

Part 1 General

1.1 INTENT

- .1 This section applies to all sections of Section 21, 22, 23 and Comply with all requirements of other discipline's specifications.
- .2 Provide complete, fully tested and operational mechanical systems to meet requirements described herein and in complete accord with applicable codes and ordinances to their latest edition include provincial, municipal, bylaws and authorities having jurisdiction. In the event of conflict between contract documents and Codes, the more stringent requirement shall be adhered to at no additional cost.
- .3 Obtain all permits and pay for all applicable fees and charges, including inspection charges by the authorities that issue the permits. Arrange and coordinate all related inspections to provide certificates.
- .4 Contract documents of the Specifications and Drawings are generally diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .5 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents. Provide adequate access space for maintenance and service.
- .6 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment as determined by the Contract Administrator.
- .7 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors. Uncrate equipment, assemble, move in place and install complete; start-up and test.

1.2 CITY REQUIREMENTS DURING WARRANTY

- .1 Unless specified otherwise the City shall be responsible for all routine maintenance requirements as required in the manufacturers instructions after substantial performance.

1.3 COORDINATION OF WORK

- .1 Cooperate and coordinate with other trades on the project.
- .2 Make reference to electrical, mechanical, structural and architectural drawings when setting out work. Consult with respective traders in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.
- .3 Where dimensional details are required, work with the applicable architectural and structural drawings.

1.4 MATERIALS

- .1 Materials and equipment installed shall be new, full weight and of quality specified. Use same brand or manufacturer and model for each specific application.

- .2 Each major component of equipment shall bear manufacturer's name, address, catalog and serial number in a conspicuous place.
- .3 Replace materials or workmanship below specified quality and relocate work wrongly placed to satisfaction of the Contract Administrator and at no cost to the City.
- .4 Install materials and equipment in a quality manner providing good workmanship by competent tradesmen.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading in accordance with manufacturer's written instructions.

1.6 AVAILABILITY OF EQUIPMENT AND MATERIALS

- .1 Make known in writing to the Contract Administrator ten (10) days prior to the tender closing date any materials specified that are required to complete the work which are not currently available or will not be available for use as called for herein. Failing to do so, it will be assumed that the most expensive alternate has been included in the tender price.

1.7 METRIC CONVERSION

- .1 All units in this Section are expressed in SI units. Soft metric conversions are used throughout.
- .2 Submit all shop drawings and maintenance manuals in SI units.
- .3 On all submittals use the same SI units as stated in the specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial
 - .1 Where pipes are specified with metric dimensions and only Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide adapters to ensure compatible connections to all metric sized fittings, equipment and piping.
 - .2 When CSA approved SI Metric pipes are available and are provided, the contractor shall provide adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.
 - .3 Record accurately on "as-constructed" drawings the type of pipe (i.e., Metric or Imperial) installed.

EQUIVALENT NOMINAL DIAMETERS OF PIPES

mm	Inches		mm	Inches		mm	Inches
3	1/8		50	2		300	12
6	1/4		65	2-1/2		375	15
10	3/8		75	3		450	18
15	1/2		100	4		500	20
20	3/4		125	5		600	24
25	1		150	6		750	30
30	1-1/4		200	8			
40	1-1/2		250	10			

- .5 Metric Duct Sizes
 - .1 The metric duct sizes are expressed as 25 mm = 1 inch.

1.8 DRAWINGS AND SPECIFICATIONS

- .1 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.
- .2 Should any discrepancy appear between drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of the plans and specifications, obtain a ruling from the Contract Administrator in writing or by Addendum. If this is not done, it will be assumed that the most expensive alternate has been included.
- .3 Prior to construction start, examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work can be satisfactorily carried out without changes to building.

1.9 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.

1.10 ACCESS DOORS

- .1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:
 - .1 Valves
 - .1 Volume and splitter dampers
 - .2 Fire dampers
 - .3 Cleanouts and traps
 - .4 Controls, coils and terminal units
 - .5 Expansion joints
 - .6 Filters
 - .7 Strainers
- .2 Steel frame access panel with stainless steel piano-type hinge, channel reinforced steel door panel, three "Symmons" fasteners per door. Door panel recessed to receive ceiling or wall material to give finished appearance showing only hinge and fasteners. Provide acoustic gasket between door panel perimeter and steel frame. Rated access doors shall be UL-listed.
- .3 Sizes to be 200 mm x 200 mm for cleanout, 300 mm x 300 mm for hand
600 mm x 600 mm for body access minimum.
- .4 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.

1.11 FIRE-STOPPING

- .1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations. The contractor is required to coordinate with the architectural drawings to contractual rated wall types and installation details.
- .2 Fire-stopping materials to meet CAN/ULC-S115. Acceptable Materials: "Tremco" or "National Firestopping".

- .3 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per manufacturer's instructions.

1.12 ESCUTCHEON AND PLATES

- .1 Provide escutcheon and plates on piping and ductwork passing through finished walls, floors and ceilings.
- .2 Escutcheons shall be split type, stainless or chrome plated steel.

1.13 CERTIFICATE OF SUBSTANTIAL PERFORMANCE

- .1 Refer to General Conditions.
- .2 Prior to application for a "Certificate of Substantial Performance" of the work, the contractor shall certify the following in writing to the Contract Administrator:
 - .1 The systems are installed and suitable for operation for the purpose intended.
 - .1 All equipment within mechanical rooms is installed.
 - .2 All pumps and equipment are installed and electrical connections made.
 - .3 All contractor system start-up and test sheets have been completed and submitted for review.
 - .4 All thermal insulation is installed.
 - .5 All static pressure tests are complete.
 - .6 All access doors are suitably located, and equipment easily accessible including plumbing cleanouts.
 - .7 All piping is installed, painted and clearly identified complete with flow arrows.
 - .8 Systems are chemically cleaned and flushed.
 - .9 All equipment is checked for operation, alignment amperage draw and rotation.
 - .10 All equipment is lubricated as per manufacturer's data.
 - .11 All plumbing fixtures are installed, solidly supported and in operation. Domestic water lines are flushed and disinfected.
 - .12 All valves are tagged, terminal air boxes are identified and numbered, and all equipment identified. Painting of equipment is completed and escutcheons are installed.
 - .13 All necessary tests and start-up procedures on equipment have been made, including those required by authorities.
 - .14 Following information has been submitted:
 - .15 Final draft of O & M Manuals.
 - .16 Final certificates from authorities having jurisdiction.
 - .17 System cleaning reports.
 - .18 Reports from manufacturer on noise and vibration control devices.
 - .19 Completed record drawings.
 - .3 Identify any systems which cannot be installed and/or placed in operation for reasons beyond the normal control of the contractors and submit a statement of the value of the remaining work required to complete the project.
 - .4 Within ten (10) days of receipt of a written application for a "Certificate of Substantial Performance", the Contract Administrator shall visit the site.

- .5 If, after the Contract Administrator's site visit the application for a "Certificate of Substantial Performance" is not approved, the contractor shall reapply in accordance with the Contract Administrator's site visit report and pay for costs of re-inspection services.

1.14 EQUIPMENT PROTECTION AND CLEAN-UP

- .1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Thoroughly clean piping and equipment of dirt, cuttings and other foreign substances.
- .4 Ensure that existing equipment to be turned over to the Contract Administrator or reused is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.15 TEMPORARY OR TRIAL USAGE

- .1 Temporary or trial usage requested by the City of mechanical equipment supplied under contract shall not represent acceptance. Operate and maintain all equipment and systems during trial usage.
- .2 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

1.16 SITE UTILITY SERVICES

- .1 Maintain liaison with the City to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.
- .2 Contractor shall confirm all elevations and locations of existing services prior to and during excavation.
- .3 Contractor shall provide Contract Administrator with as-constructed of site services. As- constructed to be dimensioned to grid lines or building exterior walls.

1.17 ELECTRICAL MOTORS

- .1 Supply mechanical equipment complete with electrical motors. Provide a complete listing of all motors required on the project within twenty (20) days of contract award. List K.W. Voltage, Phasing, efficiency etc. Provide list to Contract Administrator and Electrical Sub-Contractor for review.
- .2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be CSA labeled. All motors to be approved for use in the designated area classification by the Authority having Jurisdiction.
- .3 Unless specified otherwise, provide motors for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC design C or D.
- .4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection. Motors 30 kW and larger shall have thermistor protection.

- .5 Provide motors with complete nameplate data.
- .6 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .7 Provide motors designed with Class B insulation use Class F insulation for totally enclosed motors and motors fed from variable frequency drives.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Electrical motors, drives and guards for mechanical equipment and systems.
- .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and mechanical drawings.
- .3 Control wiring and conduit is specified in Section 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Section 22 and 23. Refer to Section 26 for quality of materials and workmanship.

1.2 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.
- .2 This section applies to Section 21, 22, 23.

1.3 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-2004, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)

1.4 STANDARDS

- .1 Refer to item 1.17 in Section 22 05 01.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.
- .2 Submit shop drawings indicating motor manufacturer, frame size, voltage, full load amps, insulation class, motor grade, and dimensions.
- .3 Submit manufacturer's recommended maintenance tasks for a one year period, based on application of the motor. Include maintenance schedules and lubrication products.
- .4 Submit a copy of typical Warranty Certificate.

