

PART 1 - GENERAL

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| <u>1.1 RELATED
REQUIREMENTS</u> | .1 | Section 21 05 01. |
| <u>1.2 ACTION AND
INFORMATIONAL
SUBMITTALS</u> | .1 | Submit in accordance with Section 01 33 00 -
Submittal Procedures. |
| | .2 | Product Data:
.1 Submit manufacturer's instructions,
printed product literature and data sheets for
HVAC components. |
| <u>1.3 CLOSEOUT
SUBMITTALS</u> | .1 | Submit in accordance with Section 01 78 00 -
Closeout Submittals. |
| | .2 | Operation and Maintenance Data: submit
operation and maintenance data for
incorporation into manual.
.1 Operation and maintenance manual approved
by, and final copies deposited with,
Departmental Representative before final
inspection.
.2 Site records:
.1 Departmental Representative will
provide 1 set of reproducible mechanical
drawings. Provide sets of white prints as
required for each phase of work. Mark
changes as work progresses and as changes
occur. Include changes to existing
mechanical systems, control systems and
low voltage control wiring.
.2 Transfer information weekly to
reproducibles, revising reproducibles to
show work as actually installed.
.3 Use different colour waterproof ink
for each service.
.4 Make available for reference
purposes and inspection. |
| | .3 | As-built drawings:
.1 Prior to start of Testing,
Adjusting and Balancing for HVAC, |

finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED"

(Signature of Contractor) (Date).

.3 Submit to Departmental Representative for approval and make corrections as directed.

.4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

- .3 Complete CSC CMMS forms for all new equipment installation, as found in Section 01 78 00 Closeout Submittals.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 NOT USED

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 installation in accordance with manufacturer's written instructions.
- .2 Follow the requirements of Federal Halocarbon regulations 2003 as attached.

3.2 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to

acceptance. Supply labour, material, and instruments required for testing.

- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.7 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

PART 1 - GENERAL

1.1 RELATED
REQUIREMENTS

- .1 Division 23.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.

1.3 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 02 Standard General Requirements.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY,
STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 02 Standard General Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
 - .1 Primers, Paints, and Coatings: in accordance with manufacturer's recommendations for surface conditions.
 - .2 Primer: maximum VOC limit 250 g/L to Standard GS-11.
 - .3 Paints: maximum VOC limit 150 g/L to Standard GS-11.
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Sealants: maximum VOC limit to SCAQMD Rule 1168.
- .3 Sealants: maximum VOC limit to SCAQMD Rule 1168.
- .4 Adhesives: maximum VOC limit to SCAQMD Rule 1168.

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 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 to 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 and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion 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 valves at branch take-offs for isolating purposes except where specified.

.7 Install ball valves for glycol service.

.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 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 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 00 02 Standard General Requirements supplemented as specified in relevant mechanical sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT 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 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 CLEANING

- .1 Clean in accordance with Section 01 00 02 Standard General Requirements.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 1 - GENERAL

1.1 RELATED
REQUIREMENTS

- .1 Section 22 and 23.

1.2 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 105/A 105M-05, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.3 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 02 - Standard General Requirements.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Manufacturer, model number, line contents, pressure and temperature rating.
 - .2 Movement handled, axial, lateral, angular and the amounts of each.
 - .3 Nominal size and dimensions including details of construction and assembly.

1.4 CLOSEOUT
SUBMITTALS

- .1 Provide maintenance and operation data in accordance with Section 01 00 01 - Project Specific General Requirements.
 - .1 Data to include:
 - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.5 DELIVERY,
STORAGE AND
HANDLING

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

PART 2 - PRODUCTS

2.1 FLEXIBLE
CONNECTION

- .1 Application: to suit motion.
- .2 Minimum length in accordance with manufacturer's recommendations.
- .3 Inner hose: corrugated.
- .4 Diameter and type of end connection: as indicated.
- .5 Operating conditions:
 - .1 To match system requirements.
- .6 Three flexible grooved couplings placed in close proximity to vibration source for vibration attenuation and stress relief.

2.2 ANCHORS AND
GUIDES

- .1 Anchors:
 - .1 Provide as indicated.
 - .2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.
- .2 Alignment guides:
 - .1 Provide as indicated.
 - .2 To accommodate specified thickness of insulation.
 - .3 Vapour barriers, jackets to remain uninterrupted.

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 expansion loops and flexible connections in accordance with manufacturer's instructions.
- .2 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

3.3 PIPE CLEANING AND START-UP

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

3.4 PERFORMANCE VERIFICATION

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

3.5 CLEANING

- .1 Clean in accordance with Section 01 00 01 - Project Specific General Requirements.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100-01, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-01, 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 00 02 Standard General Requirements.
- .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 in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Collect, separate and place in designated containers for packaging 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.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, aluminum body, solar powered, digital LCD display.

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 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 Gasketed pressure relief back with solid front.
 - .4 Bronze stop cock.
 - .5 Oil filled for high vibration applications.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 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 Water heating and cooling coils.
 - .2 Water boilers.
 - .3 DHW tanks.
- .3 Install wells 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 control valves.
 - .3 Outlet of boilers.
 - .4 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere.
- .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.

PART 1 - GENERAL

1.1 RELATED
REQUIREMENTS

- .1 Division 22 & 23.

1.2 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.

1.3 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 02 Standard General Requirements.

- .2 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..

1.4 CLOSEOUT
SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 02 Standard General Requirements.

1.5 MAINTENANCE
MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
 - .1 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.

1.6 DELIVERY,
STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 02 Standard General Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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 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 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.
- .4 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B 62.
 - .2 Pressure rating: Class125 760-kPa CWP.
 - .3 Connections: solder ends to ANSI.
 - .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.

.5 Globe Valves:

.1 50mm and under, composition disc, Class 125, screwed ends:

.1 Body and bonnet: screwed bonnet.

.2 WP=860kPa steam, 1.4 MPa WOG.

.3 Disc and seat ring: renewable rotating disc (composition to suit conditions), regrind able bronze seat, loosely secured to bronze stem to ASTM B505.

.4 Operator: Handwheel.

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 Clean in accordance with Section 01 00 02 Standard General Requirements.

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

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASTM International Inc.
 - .1 ASTM A 49, Standard Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A 126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 ASTM A 536, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM B 85/B 85M, Standard Specification for Aluminum-Alloy Die Castings.
 - .7 ASTM B 209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-61, Pressure Testing of Steel Valves.
 - .2 MSS SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP-82, Valve Pressure Testing Methods.
 - .5 MSS SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 ULC C-267-B

1.2 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 02-Standard General Requirements.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT
SUBMITTALS

- .1 Submit maintenance data for incorporation into manual specified in Section 01 00 01- Project SPecific General Requirements.

1.4 DELIVERY,
STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 01- Project SPecific General Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.5 MAINTENANCE
MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size, minimum 1.
 - .3 Stem packing: one for every 10 valves, each size, minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.

PART 2 - PRODUCTS

2.1 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B 209 Class B.
 - .2 Connections: flanged ends plain face with 2 mm raised face with serrated finish to ANSI B16.1.
 - .3 Inspection and pressure testing: to MSS SP-82.
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
 - .7 Gland packing: non-asbestos.
 - .8 Handwheel: die-cast aluminum alloy to ASTM B 85/B 85M or malleable iron to ASTM A 49. Nut of bronze to ASTM B 62.
 - .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

2.2 GATE VALVES

- .1 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides

designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.

