical rating: NEMA IV.

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.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 49.01 - Seismic Restraint Systems (SRS) - Type P2 Buildings.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
  .1 ASME B31.1-2014, Power Piping.

.2 ASTM International
  .1 ASTM A125-1996(2013)e1, Standard Specification for Steel Springs, Helical, Heat-Treated.
  .2 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  .3 ASTM A563-15, Standard Specification for Carbon and Alloy Steel Nuts.

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

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 and ASME B31.1.

.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: galvanized after manufacture.
  .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
  .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

2.3 PIPE HANGERS (Cont'd)

.2 Upper attachment structural: suspension from lower flange of I-Beam:
   .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
      .1 Rod: 9 mm UL listed.
   .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.

.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 58.
   .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 to MSS SP 58 via concrete pre-drilling.

.5 Manufactured assemblies:
   .1 Sway braces for seismic restraint systems: to Section 23 05 49.01 - Seismic Restraint Systems (SRS) - Type P2 Buildings.

.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.

.8 Adjustable clevis: material to MSS SP 58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
   .1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 58.

.10 U-bolts: carbon steel to MSS SP 58 with 2 nuts at each end to ASTM A563.
   .1 Finishes for steel pipework: black.
   .2 Finishes for copper, glass, brass or aluminum pipework: black, with epoxy coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 58.

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 A307.

2.4 RISER CLAMPS (Cont'd)

.4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:
   .1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP 58, galvanized sheet carbon steel. Length designed for maximum 3 m span.

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

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

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

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

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

2.7 VARIABLE SUPPORT SPRING HANGERS

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

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops..

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

2.8 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

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.

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

3.3 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code and authority having jurisdiction.

.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.

3.3 HANGER SPACING (Cont'd)

.4 (Cont'd)

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 58.

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

PART 1 - GENERAL

1.1 REFERENCES

.1 National Research Council Canada (NRCC)
- .1 NRCC NBCC-2010, National Building Code of Canada 2010.

1.2 DEFINITIONS

.1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.

.2 SRS: acronym for Seismic Restraint System.

1.3 DESCRIPTION

.1 SRS fully integrated into, and compatible with:
- .1 Noise and vibration controls specified elsewhere.
- .2 Structural, mechanical, electrical design of project.

.2 Systems, equipment not required to be operational during and after seismic event.

.3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

.4 Designed by Professional Engineer specializing in design of SRS and registered in Province of Ontario.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.3 Submit design data including:
- .1 Full details of design criteria.
- .2 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
- .3 Separate shop drawings for each SRS and devices for each system, equipment.
- .4 Identification of location of devices.
- .5 Schedules of types of SRS equipment and devices.
- .6 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
- .7 Installation procedures and instructions.
- .8 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract Documents, materials lists, design calculations, schematics, specifications.

.4 Submit additional copy of shop drawings and product data to Structural Engineer for review of connection points to building structure.

PART 2 - PRODUCTS

2.1 SRS MANUFACTURER

.1 SRS from one manufacturer regularly engaged in SRS production.

2.2 GENERAL

.1 SRS to provide gentle and steady cushioning action and avoid high impact loads.

.2 SRS to restrain seismic forces in every direction.

.3 Fasteners and attachment points to resist same load as seismic restraints.

.4 SRS of Piping systems compatible with:
   .1 Expansion, anchoring and guiding requirements.
   .2 Equipment vibration isolation and equipment SRS.

.5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.6 Attachments to RC structure:
   .1 Use high strength mechanical expansion anchors.
   .2 Drilled or power driven anchors not permitted.

.7 Seismic control measures not to interfere with integrity of firestopping.

2.3 SLACK CABLE RESTRAINT SYSTEM (SCS)

.1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

2.4 SERVICE UTILITIES ENTRANCE INTO BUILDING

.1 Provide flexibility to prevent breakage in the event of earthquake activity.

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 Attachment points and fasteners:
  .1 To withstand same maximum load that seismic restraint is to resist and in every direction.