1.6 ELECTRICAL REQUIREMENTS

- .1 Voltage and Frequency
Motors will be rated for operation on a 3-phase, 60 Hz power supply at 575 Volts or 208 Volts. All motors shall be designed and manufactured to operate with 10% voltage and $\pm 5\%$ frequency variations of the nameplate ratings. Combined voltage and frequency variation shall not exceed $\pm 10\%$. Confirm voltage for all motors with Section 26.
- .2 Operating Characteristics
 - .1 Torques
Motors shall meet or exceed the locked rotor (starting) and minimum breakdown torques specified in NEMA standard for Design B for the ratings specified.

- .2 Currents
Locked rotor (starting) currents shall not exceed NEMA Design B maximum values for the specified rating. Motors shall be capable of a 20 second stall at six times full load current without injurious heating to the motor components.
- .3 Efficiency
Motors shall be Premium Efficient design and have a minimum and nominal full load efficiency which will meet or exceed the values listed in NEMA MG1-12.55 Table 12-6B when tested in accordance with NEMA test standard MG1-12.54.1, IEEE Test Procedure 112, Method B using accuracy improvement by segregated loss determination including stray load loss measurements. The minimum efficiency shall be guaranteed.
- .4 Power Factor
The power factor of 3600 and 1800 rpm, 3 through 186.5 kW (250 HP) ratings at full load, at full voltage shall be a minimum of 85%. Six-pole ratings will be excluded from this requirement.

Service Factor and Ambient

Standard motors will be rated for a 1.15 service factor in a 40°C (104°F) ambient.

- .3 Insulation
 - .1 Standard motors shall have a full Class F non-hygroscopic insulation system.
 - .2 Standard motors shall be dipped and baked in polyester varnish to consolidate the winding.

1.7 MECHANICAL CONSTRUCTION

- .1 Frame Size
 - .1 Horsepower/frame relationship shall conform to the latest NEMA standard for T-frame motors.
 - .2 Motors covered by this specification will be 143T-449T frame sizes.
- .2 Motor Type
 - .1 TEFC Totally Enclosed Fan Cooled: The motor shall be designed so as to prevent the free exchange of air between the inside and outside of the motor housing. An integral fan shall be provided to direct cooling air over the exterior surface of the frame. The fan shall be one piece constructed of a corrosion-resistant material. The fan covers shall be constructed of pressed steel for frames 140T-400T and of Cast iron for 440T frames. The motor frame and end brackets shall be cast iron construction and shall have a stainless steel nameplate. Two drains shall be provided in the lowest point in the frame.
- .3 Bearings
 - .1 All motors shall have anti-friction bearings, sized for L-10 life of at least 50,000 hours under minimum V belt heave sizes for maximum loading conditions (see NEMA Standard MG1-14.41 Table 14-1) or 150,000 hours L-10 life for a direct connected load.
 - .2 Bearings shall be double-shielded, vacuum degassed steel ball bearings selected for electric motor service.
 - .3 Bearing housings shall be re-greasable with provisions for purging old grease.

- .4 Bearings shall be lubricated with a premium moisture resistant grease of a temperature range of -29°C (-20°F) to + 149°C (300°F).
- .5 Cast iron inner bearing caps.
- .6 All fasteners and motor hardware shall be stainless steel.
- .7 Conduit box shall be cast iron, diagonally split and rotatable in 90 degree increments.
 - .1 Four (4) hex head bolts shall be used to secure conduit box to frame.
 - .2 Four (4) hex head bolts shall be used for the conduit box cover.
- .8 External hardware shall be stainless steel to resist corrosion.
- .9 External full gloss epoxy enamel paint shall withstand industrial environments.
- .10 Nameplates shall be of stainless steel and stamped per NEMA Standard MG1-10.40. Nameplate information shall include the nominal efficiency value per standard MG1-12.54.2.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 General Electric, US Motor, Baldor Century E Plus (VAV), Reliance XE
- .2 Siemens PE-21, Westinghouse Optim HE, Marathon.

2.2 TESTING

- .1 Production Tests: Each motor shall receive a routine commercial test per NEMA MG-1.12. Prototype test reports shall be for each rating.
- .2 Sound Level: The noise level of each motor shall comply with NEMA MG-1.12.49.
- .3 Vibration Level: The vibration level of each motor shall not exceed those values listed in NEMA MG-1.12.05.

Part 3 Execution

- .1 Not Applicable.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.
- .2 This section applies to Section 21, 22, 23.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB 14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB 14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.
- .2 Submit data sheets on thermometers and pressure gauges indicating service, and temperature or pressure ranges, to the Contract Administrator for review.
- .3 Submit list of all meters, including location, service, flow and corresponding reading for flow.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Thermometers: Marsh, Weksler, Trerice, Ashcroft,
- .2 Pressure gauges: Marsh, Trerice, Ashcroft, Weksler.
- .3 Static pressure gauges: Dwyer, Magnehelic
- .4 Positive displacement meters; Neptune, Rockwell, Badger
- .5 Flow Meters: Gerand, Preso

2.2 THERMOMETERS

- .1 Dial Thermometers: 75 mm diameter dial in drawn stainless steel case, bimetallic helix actuated, brass separable socket of flange and bushing, glass cover, adjustable pointer.

2.3 PRESSURE/TEMPERATURE TAPS

- .1 Fitting to allow a 3 mm (12 gauge) O.D. plug-in gauge to measure temperature or pressure.
 - .1 Maximum pressure: 3450 kPa (500 psi).
 - .2 Maximum temperature: 135°C (275°F).
- .2 Fitting constructed of:
 - .1 6 mm (¼”) NPT stainless steel body with hex head screw cap and gasket.

- .2 Protective screw cap to have retaining strap.
- .3 Two self-closing valves constructed of nordel.
- .3 Test kit including the following:
 - .1 One 65 mm (2½") diameter pressure gauge with 3 mm (12gauge) O.D. plug-in stem.
 - .2 Two 45 mm (1¾") diameter temperature gauges with 3 mm (12 gauge) O.D. x 125 mm (5") plug-in stem, range 0 to 110°C (-32 to 230°F).
 - .3 All above in protective carrying case with operating instructions.
- .4 Installation:
 - .1 Install pressure/temperature taps into threaded pipe nipples welded to wall of pipe. Locate fittings in accessible spaces.
 - .2 Provide one pressure/temperature taps test kit.

2.4 PRESSURE GAUGES

- .1 100 mm (4") diameter, drawn stainless steel case, phosphor bronze bourdon tube, brass movement, extruded brass socket, 1% midscale accuracy, front calibration adjustment, black figures on white background. Pressure gauges shall be liquid filled with ½% accuracy in locations subject to vibration (on pumps, air handling units, and chillers), and 1% accuracy in all other locations. Provide needle valve and syphon for steam service, pulsating damper and ball valve for water service.

2.5 STATIC PRESSURE GAUGES

- .1 Dial Gauge: 100 mm (4") dial, diaphragm actuated, suitable for positive, negative, or differential pressure measurement. Accuracy within ±2% of full scale, complete with static pressure tips and mounting accessories.
- .2 Inclined Vertical Manometer: molded plastic manometer, accuracy within ±3% of full scale, suitable for positive, negative or differential pressure measurement, complete with static pressure tips, and mounting accessories.

2.6 POSITIVE DISPLACEMENT METERS

- .1 Rotating disc measuring chamber, disc material to suit fluid encountered, odometer-type direct reading totalizer counter with 6 numerical wheels for cumulative readings.

2.7 VENTURI FLOW METERS

- .1 Provide calibrated venturi flow meter elements where shown on drawings.
- .2 Each venturi element shall be complete with safety shut-off valves and quick coupling connections. A permanent metal tag shall be attached with a chain showing designed flow rates, meter readings for designed flow rates, metered fluid, line size and tag number.
- .3 Supplier to select flow meters to provide mid-range reading on portable meter specified below. Flow meters selected with readings less than 25% of full scale will not be accepted.
- .4 Liquid Service:
Venturis 50 mm (2") and smaller to be stainless steel threaded.
Venturis 65 mm (2½") and larger to be steel for butt weld installation.
Rating: 1750 kPa, 120°C (250 psi, 250°F).

- .5 Accuracy of flow measuring elements shall be $\pm 1\%$. Permanent head loss not to exceed 10% of differential pressure reading.
- .6 Venturis are required to be selected to provide a pressure differential of not less than 375 mm W.G (15" WG). and not more than 1125 mm W.G (45" WG).
- .7 Provide a portable meter set of dry diaphragm type with a round 150 mm (6") diameter dial. Meter range shall be 0 - 2540 mm W.G. (0-100" WG) with a 270° dial. All wetted parts shall be of copper construction. Meter shall include pulsation damper, equalizing valve, 2-bleed valves, master chart for direct conversion of meter readings to metric engineering units, rust proof carrying case, two 3-m (10'-0") each rubber test hoses with brass quick connect valves to venturi element.