.2 Disc: solid offset taper wedge, bronze to ASTM B 62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.

.3 Seat rings: renewable bronze screwed into body.

.4 Stem: nickel-plated steel.

.5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.

.6 Seat rings: integral with body.

.7 Stem: nickel-plated steel.

.8 Pressure-lubricated operating mechanism.

.9 Operator: handwheel

2.3 VALVE OPERATORS

.1 Install valve operators as follows:

.1 Handwheel: on valves except as specified.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms.

2.4 GLOBE VALVES

.1 65mm to 250mm, OSY:

.1 Body: with multiple-bolted bonnet.

.2 WP: 860kPa steam, 1.4 MPa CWP.

.3 Bonnet-yoke gasket: non-asbestos.

.4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

.5 Seat ring: renewable, regrindable, screwed into body.

.6 Stem: bronze to ASTM B62.

.7 Operator: Handwheel.

.8 Acceptable materials: Jenkins Fig. 2342J; Kitz; Victaulic; NCI and Mueller.

2.5 CHECK VALVES

- .1 Swing check valves, Class 125:
 - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.
 - .1 Up to NPS 16: cast iron to ASTM A 126 Class B.
 - .2 Ratings:
 - .1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.
 - .2 NPS 14 - 16: 860 kPa steam; 1.03 MPa CWP.
 - .3 NPS 18 and over: 1.03 MPa CWP.
 - .3 Disc: rotating for extended life.
 - .1 Up to NPS 6: bronze to ASTM B 62.
 - .2 NPS 8 and over: bronze-faced cast iron.
 - .4 Seat rings: renewable bronze to ASTM B 62 screwed into body.
 - .5 Hinge pin, bushings: renewable bronze to ASTM B 62.
 - .6 Disc: A126 Class B, secured to stem, rotating for extended life.
 - .7 Seat: cast iron, integral with body.
 - .8 Hinge pin: exelloy; bushings: malleable iron.
 - .9 Identification tag: fastened to cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.

3.2 CLEANING

- .1 Clean in accordance with Section 01 00 01- Project SSpecific General Requirements.
- .2 Clean installed products in accordance to manufacturer's recommendation.

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Butterfly Valves.
- .2 Related Sections:
 - .1 Section 01 00 01 - Project Specific General Requirements.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
 - .3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .4 ANSI/ASME B16.11, Forged Fittings, Socket-Welding and Threaded.
 - .5 ANSI/ASME B16.25, Buttwelding Ends.
 - .6 ANSI/ASME B16.34, Valves - Flanged, Threaded and Welding Ends.
- .2 American National Standards Institute (ANSI) American Petroleum Institute (API)
 - .1 ANSI/API 609, Lug and Water Type Butterfly Valves.
- .3 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A 126, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B 209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-67, Butterfly Valves.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 00 02 - Standard General Requirements.
- .2 Product Data:
 - .1 Submit shop drawings and product data in accordance with Section 01 00 01 - Project Specific General Requirements.
 - .2 Submit data for valves specified in this section.
- .3 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 00 01 - Project Specific General Requirements.

1.4 EXTRA MATERIAL

- .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size. Minimum 1.
 - .2 Discs: one for every 10 valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.

1.5 QUALITY
ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.6 DELIVERY,
STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Collect and separate for disposal, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

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: Wafer or Lug type: 65mm and larger.
- .5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.
 - .1 50mm-300mm: 200psig.
- .6 Minimum seat temperature ratings to 135°C.
- .7 Application: on-off operation.
- .8 Full lug body (threaded).
- .9 Operators:
 - .1 65mm-150mm: handles capable of locking in any of ten (10) positions - 0° to 90°. 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 200mm and larger: manual enclosed gear operator.
- .10 Designed to comply with MSS SP-67 and API 609.
- .11 Compatible with ANSI Class 125/Class 150 flanges.
- .12 Construction:
 - .1 Body ductile iron.
 - .2 Disc: 316 SS.
 - .3 Seat: EPDM.
 - .4 Shaft: 316 stainless steel.
 - .5 Taper pin: 316 SS.
 - .6 Key: stainless.
 - .7 O-Ring: Buna-N.
 - .8 Bushings: Teflon.

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.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 22 & 23.

1.2 REFERENCES

- .1 American National Standards
Institute/American Society of
Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1, Power Piping.
- .2 American Society for Testing and
Materials International (ASTM)
 - .1 ASTM A 125, Specification for
Steel Springs, Helical, Heat-
Treated.
 - .2 ASTM A 307, Specification for
Carbon Steel Bolts and Studs, 60,000
PSI Tensile Strength.
 - .3 ASTM A 563, Specification for
Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization
Society of the Valves and Fittings
Industry (MSS)
 - .1 MSS SP 58, Pipe Hangers and
Supports - Materials, Design and
Manufacture.
 - .2 ANSI/MSS SP69, Pipe Hangers
and Supports - Selection and
Application.
 - .3 MSS SP 89, Pipe Hangers and
Supports - Fabrication and
Installation Practices.
- .4 Underwriter's Laboratories of Canada
(ULC)

1.3 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 MSS
SP 58. ASME B31.1 or

.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.

1.4 ACTION AND
INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance
with Section 01 00 02 - Standard
General Requirements.

.2 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.

.3 Certificates:

.1 Submit certificates signed by
manufacturer certifying that
materials comply with specified
performance characteristics and
physical properties.

.4 Manufacturers' Instructions:

.1 Provide manufacturer's
installation instructions.
.1 Departmental
Representative will make
available 1 copy of systems
supplier's installation
instructions.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 00 02- Standard General Requirements.

1.6 DELIVERY, STORAGE,
AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 00 02 - Standard General Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 All hangers must be outside insulation.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process.
 - .3 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: 9 mm ULC listed.
 - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, ULC listed.
- .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, ULC listed.
 - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut, ULC listed.
- .4 Upper attachment to concrete.
 - .1 Ceiling: Carbon steel welded clevis plate.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate ULC listed for pipe 20 mm to 200mm.
- .5 Steel Joist:
 - .1 Cold piping 50 mm and under:
steel washer plate with double locking nuts.
 - .2 Cold piping: 65 mm and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.

- .6 Steel channel or angle (bottom):
 - .1 Cold piping 50 mm and under, malleable iron C clamp to MSS-SP-58, Type 23, ULC listed.
 - .2 Cold piping 65 mm and larger and all hot piping, universal channel clamp. ULC listed.
- .7 Shop and field-fabricated assemblies
 - .1 Trapeze hanger assemblies. Submit drawing with loading.
 - .2 Steel brackets.
 - .3 Sway braces to prevent lateral movement.
- .8 Hanger rods: threaded rod material to MSS SP58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Carbon steel threaded rod, electro-galvanized finish for mechanical rooms.
- .9 Pipe attachments: material to MSS SP58.
 - .1 Cold piping, steel or cast iron: hot piping steel, with less than 25 mm horizontal movement, hot piping steel, with more than 300 mm middle attachment length, adjustable clevis to MSS-SP-58, Type 1. ULC listed.
 - .2 Cold copper piping, hot copper piping with less than 25 mm horizontal movement, hot copper piping with more than 300 mm middle attachment length, adjustable clevis to MSS-SP-58, Type 1. Copper plated.