.2 Slack Cable Systems (SCS):
  .1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.
  .2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
  .3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.
  .4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
  .5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.
  .6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.
  .7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.

.3 Install SRS at least 25 mm from equipment, systems, services.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services.

.2 Inspection and Certification:
  .1 SRS: inspected and certified by Seismic Engineer upon completion of installation.
  .2 Provide written report to Departmental Representative with certificate of compliance.

.3 Commissioning Documentation:
  .1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-24.3-92, Identification of Piping Systems.

PART 2 - PRODUCTS

2.1 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.

2.2 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 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.

2.2 IDENTIFICATION OF PIPING SYSTEMS (Cont'd)

.7 Colours and Legends:(Cont'd)

.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
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN

2.3 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.

2.4 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.

2.5 LANGUAGE

.1 Identification in English and French.

.2 Use one nameplate and label for each language.

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 LOCATION OF IDENTIFICATION ON PIPING 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.

3.2 LOCATION OF IDENTIFICATION ON PIPING SYSTEMS (Cont'd)

.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.

3.3 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.

END

PART 1 - GENERAL

1.1 EXCEPTIONS

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

1.2 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.

1.3 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.

1.4 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.

1.5 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.

1.6 START OF TAB

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

.2 Start TAB when provisions for TAB are 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 Liquid systems:
  - .1 Flushed, filled, vented.
  - .2 Strainers in place, baskets clean.
  - .3 Isolating and balancing valves installed, open.
  - .4 Calibrated balancing valves installed, at factory settings.

1.7 APPLICATION TOLERANCES

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

1.8 ACCURACY TOLERANCES

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

1.9 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.

1.10 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.11 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 electronic copy of TAB Report to Departmental Representative for verification and approval, in English complete with index tabs.

1.12 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.

1.13 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, lock devices in set positions.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.14 COMPLETION OF TAB

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

1.15 HYDRONIC SYSTEMS

.1 Cooling Coils:
- .1 Fluid used. Identify fluid used; water, % water/ethylene glycol mixes, steam, etc.
- .2 Fluid flow rate.
- .3 Fluid Specific Heat, at mean temperature.
- .4 Fluid Specific Gravity, at mean temperature.
- .5 Fluid entering and leaving temperatures and pressures.
- .6 Fluid side heat transfer rate.

1.16 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:
- .1 Qualifications of TAB personnel: as for air systems specified this section.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C335/C335M-10e1, Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
  - .2 ASTM C449-07(2013), Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .3 ASTM C547-15, Standard Specification for Mineral Fiber Pipe Insulation.

.2 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

.3 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.4 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies,
  - .2 CAN/ULC S702-14, Standard for Thermal Insulation Mineral Fibre for Buildings.

1.2 DEFINITIONS

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

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

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 C335/C335M.

.3 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
- .1 Mineral fibre: to CAN/ULC S702 & ASTM C547.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to CAN/ULC S702 & ASTM C547.

2.3 INSULATION SECUREMENT

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

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

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

2.4 CEMENT

.1 Thermal insulating and finishing cement:
- .1 Hydraulic setting or Air drying on mineral wool, to ASTM C449.

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 JACKETS

.1 Polyvinyl Chloride (PVC):
- .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
- .2 Colours: White.
- .3 Minimum service temperatures: -20 degrees C.
- .4 Maximum service temperature: 65 degrees C.
- .5 Moisture vapour transmission: 0.02 perm.

2.7 JACKETS (Cont'd)

.1 (Cont'd)
- .6 Thickness: 0.015 mm.
- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.

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.
- .2 Jacket: PVC.

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

.3 Thickness of insulation as listed in following table.

Applic-ation	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

.4 Finishes:
  .1 Exposed indoors: PVC jacket.
  .2 Exposed in mechanical rooms: PVC jacket.
  .3 Concealed, indoors: canvas on valves, fittings. No further finish.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

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.