Part 3 Execution

3.1 INSTALLATION

- .1 Install positive displacement meters with isolating valves. Provide valved bypass for liquid service meters.
- .2 Install flow meters in uninterrupted straight pipe, minimum 2 pipe diameters downstream and 5 pipe diameters upstream, or according to manufacturers recommendations.
- .3 Provide one pressure gauge per pump installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- .4 Select gauges so that normal operating point is approximately mid-point of instrument range.
- .5 On pipes 65 mm (2½") and smaller, place well in tee used in lieu of an elbow to accommodate well.

3.2 METERS AND GAUGES INSTALLATION SCHEDULE

- .1 Thermometers:
 - .1 Supply and return headers of central equipment
 - .2 Boilers, inlet and outlet
 - .3 Heating coils, inlet and outlet
 - .4 And where shown on drawings.
- .2 Pressure/Temperature Taps:
 - .1 All control sensor tapings
 - .2 Major coils, inlet and outlet
 - .3 Where shown on drawings
- .3 Pressure Gauges:
 - .1 Pumps
 - .2 Expansion Tanks
 - .3 Pressure Tanks
 - .4 Domestic Cold Water to Standpipe and/or Sprinkler
 - .5 Leaving side of automatic make-up valves
 - .6 Leaving side of pressure reducing valves
 - .7 And where shown on drawings

- .4 Static Pressure Gauges:
 - .1 Across built-up filter banks
 - .2 Across unitary filter sections
 - .3 Across supply and return fans
 - .4 Where shown on drawings

- .5 Positive Displacement Meter:
 - .1 Domestic Cold Water
 - .2 Heating System Make-up
 - .3 And where shown on drawings.

- .6 Flow Meters:
 - .1 Where shown on drawings

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.
- .2 This section applies to Section 21, 22, 23.

1.2 REFERENCES

- .1 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-80-2003, 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 MANUFACTURER

- .1 Provide valves of the same type by the same manufacturer throughout.
- .2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
- .3 All valves shall meet the requirements of the Manufacturers Standardization Society, Standard Practice standards, latest edition.
- .4 Ball valves to be ULC listed, SP. 110 Standard.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.

1.5 QUALITY ASSURANCE

- .1 Products shall be product of manufacturer regularly engaged in production of such units who issues complete catalogue data on such products.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Angle Valves: Jenkins, Crane, Toyo, Kitz,Dahl
- .2 Swing Check Valves: Jenkins, Crane, Kitz, Mueller SPX, Victaulic
- .3 Silent Check Valves: Val-Matic, APCO, Stream Flo, Mueller SPX
- .4 Ball Valves; Jenkins, Crane, Toyo, Kitz, MAS
- .5 Drain Valves: Dahl, Crane, Jenkins, Toyo, Kitz, Hammond
- .6 Strainers: Jenkins, Crane, Kitz, Mueller SPX, Victaulic

2.2 DOMESTIC COLD WATER SYSTEM

- .1 Ball Valves up to 50 mm (2"): 2 piece stainless steel bodies, full port, chrome plated, solid bronze ball, threaded or solder ends, TFE seat and packing. 4134 kPa (600 psi) non-shock WOG rating. Jenkins Figure 901J, Toyo #5044A, Toyo #5049A, Kitz #58, Kitz #59.
- .2 Swing Check Valves up to 50 mm (2"): Stainless steel body screw-in cap, renewable no. 125 composition disc, threaded ends 860 kPa (125 psi) steam. Jenkins Figure 4475J, Toyo #236T.
- .3 Silent Check Valves for Pump Discharge:
 - .1 Up to 50 mm (2"): Stainless steel body, SS stem, 316 SS spring, Teflon disc and seat ring, 430 SS seat screw, threaded ends. 1380 kPa (200 psi) water. Val Matic VM-S1400.
 - .2 65 mm and over: Wafer style, Stainless steel body, 316 SS seat, plug, spring and bushing. ANSI Class 125. Val Matic, Series 1400.
- .4 Drain Valves:
 - .1 Drain Valves up to 50 mm (2"): Stainless steel body, brass cap, stem, and ball. Teflon stem seals and Teflon seat. Hose thread end. Working pressure 1725 kPa (250 psi) at 121°C (250°F). Dahl 50.430, Jenkins Fig 901CJ, Toyo #5046, Kitz #68AC.

2.3 DOMESTIC HOT WATER SYSTEM

- .1 Valves to be used in the hot water section of the system shall be exactly as specified in the cold water section with one exception, that all composition disc valves shall be fitted with discs suitable for hot water, rated for 2756 kPa (400 psi) at 94°C (200°F).

2.4 VALVE OPERATORS

- .1 Provide suitable hand wheels for gate, globe or angle, radiation and drain valves and inside hose bibbs.
- .2 Provide one plug cock wrench for every ten plug cocks sized 50 mm and smaller, minimum of one. Provide each plug cock sized 65 mm and larger with a wrench, with set screw.
- .3 Provide valves larger than 100 mm located more than 2,100 mm from floor in equipment rooms with chain operated sheaves. Extend chains to 1,500 mm above floor and hook to clips to arrange to clear walking aisles.

2.5 CIRCUIT BALANCE VALVES

- .1 Suitable for throttling. All metal parts non-ferrous, die cast non porous copper alloy. Flow measuring accuracy $\pm 2\%$. Positive shut-off, drain connection with cap. Memory balancing feature. Fittings for connection of portable differential pressure meter.
- .2 Body and Bonnet: Brass alloy CW617.
- .3 Stem and Disc: Brass alloy B16.
- .4 Elastomers: EPDM.
- .5 Handwheel: Reinforced nylon ABS.
- .6 Y-pattern and equal percentage globe-style with three functions:

- .1 Precise flow measurement.
- .2 Precision flow balancing.
- .3 Positive drip-tight shut-off.
- .7 Maximum working pressure: 2070 kPa.
- .8 Standard acceptance: Armstrong, Bell & Gossett circuit setter.

2.6 STRAINERS

- .1 Minimum 700 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 50 mm and under, bronze body, screwed ends with 0.75 mm (22 gauge) stainless steel perforated screen and brass cap.
- .3 65 mm and over, cast iron body, flanged ends, with 1 mm (20 ga) stainless steel perforated screen and bolted cap.
- .4 Size 125 mm and larger: Flanged iron body, Y pattern with 3 mm (11 ga) stainless steel perforated screen.
- .5 Screen free area shall be minimum three times area of inlet pipe.

Part 3 Execution

3.1 INSTALLATION AND APPLICATION

- .1 Install valves with stem upright or horizontal, not inverted.
- .2 Install valves for shut-off and isolating service, to isolate all equipment, parts of systems, or vertical risers.
- .3 Use memory balancing valves in domestic hot water recirculating systems.
- .4 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.
- .5 Size drain lines and drain valves equal to size of apparatus drain connection.
- .6 For pipe sizes 20 mm ($\frac{3}{4}$ ") and over, minimum drain size to be 20 mm ($\frac{3}{4}$ ").
- .7 Provide hose thread connection with cap and chain for 20 mm ($\frac{3}{4}$ ") drain valves located in ceiling and public areas.
- .8 Provide male NPT nipples with threaded pipe cap for drain sizes over 20 mm ($\frac{3}{4}$ ") where not piped directly to floor drains.
- .9 Provide valved drain and hose connection off the bottom of all strainers.
- .10 Install strainers on the inlet to all pumps. Use temporary strainers during construction and system cleaning. Remove temporary and install permanent strainers prior to system balancing.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.
- .2 This section applies to Section 21, 22, 23.

1.2 REFERENCES

- .1 Pipe supports shall meet the requirements of ANSI B31.1 Power Piping.
- .2 Duct hangers shall follow the recommendations of the current edition of the SMACNA Duct Manuals.

1.3 GENERAL REQUIREMENTS

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, and provide for expansion and contraction.
- .2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
- .3 Select hangers and supports for the service and in accordance with manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
- .4 Fasten hangers and supports to building structure or inserts in concrete construction.
- .5 Provide and set sleeves or block-outs required for equipment, including openings required for placing equipment.
- .6 Provide sleeves for all piping and ductwork penetration through walls, ceilings, floors and footings. Sleeves to be sized to allow insulation to pass through and to project through both sides of wall.
- .7 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the Contract Administrator.
- .8 Obtain approval prior to drilling for inserts and supports for piping system and ductwork. Discuss and obtain approval for hanging systems and methods with Contract Administrator.
- .9 Obtain approval prior to using percussion type fastenings.
- .10 Use of piping, ductwork or equipment for hanger supports and use of perforated band iron, wire or chain as hangers is not permitted.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.

Part 2 Products

2.1 INSERTS

- .1 Inserts shall be malleable iron or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, and lugs for attaching to forms.
- .2 Size inserts to suit threaded hanger rods.