.3 Suspended hot piping, steel and copper, with horizontal movement in excess of 25 mm, hot steel piping with middle attachment 300 mm or less, pipe roller to MSS-SP-58, Type 43.

.4 Bottom supported hot piping, steel and copper, pipe roller stand to MSS-SP-58, Type 45.

.5 Suspended hot piping, steel and copper with horizontal movement less than 25 mm, with noise more than 300 mm middle attachment, adjustable clevis to MSS SP-58, Type 1, ULC listed.

.10 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for riveting to insulation shields.

.11 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.12 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

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

.13 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span. Assembly to maintain uninterrupted vapor barrier.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05500 - Metal Fabrication. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.9 HOUSEKEEPING PADS

.1 For base-mounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.

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.

3.1 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, chillers, elsewhere as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .1 Bolt-tightening torques to be to industry standards.
 - .2 Steel pipes: Install below coupling or shear lugs welded to pipe.
 - .3 Cast iron pipes: Install below joint.
 - .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.2 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial 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, but not less than one hanger at joints.

.4 Within 300 mm of each elbow.

<u>Maximum Pipe Size: mm</u>	<u>Maximum Spacing Steel</u>	<u>Maximum Spacing Copper</u>
up to 32	2.1 m	1.8 m
40	2.7 m	2.4 m
50	3.0 m	2.7 m
65	3.6 m	3.0 m
75	3.6 m	3.0 m
100	4.2 m	3.6 m
125	4.8 m	
150	5.1 m	
200	5.7 m	
250	6.6 m	
300	6.9 m	

.5 Pipework greater than 300 mm: to MSS SP69.

3.3 HANGER INSTALLATION

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

.2 Adjust hangers to equalize load.

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

3.4 HORIZONTAL MOVEMENT

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

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

3.5 FINAL ADJUSTMENT

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

3.6 CLEANING

- .1 Clean in accordance with Section 01 00 02 - Standard General Requirements.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems including the installation and location of identification systems.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Requirements
 - .1 Division 22 & 23.

1.2 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.

1.3 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 00 02 Standard General Requirements.
- .3 Product data to include paint colour chips, other products specified in this section.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 00 02 Standard General Requirements.
- .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 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 00 02 Standard General Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.

.3 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

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, 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 Locations:

.1 Terminal cabinets, control panels: use size # 5.

.2 Equipment in Mechanical Rooms: use size # 9.

2.3 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 20 mm and smaller: waterproof
and heat-resistant pressure sensitive
plastic marker tags.

.2 Other pipes: pressure sensitive
plastic-coated cloth with protective
overcoating, waterproof contact adhesive
undercoating, suitable for ambient of
100% RH and continuous operating
temperature of 150°C and intermittent
temperature of 200°C.

.7 Colours and Legends:

.1 Where not listed, obtain direction
from Departmental Representative.

.2 Colours for legends, arrows: to
following table:

Background colour: Legend, arrows:

Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background color marking and
legends for piping systems:

Contents	Background color	Legend
Marking		
City water	Green	CITY WATER
HW Heating supply	Yellow	HEATING SUPPLY
HW Heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Domestic HW supply	Green	DOM. HW SUPPLY
Dom. HWS recirc.	Green	DOM. HW CIRC
Domestic CW supply	Green	DOM. CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Propane	Yellow	PROPANE
Glycol heating supply	Yellow	GLYCOL SUPPLY
Glycol heating return	Yellow	GLYCOL RETURN

- .8 Identify glycol tanks with type and concentrations of antifreeze solution.

2.4 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.

2.5 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.

2.6 LANGUAGE

- .1 Identification in English and French.
- .2 Use one nameplate, label, etc for both languages.

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 Interior Painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide CSA registration plates as required by respective agency.

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 At beginning and end points of each run and at each piece of equipment in run.
- .7 At point immediately upstream of major manually operated valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .8 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 Number valves in each system consecutively.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 00 02 Standard General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 RELATED
REQUIREMENTS

- .1 Division 23.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1-SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International Inc.
 - .1 ASTM C 335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C 533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .4 ASTM C 547, Standard Specification for Mineral Fiber Pipe Insulation.
 - .5 ASTM C 553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .6 ASTM C 612-[04e1], Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .7 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C 921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB 51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .4 Health Canada/Workplace Hazardous Materials

Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Thermal Insulation Association of Canada
(TIAC)

.1 National Insulation Standards 2005.

.6 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Standard Method of Test for
Surface Burning Characteristics of Building
Materials and Assemblies.

1.3 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 insulation and
adhesives, include product characteristics,
performance criteria, physical size, finish
and limitations.

.3 Samples:

.1 Provide for review: complete assembly of
each type of insulation system, insulation,
coating, and adhesive proposed.

.1 Mount sample on 12 mm plywood
board.

.2 Affix typewritten label beneath
sample indicating service.

.4 Manufacturer's Instructions:

.1 Include procedures to be used and
installation standards to be achieved.

1.4 DELIVERY,
STORAGE AND
HANDLING

.1 Deliver, store and handle materials in
accordance with Section 01 61 00 - Common
Product Requirements and with manufacturer's
written instructions.

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

- .3 Store at temperatures and conditions recommended by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 Fire and smoke ratings to CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre: 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: ASTM C 547.
 - .2 Maximum "k" factor: ASTM C 547.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52MA.
 - .3 Maximum "k" factor: ASTM C 547.
- .5 TIAC Code C-1: rigid mineral fibre board, unfaced.
 - .1 Mineral fibre: ASTM C 612.
 - .2 Maximum "k" factor: ASTM C 612.
- .6 TIAC Code C-2: mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket.
 - .1 Mineral fibre: ASTM C 553.
 - .2 Jacket: to CGSB 51-GP-52MA.
 - .3 Maximum "k" factor: ASTM C 553.

2.3 CEMENT

- .1 Thermal insulating and finish
 - .1 To: ASTM C 449/C 449M.

.2 Hydraulic setting on mineral wool, to
ASTM C 449.

2.4 JACKETS

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

2.5 INSULATION SECUREMENTS

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on both faces of insulation.
- .7 Fasteners: 4 mm diameter pins with 35 mm square clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER
LAP ADHESIVE

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

2.7 INDOOR VAPOUR
RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with 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 testing of equipment and adjacent piping systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards
 - .1 Hot equipment: To TIAC code 1503-H.
 - .2 Cold equipment: to TIAC code 1503-C.
- .2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.
- .3 Provide vapour retarder as recommended by manufacturer.

- .4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
- .5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports outside vapour retarder jacket.
- .7 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE,
PRE-FABRICATED,
INSULATION AND
ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements, flanges and unions at equipment.
- .2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.5 EQUIPMENT
INSULATION
SCHEDULES

Hot water
expansion tanks 150 mm

- .1 Finishes:
 - .1 Equipment in mechanical rooms: TIAC code CEF/1 with Aluminum jacket.