3.2 CLEANING HYDRONIC AND STEAM SYSTEMS (Cont'd)

.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 Use water metre to record volume of water in system to +/- 0.5%.
- .3 Add chemicals under direct supervision of chemical treatment supplier.
- .4 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.
- .5 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.
- .6 Add chemical solution to system.
- .7 Establish circulation, raise temperature slowly to maximum design 82 degrees C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. 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 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
- .7 Repeat with water at design temperature.
- .8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
- .9 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .10 Adjust pipe supports, hangers, springs as necessary.
- .11 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .12 Check operation of drain valves.
- .13 Fully open balancing valves (except those that are factory-set).
- .14 Check operation of over-temperature protection devices on circulating pumps.
- .15 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 23.01 - Valves - Bronze.

1.2 REFERENCES

.1 American Welding Society (AWS)
  .1 AWS A5.8M/A5.8:2011-AMD 1, Specification Filler Metals for Brazing and Braze Welding.

.2 ASME
  .1 ASME B16.15-2013, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
  .2 ASME B16.18-2012, Cast Copper Alloy, Solder Joint Pressure Fittings.
  .3 ASME B16.22-2013, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 ASTM International
  .1 ASTM B32-08(2014), Standard Specification for Solder Metal.
  .2 ASTM B88M-13, Standard Specification for Seamless Copper Water Tube Metric).

PART 2 - PRODUCTS

2.1 PIPING

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

2.2 FITTINGS

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

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

.3 Cast copper alloy solder joint pressure fittings: to ASME B16.18.

2.3 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32.

.2 Silver solder BCUP: to AWS A5.8.

.3 Brazing: as indicated.

2.4 VALVES

.1 Connections:
  .1 NPS 2 and smaller: ends for soldering.

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

PART 3 - EXECUTION

3.1 CIRCUIT BALANCING VALVES

.1 Install flow balancing valves as indicated.

.2 Remove handwheel after installation and TAB is complete.

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

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 05 - Installation of Pipe Work.

.2 Section 23 05 23.01 - Valves - Bronze.

.3 Section 23 05 23.05 - Butterfly Valves.

1.2 REFERENCES

.1 American Water Works Association (AWWA)
  - .1 AWWA C111/A21.11-12, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.2 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 B16.5-2013, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
  - .4 ASME B16.9-2013, Factory-Made Wrought Buttwelding Fittings.
  - .5 ASME B18.2.1-2012, 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).

.3 ASTM International
  - .1 ASTM A47/A47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.4 CSA International
  - .1 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
  - .1 MSS-SP-67-2011, Butterfly Valves.

PART 2 - PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 To NPS 8: Schedule 40.
  - .2 NPS 10 and over: Schedule 30.

2.2 PIPE JOINTS

.1 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

.2 Flanges: raised face, weld neck.

.3 Flange gaskets: to AWWA C111/ A21.11.

2.2 PIPE JOINTS (Cont'd)

.4 Pipe thread: taper.

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

2.3 FITTINGS

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

.2 Butt-welding fittings: steel, to ASME B16.9.

.3 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

2.4 VALVES

.1 Connections:
- .1 NPS 2-1/2 and larger: flanged ends.

.2 Butterfly valves: to MSS-SP-67:
- .1 NPS 2-1/2 and over:: as specified Section 23 05 23.05 - Butterfly Valves.

.3 Balancing, for TAB:
- .1 Sizes: calibrated balancing valves, as specified Section 23 05 23.01 - Valves - Bronze.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

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

END

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International
  - .1 ASTM A278/A278M-01(2011), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
  - .2 ASTM B62-15, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/2 connection and rated at 1034 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 1034 kPa working pressure.

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

2.2 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, solder end connections, Y pattern.

.2 NPS 2-1/2 to 12: cast steel body to ASTM A278/A278M, Class 250, flanged connections.

.3 Blowdown connection: NPS 1.

.4 Screen: stainless steel with 1.19 mm perforations.

.5 Working pressure: 1034 kPa.

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 data sheets.

3.2 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

.4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.

3.3 AIR VENTS

.1 Install at high points of systems.

.2 Install ball valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

END