2.2 PIPE HANGERS AND SUPPORTS

- .1 Hangers, Pipe Sizes 15 mm (½") to 40 mm (1½"): Adjustable wrought steel ring.
- .2 Hangers, Pipe Sizes 50 mm (2") and over: Adjustable wrought steel clevis.
- .3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods. Cast iron roll and stand for hot pipe sizes 150 mm (6") and over. Cup washers for hot piping below 150 mm (6").
- .4 Wall Support, Pipe Sizes to 75 mm (3"): Cast iron hook.
- .5 Wall Support, Pipe Sizes 100 mm (4") and Over: Welded steel bracket and wrought steel clamp, adjustable steel yoke and cast iron roll for hot pipe sizes 150 mm (6") and over.
- .6 Vertical Support: Steel riser clamp.
- .7 Floor Support, Pipe Sizes to 100 mm (4") and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier or steel support.
- .8 Floor Support, Hot Pipe Sizes 125 mm (5") and Over: Adjustable cast iron roll and stand, steel screws and concrete pier to steel support.
- .9 Design hangers so they cannot become disengaged by movements of supported pipe.
- .10 Provide copper plated hangers and supports for copper piping.
- .11 Provide galvanized hangers and supports for galvanized piping.
- .12 Support all piping below grade and under floor slabs in 3.2 mm (10 gauge) continuous cadmium plated channel. Support channel with cadmium plated clevis hangers and rods. Install supports on centers as specified in 3.2. Extend cadmium plated hanger rods 450 mm (18") above slab rebar and bend back over rebar so as to provide a minimum of 450 mm (18") of support in slab. Do not stress rod when bending.

2.3 DUCT HANGERS AND SUPPORTS

- .1 Conform to current edition of SMACNA handbooks.

2.4 HANGER RODS

- .1 Provide stainless steel or galvanized steel hanger rods, threaded both ends, threaded one end, or continuous threaded.

2.5 SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/- 5% spring rate tolerance, tested for free height, spring rate, loaded height.

- .2 Load adjustability: 15% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities. Total travel to be actual travel +/- 20%. Difference between total travel and actual travel 25 mm minimum.
- .3 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .4 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

2.6 HOUSE-KEEPING PADS FOR EQUIPMENT

- .1 Provide minimum 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.
- .2 Provide reinforced concrete housekeeping pads poured directly on structural floor slab 100 mm (4") thick minimum, extended 100 mm (4") minimum beyond machinery bedplates and chamfer pad edges. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment.
- .3 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- .4 Provide rigid anchors for ducts and pipes immediately after vibration isolation connections to equipment unless spring hangers are specified.

2.7 FLASHING

- .1 Steel Flashing: 0.5 mm (26 gauge) galvanized steel.
- .2 Lead Flashing: 24.4 kg/m² (5 lb/ft² sheet lead for waterproofing, 4.88 kg/m² (1 lb/ft² sheet lead for soundproofing.
- .3 Safes: 24.4 kg/m² (5 lb/ft² sheet lead or 0.5 mm (26 gauge) neoprene.
- .4 Caps: Steel, 0.8 mm (22 gauge) minimum, 1.6 mm (16 gauge) at fire resistance structures.

2.8 SLEEVES

- .1 Pipes through Floors: Form with stainless steel pipe or approved PVC sleeves.
- .2 Pipes through Walls: Form with stainless steel pipe.
- .3 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

2.9 SEALS

- .1 Provide modular mechanical type seals between pipes and sleeves where passing through perimeter walls below grade (basement). These to consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve when linking bolts are tightened in sequence. Equal to "Link-seal" by Thunderline.

Part 3 Execution

3.1 INSERTS

- .1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- .2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100 mm (4") or ducts over 1500 mm (60") wide.
- .3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- .4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed 100 mm (4") minimum square steel plate and nut above slab.

3.2 PIPE HANGERS SPACING

- .1 Plumbing piping: to Canadian Plumbing Code, Provincial Code and/or authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .4 Support horizontal steel and copper piping as follows:

Maximum Pipe Size UP to:	Maximum Spacing Steel	Maximum Spacing Copper	Hanger Rod Diameter
up to 30	2.1 m	1.8 m	10 mm
40	2.7 m	2.4 m	10 mm
50	3.0 m	2.7 m	10 mm
65	3.6 m	3.0 m	10 mm
75	3.6 m	3.0 m	15 mm
100	4.2 m	3.6 m	20 mm
150	5.0 m	4.0 m	20 mm
200	5.5 m		25 mm
Over 250	6.0 m		25 mm

- .5 Install hangers to provide minimum 15 mm (½") clear space between finished covering and adjacent work.
- .6 Use oversize hangers to accommodate pipe insulation thickness. For pipes up to 50 mm (2") use high density rigid pipe insulation at hanger location, with an insulation protection shield. For pipes 65 mm (2½") and over use insulation protection saddle.
- .7 Ensure that rod is vertical under operating conditions at equalize loads.
- .8 Place a hanger within 300 mm (12") of each horizontal elbow.
- .9 Use hangers which are vertically adjustable 40 mm (1½") minimum after piping is erected.
- .10 Support cast iron horizontal drainage pipe near each hub and on each side of gasket and clamp joints, with 1500 mm (60") maximum spacing between hangers.

- .11 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.
- .12 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .13 Where practical, support riser piping independently of connected horizontal piping.

3.3 LOW VELOCITY DUCT HANGERS AND SUPPORTS

- .1 Hanger Minimum Sizes:
 - .1 Up to 750 mm wide: 25 mm x 1.6 mm (16 ga) at 3,000 mm spacing.
 - .2 790 to 1,200 mm wide: 40 mm x 1.6 mm (16 ga) at 3,000 mm spacing.
 - .3 Over 1,200 mm wide: 40 mm x 1.6 mm (16 ga) at 2,400 mm spacing.
- .2 Horizontal Duct on Wall Supports Minimum Sizes:
 - .1 Up to 450 mm wide: 40 mm x 1.6 mm (16 ga) or 25 x 25 x 3 mm (11 ga) at 2,400 mm spacing.
 - .2 475 mm to 1,000 mm wide: 40 mm x 40 mm x 3 mm (11 ga) at 1200 mm spacing.
- .3 Vertical Duct on Wall Supports Minimum Sizes at 3600 mm spacing:
 - .1 Up to 600 mm wide: 40 mm x 1.6 mm (16 ga).
 - .2 625 mm to 900 mm wide: 25 mm x 25 mm x 3 mm (11 ga).
 - .3 925 mm to 1,200 mm wide: 30 mm x 30 mm x 3 mm (11 ga).
 - .4 Over 1,200 mm wide: 50 mm x 50 mm x 3 mm (11 ga).
- .4 Vertical Duct Floor Supports Minimum Sizes, Riveted or Screwed to Ducts:
 - .1 Up to 1,500 mm wide: 40 mm x 40 mm x 3 mm (11 ga).
 - .2 Over 1,500 mm wide: 50 mm x 50 mm x 3 mm (11 ga).

3.4 FLASHING

- .1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors and roofs.
- .2 Flash vent and soil pipes projecting 75 mm (3") minimum above finished roof surface with lead worked 25 mm (1") minimum into hub, 200 mm (8") minimum clear on sides with minimum 600 mm (24") x 600 mm (24") sheet size. For pipes through outside walls, turn flange back into wall and caulk.
- .3 Flash floor drains over finished areas with lead 250 mm (10") clear on sides with minimum 900 mm (36") x 900 mm (36") sheet size. Fasten flashing to drain clamp device.
- .4 Provide curbs for mechanical roof installations 200 mm (8") minimum high. Flash and counterflash with galvanized steel, soldered and made waterproof.

3.5 SLEEVES

- .1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeve.
- .2 Extend sleeves through potentially wet floors 25 mm (1") above finished floor level. Caulk sleeves full depth and provide floor plate.

- .3 Piping passing through floor, ceiling or wall, close off space between duct and sleeve with non-combustible insulation. Caulk both sides.
- .4 Sleeves provided through walls or floors where liquids could potentially pass from one side to the other, provide sleeves with a 25 mm (1") 'flange' welded to the external face of the sleeve at the mid point of the thickness of the structure to provide a water stop.
- .5 Install chrome plated escutcheons where piping passes through finished surfaces.

3.6 FINISHES ON HANGER AND SUPPORTS

- .1 All hanger rods, hangers and supports shall be stainless steel or factory primed with alkyd red oxide primer to CAN/CGSB-1.40.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.
- .2 This section applies to Section 21, 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 SUBMITTALS

- .1 Submit shop drawings in accordance with E4.

1.4 QUALITY CONTROL

- .1 Color code mechanical equipment, piping and exposed ductwork. Refer to color schedule at end of this section.
- .2 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow color, with minimum 20 mm ($\frac{3}{4}$ ") high black lettering equal to Brady System B-500, vinyl cloth labels for non insulated surfaces; and Brady B946 for insulated surfaces.

1.5 EQUIPMENT PROTECTION AND CLEAN-UP

- .1 Ensure that equipment and surfaces are carefully covered with tarping, or heavy duty plastic. Ensure that spills and splatter on finishes and equipment are cleaned up totally and promptly.

Part 2 Products

- .1 Refer to Section 09 91 00 - PAINTING.