3.6 CLEANING

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

PART 1 - GENERAL

- | | | |
|--|----|--|
| <u>1.1 SUMMARY</u> | .1 | Section Includes:
.1 Thermal insulation for piping and piping accessories in commercial type applications. |
| <u>1.2 REFERENCES</u> | .1 | Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS). |
| | .2 | Manufacturer's Trade Associations
.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards. |
| | .3 | Underwriters' Laboratories of Canada (ULC)
.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering. |
| <u>1.3 DEFINITIONS</u> | .1 | For purposes of this section:
.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as specified. |
| | .2 | TIAC ss:
.1 CRF: Code Rectangular Finish.
.2 CPF: Code Piping Finish. |
| <u>1.4 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Submittals: in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet 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.

1.5 QUALITY
ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least [3] years successful experience in this size and type of project, qualified to standards of TIAC.
- .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 and Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE
RATING

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

2.3 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 & ASTM C 547.
 - .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 & ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 & ASTM C 547.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702 & ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 & ASTM C 547.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket. Jacket is not required on outdoor installations if insulation is UV stabilized.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

2.4 INSULATION
SECUREMENT

- .1 Tape: self-adhesive, uni-cellular, 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, 19mm wide, 0.5 mm thick.

2.5 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 deg. C.
 - .4 Maximum service temperature: 65 deg. C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .7 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .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.
- .3 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: compatible with insulation.

2.6 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

- .1 Caulking to be approved for use. Submit for approval by Departmental Representative.

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 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .4 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 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING
INSULATION
SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .2 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Seals: lap seal adhesive, lagging adhesive.
- .5 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code: 1501-C.
- .6 TIAC Code: A-2..
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code: 1501-H.
- .7 Thickness of insulation to appropriate TIAC code
- .8 Finishes:
 - .1 Exposed indoors: PVC jacket.
 - .2 Exposed in mechanical rooms: PVC jacket.
 - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
 - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
 - .5 Outdoors: water-proof SS jacket.
 - .6 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.
 - .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 RELATED
REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures
 - Section 23 52 00 - Heating Boilers
 - Section 01 45 00 - Quality Control
 - Section 01 78 00 - Closeout Submittals
 - Section 23 05 05 - Installation of Pipework
 - Section 23 05 23.01 - Valves - Bronze

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME-B16.3-2006, Malleable-Iron Threaded Fittings: Classes 150 and 300.
 - .2 ASME-B16.9-2007, Factory-Made Wrought Steel Buttwelding Fittings.
- .2 ASTM International
 - .1 ASTM A 47/A 47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B 61-08, Standard Specification for Steam or Valve Bronze Castings.
 - .4 ASTM B 75M-99(2005), Standard Specification for Seamless Copper Tube
- .3 CSA International
 - .1 CSA-B139-09, Installation Code for Oil Burning Equipment.
 - .2 CSA-B140.0-03, Oil Burning Equipment: General Requirements.
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
 - .1 MSS-SP-80-[08], Bronze Gate, Globe, Angle and Check Valves.

1.3 ADMINISTRATIVE
REQUIREMENTS

- .1 Pre-Installation Meeting:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Charts.
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.4 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, specifications and datasheets for piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Indicate on manufacturer's catalogue literature the following:
Boilers, Valves
 - .2 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Indicate VOC's for adhesive and solvents during application and curing.
- .4 Test Reports:
 - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .5 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply

with specified performance characteristics and physical properties.

- .6 Manufacturers' Instructions: provide manufacturer's installation instructions.

1.5 CLOSEOUT
SUBMITTALS

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

1.6 QUALITY
ASSURANCE

- .1 Sustainability Standards Certification:
- .2 Ensure piping is installed by individual authorized by authority having jurisdiction.

1.7 DELIVERY,
STORAGE AND
HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 FILL VENT AND
CARRIER PIPE

- .1 Materials as per CSA-B139.
- .2 Steel: to ASTM A 53/A 53M, Schedule 40, continuous weld or electric resistance welded,

screwed.

- .3 Copper: type K, soft copper tubing, to ASTM B 75M, in continuous lengths.

2.2 STEEL PIPE
COATING

- .1 Bituminous paint: in accordance with manufacturer's recommendations.

2.3 JOINTING
MATERIAL

- .1 Screwed fittings: Teflon tape or pulverized lead paste.
- .2 Brazed fittings: 85/15.

2.4 FITTINGS

- .1 Steel:
 - .1 Malleable iron: screwed, banded, Class 150 to ASME-B16.3.
 - .2 Welding: butt-welding to ASME-B16.9.
 - .3 Unions: malleable iron, brass to iron, ground seat, screwed, to ASTM A 47/A 47M.
 - .4 Nipples: Schedule 40, to ASTM A 53/A 53M.
- .2 Copper:
 - .1 Piping: brazed type.
 - .2 Connections to equipment: compression.

2.5 GATE VALVES

- .1 NPS 2 and under, screwed bonnet: rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, solid wedge disc as specified under Section 23 05 23.01 - Valves - Bronze.

2.6 GLOBE VALVES

- .1 NPS 2 and under, screwed: to MSS-SP-80, Class 125, 860 kPa, bronze body, screwed over bonnet, renewable bronze disc as specified under Section 23 05 23.01 - Valves - Bronze.
 - .1 Lockshield handles: as indicated.

-
- | | | |
|-------------------------------------|----|---|
| <u>2.7 BALL VALVES</u> | .1 | NPS 2 and under: bronze body, screwed ends, TFE seal, hard chrome ball, 4 MPa, WOG as specified under Section 23 05 23.01 - Valves - Bronze. |
|
 | | |
| <u>2.8 SWING CHECK VALVES</u> | .1 | NPS 2 and under, screwed: to MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc suitable for oil service, screw in cap, re-grindable seat as specified under Section 23 05 23.01 - Valves - Bronze. |
|
 | | |
| <u>2.10 LUBRICATED PLUG COCKS</u> | .1 | NPS 2 and under, screwed: to ASTM B 61, Class 150, 1 MPa, bronze body. |
|
 | | |
| <u>2.11 FUEL OIL TRANSFER PUMPS</u> | .1 | Two positive displacement self-priming, rotary gear type, direct driven from TEFC motor, mounted on common base. Complete with mechanical seal, permanently sealed ball bearings, relief valve, compound gauge on inlet, pressure gauge on discharge. |
| | .2 | Capacity:
.1 Pumped fluid: number 2 fuel oil.
.2 Flow rate: as 342L/h
.3 Motor: .25 kw, 115 V, 1 ph., 60 Hz, 1725 r/min. |
|
 | | |
| <u>2.12 OIL FILTER</u> | .1 | Duplex type replaceable cartridge type as recommended by oil burner manufacturer. |
| | .2 | Furnish spare filter cartridge. |

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 PIPING

- .1 Install piping in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified.
- .2 Install oil piping system in accordance with CSA-B139 and CSA-B140.0.
- .3 Slope piping down in direction of storage tank unless otherwise indicated.
- .4 Underground piping to be protected in conformance with CAN/ULC-S603.1.
- .5 Above ground piping to be protected from physical impact due to impact.
- .6 Piping inside building:
 - .1 Ensure piping in solid flooring is installed to CSA-B139 authority having justification.
 - .2 Use flare joint to CSA-B139 copper piping.
 - .3 Install filter, gate valve, and fire valve at burners.
- .7 Clearly label piping runs in legible form indicating;
 - .1 Piping product content.
 - .2 Direction of flow.
 - .3 Identify transfer points in piping systems to CPPI Colour-Symbol System to Mark Equipment and Vehicles for Product Identification

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless approved otherwise by Departmental Representative
- .2 Install ball valves at branch take-offs, to isolate pieces of equipment and as indicated.
- .3 Install globe valves for balancing and in by-pass around control valves.
- .4 Install swing check valves on discharge of pumps and as indicated.
- .5 Install plug cocks as indicated.