Part 3 Execution

3.1 GENERAL

- .1 Identify piping with labels, color bands, and flow arrows. On all systems, provide identification at 15 m (50 ft) maximum intervals, before and after pipes passing through walls, at all sides of tees, behind access doors and in equipment rooms as required.
- .2 Apply color bands at both ends of the label with primary color bands used to secure both ends of individual labels. Refer to color schedule at end of this section.
- .3 Provide 20 mm ($\frac{3}{4}$ ") diameter brass, lamacoid or metal photo black numbers, secured to valve stem with key chain.
- .4 Provide neat, typewritten directories, giving valve number, services and location. Frame one copy under glass for wall mounting as directed, second copy to be forwarded to Contract Administrator. Include copies in O & M Manuals.

- .5 Identify all equipment excluding pipe and duct with screwed down lamacoid plates having 6 mm (1/4") minimum letter size. Identification to match as built drawings equipment name and number.
- .6 Identify electric starting switches, thermostats controlling motors, remote push button stations, and controls equipment supplies under this Section with lamacoid plates having 6 mm (1/4") minimum letter size. Identification to state equipment controlled and match to control shop drawing identification numbers.
- .7 Identify the purpose of duct access panels with self adhesive Brady stick-on colored labels. Apply labels conforming to the following schedule:

	<u>Color</u>	<u>Letters</u>
Cleaning and service access	yellow	C.A.

Note: Provide black lettering in all cases.

- .8 Identify the location of the following items of equipment which are concealed above a ceiling with Avery "Data Dots". The colors shall conform to the following schedule:

Concealed equipment and cleaning access	yellow
Control equipment, including control and valves	black
Pipe mounted equipment with the exception of fire, smoke, sprinkler and control equipment	green

3.2 COLOR CODE SCHEDULE

- .1 Color numbers are called for in Canadian Government Specification No. 5-GP-1a. Colors assigned from CGSB 1-GP-12c for color code identification.
Mechanical Primary Colors for Pipe Lines/Equipment

-	Yellow	:	505-102
-	Light Blue	:	502-106
-	Green	:	503-107
-	Orange	:	508-102
-	Brown	:	504-103
-	Red	:	509-102
-	White	:	513-101
-	Aluminum	:	515-101
-	Purple	:	501-101
-	Grey	:	501-107

Secondary Colors for Bands

-	Red	:	509-102
-	Orange	:	508-102
-	Blue	:	502-106

Banding

- Red : to indicate extremely hazardous material
- Orange : to indicate mildly hazardous material
- Blue : to indicate non-hazardous material

.2 Identification Symbols and Colors for Piping

	<u>Pipe Color</u>	<u>Stripe Color</u>	<u>Symbol</u>
Carbon Dioxide (Fire Extinguisher)	Red		C02
Domestic Cold Water	Light Blue	None	Cold Wat.
Domestic Hot Water	Green	Orange 60°C to 100°C (140°F to 212°F)	Hot Wat.
Domestic Hot Water Recirculation	Green	Blue Below 60°C (140°F)	Hot Wat. R.
Drains	Aluminum	Red or Orange	Drain
Vent	Aluminum	Red or Orange	Vent
Glycol Supply	Green	Orange	GHS
Glycol Return	Green	Orange	GHR
Natural Gas	Yellow	Red	Nat.Gas
Motor Guards	Red machinery Enamel		
Hangers, Brackets, & Supports	Black Machinery Enamel		

.3 Ductwork

All ductwork to be identified as follows, complete with directional arrows:

Supply Air	S/A
Return Air	R/A
Outside Air	O/A
Exhaust Air	E/A
Relief Air	Rel/A

.4 Equipment Bases/Housekeeping Pads
 Floor Finish.

3.3 MECHANICAL CONTROL SYSTEMS

- .1 Conduit pull boxes, terminal boxes and junction boxes - GREY Covers - GREY with black 'C'.
- .2 Main and secondary control panels, factory finish acceptable - control Contractor to install company label to identify.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Hot and Cold Equipment Insulation
- .2 Tanks, Pipeline Devices, Pumps Insulation
- .3 Adhesives, tie wires, tapes.
- .4 Recovering.

1.2 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.
- .2 This section applies to Section 21, 22, 23.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM C335-05ae1, Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .3 ASTM C449-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-08, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52MA-89, Vapor Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .3 Thermal Insulation Association of Canada (TIAC)
 - .1 National Insulation Standards 1992 (R1999).

1.4 QUALITY ASSURANCE

- .1 The Contractor should submit, within three (3) Business days of a request by the Contract Administrator, proof satisfactory to the Contract Administrator of the qualifications of the proposed Sub-Contractor completing the Work in this Section.

- .2 Materials shall meet or exceed fire and smoke hazard ratings as stated in this section and defined in applicable building codes.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.
- .2 Submit shop drawings which indicate complete material data, "K" value, temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.
- .3 Submit samples of proposed insulating and recovering materials.

1.6 JOB CONDITIONS

- .1 Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.
- .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.7 ALTERNATIVES

- .1 Alternative insulations are subject to approval. Alternatives shall provide the same thermal resistance within 5% at normal conditions as material specified.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Owen's Corning/Fiberglas Canada Inc., Manson, Knauf Fiberglass.

2.2 GENERAL

- .1 Insulation Materials, Recovery Jackets, Vapor Barrier Facings, Tapes and Adhesives shall be In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.
- .2 All insulation materials shall meet Building Code Standards, and packages or containers of such materials shall be appropriately labeled.

2.3 MATERIALS

- .1 Hot Equipment: Rigid fibrous glass, or mineral fiber insulation, "K" value maximum 0.035 W/m. °C, at 24°C (0.24 btu in/hr/ft² at 75°F). Service temperature -14°C (7°F) to 200°C (392°F).
- .2 Cold Equipment: Rigid fibrous glass, or mineral fiber insulation, with factory applied reinforced aluminum foil vapor barrier, "K" value maximum 0.035 W/m. °C, at 24°C (0.24 btu in/hr/ft² at 75°F). Service temperature -10°C (14°F) to 100°C (212°F).
- .3 Provide Velcro or zippered removable insulation coverings over equipment access ports, controls devices and connection fittings. Do not insulate over nameplates or other data plates. Finish all exposed edges to the exterior insulation finish specified.

- .4 The insulation on all hot and cold equipment shall be the same thickness as the connected piping and not less than 50 mm thick.
- .5 Recovery Jackets: ULC listed canvas 220 g/m² (0.044 lbs/ft²) plain weave cotton fabric with ULC listed dilute fire retardant lagging adhesive.

2.4 INSULATION SECUREMENTS

- .1 Tape: Self-adhesive, aluminum 50 mm wide minimum.
- .2 Contact adhesive: Quick setting and canvas adhesive: Washable.
- .3 Tie wire: 1.5 mm diameter stainless steel.
- .4 Bands: Stainless steel, 20 mm wide and 0.5 mm thick.

2.5 VAPOUR RETARDER

- .1 Lap adhesive: Water based, fire retardant type, compatible with insulation.
- .2 Indoor finish: Vinyl emulsion type acrylic, compatible with insulation.
- .3 Outdoor: Vinyl emulsion type acrylic, compatible with insulation.
- .4 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

Part 3 Execution

3.1 PREPARATION

- .1 Do not install covering before piping and equipment has been tested and approved.
- .2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 INSTALLATION

- .1 Ensure insulation is continuous through inside walls. Pack around pipes with fire proof self-supporting insulation material, properly sealed.
- .2 Locate insulation or cover seams in least visible locations.
- .3 Provide recovering jackets on exposed insulation throughout.
- .4 Flare out staples may be used to secure jacket laps on hot systems. Staples are to be applied on 100 mm (4") centers.
- .5 Equipment: Apply insulation with edges tightly butted, joints staggered and secured in place by metal bands. Where necessary, weld on suitable anchors. Provide sufficient clearance around openings for normal operation of equipment. Finish surface of cold equipment insulation with vapor barrier jacket sealed with vapor barrier adhesive. Make uneven surfaces smooth with insulating cement.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Piping insulation.
- .2 Adhesives, tie wires, tapes.
- .3 Recovering.

1.2 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.
- .2 This section applies to Section 21, 22, 23.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM C335-05ae1, Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .3 ASTM C449-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - .5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-08, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52MA-89, Vapor Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .3 Thermal Insulation Association of Canada (TIAC)
 - .1 National Insulation Standards 1992 (R1999).

1.4 QUALITY ASSURANCE

- .1 Insulation shall be installed by skilled workmen regularly engaged in this type of work.
- .2 Materials shall meet or exceed fire and smoke hazard ratings as stated in this section and defined in applicable building codes.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.
- .2 Submit shop drawings which indicate complete material data, "K" value, temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.
- .3 Submit samples of proposed insulating and recovering materials.

1.6 JOB CONDITIONS

- .1 Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.
- .2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.7 ALTERNATIVES

- .1 Alternative insulations are subject to approval. Alternatives shall provide the same thermal resistance within 5% at normal conditions as material specified.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Owen's Corning/Fiberglas Canada Inc., Manson, Knauf Fiberglass.

2.2 GENERAL

- .1 Insulation Materials, Recovery Jackets, Vapor Barrier Facings, Tapes and Adhesives shall be in accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.
- .2 All insulation materials shall meet Building Code Standards, and packages or containers of such materials shall be appropriately labeled.
- .3 Insulate fittings and valve bodies with preformed insulated fittings.

2.3 MATERIALS

- .1 Cold Piping: Formed fine fibrous glass or formed mineral fiber pipe insulation, with factory applied vapor barrier jacket, factory molded to conform to piping, "K" value maximum 0.035 W/m. °C at 24°C (0.24 btu in/hr/ft² at 75°F). Service temperature: 4°C (40°F) to 100°C (212°F).
- .2 Hot Piping: Formed fine fibrous glass or mineral fiber pipe insulation, with factory applied general purpose jacket, factory molded to conform to piping, "K" value maximum 0.035 W/m. °C, at 24°C (0.24 btu in/hr/ft² at 75°F). Service temperature up to 150° C (300°F).
- .3 Refrigerant Piping: Foamed plastic of closed cell structure or closed cell elastomer, "K" value maximum 0.04 W/m. °C at 24°C (0.28 btu in/hr/ft² at 75°F). Maximum water vapor transmission rating of 0.1 perms unjacketed, 0.1 perms jacketed.

- .4 Recovery Jackets:
 - .1 ULC listed canvas 220 g/m² (0.044 lbs/ft²) plain weave cotton fabric with ULC listed dilute fire retardant lagging adhesive.
 - .2 Polyvinyl Chloride (PVC): One-piece molded type and sheet to CAN/CGSB 51.53 with pre-formed shapes. All PVC jacket joints shall be sealed with CFIA compliant sealants.

2.4 INSULATION SECUREMENTS AND SEAL

- .1 Tape: Self-adhesive, aluminum 50 mm wide minimum.
- .2 Contact adhesive: Quick setting and canvas adhesive: Washable.
- .3 Tie wire: 1.5 mm diameter stainless steel.
- .4 Bands: Stainless steel, 20 mm wide and 0.5 mm thick.
- .5 Waterproof Caulking to all outdoor pipe:

2.5 VAPOUR RETARDER

- .1 Lap adhesive: Water based, fire retardant type, compatible with insulation.
- .2 Indoor finish: Vinyl emulsion type acrylic, compatible with insulation.
- .3 Outdoor: Vinyl emulsion type acrylic, compatible with insulation.
- .4 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

Part 3 Execution

- .1 Do not install covering before piping and equipment has been tested and approved.
- .2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 INSTALLATION

- .1 Ensure insulation is continuous through inside walls. Pack around pipes with fire proof self-supporting insulation material, properly sealed.
- .2 Insulate complete system including piping, fittings, valves, unions, flanges, strainers. Do not insulate flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.
- .3 Finish insulation neatly at hangers, supports and other protrusions.
- .4 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.
- .5 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, pipe shafts and suspended ceiling spaces is not considered exposed. Make smooth uneven insulated surfaces before recovering.
- .6 Cover insulation exposed to outdoors with aluminum jacket secured with aluminum bands on 200 mm (8") centre. Lap circumferential joints 75 mm (3") minimum and seal with compatible waterproof lap cement. Lock form longitudinal joints and seal.

- .7 Cold Piping: Seal lap joints with 100% coverage of vapor barrier adhesive. Seal butt joints with 50 mm (2") wide strips of vapor barrier sealed with vapor barrier adhesive. For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells, seal all laps and joints.
- .8 Flare out staples may be used to secure jacket laps on hot systems. Staples are to be applied on 100 mm (4") centers.
- .9 Hot Piping: For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells.
- .10 Refrigerant Piping: Cover fittings and valves with equivalent thickness of pipe insulation material. Apply with edges tightly butted. Seal joints with sealer.
- .11 Engine Exhaust and Muffler: Tightly butt insulation with staggered joints secured with metal bands or wire. Cover fittings with equivalent thickness of insulation.

3.3 INSULATION THICKNESS SCHEDULE

	Piping	Pipe Sizes mm (in)	Insulation Thickness mm (in)	Recovery Jacket
.1	Domestic Cold Water Piping	15 (1/2") to 20 (3/4") 25(1") and Over	15 (1/2") 25 (1")	Low smoke PVC
.2	Domestic Hot Water Supply and Recirculation Piping	15 (1/2") to 50 (2") Over 50 (2")	25 (1") 40 (1 1/4")	Low smoke PVC
.3	Condensate Drains from Air Handling Units	All Size	15 (1/2")	Low smoke PVC
.4	Vents within 3 m (10'-0") of Roof Outlet	All Size	25 (1")	Low smoke PVC

NOTE: Pipe insulation for piping installed in 40 x 90 mm (2" x 4") wall cavity can be reduced to 15 mm (1/2"), for pipe sizes 40 mm (1 1/2") to 65 mm (2 1/2"). Install insulation to thickness specified for piping outside the wall cavity.

Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Piping and Fittings
- .2 Backflow Preventers.
- .3 Hose Bibb
- .4 Hose Reel
- .5 Unions, Flanges, and Couplings

1.2 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
 - .1 ANSI/ASME B16.15-2006, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-2001 (R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-2001 (R2005), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-2006, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube (Metric).
 - .3 ASTM F492-95, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
- .3 American Water Works Association (AWWA).
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.

1.5 GENERAL REQUIREMENTS

- .1 Provide materials, equipment and labor to install plumbing as required by Manitoba and Local Codes as specified herein.
- .2 Provide water connections to equipment furnished in other sections of this specification and by the City.
- .3 Provide and include charges for connections to Municipal and Utility Company services, including costs to maintain temporary water supply pending acceptable water quality tests, where applicable.
- .4 Provide an approved water meter and bypass installation conforming to Local Codes and Standards.

1.6 QUALITY ASSURANCE

- .1 Domestic Water, Piping: Federal, Provincial and Municipal codes.
- .2 Non specified pipe joining and pipe fitting methods such as T-drill and Press Fit are not permitted in any piping system covered under Section 22.

Part 2 Products

2.1 PIPING AND FITTINGS

- .1 Domestic water, above ground (inside building)
 - .1 Piping:
 - .1 Type 'L' hard seamless copper tubing to ASTM B88M
 - .2 Fittings:
 - .1 Wrought copper, bronze with lead free solder, brazed for pipes over 50 mm
 - .2 Cast bronze with screwed joints
 - .3 Ductile Iron with rigid grooved mechanical joints.
- .2 Domestic water, buried
 - .1 Piping:
 - .1 Type K soft copper to ASTM B88M
 - .2 PVC, Class 150, conforming to CSA B137.3 and AWWA C900, complete with tracer wire
 - .2 Fittings:
 - .1 PVC Hub & Spigot, with "O" Ring joints.
 - .2 Copper no joints permitted.
 - .2 Holding tanks flush pipe and fittings: Stainless steel
- .3 Refer to 22 05 53 - Painting and Identification.

2.2 BACKFLOW PREVENTERS

- .1 Backflow preventer assembly complete with shut-off valves before and after check valves and test cocks. Assembly shall meet current AWWA requirements and CSA B64 standards.

- .2 Provide complete atmospheric vent backflow preventer assembly, consisting of two (2) positive sealing replaceable check valves with bronze seats, integral strainer and threaded vent connection.

2.3 HOSE BIBB

- .1 Exposed non-freeze anti-siphon automatic draining wall faucet complete with exterior chrome finish, brass casing, all bronze interior parts, anti-siphon integral vacuum breaker, operating rod with free-floating compression closure valve, wall support, replaceable seat washer, combination 15mm female solder inlet and 15mm male IP inlet connection and 20mm male hose.
- .2 Standard Acceptance: ZURN Z1345

2.4 HOSE REEL – HR-1

- .1 Retraction hose reel with following:
 - .1 37.5mm rubber hose with 7.6 m (25') length for 414 Ka pressure @ 1.24 gpm.
 - .2 A hose bumper.
 - .3 A hose bend restrictor.
 - .4 A self closing pre-rinse valve, with straight nozzle and diffuser.
 - .5 A angled pre-rinse spray head.
 - .6 A elevated vacuum breaker.
- .2 Standard Acceptance: ZURN Z89100-PR1.

2.5 UNIONS, FLANGES, AND COUPLINGS

- .1 Rigid grooved mechanical couplings shall have an angle bolt pattern design and shall provide system support and hanging requirements in accordance with ASME B31.1. Rigid couplings shall be used in all locations unless otherwise noted. Standard of acceptance Victaulic Style 07
- .2 Flexible grooved mechanical couplings shall only be used around equipment to attenuate noise and vibration. Noise and vibration reduction at mechanical equipment is achieved by installing three (3) flexible couplings near the vibrations source. Standard of acceptance Victaulic Style 77, 75
- .3 For grooved mechanical couplings on hot water, glycol, chilled water and potable water service the gasket material shall be Grade "E" EPDM compound (green color coded stripe) conforming to ASTM D-2000 designation. Grade "E" gaskets are UL/ULC classified to ANSI/NSF 61 for -34°C to 110°C-30°F to +230°F operating temperature range. Any deviations from the above in the way of special lubricants or special clauses in the manufactures literature as to limitations on hot water must be brought to the attention of the Contract Administrator and may not be accepted.
- .4 Official submission of shop drawings required.