3.4 OIL TRANSFER
PUMPS

- .1 Equip pumps with check valve installed below suction pump to permit contents of pipe to drain back to storage tank if suction is broken.
- .2 Install as indicated.
- .3 Install ball -valves on inlet and discharge connections.
- .4 Install pressure gauge at pump discharge, compound gauge on pump inlet connection.
- .5 Install relief valve in pump discharge piping with relief valve discharge pipe to return line to tank.

3.5 OIL FILTERS

- .1 Install ULC approved filter in supply line to new boilers.
- .2 At time of acceptance, replace filter cartridge with new.

3.6 OVERFILL AND
SPILL PROTECTION

- .1 To CSA-B139.

-
- 3.7 LEAK DETECTION .1 Install slab leak detectors to ULC ORD C107.12 in piping trench near fitting locations.
- 3.8 FIELD QUALITY CONTROL .1 Site Tests/Inspection:
- .1 Test system to CSA-B139 and CSA-B140.0 and authorities having jurisdiction.
 - .2 Isolate tanks from piping pressure tests.
 - .3 Maintain test pressure during backfilling.
- 3.10 CLEANING .1 Clean in accordance with manufacturer's written recommendations, supplemented as follows:
- .1 Flush after pressure test with number 2 fuel oil for a minimum of two hours. Clean strainers and filters.
 - .2 Dispose of fuel oil used for flushing out in accordance with requirements of authority having jurisdiction.
 - .3 Ensure vents from regulators, control valves are terminated in approved location and are protected against blockage and damage.
 - .4 Ensure entire installation is approved by authority having jurisdiction.
 - .5 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 in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 1 - GENERAL

- | | | |
|--|----|--|
| <u>1.1 SUMMARY</u> | .1 | Section Includes:
.1 Steel materials, components and installation for the outdoor and indoor distribution systems for LPG products. |
| <u>1.2 REFERENCES</u> | .1 | Canadian Standards Association CSA B149.2-00 Propane Installation Code. |
| | .2 | American Society for Testing and Materials International (ASTM)
.1 ASTM A 48/A 48M-03, Standard Specification for Gray Iron Castings.
.2 ASTM A 181/A 181M-01, Specification for Carbon Steel Forgings, for General Purpose Piping.
.3 ASTM A 193/A 193M-05, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
.4 ASTM A 194/A 194M-04a, Standard Specification for Carbon and Alloy-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both. |
| | .3 | Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS). |
| | .4 | National Fire Code of Canada 2005. |
| | .5 | Transport Canada/Canadian Transport Commission
.1 General Order No. 0-32, Regulations Respecting the Design, Location, Construction, Operation and Maintenance of Stationary Bulk Storage for Flammable Liquids SOR /85-472. |
| <u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 01 - Project Specific General Requirements. 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 00 02 - Standard General Requirements.

- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 00 01 - Project Specific General Requirements.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of New Brunswick.
 - .2 Indicate following:
 - .1 Pipe network plan.
 - .2 Connections at distribution points.
 - .3 Type and location of valves, strainers, disconnect and pipe couplings.
- .3 Quality assurance submittals: submit following in accordance with Section 01 00 01 - Project Specific General Requirements.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 00 01 - Project Specific General Requirements.

PART 2 - PRODUCTS

2.1 STEEL PIPING

- .1 Pipe: to API 5L, schedule40.

- .2 Fittings: threaded, carbon steel, seamless or resistance weld. Wall thickness same as corresponding pipe size.
- .3 Joints:
 - .1 Aboveground: threaded joints using compound approved for product being handled.
- .4 Corrosion and product protection:
 - .1 Protect piping against external corrosion by painting.

2.2 VALVES

- .1 Steel without copper bearing alloy: to API 6D. Class 150, 1 MPa.
- .2 NPS 1 1/2 and smaller: ball valves.

2.3 IDENTIFICATION

- .1 Valves: identify with tags, octagonal, red, with green circle for combustible liquid, flammable liquids resistant, fireproof, permanently inscribed with clear legible characters.
- .2 Flammable and combustible liquids pipe: label in accordance with CSA B149.2-00.

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 HANDLING

- .1 Protect and shield pre-coated equipment and piping.
- .2 Locate propane storage tank and piping as indicated on drawings.

3.3 PROVISION FOR

- .1 Install loops offsets as required.

EXPANSION

3.4 SUPPORTS

- .1 Above-ground piping: prevent excessive vibration and stress on adjacent equipment.

3.5 PROTECTION

- .1 Protect piping system from damage by vehicular traffic using guard devices, painted with warning colours.

3.6 SLEEVES

- .1 Install where pipes pass through walls or floors. Firestop around pipes.

3.7 LOCATION OF PIPEWORK

- .1 General: locate not to constitute hazard to personnel, buildings or equipment.
- .2 Above-ground outdoor piping:
 - .1 Do not locate on exterior walls constructed of combustible material.
 - .2 Do not locate above roofs, windows, or door openings.

3.8 INDOOR INSTALLATION

- .1 Install to approval of authority having jurisdiction.
- .2 Take most direct route possible or practicable.
- .3 Install overhead piping close to ceiling or beams or along walls, where possible. Support from building structure at least 1800 mm from floor.
- .4 Steel frame buildings: use bolted clips or pipe hangers attached to flanges with retaining strap.
- .5 Concrete ceilings: use through bolts or poured-in-place expansion shields.
- .6 Hanger spacing:
 - .1 Up to NPS1 1/4, 3700 mm.
 - .2 NPS 1 1/2 and over, 4600 mm.
 - .3 Design to prevent lateral movement.

- .7 Exposed risers: protect against mechanical damage by installing:
 - .1 Adjacent to walls or pilasters.
 - .2 Between flanges of steel columns.
 - .3 Guards.
- .8 Install loops or swing connections to compensate for pipe movement.
- .9 Do not jeopardize fireproofing of structural elements or fire separations.

3.9 VALVES

- .1 Install valves to control flow and to isolate equipment at following locations:
 - .1 Fill and withdrawal connections of above-ground tanks.

3.10 FIELD QUALITY CONTROL

- .1 Testing:
 - .1 Prior to testing, remove foreign matter, flush piping and equipment using same petroleum product as one being transported.
 - .2 Dispose of testing and flushing liquid to approval of authority having jurisdiction.
 - .3 Pressure test with air nitrogen to at least 1.5 times maximum operating pressure. Submit certificate of tests and test results to Consultant.
 - .4 Isolate tanks from piping system pressure tests.
 - .5 Test piping systems and pumps with compressed air to 700 kPa. Hold pressure for 24 hours.
 - .6 Should there be loss of pressure, soap test each joint or use tracer gas with compressed air as directed by Consultant.