- .5 For domestic water, grooved mechanical coupling housings are cast with an angle pattern bolt pad for direct connection of copper tubing without flaring to IPS dimensions. Gaskets shall be molded of synthetic rubber in a FlushSeal configuration conforming to the copper tube size (CTS) outside diameter and coupling housing. Standard of acceptance Victaulic Style 606

Part 3 Execution

3.1 PREPARATION

- .1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.
- .2 Use Victaulic roll grooving tools to groove pipe in accordance with manufacturer's specifications. Use copper rolls for copper pipe as provided by Victaulic.

3.2 CONNECTION

- .1 Use grooved mechanical couplings and mechanical fasteners as manufactured by Victaulic where allowed, in accessible locations and mechanical rooms and where access can be obtained without removal of equipment or other materials such as ductwork etc. All grooved components shall be of one manufacturer and conform to local code approval. A gauged torque wrench must be used if required by the manufacturer.
- .2 Use stainless steel couplings with galvanized pipe.
- .3 Make connections to equipment, specialty components, and branch mains after isolation valves, with unions or flanges.
- .4 Provide dielectric type connections wherever jointing dissimilar metals in open systems. Brass adapters and valves are acceptable.
- .5 Use insulating plastic spacers for copper pipe installation in metal studs.

3.3 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One piece type with stainless steel set screws.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.4 ROUTE AND GRADES

- .1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furring to a minimum.
- .2 Slope water piping 0.2% and provide hose bibb drains at low points.

- .3 Provide air collection chambers with manual air vent at all high points of system. Collection chambers to be 25 mm (1") dia or line size whichever is greater and 150 mm (6") high minimum. Square tees may only be used to assist with complete venting and draining.
- .4 Make reductions in water and steam pipes with eccentric reducing fittings installed to provide drainage and venting. Top flat for water.
- .5 Grade horizontal drainage and vent piping 2% minimum.
- .6 Pipe the discharge from all relief valves, safety valves, vents, drains, equipment blowdowns, water columns, and overflows to the nearest building drain.

3.5 INSTALLATION

- .1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.
- .2 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.
- .3 Install piping material specified as inside the building to 2500 mm (8'-0") outside of building.
- .4 Hose bibb: Install a shut off valve inside of wall before the hose bibb.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Piping and Fittings
- .2 Gas Regulator.
- .3 Unions, Flanges, and Couplings

1.2 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.

1.3 REFERENCES

- .1 Welding materials, fabrication standards and labour qualifications must conform to ANSI/ASME B31.1, ANSI B16.25, ASME Section IX, and the Provincial Board of Labour Regulations.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
 - .1 ANSI/ASME B16.15-2006, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-2001 (R2005), Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-2001 (R2005), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-2006, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .3 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube (Metric).
 - .3 ASTM F492-95, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
- .4 American Water Works Association (AWWA).
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .5 Canadian Standards Association (CSA International).
 - .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings. CAN/CSA-B149.1 (latest edition), Natural Gas and Propane Installation Code.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.

1.5 GENERAL REQUIREMENTS

- .1 Provide materials, equipment and labor to install plumbing as required by Provincial and Local Codes as specified herein.

1.6 QUALITY ASSURANCE

- .1 Natural gas piping to meet Federal, Provincial and Municipal codes.
- .2 Non specified pipe joining and pipe fitting methods such as T-drill and Press Fit are not permitted in any piping system covered under Section 22.

Part 2 Products

2.1 PIPING AND FITTINGS

- .1 Gas Pipe: Steel schedule 40, ASTM A53, Grade B
- .2 Gas Pipe Fittings: Banded malleable iron, 1035 kPa (150 psi), for sizes 40 mm (1½") and under with screwed joints. Steel, same schedule as pipe, for sizes 50 mm (2") and larger with welded joints.
- .3 Vent Pipe and Fittings: CPVC Schedule 80 BH Class II.
- .4 Refer to 22 05 53 - Painting and Identification.

2.2 GAS REGULATOR

- .1 Direct operated and spring loaded gas pressure regulator; cast iron body, stainless steel spring control and relief valve and vent screen. Size for full gas load to reduce gas pressure from 35 kPa (5 psi) to 1.74 kPa (7") W.C.
- .2 Standard acceptance: Fisher 25mm (1") HSR Series FSHSR-CDBBMY

2.3 UNIONS, FLANGES, AND COUPLINGS

- .1 Size 50 mm (2") and under: 1035 kPa (150 psi) malleable iron, bronze to iron ground joint unions for threaded ferrous piping, air tested for gas service, all bronze for copper piping.
- .2 Flange bolting: For systems up to 120°C (250°F), use carbon steel stud bolts, semi-finished, and heavy hex nuts, ASTM A307-GrB. For systems up to 215°C (420°F), use alloy steel bolts ASTM A193-GrB7, and semi-finished heavy hex nuts ASTM A194-Gr2H.

Part 3 Execution

3.1 PREPARATION

- .1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

- .2 Protect all steel pipes when stored on site from external conditions and ensure protective coating remains intact. If in the opinion of the Contract Administrator, deterioration of the protective coating has instigated corrosion, all rust must be removed down to bare metal and prime coated with red oxide paint.

3.2 CONNECTION

- .1 Screw joint steel piping up to and including 40 mm (1½"). Weld 50 mm (2") piping.
- .2 Make screwed joints with full cut standard taper pipe threads with approved Teflon tape or non-toxic joint compound applied to male threads only, equal to Jet-Lube V-2 multi-purpose thread sealant.
- .3 Make connections to equipment, specialty components, and branch mains after isolation valves, with unions or flanges.

3.3 ROUTE AND GRADES

- .1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations.
- .2 Grade horizontal drainage and vent piping 2% minimum.
- .3 Pipe the discharge from all relief valves, safety valves, vents, drains and overflows to the nearest building drain.

3.4 INSTALLATION

- .1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.
- .2 Provide clearance for proper installation and for access to valves, air vents, drains and unions.
- .3 All steel piping below grade shall be yellow jacketed.
- .4 Guy wire support gas pressure regulator vent pipe if it is applicable.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Piping and Fittings
- .2 Cleanouts
- .3 Floor drains
- .4 Manholes
- .5 Vacuum breakers
- .6 Trap Seal Primers
- .7 Backflow Valves

1.2 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B306-02, Standard Specification for Copper Drainage Tube (DWV).
 - .2 ASTM C564-08, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67-1972 (R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA B125-01, Plumbing Fittings.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.

1.5 GENERAL REQUIREMENTS

- .1 Provide materials, equipment and labor to install sanitary system as required by Provincial and Local Codes as specified herein.
- .2 Provide drainage connections to equipment furnished in other sections of this specification.
- .3 Provide and include charges for connections to Municipal and Utility Company services.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Cleanouts, Floor Drains: Roto Tech Smith, Zurn, Ancon.
- .2 Vacuum Breakers: Febco, Watts
- .3 Trap seal primers: Zurn

- .4 Backflow Valves: Febco, Watts

2.2 PIPING AND FITTINGS

- .1 Sanitary drainage, inside building, above ground
- .1 Piping:
 - .1 DWV copper, ASTM B306
 - .2 Cast iron, CSA B70
 - .2 Fittings:
 - .1 Cast iron with Gasket clamp joints.
 - .2 Wrought or cast copper: to CAN/CSA B125 with lead free solder.
- .2 Sanitary drainage, inside building, below ground
- .1 Piping:
 - .1 Cast iron, CSA B70
 - .2 PVC-DWV, CAN/CSA B182.1
 - .3 Concrete pipe for sizes over 300 mm
 - .2 Fittings:
 - .1 Cast iron with Gasket clamp joints.
 - .2 PVC-DWV with solvent weld joints
 - .3 Hub & spigot for concrete.
- .3 Vent pipe, inside building related to pit and buried outside building
- .1 Piping:
 - .1 Series DR 32.5 PVC or Stainless steel
 - .2 Fittings:
 - .1 Match piping.

2.3 CLEANOUTS AND CLEANOUT ACCESS COVERS

- .1 Provide caulked or threaded type extended to finished floor or wall surface. Provide bolted coverplate cleanouts on vertical rainwater leaders only. Ensure ample clearance at cleanout for rodding of drainage system.
- .2 Floor cleanout access covers in unfinished areas shall be round with nickel bronze scoriated frames and plates. Provide round access covers in finished areas with depressed centre section to accommodate floor finish. Wall cleanouts to have chrome plated caps.

2.4 FLOOR DRAINS

- .1 FD-1:
 - .1 Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with "TYPE B" polished, nickel bronze strainer.
 - .2 Size 50mm pipe with acid resistant epoxy coated cast iron.
- .2 FD-2:
 - .1 Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with "TYPE BF" polished, nickel bronze open throat oval funnel grate with stainless steel screws.
 - .2 Size 50mm pipe with acid resistant epoxy coated cast iron.
 - .3 Used for all equipment drain.