3.11 CLEANING

- .1 Proceed in accordance with Section 01 00 01 - Project Specific General Requirements.
- .2 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 Section Includes.
 - .1 Materials and installation for steel piping, valves and fittings for hydronic systems in building services piping.
- .2 Related Requirements
 - .1 Division 23 & 25.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.3-98, Malleable Iron Threaded Fittings.
 - .3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
 - .4 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
 - .5 ASME B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 47/A 47M-99, Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A 53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A 536-84(1999)e1, Standard Specification for Ductile Iron Castings.
 - .4 ASTM B 61-02, Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
 - .2 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 00 02 - Standard General Requirements.

- .2 Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 00 02 - Standard General Requirements.

1.4 QUALITY ASSURANCE

- .1 Health and Safety.
 - .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal.
 - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .2 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .3 Fold up banding, flatten and place in designated area for recycling.

1.6 MAINTENANCE

- .1 Extra Materials.
 - .1 Provide following spare parts:
 - .1 Valve seats: one for every ten valves, each size. Minimum one.
 - .2 Discs: one for every ten valves, each size. Minimum one.
 - .3 Stem packing: one for every ten valves, each size. Minimum one.
 - .4 Valve handles: two of each size.
 - .5 Gaskets for flanges: one for every ten flanges.

PART 2 - PRODUCTS

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 To NPS6: Sch 40.
 - .2 Manufactured in United States or Canada.

2.2 PIPE JOINTS

- .1 50 mm and under: screwed fittings with Teflon tape or pulverized lead paste.
- .2 65 mm and over: Roll grooved with coupling to CSA B242.
- .3 Pipe thread: taper.
- .4 Bolts and nuts: to ANSI/ASME B18.2.1 and ANSI/ASME B8.2.2.
- .5 Roll grooved coupling gaskets: type EPDM.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ANSI/ASME B16.1, Class 125.
 - .2 Steel: to ANSI/ASME B16.5.
- .3 Butt-welding fittings: steel, to ANSI/ASME B16.9.
- .4 Unions: malleable iron, to ASTM A47/A47M and ANSI/ASME B16.3.
- .5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M.

2.4 VALVES

- .1 See Sections 23 05 23.01; 23 05 23.02; and 23 05 23.05.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

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

3.2 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.

3.3 CLEANING, FLUSHING AND START-UP

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

3.4 TESTING

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

3.5 BALANCING

- .1 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for Mechanical for applicable procedures.

3.6 PERFORMANCE VERIFICATION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 23

.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME-04(2007), Boiler and Pressure Vessel Code.
- .2 ASTM International Inc.
 - .1 ASTM A 47/A 47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 278/A 278M-01(2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650°F(350°C).
 - .3 ASTM A 516/A 516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A 536-84(2004), Standard Specification for Ductile Iron Castings.
 - .5 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B51-03(R2003), Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CSA B51-03(R2005), Boiler, Pressure Vessel, and Pressure Piping Code, Supplement #1.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 02 -Standard General Requirements.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and operation data in accordance with Section 01 00 02- Standard General Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 00 02 - Standard General Requirements.
- .2 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

PART 2 - PRODUCTS

2.1 BLADDER TYPE EXPANSION TANK

- .1 Horizontal steel bladder type expansion tank.
- .2 Capacity: 1514 Liters
- .3 Size: 1829mm x 914mm Diameter
- .4 Bladder sealed in EPDM suitable for 115°C operating temperature.
- .5 Working pressure: 860 kPa with ASME stamp and certification.
- .6 Air pre-charged to 84 kPa (initial fill pressure of system).
- .7 Supply saddles for horizontal installation.
- .8 Supports: provide supports with hold down bolts and installation templates.
- .9 Tank shall be constructed and stamped in accordance with ASME Boiler and Pressure Vessel Code.

2.2 AUTOMATIC AIR VENT

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 860 kPa working pressure.
- .2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860kPa working pressure. For use in mechanical rooms.
 - .1 Float: solid material suitable for 115°C working temperature.

2.3 AIR SEPARATOR - EXPANSION TANK FITTING

- .1 Complete with adjustable vent tube and built-in manual vent valve.
- .2 Working pressure: 860 kPa.

2.4 AIR SEPARATOR - IN-LINE

- .1 Size: NPS 8
- .2 Working pressure: 860 kPa.

2.5 PIPE LINE STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B 62, screwed connections, Y pattern.
- .2 Screen: stainless steel with 1.19 mm perforations.
- .3 Working pressure: 860 kPa.

2.6 HYDRONIC SYSTEM FEEDER

- .1 383 L storage/mixing tank c/w pump, pump suction hose and strainer, integral pressure switch and check valve, pre-charged diaphragm type accumulator tank, manual diverter valve, pressure regulating valve (adjustable 35-380kPa) and pressure gauge. 115/60/1 power supply. CSA approved. Auxiliary contact for EMCS.

2.7 CIRCUIT BALANCING VALVE-CIRCUIT SETTER

- .1 General:
 - .1 Designed to provide precise flow measurement and control, with valved ports for connection to differential pressure meter.
- .2 Accuracy:
 - .1 Readout to be within $\pm 2\%$ of actual flow at design flow rate.
- .3 Pressure die-cast dezincification resistant copper alloy metal construction, 1.7MPa, 121°C, screwed ends, Teflon disc, screw-in bonnet.

- .1 Flow control: at least four (4) full turns of handwheel and digital handwheel and tamperproof concealed mechanical memory.
- .4 Insulation:
 - .1 Use prefabricated shipping packaging of 5.4R polyurethane as insulation.
- .5 Drain connection:
 - .1 18mm valved and capped, suitable for hose socket.
 - .2 Incorporated into valve body or provided as separate item.

2.8 SUCTION DIFFUSER (PUMP 50MMØ & LARGER)

- .1 Body: cast iron with flanged connections.
- .2 Strainer: with built-in, disposable 1.19mm mesh, low pressure drop screen and NPS 1 blow down connection.
- .3 Permanent magnet particle trap.
- .4 Full length straightening vanes.
- .5 Pressure gauge tappings.
- .6 Adjustable support leg.

2.9 MULTI-PURPOSE VALVE (TRIPLE DUTY PUMP 50MMØ & LARGER)

- .1 Body: cast iron with flanged connections, bronze gland, stainless steel stem sleeve, cast iron plug (non-lubricated), brass clapper, brass seat with "O" ring seal.

2.10 SAFETY PRESSURE RELIEF VALVE

- .1 ASME Rated.
- .2 Sized for heating capacity of system served.

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

3.4 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

3.5 EXPANSION TANKS

- .1 Adjust expansion tank pressure as indicated

- .2 Install lock shield type valve at inlet to tank.

3.6 PRESSURE SAFETY RELIEF VALVES

- .1 Run discharge pipe to terminate above nearest drain.

3.7 PERFORMANCE VERIFICATION

- .1 Performance Verification
 - .1 Where available, carry out performance verification in accordance with manufacturer's start-up and verification procedures.
- .2 Submit copy of performance verification (PV) form and procedures, with shop drawing submissions.
- .3 When specified elsewhere, start-up and performance verification procedure shall be carried out by manufacturer's representative.

3.8 CLEANING

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 23.

1.2 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .3 Canadian Standards Association (CSA International).
 - .1 CSA-B214-07, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers' Association (NEMA).
 - .1 NEMA MG 1-2006, Motors and Generators.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 EQUIPMENT

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

2.2 BASE MOUNTED CIRCULATOR PUMPS

- .1 Gasket: Confined non-asbestos fiber.
- .2 Impeller: cast bronze.
- .3 Shaft: Carbon steel with stainless steel sleeve.
- .4 Base Plate: Fabricated steel.
- .5 Coupler: Flexible with steel guard.
- .6 Motor: to NEMA Premium Efficiency resilient mounted, drip proof, sleeve bearing, as indicated. VFD compatible.
- .7 Capacity: as indicated.
- .8 Design pressure: 860 kPa.
- .9 Accessories: suction diffuser, and triple duty valve.

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 Pipe drain tapping to floor drain.
- .5 Check rotation prior to start-up.
- .6 Install pressure gauge test cocks.

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

3.5 CLEANING

.1 Clean in accordance with Section 01 00 02 - Standard General Requirements.

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

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials, accessories and installation for breechings, chimneys and stacks.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- .2 Underwriters' Laboratories of Canada (ULC)
- .3 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 00 02 - Standard General Requirements. 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 00 02 - Standard General Requirements.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 00 02 - Standard General Requirements.
 - .2 Indicate following:
 - .1 Methods of sealing sections.
 - .2 Methods of expansion.
 - .3 Details of thimbles.
 - .4 Bases/Foundations.
 - .5 Supports.
 - .6 Guy details.
 - .7 Rain caps.
- .3 Quality assurance submittals: submit following in accordance with

Section 01 00 02 - Standard General Requirements.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Closeout Submittals

.1 Submit operation and maintenance data for incorporation into manual specified in Section 01 00 02 - Standard General Requirements.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial regulations.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

.3 Certificates:

.1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 00 02 - Standard General Requirements.

PART 2 - PRODUCTS

2.1 PRESSURE CHIMNEY AND BREECHING

.1 ULC labeled, 760°C rated.

.2 Sectional, prefabricated, double wall with mineral wool insulation with mated fittings and couplings.

.1 Liner: 0.4mm thick, type 316 stainless steel.

.2 Shell: 0.4mm thick, type 316 stainless steel.

.3 Outer seals between sections: to suit application.

.4 Inner seals between sections: to suit application.

2.2 ACCESSORIES

- .1 Cleanouts: bolted, gasketed type, full size of breeching, as indicated.
- .2 Barometric dampers: single double acting, 70% of full size of breeching area.
- .3 Hangers and supports: in accordance with recommendations of Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA).
- .4 Rain cap.
- .5 Expansion sleeves with heat resistant caulking, held in place as indicated.
- .6 Guy wires and associated roof supports as required to support 5000mm chimney extension on roof.

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 - GENERAL

- .1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.
- .2 Suspend breeching at 1.5 m centers and at each joint.
- .3 Support chimneys at bottom, roof and intermediate levels as indicated.
- .4 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.

- .5 Install flashings on chimneys penetrating roofs, as indicated.
- .6 Install rain caps and cleanouts, as indicated.
- .7 Support rooftop chimney extension as indicated.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 00 02 - Standard General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Related Requirements
 - .1 Division 22, 23 & 25.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)
- .2 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, 2004.
- .3 Canadian Standards Association (CSA).
 - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA-B149.1, Natural Gas & Propane Installation Code.
 - .3 CAN/CSA-B139.1, Installation Code for Oil-Burning Equipment.
 - .4 CAN/CSA-B140.7, Oil Burning Equipment: Steam and Hot Water Boilers.
- .4 Electrical and Electronic Manufacturer's Association of Canada (EEMAC).
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 New Brunswick Boiler and Pressure Vessel Act, 84-175

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 02 - Standard General Requirements. 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.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Indicate the following:

- .1 General arrangement showing terminal points, instrumentation test connections.
 - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
 - .3 Foundations with loadings, anchor bolt arrangements.
 - .4 Piping hook-ups.
 - .5 Equipment electrical drawings.
 - .6 All miscellaneous equipment.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .4 Closeout Submittals:
- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 33 00.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, and applicable Provincial regulations.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 33 00.

1.6 MAINTENANCE

- .1 Extra materials:
 - .1 Special tools for burners, manholes, hand holes and Operation and Maintenance.
 - .2 Spare parts for 1 year of operation.

- .3 Spare gaskets.
- .4 Spare gauge glass inserts.
- .5 Safety valve test gauge.
- .6 Probes and sealants for electronic ignition.
- .7 Spare burner nozzles.

1.6 WARRANTY

- .1 Provide two (2) year manufacturer warranty on all components of boiler equipment supplied under this contract.
- .2 Boiler supplier or their representative to ensure quick response time (24 hours or less) to deal with all warranty issues associated with boiler equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Packaged hot water boiler:
 - .1 Complete with necessary accessories and controls.
 - .2 Factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CSA standards.
 - .3 Ready for attachment to piping, electrical power, controls, flue gas exhaust.
 - .4 Designed and constructed to ANSI/ASME and the New Brunswick Boiler and Pressure Vessel Code.
 - .5 CRN (Canadian Registration Number), to CSA B51.
 - .6 Boiler packages to bear ULC label.
- .2 Performance:
 - .1 In accordance with American Boiler Manufacturers Association (ABMA), testing procedures.
 - .2 Boiler efficiency: 80% minimum.
 - .3 #2 Fuel Oil.
 - .4 Hot water: 1724 kPa maximum working pressure.
 - .5 Flue gas temperature leaving boiler:
 - .1 Not to exceed 200°C.
 - .2 Above dew point conditions at minimum firing rate.
- .3 Electrical:
 - .1 Power: 575V, 3 phase, 60Hz.
 - .2 Controls: 120V, 1 phase, 60Hz.
 - .3 Electrical components: CSA approved.
- .4 Controls: factory wired in enclosure, mounted on boiler.

- .5 Thermal insulation:
 - .1 100 mm thick fiberglass. Seal insulation at all access points, piping connections with insulating cement or asphaltic paint.
- .6 Jackets: heavy gauge metal, finished with heat resisting paint.
- .7 Start-up and on-site performance tests: 1 day per boiler.
- .8 Training: Two (2) days training for boilers, one (1) after final performance testing is complete and one (1) day 3-5 weeks later to verify performance.
- .9 Trial usage:
 - .1 Departmental Representative may use boilers for test purposes prior to acceptance and commencement of warranty period.
 - .2 Supply labor, materials and instruments required for tests.

2.2 COIL TUBE OIL-FIRED BOILER

- .1 Provide (2) two packaged, forced circulation, horizontally fired, recirculation type, multiple coiled tube, hot water boilers equipped with a modulating forced draft burner.
 - .1 Boilers shall meet all criteria for a coil tube boiler as defined in the New Brunswick Boiler and Pressure Vessel Act 84-175.
- .2 Each boiler is to be shipped disassembled in component sizes to fit through the 1778mm wide x 2057mm high mechanical room doorway. One factory technician to assist/supervise reassembly at site.
- .3 Boiler Design Features to include:
 - .1 Double wall construction, air insulated boiler shell with combustion air preheated through the entire length of the double shell casing space, and a single wall steel rear inspection door with davit arm, accessible without disturbing refractory seal;
 - .2 Multiple, identical, sectional, parallel connected, single pass, counter flow principle coil bundle assemblies, each bundle interlocked by means of thermocouples with coil shut-down control to shut-down coils in event of high coil temperature.
 - .3 Single stage, centrifugal, recirculation water pump with a stainless steel shaft and a balanced combustion air fan with backwardly inclined blades, both direct driven.

- .4 Boiler safeguards to include:
 - .1 Low water cut-offs
 - .2 Combustion air protection
 - .3 Flue gas temperature monitoring
 - .4 Coil temperature protection
 - .5 3-phase overload protection
 - .6 Control panel voltage protection
 - .7 Low oil atomizing air protection
 - .8 Contacts for remote alarm connections
 - .9 Pre-purge flame failure device
- .5 Individual coil temperature sensing via J-type thermocouple, interlocked with the burner control. In the event of high limit the burner will shut off and alarm sound.
- .6 Differential pressure sensor to ensure pressure across supply and return manifold to prove flow.
- .7 minimum of 3 water temperature controls; one automatic reset type for burner on-off control, one for burner firing rate, and one manual reset type for burner cut-out if excessive water temperature conditions occur;
- .8 ASME rated factory set relief valves shipped loose for site installation.
- .5 Acceptable Material: Thermogenics Inc, Thermocoil Coil-Tube hot water boiler;
 - .1 Contractor is responsible for obtaining acceptance of any alternate boiler as a Coil Tube Boiler (as defined under New Brunswick regulations) from the New Brunswick Chief Boiler Inspector prior to submittal of alternate.

2.3 OIL BURNERS

- .1 Fully modulating forced draft burner with a turn-down ratio of 10:1 without burner cycling with:
 - .1 Electric spark ignition and interrupted gas pilot
 - .2 No. 2 fuel oil piping train with compressed air piping train with low pressure monitoring switch for site connection of compressed air, atomizing air solenoid valve, direct drive fuel oil pump with, oil pressure monitoring switch, automatic oil valves and oil nozzle and oil manifold pressure gauges

- .3 2 automatically operated safety shut-off valves in oil supply line to burner valves, piped in series but wired in parallel
- .4 Oil pressure monitoring switch interlocked to accomplish a non-recycling safety shut-down in event of low oil pressure

2.4 CONTROLS

- .1 Factory installed and wired 120 volt, modular, solid-state, microprocessor-based, electronic, programmed control system
- .2 PID-based control algorithms.
- .3 Wiring harnesses for plug-in operation, including boiler-to-burner.
- .4 Alpha-numeric display for all system temperatures and setpoints including:
 - .1 Boiler supply temperature
 - .2 Boiler return temperature
 - .3 Stack temperature
 - .4 System setpoint
 - .5 Burner firing time
- .5 The following auxiliary contacts for connection to building management system for each boiler:
 - .1 Enable/disable
 - .2 Monitoring of firing rate
 - .3 Alarm condition
 - .4 Shut-off and reactivation of the burner
- .5 The ability to perform diagnostics from a remote site by maintenance staff and/or equipment manufacturer. Access to remote diagnostics to be at the discretion of CSC.
- .6 Human machine interface with display and operating unit with cable to facilitate lead/lag control, trending, and internet communications, and following features:
 - .1 Capability of configuring all parameters
 - .2 Bilingual (English/French) clear text display with 4 lines x 16 characters
 - .3 Programming port
- .7 Self-checking, 100% safety shut-down flame scanner with following features:
 - .1 High sensitivity infrared flame detector with required cable
 - .2 Filter for minimizing impact from glowing refractory or 60 Hz lighting

- .3 Front or side viewing
- .4 Integral self-checking amplifier for continuous use
- .5 20 mm adapter with heat shield
- .8 Load controller capable of reading temperature and/or pressure and modulating to a set-point, and required temperature/pressure sensors
- .9 Hardware for wiring to 4 actuators and ability to run 3 actuators simultaneously
- .10 Thermal shock protection (low fire and/or ramping start)
- .11 NEMA 2 enamelled steel control panel with lockable door(s), factory mounted on front of boiler and complete with terminal blocks for power and control wiring connections

2.5 TEMPORARY RENTAL BOILER PACKAGE

- .1 Provide (2) two temporary oil fired, hot water boiler packages, delivered to site in shipping containers for outdoor placement.
 - .1 Boilers must possess a New Brunswick Operating Certificate and meet all New Brunswick boiler regulations.
- .2 Contractor shall coordinate delivery and set-up with rental package supplier.
- .3 Each Packaged Boiler System to include:
 - .1 150 BHP, oil-fired, hot water boiler with a minimum capacity of 1960 KW c/w modulating oil-fired burner;
 - .2 System circulator pump package capable of delivering a flow of 61 l/s @ 32m of head.
 - .3 #2 fuel oil pump matched to the boiler's consumption rate.
 - .4 1830mm high exhaust stack outlet connection from boiler through container roof (shipped loose if required).
 - .5 Chemical treatment equipment
 - .6 Single point electrical connection, 575V/3ph/60Hz. All internal wiring to be inside container.
 - .7 Disconnect Switch. Verify size with boiler supplier.
 - .8 Containers to include floor drain, integral lighting and electric heat.
 - .9 150 mm Hot Water Supply/Return Connections
 - .10 ASME rated factory set relief valves shipped loose for site installation.
 - .11 All expansion tanks, air vents, valves and accessories for a fully functioning heating system of noted capacity.
- .4 Controls:
 - .1 Each boiler package shall include a guarded plant panel capable of monitoring system control points and sending an

alarm to the ECMS. Each panel shall include at a minimum the following alarm points:

- .1 Low water
- .2 High Water
- .3 Flame failure

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 ANSI/ASME Boiler and Pressure Vessels Code Section IV, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Secure each boiler in place, level and plumb, on neoprene-steel-neoprene vibration isolation pads on a concrete housekeeping pad.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 Make required piping connections to inlets and outlets and flue as recommended by boiler manufacturer.
- .5 Secure air compressor set in place on neoprene-steel-neoprene vibration isolation pads on a concrete housekeeping pad as indicated. Install components supplied loose with compressor set.
- .6 Make required piping connections to inlets and outlets and flue as recommended by boiler manufacturer.
- .7 Pipe hot water relief valves full size to nearest drain.

3.3 FIELD QUALITY CONTROL

- .1 Commissioning:
 - .1 Manufacturer to:
 - .1 Certify installation.

- .2 Start up and commission installation.
- .3 Carry out on-site performance verification tests.
- .4 Demonstrate operation and maintenance.
- .5 Allow for a minimum one (1) week training during start-up. Allow for return to site one (1) month from interim inspection for the same technician to return to site for another week for additional training, debugging, and systems configuration (as required).
- .2 Provide Departmental Representative at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.
- .3 General contractor shall operate boilers for a minimum of two (2) weeks after training has occurred until operational takeover by CSC facility maintenance staff, for both the temporary boiler switchover and then for the permanent boilers after the substantial completion inspection.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.