2.5 TRAP SEAL PRIMERS

- .1 Electronic automatic trap primer complete with slow closing 24 VAC solenoid valve, 120-24 VAC transformer, sediment strainer, brass ball type stop valve, brass atmospheric vacuum breaker, union and access door/mounting box for concealed installations with 15mm copper/pex tubing connections between primer valve and floor drain. Only one outlet shall be used for each drain. Standard of acceptance: Zurn Z1020
- .2 Electronic program shall provide a six second water injection to traps every twenty-four hours.
- .3 Refer to plumbing fixture schedule on drawing.

2.6 BACKFLOW VALVES

- .1 Provide complete assembly, epoxy coated, cast-iron body, bronze flapper check valve, bolted access cover with neoprene gasket extended floor access and neoprene gasketed heavy-duty nickel-bronze cover heavy gauge steel epoxy coated access housing and neoprene gasketed heavy-duty nickel-bronze cover.

Part 3 Execution

3.1 INSTALLATION

- .1 Bury outside drainage pipe minimum 2400 mm (8'-0").
- .2 Plumbing lines installed outside the building shall be separated by a minimum of 1 m (3'-0") horizontally between the outside surfaces of the lines. The lines are not permitted to be stacked.
- .3 Lubricate cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover, remove cleanout plugs, re-lubricate and re-install using only enough force to ensure permanent leakproof joint.
- .4 Install 15mm DCW pipe from trap primer to floor drain trap connections.
- .5 Drainage lines shall grade 2% for size equal or smaller than 75mm unless otherwise noted on drawings.
- .6 Plumbing vents shall be located minimum 5 m (16'-0") from air intakes.

3.2 SERVICE CONNECTION

- .1 Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with sufficient slope for drainage and adequate cover to avoid freezing.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.
- .2 Submit shop drawings indicating capacity rating, physical dimensions, wiring diagrams, materials of construction, code compliance, etc. As indicated on schedules.
- .3 Provide operating and maintenance manuals with complete description of product for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.3 QUALITY ASSURANCE

- .1 Sump Pumps shall be the product of manufacturer regularly engaged in production of such units who issues complete catalogue data on such products.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Sump Pumps: Zoeller, Grundfos.

2.2 SUMP PUMP PACKAGE

- .1 Completely submersible centrifugal with 50mm (2”) solid handling capability.
- .2 Durable Epoxy Coated Cast Iron Construction or stainless steel.
- .3 Non Clogging Vortex Impeller with stainless steel shaft and seals
- .4 Quick Disconnect complete with stainless steel guide plate with stainless steel upper rail support, stainless steel chain kit and 50 mm x 50 mm connections.
- .5 7.5m (25 ft) Power Cable
- .6 50 mm NPT Discharge
- .7 Simplex Control Panel with Disconnect, Nema 4X Enclosure, Clear Dead Front Panel, Float Switches (3) c/w 20 ft Cable, High Level Alarm Circuit, Top Mounted Alarm Light, Alarm Horn with Silence and Test Switches, Dry Auxilliary Contact, Lockable Latch and HOA Switch.
- .8 Discharge Check Valve and isolation Ball Valve.
- .9 Standard of Acceptance: Zoeller 6200 series.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations.
- .2 Refer to Pump Schedule on drawings.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Electric Domestic Water Heaters
- .2 Expansion Tanks

1.2 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.4 GENERAL REQUIREMENTS

- .1 Provide materials, equipment and labor to install electric domestic water heater as required by Provincial and Local Codes as specified herein.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.
- .2 Submit shop drawings indicating capacity rating, physical dimensions, wiring diagrams, materials of construction, code compliance, etc. As indicated on schedules.
- .3 Provide operating and maintenance manuals with complete description of product for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.6 QUALITY ASSURANCE

- .1 Electric Domestic Water Heaters shall be the product of manufacturer regularly engaged in production of such units who issues complete catalogue data on such products.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Electric Domestic Water Heater: A O Smith, John wood, GSW
- .2 Expansion Tank Amtrol , Armstrong, TACO

2.2 DOMESTIC WATER HEATERS

- .1 General
 - .1 Construct electric domestic hot water heaters to CSA C22-110, CSA C191 and ASHRAE 90.1-2007.
- .2 Electric Domestic Water Heater
 - .1 Glass Lined Tank with heavy foam insulation rated at 862 pa working pressure.
 - .2 Heavy-duty medium watt density elements have incoloy sheathing and prewired leads: provides excellent protection against oxidation and scaling.
 - .3 Element sensing constantly the element and current on/off state.

- .4 Low Water Cut Off – Factory standard on board low water cutoff uses a remote electronic immersion type probe to prevent energizing of the elements in the event of low water condition and eliminates accidental dry firing.
- .5 Multiple element contactors are sequenced on with one-second delay between stages. Prevents high amp electrical loads from hitting the electric system to provide a smoother operating.
- .6 Automatically controlled system lowers the Operating Set Point by a programmed value during user-defined time periods.
- .7 Powered a unique combination of a conventional magnesium anode provide maximum corrosion protection.

2.3 EXPANSION TANK

- .1 Tank shall be ASME closed type, welded steel rated air tight air cushion for working pressure, cleaned, prime coated and supplied with steel support saddles.
- .2 Provide gauge glass set consisting of brass compression stops and guard. Glass shall be long enough to cover the tank from 50 mm above the bottom to 50 mm below the top. Maximum length of each glass shall be 600 mm.
- .3 Provide quick connect air inlet of automotive tire valve type on top of tank and tank drain hose bibb on bottom of tank.
- .4 Factory precharged to 380 kPa diaphragm type sealed in EPDM and 100% tested for maximum 1035 kPa working pressure and maximum 93 degrees C operating temperature.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations.
- .2 Install on minimum 100mm thick concrete pad or steel frame.
- .3 Refer to Electric Water Heater and Expansion Tank Schedules on drawings.

3.2 START-UP

- .1 Provide the services of a factory trained representative to start up the equipment, test the efficiency and train the operators.
- .2 The domestic hot water tanks have integral electric elements and integral aquastat controls to maintain the hot water at a setpoint of 60C (140F).

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Sink and faucets

1.2 RELATED SECTIONS

- .1 Entire Specification – All areas of common work.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA B45 SERIES-02, Plumbing Fixtures.
 - .2 CSA B125-01, Plumbing Fittings.
 - .3 CSA B651-2004, Accessible Design for the Built Environment.

1.4 GENERAL REQUIREMENTS

- .1 Provide new fixtures, CSA approved, free from flaws and blemishes with finished surfaces clear, smooth and bright.
- .2 Provide CSA approved plumbing fittings. Visible parts of fixture brass and accessories shall be heavily chrome plated.
- .3 Fixtures shall be product of one manufacturer. Fittings of same type shall be product of one manufacturer.

1.5 JOB CONDITIONS

- .1 Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

1.6 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with E4.
- .2 Submit shop drawings indicating capacity rating, physical dimensions, materials of construction, code compliance, etc. As indicated on schedules.
- .3 Provide operating and maintenance manuals with complete description of product for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

Sink	:	Metal-Tech, Kohler, Toto, Olsonite, Cowtoco, Moldex, Toto.
Plumbing brass	:	Symmons, American Standard, Franke, Cambridge Brass, Waltec, Kohler, Chicago Faucet, Zurn Aqua Spec

2.2 GENERAL

- .1 Refer to Plumbing Fixture Schedule

2.3 PIPING:

- .1 Hot and cold water supplies to fixtures:
 - .1 Chrome plated flexible supply pipes with handwheel stop, reducers, and escutcheon.
- .2 Waste:
 - .1 Brass P-trap with clean out on fixtures not having integral trap.
 - .2 Chrome plated in exposed places.

2.4 SINK

- .1 Stainless Steel sink with rolled edge on front and both ends.
- .2 Full backsplash with the sides capped off.
- .3 Legs are made of 16mm diameter Stainless Steel Tubing with Heavy 16 gauge wall.
- .4 Leg Gussets are 16 gauges Stainless Steel, Type 304.
- .5 Centre Wastes with Stainless Steel Basket Strainers.
- .6 Plastic adjustable bullet feet are standard equipment.
- .7 Depth of sink compartment is 14”.
- .8 Height to top of sink is 35” from floor.
- .9 Holes are pre-punched for faucets at 8” on centre.
- .10 C/w one integral drain board on right
- .11 Supply Bedpan Cleanser Faucet and Wall-Mount Faucet with retractable hose and spray nozzle.
- .12 Include all mounting brackets.
- .13 Soap dispenser and paper towel dispenser included.
 - .1 Soap Dispensers: high impact polymer, surface mounted.
 - .1 Acceptable material: Bobrick B-5050.
 - .2 Paper Towel Dispensers: stainless steel housing, for C-fold or multifold towels, surface mounted.
 - .1 Acceptable material: Bobrick B-2620.

Part 3 Execution

3.1 INSTALLATION

- .1 Install each fixture with its own trap, easily removable for servicing and cleaning. At completion thoroughly clean plumbing fixtures and equipment.
- .2 Provide chrome plated rigid or flexible supplies to fixtures with screw driver stops, reducers and escutcheons.
- .3 Provide pressure reducing valves on water lines to fixtures which are not rated for the system operating pressures.

3.2 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
 - .1 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Adjust flush valves to suit actual site conditions.
 - .2 Checks:
 - .1 Aerators: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
 - .3 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION