1. GENERAL

1.1 Intent

.1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.

.2 Contract Documents and Drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.3 Follow Manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

.4 Install equipment generally in locations and routes shown. Run piping and ductwork close to building structure, parallel to building lines to maximize headroom and with minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at no extra cost.

.5 Install equipment to provide access and ease of maintenance.

.6 Connect to equipment specified in other Sections.

.7 Install control valves, control dampers, thermal wells, and other devices on piping and ducts.

1.2 Coordination of Work

.1 Make reference to electrical, plumbing, structural and architectural Drawings when setting out Work. Consult with respective Divisions 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.

.2 Where dimensional details are required, work with the applicable architectural and structural Drawings.

.3 Any areas indicated as space for future materials or equipment shall be left clear.

1.3 Quality of Work

.1 All Work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Contract Administrator.

1.4 Metric Conversion

.1 All units in this Division are expressed in SI units.

.2 Submit all Shop Drawings and maintenance manuals in SI units.

.3 On all submittals (Shop Drawings etc.) 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 Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.

.2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

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

.5 Metric Duct Sizes:

.1 The Metric duct sizes are expressed as 25 mm = 1 inch.

1.5 Salvage

.1 Remove from Site all equipment, ducting or piping which is no longer required because of Work under this Contract.

.2 Turnover to and deliver to the City's storage area all items which have been determined to have salvage value and has been removed due to the Work.

1.6 Cutting, Patching and Coring

.1 Provide holes and sleeves, cutting and fitting required for mechanical Work.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Contract Administrator before cutting or burning structural members.

.4 Provide openings and holes required in precast members for mechanical Work. Cast holes 100 mm or larger in diameter. Field-cut smaller than 100 mm.

.5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.7 Installation of Equipment

.1 Pipe all equipment drains to building drains.

.2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.

.3 Maintain permanent access to equipment for maintenance.

1.8 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 S115. Acceptable Materials: "Tremco" or "National Firestopping", or Hilti CP680 Cast-in-Place Firestopping System.

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

1.9 Connections to Existing Services

.1 Maintain liaison with the City and provide a schedule to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.

.2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on-site. Provide a minimum of forty-eight (48) hours' notice for all service shutdown.

.3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff.

1.10 Equipment and Materials

.1 Materials and equipment installed shall be new, full weight and of quality specified.

.2 Each major component of equipment shall bear manufacturer's name, address, catalogue and serial number in a conspicuous place.

.3 Where two (2) or more products of the same type are required, products shall be of the same manufacturer.

1.11 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 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.12 Electrical Motors

.1 Supply mechanical equipment complete with electrical motors.

.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 labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch.

.3 All motors intended for use with a variable speed drive (variance frequency drive) shall be inverter only rated. Variable speed drive shall be matched to motor.

.4 Two speed motors shall have separate winding for each speed.

.5 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.

.6 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.

.7 Motors less than ½ hp shall be 120 V, 60 Hz, 1 phase. Motors ½ hp and larger shall be 3 phase at the indicated voltage.

.8 All motors shall be 1800 rpm except where indicated.

.9 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.

.10 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.

.11 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.

.12 All motors shall be premium efficiency rated according to NEMA standards unless specified otherwise.

.13 All motors shall be inverter duty rated when driven by a variable speed drive.

1.13 Access Doors

.1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:

.1 Valves

.2 Volume and splitter dampers

.3 Fire dampers

.4 Cleanouts and traps

.5 Controls, coils and terminal units

.6 Expansion joints

.7 Filters

.8 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 Mark removable ceiling tiles used for access with colour coded dots.

.4 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.

.5 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.

1.14 Miscellaneous Metals

.1 Provide all necessary miscellaneous metals to hang or support materials, equipment and provide access for work under this contract.

.2 All miscellaneous metals shall be prime painted.

.3 Miscellaneous metals shall include but are not limited to:

.1 Hangers for equipment, piping and ductwork.

.2 Support for equipment.

1.15 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.

1.16 Cutting, Patching and Coring

.1 Provide holes and sleeves, cutting and fitting required for mechanical work.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Contract Administrator before cutting or burning structural members.

.4 Provide openings and holes required in precast members for mechanical work. Cast holes 100 mm or larger in diameter. Field-cut smaller than 100 mm.

.5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.17 Outdoor Piping Sealant

.1 Unless otherwise noted, all outdoor openings around pipe penetrations shall have the gap filled with an adhesive/sealant to provide a weatherproof seal.

.2 Adhesive/sealant shall be polyurethane based, temperature range of -40°C to 93°C, paintable with the use of primer, sandable, and have high UV resistance.

.3 Acceptable adhesive/sealant: Silaprene Solid Seal from Faucher Industries (Model: 642-2256, White).

.4 Acceptable adhesive/sealant: Silaprene Solid Seal from Faucher Industries (Model: 642-2263, Grey).

1.18 Painting and Identification

.1 Colour code mechanical equipment, piping and exposed ductwork. Refer to colour coding schedule below.

.2 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow colour, with minimum 20 mm high black lettering equal to Brady System B-500, vinyl cloth labels for non-insulated surfaces; and Brady B 946 for insulated surfaces.

.3 Identify piping with labels and flow arrows. Provide identification at 3 m maximum intervals, before and after pipes pass through walls, at all sides of tees, behind access doors and in equipment rooms as required.

.4 Provide 20 mm diameter brass, with metal photo black numbers, or white lamacoid with black engraved numbers, secured to valve stem with key chain.

.5 Provide neat, typewritten directories, giving valve number, services and location. Frame one (1) copy under glass for wall mounting as directed, second copy to be forwarded to the City. Include copies in O&M Manuals.

.6 Tag automatic controls, instruments and relays and match/key to control shop drawing identification numbers. Tag all equipment and control panels.

.7 Identify electric starting switches, thermostats controlling motors, remote push button stations, and controls equipment supplied under this division with lamacoid plates having 6 mm (1/4 inch) minimum letter size. Identification to state equipment controlled.

.8 Identify the usage of duct access panels with self-adhesive Brady stick-on coloured labels. Apply labels conforming to the following schedule.

	Colour	Letters
Cleaning and service access	yellow	C.A.
Controls, including heat sensors	black	C.
Dampers (backdraft, balance & control)	blue	D.
Fire dampers	red	F.D.

Note: Provide black lettering for yellow or white background, white for all other colours.

1.19 Colour Coding Schedule

.1 Identification Symbols and Colour for Piping

Item	Pipe Colour	Symbol
Glycol Return	Red	GLR
Glycol Supply	Red	GLS
Heating Hot Water Return	Red	HWR
Heating Hot Water Supp.	Red	HWS
Natural Gas	Yellow	Nat. Gas

.2 Identification Symbols and Colours for Equipment:

Item	Equipment Colour
Motor Guards	Red Machinery Enamel
Hangers, Brackets, Hanger Rods	Black Machinery Enamel
Supports	Black

.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.

.4 Ductwork

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

Return Air	R.A.
Supply Air	S.A.
Mixed Air	M.A.
Combustion Air	Comb. Air
Exhaust Air	E.A.

1.20 Temporary Heat

.1 Do not use the permanent system for temporary heating purposes without written permission from the Contract Administrator.

.2 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged parts before final inspection.

.3 Use of permanent systems for temporary heat shall not modify terms of warranty.

.4 Operate heating systems under conditions which ensure no temporary or permanent damage. Operate with proper safety devices and controls installed and fully operational. Operate systems only with treated water as specified.

.5 Air systems shall not be used for temporary heating.

.6 When permanent systems are used for temporary heat, provide alarm indicating system failure. Connect alarm to independent alarm company system.

.7 Where pumps are used for temporary heating, replace mechanical seals, regardless of condition, with new mechanical seals.

1.21 Temporary or Trial Usage

.1 Temporary or trial usage by the City or Contract Administrator of mechanical equipment supplied under Contract shall not represent acceptance.

.2 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

.3 Avoid thermal shock to heating system by coordination with the City during planning, construction and operation of temporary heating system.

1.22 Substantial and Total Performance

.1 Prior to requesting an inspection for Substantial Performance, provide a complete list of items which are deficient.

.2 A certificate of Substantial Performance will not be granted unless the following items are completed:

.1 Heating & ventilation systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation. Commissioning checklists must be submitted prior to the request by the Contractor to have a Substantial Completion Inspection.

.2 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.

.3 Air and water systems have been balanced with draft report submitted to the Contract Administrator.

.4 Valve tagging and equipment identification is complete.

.5 Systems have been chemically cleaned. Flush and initiate water treatment. Provide report from Manufacturer's Representative to confirm status of treatment.

.6 Draft Operating/Maintenance Manuals have been submitted.

.7 Operating and Maintenance demonstrations have been provided to the City.

.8 Written inspection report by Manufacturer’s Representative has been submitted for noise and vibration control devices and flexible connections.

.9 Record Drawings have been submitted.

.10 Fan plenums have been cleaned, and temporary filters have been replaced with permanent filters.

.11 All previously identified deficiencies have been corrected.

.3 Prior to Total Performance Inspection provide declaration in writing that deficiencies noted at time of Substantial Performance Inspection have been corrected and the following items completed prior to the Total Performance Inspection:

.1 Submit final air and water balance reports.

.2 Submit final operating and maintenance manuals.

.3 Complete final calibration.

.4 Mail warranty forms to the manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one (1) year.

.4 The Contract Administrator will provide one (1) visitation for the purpose of Total Performance Inspection. Subsequent visitations if required, shall be at the expense of the Contractor.

.5 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until Substantial Performance is declared.

1.23 Scope

.1 Provide rough-in for and make all connections to new and existing equipment.

1.24 Installation

.1 Make all mechanical connections to equipment supplied by others under this Contract. This shall include all water, drain, gas, exhaust, traps, ductwork and similar connections required. Provide isolation valves, unions, flanges and traps as required for a complete installation.

.2 Change to rough-in of services or final equipment connections due to a change in the make of equipment from that specified shall be made at no extra cost to the City, provided that proper Shop Drawings are available for rough-in. Prior to commencing installation of rough-in for the equipment, coordinate with the final reviewed equipment Shop Drawings and with the Manufacturer.

.3 Exposed piping shall be painted as per Contract Administrator's instructions.

.4 Arrange piping connections to allow for equipment removal.

2. PRODUCTS

2.1 Acceptable Manufacturers/Suppliers and Agencies

.1 The following listed manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed Manufacturer’s/Supplier’s.

.2 It remains the responsibility of the Contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.

.3 The Contractor shall be fully responsible for any additional Work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers list.

.4 Submit within fourteen (14) days of Contract award a copy of the list underlining the name of the Manufacturer whose price was carried in the Bid Opportunity. If no Manufacturer's names are submitted, it will be assumed that the price carried in the Bid Opportunity was that of the specified Manufacturer or where the specified product is generic, the first acceptable Manufacturer listed for each item and equipment.

.5 List of Acceptable Manufacturers/Suppliers and Agencies:

.1	Access Doors	Maxam, Acudor, Milcor, Can.Aqua, Mifab, The Williams Brothers Corporation
.2	Air Separators, Relief Valves	Armstrong, Bell & Gossett, Taco, Wheatley, Amtrol
.3	Balancing Agents	AMS, AHS, DFC, Airdronics
.4	Boilers – High Efficiency, Condensing	Camus
.5	Chimney – Polypropylene	Centrotherm
.6	Coils - Heating and Cooling	Trane, Aerofin, Engineered Air, Colmac, McQuay
.7	Controls Contractors and/or Suppliers	Johnson Controls
.8	Expansion Compensators	Flexonics, Tube Turn, Hyspan, Hydroflex, Metraflex, United Flexible, Mason
.9	Expansion Joints	Flexonics, Hyspan, Hydroflex, Metraflex, United Flexible, Mason
.10	Fire Dampers	Controlled Air, Ruskin, Canadian Advanced Air, Maxam, Nailor
.11	Flexible Connectors - Ducting	Thermaflex, G.I. Industries Type IHP
.12	Flexible Connectors - Piping	Flexonics, Tube Turn, Atlantic, Hyspan, Hydroflex, Metraflex, United Flexible, Mason
.13	Gauges - Pressure	Trerice, Marsh, Ashcroft, Weiss
.14	Grooved Mechanical Pipe Joints	Victaulic, Mech Line (only where permitted)
.15	Heat Exchangers - Plate	Bell & Gossett, Alpha Laval, Tranter, Armstrong, APV
.16	Insulation - Piping and Duct	Fibreglass Canada, Manson, Knauf Fibreglass, Plasti-Fab, Manville
.17	Piping Hangers and Saddles	Anvil International, Grinnell, Myatt, Empire Tool & Mfg., Unistrut, Tolco, Erico Canada, Taylor
.18	Pumps - Vertical In-Line	Armstrong, B & G, Taco, Leitch, Grundfos

.19	Strainers	Armstrong, Sarco, Mueller, Toyo, Anderson, Metraflex, Yarway
.20	Tank - Diaphragm Type Expansion	Amtrol, Hamlet and Garneau Inc., Armstrong, B&G, HG Specialties Inc.
.21	Thermometers	Trerice, Marsh, Ashcroft, Winters
.22	Unit Heaters - Electric	Ouellet, Reznor
.23	Valves - Butterfly	Jenkins, Keystone, DeZurik, Centreline, Monotight, Dresser, Lunkenheimer, Crane, Bray, Toyo, Grinnell
.24	Valves - Circuit Balancing	Armstrong, B & G, Wheatley, Tour & Anderson
.25	Valves - Drain, Radiator	Jenkins, Dahl, Crane, Toyo, Kitz
.26	Valves - Gate, Globe, Swing, Check, Ball	Jenkins, Toyo, Crane, Kitz, Milwaukee
.27	Valves - Relief	Armstrong, Bell & Gossett, Taco, Wheatley
.28	Valves - Suction Diffusers, Combination Check and Balance	Armstrong, B&G, Taco
.29	Vibration Isolation	Mason, Vibro Acoustic

2.2 Counter Flashing Materials

.1 Counterflashings: galvanized sheet steel of 0.85 mm (22 ga) minimum thickness.

.2 All joints in counterflashings shall be flattened and soldered double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge.

3. EXECUTION

.1 Not Applicable.

END OF SECTION

METERS AND GAUGES FOR HVAC PIPING

1. GENERAL

1.1 Scope

.1 Provide meters, gauges, and taps where shown on Drawings and/or specified herein.

.2 Submit Shop Drawings of proposed products to the Contract Administrator for review.

.3 Submit data sheets on thermometers and pressure gauges indicating service, and temperature or pressure ranges to the Contract Administrator for review.

2. PRODUCTS

2.1 Thermometers

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

.2 Mercury Thermometer: Red reading mercury filled, 2° graduations, aluminum case, 230 mm (9 inch) scale, straight shank, separable socket, adjustable angle.

2.2 Thermometer Well

.1 Stainless steel suitable for stem type thermometer with gasket and cap except in potable water and open systems, in which case brass type shall be used.

2.3 Pressure Gauges

.1 100 mm diameter, drawn steel case, phosphor bronze bourdon tube, brass movement, extruded brass socket, 1% midscale accuracy, front calibration adjustment, black figures on white background. Provide pulsating damper and pet cock for water service.

2.4 Pressure Gauge Taps

.1 Brass needle valve.

2.5 Static Pressure Gauges

.1 Dial Gauge: 100 mm 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 accuracy.

3. EXECUTION

3.1 Installation

.1 Provide one (1) pressure gauge per pump installing taps before strainers, after balancing valves, and on suction and discharge of pump. Pipe to gauge.

.2 Select gauges so that normal operating point is approximately mid-point of instrument range.

.3 On pipes 65 mm and smaller, place well in tee used in lieu of an elbow to accommodate well.

3.2 Meters and Gauges Installation Schedule

.1 Pressure Gauges:

.1 Pumps

.2 Expansion tanks

.3 and where shown on Drawings

.2 Pressure Gauge Taps:

.1 Both sides of two-way control valves

.2 All lines to three-way control valves

.3 Major coils, inlet and outlet

.4 Heat exchangers, inlet and outlet, source and load side

.5 and where shown on Drawings

.3 Thermometers:

.1 Boiler, inlet and outlet

.2 Heat exchangers, inlet and outlet on load and source side

.3 Heating coils, inlet and outlet

.4 and where shown on Drawings

.4 Thermometer Wells Only:

.1 All lines to three-way control valves

.2 and where shown on Drawings

.5 Static Pressure Gauges:

.1 Across filter banks

.2 and where shown on Drawings

.6 Static Pressure Taps:

.1 Across heating coils

.2 and where shown on Drawings

END OF SECTION

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1. GENERAL

1.1 Scope

.1 Pipe hangers and supports

.2 Duct hangers and supports

.3 Flashing for mechanical equipment

.4 Sleeving for mechanical equipment

1.2 Reference Standards

.1 Pipe supports shall meet the requirements of current edition of ANSI/ASME 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; provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.

.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 the Manufacturer's recommended maximum loading. Hangers shall have a 5.0 safety factor.

.4 Fasten hangers and supports to building steel or inserts in concrete construction.

.5 Provide and set sleeves required for equipment, including openings required for placing equipment. Provide sleeves for all pipe and duct penetrations through walls, ceilings, floors and footings.

.6 Dielectrically isolate dissimilar metals.

.7 Obtain approval from the Contract Administrator prior to drilling for inserts and supports for piping systems.

.8 Obtain approval from the Contract Administrator prior to using percussion type fastenings.

.9 Use of piping or equipment for hanger supports is not permitted.

.10 Use of perforated band iron, wire or chain as hangers is not permitted.

.11 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.

.12 Where deemed necessary by the Contract Administrator the Contractor shall, at his own cost, employ a structural engineer to design equipment supports and/or pipe anchors.

2. PRODUCTS

2.1 Inserts

.1 Inserts shall be malleable iron case or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, 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 to 40 mm: adjustable wrought steel ring.

.2 Hangers, Pipe sizes 50 mm to 100 mm: adjustable wrought steel clevis.

.3 Wall Support, Pipe Sizes to 75 mm: cast iron hook.

.4 Vertical Support: steel riser clamp.

.5 Floor Support, Pipe Sizes to 100 mm: cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.

.6 Install hangers so they cannot become disengaged by movements of supported pipe.

.7 Provide copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping. Provide galvanized hangers and supports for galvanized piping.

2.3 Hanger Rods

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

2.4 Duct Hangers and Supports

.1 Conform to current edition of SMACNA handbooks.

2.5 Flashing

.1 Steel Flashing: 0.55 mm (26 ga) galvanized steel.

.2 Lead Flashing: 25 kg/m² (5 lb/ft²) sheet lead for waterproofing, 5 kg/m² (1 lb/ft²) sheet lead for soundproofing.

.3 Safes: 25 kg/m² (5 lb/ft²) sheet lead or 0.5 mm (0.02 in) neoprene.

.4 Caps: Steel, 0.7 mm (24 ga) thickness minimum, 1.6 mm (16 ga) thickness at fire resistance structures.

2.6 Sleeves

.1 Pipes through Floors: Form with 1.2 mm (18 ga) galvanized steel.

.2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with steel pipe or 1.2 mm (18 ga) thickness galvanized steel.

.3 Ducts: Form sleeves with galvanized steel.

.4 Size large enough to allow for expansion with continuous insulation.

2.7 Pipe Seals

.1 Provide “Link-seal” pipe sealing system where passing through room foundation walls.

2.8 Finishes on Hanger Rods, Hangers and Supports

.1 All steel hanger rods, hangers and supports shall be galvanized or factory primed and painted as per Section 23 05 01 – Common Work Results for Mechanical.

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 piping over 100 mm or ducts over 1500 mm 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 square steel plate and nut above slab.

3.2 Pipe Hangers and Supports

.1 Support horizontal steel and copper piping as follows:

Nominal Pipe Size	Distance Between Supports		Hanger Rod Diameter
	Steel	Copper	
15 mm	1.8 m (6 ft)	1.5 m (5 ft)	10 mm (0.4 in)
20 mm to 40 mm	2.1 m (7 ft)	1.8 m (6 ft)	10 mm (0.4 in)
50 mm & 65 mm	3.0 m (10 ft)	2.4 m (8 ft)	10 mm (0.4 in)
80 mm & 100 mm	3.6 m (12 ft)	3.0 m (10 ft)	16 mm (0.6 in)

Nominal Pipe Size	Distance Between Supports		Hanger Rod Diameter
150 mm to 300 mm	4.2 m (14 ft)	4.0 m (13 ft)	22 mm (3/4 in)
350 mm to 450 mm	6.0 m (20 ft)	--	25 mm (1 in)

.2 Install hangers to provide minimum 12 mm (1/2 inch) clear space between finished covering and adjacent Work.

.3 Place a hanger within 300 mm of each horizontal elbow.

.4 Use hangers which are vertically adjustable 40 mm minimum after piping is erected.

.5 Support horizontal soil pipe near each hub with 1500 mm maximum spacing between hangers.

.6 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.

.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.8 Where practical, support riser piping independently of connected horizontal piping.

.9 Use oversized hangers to accommodate pipe insulation thickness. For pipes up to 50 mm, use high density rigid pipe insulation at hanger location, with an insulation protection shield. For pipes 65 mm and over, use insulation protection saddle.

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 3000 mm spacing.

.2 790 to 1200 mm wide: 40 mm x 1.6 mm (16 ga) at 3000 mm spacing.

.3 Over 1200 mm wide: 40 mm x 1.6 mm (16 ga) at 2400 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 2400 mm spacing.

.2 475 mm to 1000 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 1200 mm wide: 30 mm x 30 mm x 3 mm (11 ga).

.4 Over 1200 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 1500 mm wide: 40 mm x 40 mm x 3 mm (11 ga).

.2 Over 1500 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 minimum above roof membrane with lead worked 25 mm minimum into hub, 200 mm minimum clear on sides with minimum 600 mm x 600 mm sheet size. For pipes through outside walls turn flange back into wall and caulk.

.3 Provide continuous lead or neoprene safes below air supply casings, built-up mop sinks, shower stalls, shower room floors located above finished rooms. Solder at joints, flash into floor drains and turn up 150 mm into walls or to top of curbs and caulk into joints.

.4 Provide lead flashing around ducts and pipes passing from equipment rooms, installed according to Manufacturer's data for sound control.

3.5 Sleeves

.1 Piping and ductwork passing through floor, ceiling or wall, close off space between duct and sleeve and non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

.2 Piping passing through mechanical room floor, roof or wall, close off space between pipe and sleeve with synthetic rubber compound mechanical type seals.

.3 Sleeves provided through walls or floors where liquids could potentially pass from one side to the other, provide sleeves with a 25 mm "flange" welded to the external face of the sleeve at the mid point of the thickness of the structure to provide a water stop.

.4 Install chrome-plated escutcheons where piping passes through finished surfaces.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Pre-construction Test Report: Obtain pre-construction data on existing systems including make-up air unit supply air volume and elevator room exhaust fan flow rate. Submit a report in identical units to those shown on Contract Documents.

.2 Post-construction TAB Report: Balance, adjust, and test air and water systems and equipment and submit reports in identical units to those shown on Contract Documents.

.3 Contractor shall prepare the facility for balancing.

1.2 Quality Assurance

.1 Work specified in this Section shall be performed by an Independent Agency specialising in this type of Work, and paid by the Contractor.

.2 Test equipment and material where required by specification or authority having jurisdiction to demonstrate its proper and safe operation.

.3 Test procedures in accordance with the current applicable portions of ASME, ASHRAE, and other recognised test codes as far as field conditions permit.

.4 Perform tests on-site to the satisfaction of the Contract Administrator.

.5 Piping or equipment shall not be concealed or covered until inspected and approved by the Contract Administrator. Provide ample written notice (two (2) working days) to the Contract Administrator before tests.

.6 Coordinate with Contract Administrator at start of project, those tests that will require witnessing by the Contract Administrator.

.7 Use factory trained representatives and submit Manufacturer's check sheets for starting the following specialty equipment.

.1 Pumps

.2 Boilers

.3 Control components

.4 Chemical cleaning and treatment

.8 Prior to starting, testing, balancing, adjusting and cleaning processes, verify with Contract Administrator any tests required to be witnessed. Provide sufficient notice to Contract Administrator prior to commencement of procedures.

.9 Contract Administrator shall be allowed to witness any testing, adjusting, starting, balancing and cleaning procedures.

.10 Assume all costs associated with starting and testing, including the supply of testing or cleaning medium.

.11 Prior to starting equipment or systems, secure and review Manufacturer's installation, operation and starting instructions. Read in conjunction with procedures defined herein.

.12 Use Manufacturer's or Supplier's starting personnel where required to ensure integrity of Manufacturer's warranty.

.13 Compare installations to published Manufacturer's data and record discrepancies. Items proving detrimental to equipment performance shall be corrected prior to equipment starting.

.14 Some processes involved in starting procedures defined in this Section may be duplications of authorities' verification. To facilitate expedient completion of project, arrange for authorities to assist or witness these procedures. (Gas inspectors, boiler and pressure vessels inspections etc.)

.15 All starting, testing procedures shall be in accordance with applicable portions of the latest, current ASME, ASHRAE, AABC, CSA, NFPA, SMACNA, ASTM and ASPE codes and standards.

.16 Personnel involved in starting, testing, balancing and adjusting procedures shall be experienced in the design and operation of mechanical equipment and systems being checked and shall be able to interpret results of the reading and tests.

.17 Assume all liabilities associated with starting, testing and balancing procedures.

1.3 Submittals

.1 Obtain certificates of approval, acceptance, and comply with current rules and regulations from authorities having jurisdiction and include in Operating and Maintenance Manuals.

.2 Perform tests as specified and upon completion of mechanical installation. Provide certification of tests with detailed data as required. Itemise each test as to time performed and personnel responsible. Include in Operating and Maintenance Manuals.

1.4 Liability

.1 Take charge of work area during tests, assume responsibility for damages in event of injury to personnel, building or equipment and bear costs for liability, repairs, and restoration in this connection.

1.5 Balancing Agenda

.1 General: Submit balancing agenda to the Contract Administrator for review at least seven (7) days prior to the start of balancing Work. Start balancing Work after agenda has been approved. Include descriptive data, procedure data, and sample forms in agenda.

.2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed and selection points for proposed sound measurements.

.3 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.

.4 Sample Forms: Form showing application of procedures to typical systems.

1.6 Pre-construction Test Report

.1 Submit one (1) paper copy of draft balancing reports to Contract Administrator for review. Electronic copies acceptable with Contractor Administrators approval.

.2 Provide paper copies of final reports in Operating and Maintenance Manuals. Provide electronic copies to Contract Administrator.

.3 Include types, serial number and dates of calibration of instruments in the reports.

.4 Test report to include:

.1 Existing make-up air unit

.2 Existing elevator room exhaust fan

1.7 Post-construction TAB Report

.1 Submit one (1) paper copy of draft balancing reports to Contract Administrator for review. Electronic copies acceptable with Contractor Administrators approval.

.2 Provide paper copies of final reports in Operating and Maintenance Manuals. Provide electronic copies to Contract Administrator.

.3 Include types, serial number and dates of calibration of instruments in the reports.

.4 TAB report to include:

.1 Existing make-up air unit

.2 New Boiler

.3 New Pumps

.4 New Heat Exchanger

.5 New heating coil

1.8 System Data

.1 The following information shall be provided:

.1 Air Handling Equipment

Design Data:

- Total air flow rate;

- Fan total static pressure;
- System static pressure;
- Motor kW (hp), r/min, amps, volts, phase;
- Outside air flow rate L/s (cfm);
- Fan r/min;
- Fan kW (hp);
- Inlet and outlet, dry and wet bulb temperatures.
- Manufacturer and model;
- Size;
- Arrangement discharge and class;
- Motor type, kW (hp), r/min, voltage, phase, cycles, and load amperage;
- Location and local identification data.

Recorded Data:

- Air flow rate (S/A, O/A and R/A);
- Fan total static pressure;
- System static pressure;
- Fan r/min;
- Motor operating amperage;
- Inlet and outlet, dry and wet bulb temperatures.

.2 Pumps

Design Data:

- Fluid flow rate;
- Total head;
- kW (hp), r/min, amps, volts, phase.

Installation Data:

- Manufacturer and model;
- Size;
- Type drive;
- Motor type, kW (hp), r/min, voltage, phase, and full load amperage.

Recorded Data:

- Discharge and suction pressures (full flow and no flow);
- Operating head;
- Operating water flow rate (from pump curves if metering not provided);
- Motor operating amps (full flow and no flow);
- r/min.

.3 Expansion Tank

Design Data:

- Size;
- Capacity;

- Pressure rating.
- Installation Data:
- Manufacturer, size, capacity;
- Pressure reducing valve setting;
- Pressure relief valve setting

.4 Heating Equipment (Boilers).

Design Data:

- Heat transfer rate (heating and cooling);
- Fluid flow rate;
- Entering and leaving fluid temperatures;
- Fluid pressure drop.

Installation Data:

- Manufacturer, model, type;
- Entering and leaving fluid temperatures;
- Capacity;
- Pressure drops;
- Flow rates.

Recorded Data:

- Element type and identification (location and designation);
- Entering and leaving fluid temp (for varying outdoor temperatures);
- Fluid pressure drop;
- Fluid flow rate;
- Pressure relief valve setting.

.5 Heat Exchanger (plate and frame):

Design Data:

- Fluid flow rates (heated media, heating media);
- Fluid type;
- Inlet and outlet temperatures (both source and load side).

Installation Data:

- Manufacturer, model, type;
- Fluid flow rates (heated media and heating media);
- Inlet and outlet temperatures (both source and load side);
- Pressure relief valve setting.

Recorded Data:

- Heating media entering flow rate;
- Heated media leaving flow rate;
- Entering and leaving temperatures (for varying outdoor

- temperatures) and pressures;
- Steam pressure and temperature, and condensate temperature.

.6 Air Heating Equipment (coils)

Design Data:

- Heat transfer rate;
- Liquid and air flow rates;
- Liquid pressure drop;
- Air static pressure drop;
- Entering and leaving liquid temperatures;
- Entering and leaving air dry and wet bulb temperatures.

Installation Data:

- Manufacturer, model, type;
- Entering and leaving fluid flow and temperatures;
- Entering and leaving air flow and temperatures;
- Fluid and air side pressure drops.

Recorded Data:

- Element type and identification (location and designation);
- Entering and leaving air dry and wet bulb temperatures;
- Entering and leaving water temperatures;
- Water pressure drop;
- Air static pressure drop;
- Air and water flow rates;
- Adjusted temperature rise or drop.

2. PRODUCTS

2.1 Instruments

.1 Provide calibration histories for each instrument. Recalibration or use of other instruments may be requested when accuracy of readings is questionable.

3. EXECUTION

3.1 General Procedure

.1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required prior to operating tests.

.2 Where required by the authority having jurisdiction, gas fired appliances rated in excess of 117 kW (400 MBH) shall be subjected to an operational test established by the authority and shall pass this test before being approved for operation.

.3 Meet with Division 26 manufacturers, suppliers, and other specialists as required to ensure all phases of Work are properly coordinated prior to the commencement of each particular testing procedure. Establish all necessary manpower requirements.

.4 Operate and test motors and speed switches for correct wiring and sequences and direction of rotation. Check and record overload heaters in motor starters.

.5 Confirm voltages and operating amperages at full load.

.6 Failure to follow instruction pertaining to correct starting procedures may result in re-evaluation of equipment by an Independent Testing Agency selected by the City at Contractor's expense. Should results reveal equipment has not been properly started, equipment may be rejected, removed from Site, and replaced. Replacement equipment shall also be subject to full starting procedures, using same procedures specified on the originally installed equipment.

.7 Permanently mark, by stick-on labels, settings on valves, splitters, dampers, and other adjustment devices.

.8 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.9 Balancing shall be performed to the following accuracies:

.1	Air	central equipment	$\pm$5%
.2	Hydronic	terminal outlets	$\pm$10%
.3	Hydronic	pumps and central	$\pm$5%

3.2 Air System Procedure

.1 Perform balancing, adjusting and testing with building doors and windows in their normal operation position.

.2 The following procedure shall be adopted for central systems:

.1 Recheck central apparatus.

.2 Rebalance central apparatus to ±5%.

.3 Take static pressure readings and air supply temperature readings at ten (10) points on each air system.

.4 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. If readings are inconsistent across duct, relocate to two duct diameters or widths and re-do traverse.

.5 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.

.6 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

.7 Where modulating dampers are provided, take measurements and balance at extreme conditions. (Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating).

.8 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurisation levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. Full multi-storey building test pressure conditions at ground, intermediate and upper levels. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

.9 Complete balancing to achieve positive building pressure unless otherwise instructed. A positive pressure relative to outside of 10 Pa (0.04 in wg) minimum and 20 Pa (0.08 in wg) maximum shall be achieved, measured with negligible outside wind velocity.

3.3 Pressure Tests

.1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.

.2 Carry out tests for eight-hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and re-test and pay necessary costs for re-witnessing.

.3 Drainage Systems: Test by filling with water to produce water pressure to 30 kPa (5 psi) minimum and 62 kPa (10 psi) maximum.

.4 Water Piping: Test to 1-1/2 times maximum working pressure or 1033 kPa (150 psi), whichever is greater, water pressure measured at system low point.

.5 Natural Gas: Test as required by current edition of CAN/CGA 149.1, and authority having jurisdiction.

.6 Condensate Piping: Test to 690 kPa (100 psi) hydrostatic pressure.

.7 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air.

.8 During heating and cooling piping system tests, check linear expansion at elbows, U bends, expansion joints and offsets for proper clearance.

.9 When using water as test medium for system not using water, evacuate and dehydrate the piping and certify the lines are dry. Use agency specialising in this type of Work.

.10 Should tests indicate defective Work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines. Do not caulk.

3.4 Balancing of Hydronic Systems

.1 Open all (except pressure bypass must be closed) valves to fully open position including balancing valves, isolation valves, and control valves.

.2 Execute air balance prior to initiating hydronic balance (if coils are provided).

.3 Adjust flows through each boiler or to ensure equal flow.

.4 Check and adjust flows and temperatures at inlet side of coils.

.5 Position and mark all automatic valves, hand valves and balancing cocks for design flow through all coils, connectors and all items in system requiring circulation of hot water or glycol.

.6 Upon completion of flow readings and coil adjustments, mark setting and record data.

.7 Coordinate shaving of impellor to operating condition on pumps larger than 1.5 kW (2 hp).

.8 Ensure all bypass valves are tightly closed.

.9 After making all terminal unit adjustments, re-check settings at pumps. Re-adjust as required.

.10 Calibrate all pressure and temperature gauges.

.11 Install pressure gauges on each coil then read pressure drop through coil and set flow rate on call for full flow through coil. Set pressure drop across bypass valve to match coil full flow pressure drop.

.12 For each pump, plot maximum and minimum flows on curve.

.13 Verify pressure drops and flows through pressure control bypass valves at full operating range.

3.5 Balancing Report

.1 Submit draft copies of reports prior to final acceptance of project.

.2 Include types, serial number and dates of calibration of instruments.

.3 Record test data on CAD Drawings made from the latest available revised set of mechanical Drawings and submit copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals. CAD drawings available from the Contract Administrator upon request.

.4 Install at each piece of mechanical equipment a "Data Register" showing significant operating temperatures, pressures, amperes, voltage, brake horsepower. "Data Register" to be enclosed in a plastic holder securely attached to the equipment or to a wall in the adjacent area.

.5 Submit with report, fan and pump curves with operating conditions plotted.

.6 Report will be indexed as follows:

Air
Summary
Procedure
Instrumentation
Drawings
Equipment Summary
Fan Sheets
Fan Curves
Fan Profile Data
Static Data
Air Monitoring Station Data
Traverse Data and Schedule
Terminal Unit Summary
Outlet Data Summary and Schematics (per system)
Building Pressurisation Data Diagnostic
Water
Summary
Procedure
Instrumentation
Drawings
Pump Data
Pump Curves
Flow Stations
Coils
Equipment Data
Element Data Summary and Schematics (per system)
Diagnostic

3.6 Bring the work to an operating state and ready for balancing, including:

.1 Clean equipment.

.2 Replace filters with specified filters prior to balancing.

.3 Verify lubrication of equipment.

.4 Install permanent instrumentation.

.5 Clean piping systems and strainers, clean systems, drain and fill with clean heat exchange fluid.

.6 Complete the "start-up" of equipment.

.7 Adjust stuffing boxes and packing glands on pumps and valves.

.8 Check rotation and alignment of rotating equipment and tension of belted drives.

.9 Set control points of automatic apparatus, check-out sequence of operation.

.10 Make available control diagrams and sequence of operation.

.11 Clean Work, remove temporary tags, stickers, and coverings.

.12 Make available one (1) copy of Maintenance Manuals especially for use in balancing.

3.7 Balancing Valves and Dampers

.1 Provide and install balancing valves, dampers, and other materials requested by the Balancing Agency and/or necessary to properly adjust or correct the systems to design flows, without additional cost to the City.

3.8 Pulleys and Sheaves

.1 Provide and install pulleys and sheaves for rotating equipment, as required to properly balance the systems to design flows, without additional cost to the City.

3.9 Shaving of Pump Impellers

.1 Allow in the Contract price shaving of impellers as required to balance the pumps to design flow at operating condition.

END OF SECTION

1. CONDENSING BOILER SCHEDULE

Manufacturer	Camus
Model	DynaMax 801
Heating Input, kW (MBH)	234 (800)
Rated Heating Output, kW (MBH)	227 (776)
Maximum Operating Pressure, kPa (psi)	1100 (160)
EWT, °C (°F)	48.9 (120)
LWT, °C (°F)	65.6 (150)
Flow Rate, L/s (gpm)	3.27 (51.8)
Pressure drop, kPa (Ft Hd)	70.2 (23.5)
Fuel Source	Natural Gas
Turn Down Ratio	5:1
Inlet Gas Pressure (high fire), kPa	1.25
Gas Connections (NPT), mm (in)	25 (1)
Water Connections (NPT), mm (in)	50 (2)
Air Intake Size, mm (in)	125 (5)
Vent Size, mm (in)	150 (6)
Electrical, V/ph/Hz	120/1/60
Electrical Circuit Required	Minimum 15 amp
Gross Weight, kg (lbs)	209 (460)
W x D x H, mm (in)	610 x 1040 x 1190 (24 x 41 x 47)
Remarks	Complete with neutralization kit and internal circulator pump
Related Specifications Section	23 52 16.13

2. HYDRONIC PUMP SCHEDULE

Function	Hot Water Pump	Glycol Pump
Type	Vertical Inline Booster	Vertical Inline Booster
Impeller	Bronze	Brass
Casing	Cast Iron	Cast Iron
Medium Pumped	Water	50% Propylene Glycol
Design Pressure, kPa (psi)	1207 (175)	1207 (175)
Maximum Operating Temp., ºC (ºF)	107 (225)	107 (225)
Pump Speed, RPM	1750	1725
Design Flow Rate, L/s (USgpm)	3.60 (57)	1.36 (21.6)
Discharge Head, kPa (ft. water)	56.5 (18.9)	62.7 (21.0)
Suction/Discharge Sizes, mm (inch)	38/38 (1.5/1.5)	25/25 (1.0/1.0)
Motor Power, kW (hp)	0.56 (0.75)	0.25 (0.33)
Power Supply, V/ph/Hz	208/1/60	208/1/60
Manufacturer	Bell & Gossett	Bell & Gossett
Model	Series 60 1½ x 1½ x 5¼	Series 90 1AA
Weight, Kg (lb)	29 (63)	21 (47)
Remarks	ODP Motor	ODP Motor
Related Specifications Section	23 21 23	23 21 23

3. VALVE SCHEDULE

Type	Circuit Balancing Valve	Circuit Balancing Valve
Service	Glycol Heat Exchanger	Building Heat Pump Loop
Connection Type	NPT	NPT
Maximum Working Pressure, kPa (psi)	2,068 (300)	2,068 (300)
Operating Temperature Range, ºC (ºF)	-20 to 150 (-4 to 300)	-20 to 150 (-4 to 300)
Medium Handled	Water	Water
Flow Rate Setpoint, L/s (USgpm)	0.71 (11.3)	2.56 (40.6)
Pressure Drop, kPa (ft head)	6 (2)	15 (5)
Pipe Connection Size, mm (in)	40 (1.5)	50 (2)
Manufacturer	Armstrong	Armstrong
Model	CBV125VT	CBV200VT
Related Specifications Section	23 21 13.13	23 21 13.13

Type	Triple Duty Valve	Triple Duty Valve
Orientation	Angled	Straight
Service	Hot Water Pump	Glycol Pump
Connection Type	Flanged	Flanged
Maximum Working Pressure, kPa (psi)	1,724 (300)	1,378 (200)
Operating Temperature Range, ºC (ºF)	-20 to 120 (-4 to 250)	-20 to 120 (-4 to 250)
Medium Handled	Water	50% Propylene Glycol
Pressure Drop, kPa (ft head)	3 (1)	6 (2)
Flow Rate Setpoint, L/s (USgpm)	3.27 (51.8)	1.24 (19.6)
Pipe Connection Size, mm (in)	65 (2.5)	40 (1.5)
Manufacturer	Bell & Gossett	Bell & Gossett
Model	3DS-2½S	3DV-1½RFF
Remarks	Associated suction diffuser to be angled	
Related Specifications Section	23 21 13.13	23 21 13.13

SCHEDULES FOR HVAC

Type	3-Way Valve	3-Way Valve
Service	Hot Water System	Glycol System
Connection Type	Female NPT	Female NPT
Maximum Working Pressure, kPa (psi)	1655 (240)	1655 (240)
Operating Temperature Range, ºC (ºF)	2 to 120 (36 to 248)	2 to 120 (36 to 248)
Medium Handled	Water	50% Propylene Glycol
Pipe Connection Size, mm (in)	50 (2)	40 (1.5)
Manufacturer	Honeywell	Honeywell
Model	V5013N1097/U	V5013N1089/U
Remarks	Coordinate valve with electric actuator to ensure compatibility.	Coordinate valve with electric actuator to ensure compatibility.
Related Specifications Section	23 09 00 23 21 13.13	23 09 00 23 21 13.13

4. PLATE AND FRAME HEAT EXCHANGER SCHEDULE

Type	Plate & Frame
Load Side	
Medium	50% Propylene Glycol
Design Flow, l/s (USgpm)	1.24 (19.6)
Entering Water Temp, °C (ºF)	35 (95)
Leaving Water Temp, °C (ºF)	46.1 (115)
Pressure Drop, kPa (psi)	20.1 (2.9)
Connection size, NPT	25 (1) In / 25 (1) Out
Source Side	
Medium	Water
Design Flow, l/s (USgpm)	0.71 (11.2)
Entering Water Temp, °C (ºF)	65.6 (150)
Leaving Water Temp, °C (ºF)	48.9 (120)
Pressure Drop, kPa (psi)	4.1 (0.6)
Connection size, NPT	25 (1) In / 25 (1) Out
Heat Exchanged, kW (MBH)	48.7 (166)
Number of Plates Source/Load	29/40
Effective Heat Transfer Surface m2 (ft2)	1.08 (11.6)
Plate Material / Thickness, mm (in)	AISI 316 / 0.5 (0.02)
Dimensions L x W x H, mm (in) (Length includes carry length)	333 x 216 x 483 (13.1 x 8.5 x 19.0)
Max. Design Pressure., kPa (psi)	1034 (150)
Manufacturer	Bell & Gossett
Related Specifications Section	23 57 19.13

5. EXPANSION TANK SCHEDULE

Service	Glycol System
Type	Expansion
Tank Volume, L (USgal)	30 (8)
Acceptance Volume, L (USgal)	9 (2.4)
Diameter, mm (in)	305 (12)
Height, mm (in)	495 (19.5)
System Connection, mm (in)	15 (0.5)
Manufacturer	Amtrol
Model	AX-15V
Accessories & Remarks	Provide pressure gauge (207 kPa relief)
Related Specifications Section	23 21 14

6. GLYCOL FILL TANK SCHEDULE

Service	Glycol System
Type	Glycol Fill Tank
Tank Volume, L (USgal)	25 (6.6)
Diameter, mm (in)	300 (11.75)
Height/Length, mm (in)	400 (16)
System Connection, mm (in)	15 (0.5)
Manufacturer	Axiom
Model	MF-200
Electrical, V/ph/Hz	115/1/60
Accessories & Remarks	Complete with full tank of pre-mixed 50% PG
Related Specifications Section	23 21 14

7. UNIT HEATER SCHEDULE

Manufacturer	Ouellet
Model	OAS03008
Type	Electric
Heating Capacity, kW (MBH)	3 (10)
Air Flow, L/s (CFM)	241 (510)
Fan Speed, RPM	1550
Motor Power, kW (HP)	0.02 (1/30)
Electrical, V/ph/Hz	208/1/60
Arrangement	Horizontal
Gross Weight, kg (lbs)	20 (45)
W x D x H, mm (in)	419 x 432 x 305 (16.5 x 17 x 12)
Accessories & Remarks	Complete with wall mounted thermostat
Related Specifications Section	23 82 39

8. AIR COIL SCHEDULE

Function	Heating Coil
Location	Makeup Air Unit
Coil Model	McQuay 5WH1304C
Total Capacity, kW (MBH)	51.8 (177)
Air Data	
Airflow, L/s (cfm)	755 (1600)
EAT, °C (°F) db	-34 (-30)
LAT, °C (°F) db	21.8 (71.2)
Total Face Area, m^2 (sq. ft.)	0.28 (3)
Max. Face Velocity, m/s (fpm)	2.71 (533.3)
Rows	4
Fin Spacing, fpi	13
Dimension (H x L), mm (in)	457 x 610 (18 x 24)
Max. Air P.D., Pa (in wg)	207 (0.83)
Fluid Data	
Flow, L/s (gpm)	1.24 (19.6)
EWT, °C (°F)	46.1 (115)
LWT, °C (°F)	34.9 (94.8)
PD, kPa (ft wg)	17.6 (5.9)
Fluid Type	50% Propylene Glycol
Connection Size (Threaded), mm (in)	40 (1.5) In / 40 (1.5) Out
Overall Dimension W x H x T, mm (in)	870 x 533 x 191 (34 x 21 x 7.5)
Operation Weight kg (lb)	45 (99)
Remarks	Galvanized Steel case
Related Specifications Section	23 82 16

9. MAKE-UP AIR UNIT SCHEDULE (FOR INFORMATION ONLY)

The following schedule is for information only and used for testing and air balancing purposes.

Type	Makeup Air Unit
Make	Climatemaster
Airflow, L/s (cfm)	755 (1600)
Motor Power, kW (HP)	0.56 (0.75)

END OF SECTION

HVAC PIPING INSULATION

1. GENERAL

1.1 Scope

.1 Piping insulation

.2 Adhesives, tie wires, tapes

.3 Recovering

1.2 Quality Assurance

.1 Insulation shall be installed by skilled workers 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.

1.3 Submittals

.1 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.

.2 Submit samples of proposed insulating and recovering materials.

1.4 Job Conditions

.1 Deliver material to Site in original non-broken factory packaging, labelled 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.

2. PRODUCTS

2.1 General

.1 Insulation Materials, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives: Composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed.

.2 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

.3 Insulate fittings and valve bodies with preformed removable insulated fittings.

2.2 Materials

.1 Hot Piping: Formed fine fibrous glass or mineral fibre pipe insulation, with factory applied general purpose jacket, factory moulded to conform to piping, "K" value maximum

0.035 W/m°C (0.25 Btu-in/(hr-ft^2-°F)) at 24°C (75°F). Service temperature up to 150°C (300°F).

.2 Recovery Jackets:

.1 ULC labelled thermo-canvas flamespread less than 25 smoke developed less than 50.

.3 Cold and hot water piping up to 116ºC (240ºF): as an alternate to formed fibreglass pipe insulation, rigid phenolic closed cell foam insulation equal to Kingspan Koolphen K CFC-free rigid phenolic insulation may be used. Product shall meet ASTM-E-84 and ASTM-C-585-90 and ULC burn and smoke spread rating for non-combustible installations (ULC-S102, S127).

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 Insulate complete system including fittings, valves, unions, flanges, strainers. Do not insulate flexible connections and expansion joints. Terminate insulation neatly with plastic material travelled on a bevel.

.3 Insulate piping, fittings and valves. Do not insulate unions, flanges (except on flanged valves), "victaulic" couplings, strainers, (except on chilled water lines), flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

.4 Finish insulation neatly on hangers, supports and other protrusions.

.5 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.

.6 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawlspaces, pipe shafts and suspended ceiling spaces is not considered exposed. Make smooth uneven insulated surfaces before recovering.

.7 Flare out staples may be used to secure jacket laps on hot systems. Staples are to be applied on 100 mm centres.

.8 Hot Piping: for fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells.

3.3 Insulation Installation Thickness Schedule

.1 All piping identified in the following table shall be insulated and jacketed except as noted on Drawings.

Piping or Equipment		Pipe Sizes, mm	Insulation Thickness (fibreglass), mm	Insulation Thickness (closed cell phenolic), mm	Recovery Jacket
1.	Glycol Heating Piping	All sizes	40	25	Canvas
2.	Hot Water Heating Piping	All sizes	40	25	Canvas
3.	Boiler intake/exhaust vent Piping	All sizes	40	N/A	Canvas

3.4 Painting and Identification

.1 Paint and identify mechanical equipment, piping and exposed ductwork per Section 23 05 01 - Common Work Results for Mechanical.

END OF SECTION

1. GENERAL

1.1 General

.1 This Section describes the commissioning of the mechanical system.

.2 The commissioning of the mechanical system shall be in accordance with the Code of Practice for Commissioning Mechanical Systems in Buildings and as described in this Section.

.3 The commissioning process shall be applied to all products, equipment and systems provided under this Division.

.4 Work specified in this Section shall be performed by a Commissioning Agent who can be the Contractor and/or qualified factory representatives of their respective equipment or systems.

1.2 Scope

.1 Demonstration of equipment and systems operations.

.2 Document all commissioning on commissioning sheets.

.3 Instruction seminars for the City's personnel.

1.3 Quality Assurance

.1 Work specified shall be performed by a qualified individual(s).

.2 Boilers shall be commissioned by factory representatives.

.3 Control systems shall be commissioned by a Controls Contractor specializing in controls work.

2. COMMISSIONING PROCESS

2.1 Duties of the Commissioning Agent

.1 The Commissioning Agent shall plan, organize and implement the commissioning process.

.2 The Commissioning Agent shall prepare the commissioning plan and provide demonstration and instructions to the City’s staff over a period of time to enable the staff to become familiar with the systems.

2.2 Commissioning Schedule

.1 Incorporate commissioning activities into construction schedule. The scheduled activities shall show:

.1 Completion dates for each trade in each major section of the building.

.2 Timing of the various phases of the commissioning, testing, balancing and demonstration process.

.3 Submission dates for the various documents required prior to verification of commissioning by the Contract Administrator.

.4 Prepare a commissioning statement in which each of the four (4) phases that the process is perceived to be worked through. In sequence, the phases are expected to be:

Phase 1 - System Readiness.

Phase 2 - System Start-up, Testing, Balancing, Etc.

Phase 3 - Verification of System Commissioning.

Phase 4 - Demonstration and Instruction.

.2 Each phase is applicable to each major and separate system making up the work in Division 23 including controls and Division 26 interface as applicable.

2.3 Commissioning Phases

.1 **Phase 1** - Before starting any of the separate systems, provide written verification stating that the specific system is ready for start-up and the following conditions have been met:

.1 Copies of all test and certificates have been submitted to the Contract Administrator.

.2 Pre-construction test reports have been submitted to the Contract Administrator.

.3 All safety controls installed and fully operational (dry run test).

.4 Flushing, chemical cleaning (as required), charging, fluid operating (as required), are complete.

.5 Equipment lubrication and pre-start checks are complete.

.6 Air system cleaning complete.

.7 Filter systems installed and sealed in place (except for air system charcoal filters).

.8 Adjusting vibration isolation completed.

.9 Alignment of drives (direct and belt) completed.

.10 Control functional checks, including all alarms performed.

.11 Start-up verification checks by manufacturers representatives completed.

.12 All deficiencies to be recorded, reviewed by the commissioning team and, subsequently corrected before proceeding to the next phase, Phase 2.

.2 **Phase 2** - System Commissioning shall include but not necessarily be limited to:

.1 Activation of all systems.

.2 Testing and adjustment of all systems.

.3 As in the case of the System Readiness Phase, all deficiencies are to be recorded, reviewed by the Commissioning team and, subsequently, corrected. The process at the point of the deficiency shall be repeated before proceeding forward.

.4 Phase 2 is concluded when the installation is in full working order and acceptable for use. The work will include the following:

.1 Position all balance valves in piping systems (where appropriate).

.2 Make provisions for testing air pressures and flow rates.

.3 Set up all automatic temperature control devices.

.4 Plug all air pressure and flow measuring holes.

.5 Adjust vibration isolators as necessary.

.6 Verification by the air balance contractor that all fire dampers have been checked.

.7 Air and water balance complete.

.5 Fine Tuning:

.1 Setting up automatic controls for accurate response and precise sequencing.

.2 Correction of problems revealed by Balancing Agency and change of fan speed and pitch as necessary.

.6 Testing:

.1 The Contract Administrator shall perform a detailed check of the following:

.1 All items and functions to be later demonstrated to the City's Representatives.

.3 **Phase 3** - Verification of Commissioning.

.1 Verification of commissioning by the Contract Administrator shall not commence until the commissioning process, Phase 2, has been totally completed. Submit test procedure completion test certificates at the time of requesting the commencement of the verification procedure. The verification process will include the demonstration of the following:

.1 Location of and opening and closing of all access panels.

.2 Operation of all automatic control dampers and automatic temperature/volume adjustment controls.

.3 Proper response of all modulating valves to thermostats and sensors.

.4 Operability of randomly selected fire dampers.

.5 Operation of all equipment and systems, under each mode of operation, including:

.1 BMS control features;

.2 Automatic controls;

.3 Boilers;

.4 Make-up air systems;

.5 Pumps;

.6 Coils;

.7 Heat exchangers;

.8 Tanks-expansion & glycol fill.

.2 At the completion of Phase 3, the Contractor shall submit the following to the Contract Administrator:

.1 A letter certifying that all Work specified under this Contract is complete, clean and operational in accordance with the Specification and Drawings.

.2 A copy of Phase 2 Verification Certificates provided by the specialist trades for submission to the Contract Administrator.

.3 Record Drawings as specified.

.4 A letter from the testing and balancing agency certifying that all necessary data for inclusion in operating and maintenance manuals has been received.

.5 A statement confirming completion of Controls acceptance test, Section 23 09 00.

.3 Upon receipt of all documents and a satisfactory outcome of the verification procedure, the Contract Administrator will provide a Certificate of Verification for Phase 3.

.4 Substantial Performance may, thereupon, be declared.

.4 **Phase 4** - Demonstration and Acceptance shall not commence until the commissioning process Phase 3 has been successfully completed - verification certificate issued and Substantial Performance declared. The demonstration process is a statement of satisfaction from the Contract Administrator and City upon completion. Total Performance will not be accomplished without this achievement.

3. EXECUTION

The following systems are to be commissioned:

3.1 HVAC Systems

.1 Boilers - check out by Manufacturer's Representative, gas and water piping connections, burner and controls, flue connections, boil out, chemical treatment, capacity tests, expansion tank pressures and capacity.

.2 Pumps - alignment, rotation, motor current draw, piping connections, flow and pressure test.

.3 Piping System - pressure tests, insulation, identification, water balance, hangers, expansion.

.4 Duct System - pressure tests, insulation, identification, air balance identification.

.5 Control Valves - installation, controls, capacity modulation, connection to controls system, identification.

.6 Control Dampers - installation, operation, identification, capacity modulation, connection to controls system.

.7 Controls - See Section 23 09 00 - commissioning of controls by Controls Contractor under the supervision of the Contract Administrator.

3.2 General

.1 Contractor shall arrange for presentation and demonstration of mechanical equipment and systems by appropriate specialists and shall ensure that required Manufacturer's Representatives are in attendance.

3.3 Demonstrations

.1 Provide two (2) working days for demonstration of equipment to the City.

.2 Demonstrate specific starting and general maintenance requirements for each major piece of equipment. Ensure all labelling and identification is completed.

.3 Demonstrate the following systems, in the form of instruction seminars and Contractor guided tour of the facility.

.1 Hydronic Heating Systems;

.2 Air Systems;

.3 Control Systems;

.4 Chemical Treatment Systems;

.4 Demonstrate the following pieces of equipment:

.1 Boilers;

.2 Make-up Air Unit;

.3 Pumps;

.4 Heat Exchangers.

.5 Prepare a schedule identifying the proposed sequence of demonstration. Sequence of demonstration shall correspond to full system starting. Submit for review by Contract Administrator one (1) month prior to demonstration.

.6 Answer all questions raised by the City at demonstrations; if unable to satisfactorily answer questions immediately, provide written response within three (3) days.

END OF SECTION

CLEANING OF HVAC PIPING

1. GENERAL

1.1 Scope

.1 Provide for cleaning and degreasing of new hot water heating and glycol systems.

.2 Provide all necessary equipment and chemicals to treat hot water heating, glycol and condensate, system.

1.2 References

.1 American Society for Testing and Materials

.1 ASTM E 202, Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 Waste Management and Disposal

.1 Dispose of unused cleaning solutions at official hazardous material collections site approved by the Contract Administrator.

.2 Do not dispose of unused cleaning solutions into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

.3 Remove from Site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of corrugated cardboard, polystyrene and plastic packaging material in appropriate on-site bin for recycling in accordance with Site waste management program.

1.4 Quality Assurance

.1 Provide services of a chemical treatment agency to perform the cleaning and degreasing operation on-site and submit written reports on all situations found, actions taken and final results.

.1 Acceptable Agency: Betz Dearborn, Pace Chemicals Ltd., IPAC Chemicals Ltd.

.2 Inform the Contract Administrator and Commissioning Agent seven (7) working days prior to commencing of Work.

.3 Provide chemical treatment as specified herein and provide written reports. Reports shall be signed by the chemical treatment agency, Contractor and Commissioning Agent.

.4 Chemical treatment agency shall provide direction and assistance in the degreasing, cleaning and chemical treatment of all piping systems.

.5 Use of the permanent mechanical systems for pumping or heating of cleaning and dilution solutions is not permitted. Permanent systems shall be isolated and portable pumps and boilers utilized for the duration of the cleaning process. Permanent equipment shall be flushed, degreased and chemically treated independent of the piping systems.

1.5 Submittals

.1 Submit Shop Drawings with complete description of proposed chemicals, quantities, calculations, procedures, test kits and equipment to be supplied. Along with product Shop Drawings, provide copies of data sheets, procedure instructions and analysis reports to be used on this Project.

.2 Include with the Shop Drawings Material Safety Data Sheets (MSDS) for all chemicals to be used.

.3 Provide written reports to the mechanical contractor and Contract Administrator containing procedure of system cleaning and degreasing, giving times, dates, conditions of water and problems and actions encountered.

.4 Submit final written reports to the mechanical contractor and Contract Administrator.

2. PRODUCTS

2.1 Materials

.1 Provide sufficient chemicals to treat and test the systems from the time of activation and acceptance of the building for the first year of operation by the City.

.2 Materials which may contact finished areas shall be colourless and non-staining. Chemicals used must comply with environmental and health standards applicable to the usage on this project.

.3 System Cleaner: Alkaline compound which in solution removes grease and petroleum products.

.4 Close System Treatment: Sequestering agent to reduce deposits and adjust pH, and a corrosion inhibitor.

2.2 Equipment

.1 Solution Pumps: Provide positive displacement diaphragm type metering pumps for adding chemicals. Pumps shall have an adjustable flow rate and be suitable for chemicals to be pumped. Pumps shall be self flushing. Provide pumps with plastic solution tanks complete with agitator, pump mounting, cover, provision for fill line and pump strainer. Size the pumps and tanks to permit operation for three (3) days at 50% pump capacity without refill of tanks. Provide agitator motor with terminals and junction box for electric wiring.

3. EXECUTION

3.1 Cleaning Hydronic Systems

.1 Timing

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

.2 Do not introduce existing building loop heating water to new piping until new piping system has been cleaned and tested.

3.2 System Cleaning

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

.2 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least one (1) week prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations to be used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of Work.

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

.6 Complete analysis of water to be used to ensure water will not damage systems or equipment.

.3 Conditions at time of cleaning of systems

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers to be clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.4 Report on Completion of Cleaning

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.5 Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

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

.3 Closed loop systems: circulate system cleaner at 60°C for at least thirty-six (36) hours. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.4 Flush velocity in system mains and branches so as to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.5 Add chemical solution to system.

.6 Establish circulation, raise temperature slowly to 82°C minimum. Circulate for twelve (12) hours, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for six (6) hours at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

.7 Exact procedure may vary upon recommendation of chemical treatment agency.

.6 Glycol Systems:

.1 In addition to procedures specified above perform procedures specified herein.

.2 Test to prove concentration will prevent freezing to minus 40°C Test inhibitor strength and include in procedural report. Refer to ASTM E 202.

3.3 Start-up of Hydronic Systems

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Commission water treatment systems as specified in Section 23 08 00 - Commissioning of Mechanical.

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.10 Bring system up to design temperature and pressure over a 48 hour period.

.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.12 Adjust pipe supports, hangers, and springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, and repeat start-up procedures.

.15 Re-tighten bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.16 Check operation of drain valves.

.17 Adjust valve stem packings as systems settle down.

.18 Fully open all balancing valves (except those that are factory-set).

.19 Check operation of over-temperature protection devices on circulating pumps.

.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

1. GENERAL

1.1 General Intent and related information

.1 All Work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.

.2 The Work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Mechanical Division Sections for details.

.3 The Work of this Division shall be as required by the Specifications, Point Schedules and Drawings. This Work includes but is not limited to:

.1 Integration of the new boiler system controls and associated components with existing infrastructure (i.e. Johnson Controls Metasys).

.2 Demonstration of installed controls system.

.4 If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

.5 The City has a central monitoring system in place, and is currently monitoring building points at 219 Provencher Blvd., Winnipeg, Manitoba. These existing points are being monitored using the Johnson Controls N2 communications protocol DDC controllers. Unless otherwise stated, these points shall remain as-is.

.6 Where new DDC points are identified in this specification to be centrally monitored points, the Controls Contractor shall provide and install the required N2 protocol capable hardware and software to interface these points, and where required, extended the existing N2 trunk to any new DDC controllers. It is the Controls Contractors' responsibility to integrate any new DDC points into the City's existing Johnson Controls Metasys EA servers and workstations. These servers and workstations are located at 510 Main St. Winnipeg, MB. No new operator work stations are required under this Contract.

.7 Control Sequences

.1 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.

.2 The relationships between the points, systems and building are described in the control sequences.

.3 Review with the Contract Administrator during the Shop Drawing stage to finalize the control sequences for each system.

.4 All temperature setpoints mentioned below are initial setup values and shall be adjustable for future requirements.

.8 Control Points List

.1 A point is a specific software address which is resident in the standalone control unit (SCU) and which is identified with a particular field sensor, instrument or sensor.

.2 The point schedule contains a general list and description of the points to be connected. The Contractor shall examine the point schedule and ensure that all points required to make the described control sequences work are provided, whether included in the point schedule or not.

.3 Consult with the Contract Administrator during the Shop Drawing stage to finalize the physical terminal address of each point within the SCU.

1.2 Work by Other Trades

.1 Division 26 shall provide 120V power where required.

.2 Division 23 shall install thermal wells, control valves, dampers and devices on piping and ductwork.

1.3 Renovation or Addition Projects

.1 Control Work involves renovations to an existing control system. The Contractor shall inspect the systems prior to Bid Opportunity close and include in the submission all interlocks and relays required to provide a fully operational controls system.

.2 The Contractor shall ensure that the installation and commissioning of the automation system shall not disrupt the use of the facilities.

1.4 Quality Assurance

.1 The following companies are approved Controls Contractors:

.1 Johnson Controls Branch Office

.2 Install all components in accordance with the latest regulations of the Canadian Electrical Code, applicable Municipal and Provincial Codes and Regulations, and latest CSA Electrical Bulletins.

1.5 Submittals

.1 Provide Shop Drawings including:

.1 Complete operating data, system drawings, wiring diagrams and written detailed operational description of sequences and engineering data on each control system component. Include sizing and arrangements as requested.

.2 Samples of Graphic Display screen types and associated menus.

.3 Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.

.2 Submit approved Shop Drawings for inclusion in Operation and Maintenance Manuals per Section 01 33 00 - Submittal Procedures.

1.6 City Orientation

.1 Contractor to provide two (2) weeks written notice to the Contract Administrator and the City prior to commencing formal training sessions.

.2 Formal training sessions shall commence only after "As-Built" Drawings have been completed, reviewed and approved by the Contract Administrator.

.3 Provide seminar/workshop for operator training to cover the following:

.1 New hardware and software components.

.2 Graphics interface at 510 Main Street.

.3 Changes to existing controls.

1.7 Warranty

.1 The Contractor shall supply and install at no cost all system software and hardware updates and upgrades occurring prior to the expiration of the warranty period.

1.8 Acceptance Testing

.1 A final operational acceptance test of seven (7) consecutive days shall be conducted on the complete and total installed and operational control system to demonstrate that it is functioning properly in accordance with the specifications.

.2 The correct operation of all monitored and controlled points shall be demonstrated as well as the operation and capabilities of all sequences, reports, specialised control programs and algorithms, diagnostics and all other software.

.3 In the event of the failure of function, during the test, of any of the hardware components or software application or routines, the test will recommence and run until seven (7) failure-free test days have occurred.

.4 After successful completion of the acceptance test, the Contract Administrator will issue written acceptance of the control system.

1.9 Costs

.1 All costs incurred in testing the controls system, including City and Contract Administrator demonstration cost shall be included for under this Contract. No additional charges will be entertained by the City.

.2 All equipment, software, consumable items, personnel and facilities as required to reasonably execute the factory or Site acceptance tests, including any signal simulation equipment shall be made available under the terms of this Contract at no further cost to the City.

2. PRODUCTS

2.1 Existing Equipment

.1 The following existing control components are to be removed and turned over to the City at when the new control systems are operational:

.1 Honeywell ML7425A3013 direct-mount electronic actuator serving steam injection to building shell and tube heat exchanger.

.2 Honeywell ML7425A3013 direct-mount electronic actuator serving steam injection to make-up air unit heating coil.

.3 Honeywell T775M2006 electronic stand-alone controller.

.2 The following existing control components are to be removed and relocated as per the drawings:

.1 Return air electronic actuator and damper on existing make-up air unit.

2.2 Control Components and Accessories

.1 Control Panels

.1 Provide control panel of unitized cabinet type construction. Mount relays, switches and control point adjustment in cabinet and pilot lights, push buttons and switches flush on cabinet panel face

.2 Fabricate panels from 2.5 mm (12 ga) rolled sheet metal sheet with baked enamel finish, flush fitting, gasketted doors hung on piano type hinges and three point latches and locking handles. CSA approved for line voltage applications.

.3 Mount panels on vibration free wall or free standing angle iron supports. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.4 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.5 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 VAC supply.

.6 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.7 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum twenty five (25) conductors to each wire bundle.

.8 Provide terminal blocks, tabular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting

conductor shall be served by one terminal. Provide 20% spare unit terminals, with a minimum of two (2) spare terminals. Provide all necessary terminal block accessories such as manufacturer jumpers and marking tape.

.9 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position.

.2 Wire

.1 Control wiring for digital functions shall be 18 AWG minimum with 300V insulation.

.2 Control wiring for analog functions shall be 18 AWG minimum with 300V insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.3 Sensor wiring shall be 18 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.4 Transformer current wiring shall be 16 AWG minimum.

.3 Conduits and Cables

.1 All wiring shall be in conduit or trays. Conform to Division 26 requirements for conduit and tray specifications.

.2 Seal conduit where such conduit leaves heated areas and enters unheated area.

.3 Run low level signal lines in separate conduit from high level signal and power transmission lines.

.4 Identify each cable and wire at every termination point.

.5 Where applicable, mount field interface equipment (i.e. relays, transducers, etc.) in local device cabinets adjacent to field interface panels.

.6 Separate conduits shall be provided for pneumatic tubing and electrical wiring runs.

.7 Colour code all conductors and conduits by permanently applied colour bands on maximum 10 m intervals. Colour code shall follow base building schedule.

.4 Control Valves

.1 Valves shall be supplied by this section and installed by Section 23 21 13.13 - Hydronic Valves and Strainers.

.2 This section shall provide power and control wiring from valve operator to the building management system.

.3 Provide control valves that are properly sized and selected in accordance with load requirements and characteristics of the systems to which they are applied.

.4 Valves shall be plug, ball, and/or butterfly, as required by the specific application.

.5 Acceptable Manufacturers: Johnson Controls, Honeywell, Invensys, Belimo.

.6 Performance: 23 06 00 - Schedules for HVAC.

.5 Valve Control Operators

.1 Valve operators shall be selected to provide close off against system pressure.

.2 Unless otherwise shown on the drawings, operators to be provided and set up such that all heating valves and return air dampers are normally open (fail open) and cooling valves, exhaust and outdoor air dampers are normally closed (fail closed).

.3 Electric Operators: as manufactured by Johnson Controls, Honeywell, Belimo or Invensys. Provide "fail safe", spring return, direct coupled type, 24 VAC operators with accessories as required, each suitable in all respects for the application. Electric operators shall have 2-10V or 4-20mA control signal.

.4 Coordinate operator selection with valve selection to ensure compatibility.

.6 Pipe and Duct Mounted Temperature Sensor

.1 The sensor shall be thermistor type providing the following minimum performance requirements are met:

.1 Accuracy: ±0.5ºC or better

.2 Operating Range: -46ºC to 104ºC

.2 Diameter and length shall be as required for the application

.7 Outside Air Sensors

.1 Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.

.2 Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.

.3 Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

.8 Current Switches

.1 Current switch with field-adjustable sensitivity, field-adjustable time delay (0-15 seconds) feature to minimizes nuisance trips, linear setpoint characteristic and constant hysteresis, Self-powered, split-core, status LED provides visual indication of setpoint trip and contact action.

.2 Current sensing relays shall be used for measuring current of fans, pumps and other miscellaneous motor loads. Alarming function performed in Metasys by comparing start/stop command and the current relay status.

.9 Electrical Relays

.1 Provide relays with coil and contact ratings suitable to the application.

.2 For single switching applications, mount relay in a protective enclosure with a removable cover.

.10 Carbon Monoxide Detectors

.1 Scope of Work: Provide all labour, materials, products, equipment and service to supply and install a CO detection and control system as indicated on the drawings and specified in this section.

.2 Reference Standards: Units shall be certified to ANSI/UL 61010-1and CSA -C22.2 No. 61010-1 standards. Manufacturer shall be certified ISO-9001-2000.

.3 The monitor will be powered by 120 VAC. The Monitor will incorporate an Electrochemical cell for toxic gas monitoring.

.4 The monitor will be capable of transmitting gas concentrations to a DDC system through its 4-20 mA output. For local activation of fans or louvers (or other equipment), two on-board DPDT relays 5 A, 30 VDC or 250 VAC (resistive load) will be activated at programmable set points (and programmable before and after time delays). An 8 character, 2 line backlit LCD display will provide local gas concentration readings.

.5 Transmitter will be capable of operating within relative humidity ranges of 5-95% non-condensing and temperature ranges of -20° C to 40° C (-4° F to 104° F).

.6 The transmitter will have a plug-in capability for a gas cartridge with a smart sensor technology with self-testing capabilities accuracy of +/- 3% of full scale @ 25°C.

.7 Enclosure will be Polycarbonate with rubberized sealed cover and LED visual indications for power, alarm & fault conditions.

.8 For local activation of audible alarms, the monitor shall have an on-board device able to generate an audible output of 85 dBA @ 3 m (10 ft).

.9 Monitor alarm levels are to activate and the unit is to be installed in accordance with the following parameters:

TOXIC GASES	FIRST ALARM SET POINT (TLV-TWA)	SECOND ALARM SET POINT (TLV-STEL)	SENSOR LOCATION	RADIUS OF COVERAGE
Carbon Monoxide (CO)	12 PPM	25 PPM	3-5 ft above the floor	50 feet

.10 Standard of Acceptance: Honeywell Analytics Model E3SASCO, Stand-Alone Monitor.

.11 Thermowells

.1 Provide brass wells for water and glycol applications.

.12 Related Accessories

.1 Provide and install all necessary transformers, switches, transducers, interposing relays, interface devices, contactors, starters and EP's to perform control functions required.

3. CONTROL SEQUENCES

3.1 Boiler Heating System

.1 The boiler system replaces the existing steam system and supplies hot water to the building heat pumps and make-up air unit heating coil (via heat exchanger).

.2 Major system components include:

.1 Hot water boiler (complete with burner and internal pump)

.2 Hot water pump (external to boiler)

.3 Outdoor air temperature sensor

.4 3-way control valve

.3 When the heating system is enabled by Metasys the following shall occur:

.1 Boiler: The boiler shall be enabled and boiler onboard controls shall fully operate the boiler including but not limited to the burner and internal pump.

.2 Hot water pump: Metasys shall start the hot water pump.

.3 3-way control valve: Metasys shall monitor the building supply water temperature and modulate the 3-way control valve to maintain a temperature of 26.7°C (field adjustable).

.4 The heating system shall be enabled automatically when the heating season schedule dates and/or outside air temperature are met.

.1 Heating Season Schedule: The programming shall have the option to incorporate START and END dates to schedule and define the heating season.

.2 Outside Air Temperature Setpoint: There shall be a user definable outdoor air heating system start setpoint; any temperature below this setpoint will automatically enable the heating system. This setpoint shall initially be set to 18°C. The boiler shall be enabled for a minimum duration of one hour (user definable) to prevent over-cycling.

.5 An outside air temperature (OAT) sensor shall be connected to Metasys which will in turn provide the boiler with resetting of hot water supply (HWS) temperatures. The reset schedule will be as follows:

OAT	HWS
10°C (50°F) and higher	37.8°C (100°F)
-20°C (-4°F) and colder	65.6°C (150°F)

.6 The following alarms shall be sent to the operators via Metasys:

.1 General alarm by the boiler.

.2 If the Hot Water Pump fails to operate when enabled via current switch.

.3 If the building hot water temperature falls or rises below the setpoint by more than 10°C.

3.2 Glycol System

.1 The glycol system provides hot glycol to the make-up air unit heating coil.

.2 Major system components include:

.1 Plate-and-frame heat exchanger

.2 3-way control valve (using re-used actuator)

.3 Glycol Pump

.4 Supply air temperature sensor on discharge duct of make-up air unit (existing)

.3 When the glycol system is enabled by Metasys the following shall occur:

.1 Glycol Pump: Metasys shall start the Glycol Pump.

.2 3-way control valve: Metasys shall monitor the make-up air discharge air temperature and modulate the 3-way control valve to maintain a temperature of 20°C (field adjustable).

.4 The glycol system will be enabled via Metasys when the boiler heating system is activated.

.5 The following alarms shall be sent to the operators via Metasys:

.1 If the Glycol Pump fails to operate when enabled.

.2 If the make-up air discharge air temperature falls or rises below the setpoint by more than 5°C.

.6 The existing outside air and return air dampers are controlled by the make-up air unit controller. The existing return air damper and actuator will be relocated but damper controls will remain the same.

4. CONTROLS POINTS LIST

.1 The following is the minimum required points list for the new equipment/systems. Provide a minimum of twenty-four (24) hours trend for all points.

No.	Description	Type	Remarks
1	Boiler Enable/disable	DO	
2	Boiler status	DI	
3	Boiler OA-T Reset	AO	

No.	Description	Type	Remarks
4	Boiler HWS Temperature	AI	
5	Boiler HWR Temperature	AI	
6	Boiler general alarm	DI	
7	Building hot water supply temperature	AI	
8	Outdoor Air Temperature	AI	
9	Hot Water Pump Enable/Disable	DO	
10	Hot Water Pump Fault	DI	
11	Hot Water 3-way Valve Control	AO	
12	Glycol Pump Enable/Disable	DO	
13	Glycol Pump Fault	DI	
14	Glycol Water 3-way Valve Control	AO	
15	Make-up Air Unit SA-T	AI	

5. EXECUTION

5.1 Installation

.1 Provide all required control components to a fully functioning system as described in the control sequences, points list and drawings.

.2 Re-install damper motors on outside of ducts.

.3 Wire "hand/off/auto" selector switches such that automatic operating controls and not safety controls and electrical over current protection shall be overridden when switch is in the "hand" position.

.4 Unless specified otherwise, install all outdoor air sensors on the north exposure of the building.

.5 Install all safety limits at the operator’s level.

.6 Tag each wire at both ends with machine printed heat shrink sleeves.

5.2 Carbon Monoxide Detectors

.1 Provide complete commissioning service with written reports by the Manufacturer’s authorized representative.

END OF SECTION

NATURAL GAS PIPING

1. GENERAL

1.1 Scope

.1 Provide new gas service complete:

.1 Gas Piping

.2 Fittings and Valves

.3 Testing

.4 Service Connections

1.2 References

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.5, Pipe Flanges and Flanged Fittings.

.2 ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.4 ASME B18.2.1, Square and Hex Bolts and Screws.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A 47/A47M, Specification for Ferritic Malleable Iron Castings.

.2 ASTM A 53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM B 32, Specification for Solder Metal.

.4 ASTM B 75M, Specification for Seamless Copper Tube Metric.

.3 Canadian Standards Association (CSA)

.1 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

.2 CAN/CSA B149.1, Natural Gas and Propane Installation Code.

1.3 Product Data

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

1.4 Closeout Submittals

.1 Provide maintenance data for incorporation into manual.

2. PRODUCTS

2.1 Pipe

.1 Steel pipe: to ASTM A 53/A53M, Schedule 40, seamless as follows:

.1 NPS 1/2 to 2, screwed.

.2 NPS 2 1/2 and over, plain end.

2.2 Jointing Material

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: non-metallic flat.

.4 Soldered: to ASTM B 32, 50/50.

2.3 Fittings

.1 Steel pipe fittings, screwed, flanged or welded:

.2 Malleable iron: screwed, banded, Class 150.

.3 Steel pipe flanges and flanged fittings: to ASME B16.5.

.4 Welding: butt-welding fittings.

.5 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A47M.

.6 Bolts and nuts: to ASME B18.2.1.

.7 Nipples: Schedule 40, to ASTM A 53/A53M.

2.4 Valves

.1 Conform to CGA Standard 3.16.

.2 Provincial Code approved, lubricated plug type.

3. EXECUTION

3.1 Piping

.1 Install in accordance with Section 23 05 01 - Common Work Results for Mechanical, supplemented as specified herein.

.2 Install in accordance with applicable Provincial/Territorial Codes.

.3 Install in accordance with CAN/CSA B149.1.

.4 Install vent piping for all pressure regulators.

.5 Install drip points:

.1 At low points in piping system

.2 At connections to equipment

3.2 Valves

.1 Install valves with stems upright or horizontal unless otherwise approved by Contract Administrator.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.3 Field Quality Control

.1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.

3.4 Purging

.1 Purge after pressure test in accordance with CAN/CSA B149.1.

3.5 Pre-Start-Up Inspections

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 Cleaning and Start-Up

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems, supplemented as specified herein.

.2 In accordance with requirements of CAN/CSA B149.1, supplemented as specified herein.

3.7 Performance Verification (P.V.)

.1 Test as required by current edition of CAN/CGA 149.1, and authority having jurisdiction.

END OF SECTION

1. GENERAL

1.1 Quality Assurance

.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 latest current editions.

.2 Use welders fully qualified and licensed by Provincial Authorities.

.3 Non-specified pipe joining and pipe fitting methods such as T-drill and press fit are not permitted in any piping system covered under Division 23.

2. PRODUCTS

2.1 Pipe

	Service	Material
.1	Hot water and glycol heating to 120°C (250°F)	Steel, Sch.40, ASTM A53, Grade B heating to 120°C (250°F)
.2	Hot water and glycol heating to 120°C (250°F) For extending existing copper pipe or for short branch connections to heating equipment where obstructions occur and site bending of pipe is advantageous	Soft Copper Pipe: Type "L" seamless soft copper to ASTM B77.
.3	Equipment drains and overflows	Sch.40, galvanized steel, ASTM A120 Type L hard copper ASTM B88M

2.2 Fittings and Joints

	Service	Material	Joint
.1	Hot water and glycol heating 120ºC (250°F)	Banded malleable iron, 1033 kPa (150 psi), up to 50 mm	Screwed
		Steel, same schedule as pipe, for sizes 50 mm and larger	Welded
		Cast steel mechanical	Grooved, Victaulic Brand or Grinnel Gruv-Lok only

	Service	Material	Joint
.2	Equipment drains and overflows	Galvanized banded malleable iron	Screwed
		Wrought copper, bronze	50-50 solder
		Cast brass	Screwed

.3 Use factory fabricated butt welded fittings for welded steel pipes.

.4 Use long radius elbows for steel and cast iron water piping, including grooved mechanical fittings.

2.3 Unions, Flanges and Couplings

.1 Size 50 mm and under: 1033 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 Sizes 65 mm and over: 1033 kPa (150 psi) forged steel welding neck flanges for ferrous piping, 1033 kPa (150 psi) bronze slip-on flanges for copper piping. Gaskets shall be 1.5 mm (1/16 in) thick performed synthetic rubber bonded asbestos.

.3 Flange bolting: For systems up to 120°C (250°F), use carbon steel stud bolts, semi-flushed 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.

.4 Where permitted by the Contract Administrator, use grooved mechanical couplings to engage and lock grooved or shouldered pipe ends and to allow for some angular deflection, contraction and expansion. Couplings consist of malleable iron housing-clamps, C-shaped composition sealing gasket EPDM Grade E and steel bolts. Use galvanized couplings for galvanized pipe. All grooved mechanical couplings and fittings shall have a minimum working pressure of 1033 kPa (150 psi). Victaulic brand or Grinnel Gruv-Lok only.

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. Weld piping 65 mm and larger, including branch connections. Screw or weld 50 mm piping for liquid systems, weld 50 mm piping for air and gas systems.

.2 Make screwed joints with full cut standard taper pipe threads with approved non-toxic joint compound applied to male threads only.

.3 Make joints for plain end pipe with gasket and clamp type mechanical fastener.

.4 Clamp cast iron water pipe at fittings with 20 mm rods and properly anchor and support.

.5 Use grooved mechanical couplings and mechanical fasteners, only where permitted by the Contract Administrator.

.6 Use galvanized couplings with galvanized pipe.

.7 Make connections to equipment, specialty components, and branch mains with unions or flanges.

.8 Provide dielectric type connections wherever joining dissimilar metals. Brass adapters and valves are acceptable.

.9 Use insulating plastic spacers for copper pipe installation in metal studs.

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. 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 Equip low points with 20 mm drain valves and hose nipples.

.4 Provide air collection chambers with manual air vent at all high points of system. Collection chambers to be 25 mm dia. or line size whichever is greater and 150 mm high minimum. Square tees may only be used to assist with complete venting and draining.

.5 Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting. Top flat for water pipes.

.6 Grade horizontal drainage and vent piping 2% minimum, unless noted otherwise.

.7 Pipe the discharge from all relief valves, safety valves, vents, drains, equipment blowdowns, water columns and overflows to the nearest building drain. Pipe to glycol recovery tanks for a glycol based system.

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 of insulation and for access to valves, air vents, drains and unions.

.3 Install piping material specified as inside the building to 2400 mm outside of building.

3.5 Welded Pipe Branch Connections

.1 Make branch connections according to the following schedule.

Legend:

T: Forges tee or reducing tee

S: Socolet

W: Weldolet

HEADER PIPE SIZE (mm)	15	20	25	30	40	50	65	75	100	150	200	250	300
15	T												
20	T	T											
25	T	T	T										
30	T	T	T	T									
40	T	T	T	T	T								
50	S	S	S	T	T	T							
65	S	S	S	S	T	T	T						
75	S	S	S	S	S	T	T	T					
100	S	S	S	S	S	T	T	T	T				
150	S	S	S	S	S	W	T	T	T	T			
200	S	S	S	S	S	W	W	W	T	T	T		
250	S	S	S	S	S	W	W	W	W	T	T	T	
300	S	S	S	S	S	W	W	W	W	W	T	T	T

BRANCH PIPE SIZE (mm)

END OF SECTION

HYDRONIC VALVES AND STRAINERS

1. GENERAL

1.1 Scope

.1 Ball valves

.2 Butterfly valves

.3 Drain valves

.4 Strainers

.5 Triple Duty Valves

.6 Suction Diffusers

1.2 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.

1.3 Shop Drawings

.1 Submit copies of valves "ordering schedule" for review before ordering valves.

.2 Submit detailed Shop Drawings clearly indicating make, model, size, pressure rating, materials of construction and intended service.

2. PRODUCTS

2.1 Hot Water Heating and Glycol Water Systems

.1 Ball Valves up to 50 mm: Brass body, chrome plated brass ball, threaded or solder ends, TFE seat and packing. 4134 kPa (600 psi) non-shock WOG rating. Threaded, Red-White Fig. 5044A. Solder joint, Red-White Fig. 5049A.

.2 Butterfly Valves: Cast iron wafer full-lug body, 300 Series stainless steel shaft, bronze disc, replaceable EPDM seat, lever lock handle operator with multiple position lock plate for valve sizes to 100 mm, heavy duty gear handwheel operator with position indicator for valve sizes 150 mm and over. Minimum rating 1200 kPa (175 psi), 121°C (250°F). Keystone F1000, F1020.

.3 Drain Valves up to 50 mm: Brass 2 piece body ball valve, blowout proof stem, Teflon seats, forged brass chrome palted ball, hose end connection with cap and chain by male IP, 4200 kPa (600 psi) water, oil, gas rating, Red-White Fig. 5046.

2.2 Strainers

.1 Size 50 mm and under: Screwed brass or iron body, Y pattern with 0.75 mm (24 ga) stainless steel perforated screen.

.2 Size 65 mm to 100 mm: Flanged iron body, Y pattern with 1 mm (20 ga) stainless steel perforated screen.

.3 Size 125 mm and larger: Flanged iron body, Y pattern with 3 mm (11 ga) stainless steel perforated screen.

.4 Screen free area shall be minimum three times area of inlet pipe.

2.3 Triple Duty Valve

.1 For base mounted or inline pump discharge application, performs the functions of a nonslam check valve, throttling valve, shut-off valve and calibrated balancing valve. Equip with brass readout valves (with integral check valves) to read differential pressure across valve.

.2 Cast iron, bronze seat, replaceable bronze disc with EPDM insert.

.3 Up to 50 mm: NPT connections, 1200 kPa (175 psi) working pressure, brass stem, chatter preventing SS spring.

.4 Over 50 mm: Flanged connections, 1200 kPa (175 psi) working pressure, stainless steel stem and chatter preventing spring.

2.4 Suction Diffuser

.1 For base mounted or floor mounted vertical inline pumps.

.2 Up to 50 mm: Cast iron construction, NPT connections.

.3 Over 50 mm: cast iron straightening fitting, stainless steel combination diffuser - strainer - orifice cylinder with 4.8 mm (3/16 in) perforations, and permanent magnet. Provide complete with a 16 mesh bronze strainer.

2.5 2-way and 3-way Control Valves

.1 See Section 23 09 00 - Instrumentation and Control for HVAC.

3. EXECUTION

3.1 Installation and Application

.1 Install valves with stem upright or horizontal, not inverted.

.2 Provide threaded lug type butterfly valves for equipment isolation service. Provide wafer or threaded lug type valves for zone shut-off service.

.3 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.

.4 Size drain lines and drain valves equal to size of apparatus drain connection.

.5 For pipe sizes 20 mm and over, minimum drain size to be 20 mm.

.6 Provide hose thread connection with cap and chain for 20 mm drain valves located in ceiling and public areas.

.7 Provide male NPT nipples with threaded pipe cap for drain sizes over 20 mm where not piped directly to floor drains.

.8 Provide strainers where shown on Drawings.

.9 Provide suction diffusers where shown on Drawings. Also, provide suction diffusers instead of strainers on pump systems where a minimum of 5 pipe diameters of straight pipe length on suction side of pump is unattainable.

.10 Provide valved drain and hose connections off the bottom of all strainers.

.11 Install 2-way and 3-way control valves into pipe work provided by Section 23 09 00.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Manual Air Vents

.2 Automatic Air Vents

.3 Air separators

.4 Relief Valves

.5 Glycol Solution

.6 Circuit Balancing Valves

.7 Glycol Fill Tank

.8 Expansion Tank

1.2 Quality Assurance

.1 Thoroughly check system and make necessary corrections if system continually loses solution.

.2 Perform tests determining strength of glycol solution before system is turned over to the City. Provide test prior to end of guarantee and replenish as required. Provide written test results for review.

1.3 Submittals

.1 Provide Shop Drawings for all equipment in this Section.

2. PRODUCTS

2.1 Manual Air Vents

.1 Provide manual air vents with 25 mm or line diameter pipe which ever is greater to form air collection chamber. Collection chamber to be 150 mm high.

2.2 Automatic Air Vents

.1 Provide automatic air vents where shown on Drawings. Vents shall be non-ferrous construction, rated for 1000 kPag (145 psig) and 116°C (240°F) operating temperature.

.2 Standard of Acceptance: Bell & Gossett model 87.

2.3 Inline Air Separators

.1 Horizontal in-line air separator with heavy duty cast iron body, 12.1 bar (175 psi) working pressure with 149°C liquid temperature, integral weir to decelerate system flow.

.2 Standard of acceptance: B&G IAS

2.4 Relief Valves

.1 Provide ASME rated water pressure relief valve to protect glycol and hot water system.

.2 Standard acceptance: Watts series 174A.

2.5 Glycol Solution

.1 Provide ethylene glycol/water solution mixed at a 50/50 ratio suitable for a temperature range of -40°C (-40°F) to 104°C (220°F). Solution to be suitable for heating or cooling complete with appropriate corrosion inhibitors. Solutions must be factory premixed. Applies only for load side of the heat exchanger.

2.6 Circuit Balancing Valves

.1 Valves up to 50 mm: Brass body, stem and disk with reinforced nylon or ABS handwheel, Maximum rated pressure 2068 kPa (300 psi) and operation temperature from -20ºC to 150ºC. Maximum pressure drop of 13.8 kPa (2 psig) at design flow.

.2 Valves 65 mm to 150 mm: Ductile iron body, bronze disk, high strength engineered resin seat, brass stem, BUNA N. & EPDM ”O” rings and drain tapings. Maximum rated pressure 1724 kPa (250 psi) and maximum operation temperature to 110ºC. Maximum pressure drop of 13.8 kPa (2 psig) at design flow.

.3 Refer to Section 23 06 00 - Schedules for HVAC.

2.7 Bypass Filter

.1 Unit to consist of cartridge filter, flow indicator, flow control valves and filter cartridges. Cartridge filter; stainless steel shell of single centre bolt construction with cast nick-plated brass head, drain plug and air vent. Flow indicator - cast bronze body with two sight glasses of high temper, thermo shock-resistant glass and nylon rotor on stainless steel pin.

.1 Flow Control Valves: Cast Bronze Globe Valves, 20 mm Female NPT.

.2 Filter cartridges: 10 each of 10 micron retention, and 50 micron retention.

.3 Manufacturer: Guthrie Hydroniclean System.

2.8 Glycol Fill Tank package

.1 Glycol Fill Tank package shall include 25 L (6.6 US gallon) storage/mixing tank with molded-in level gauge, 125 mm (5 inch) fill/access opening and cover; pump suction hose with inlet strainer and check valve; pressure pump with fuse protection; low fluid level pump cut-out float switch; manual diverter valve for purging air and agitating contents of storage tank; pressure switch with snubber and two (2) sets of SPST dry contacts, each individually adjustable from 70 kPa (10 psig) to 170 kPa (25 psig) cut-out pressure; factory cut-out pressure set to 104 kPa (15 psig); and liquid filled pressure gauge. Unit to be complete with fused power supply adapter with LED indicator light, 115/1/60 to 24 VDC 60 watts AC, supplied loose for field installation.

.2 Pump performance 0.04 L/s (0.7 usgpm) at free flow, self-priming to 1.2 m (4 feet).

.3 Pressure pump shall be capable of running dry without damage.

.4 Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No.68.

.5 Tank shall be completely full of premixed 50% ethylene glycol at time of turn over.

.6 Refer to Section 23 06 00 - Schedules for HVAC.

2.9 Expansion Tank

.1 Provide expansion tank as described in Section 23 06 00 - Schedules for HVAC.

3. EXECUTION

3.1 General

.1 Do necessary piping to complete installation as shown on the Drawings specified.

.2 Thoroughly clean and flush system before antifreeze solution is added.

.3 Manually feed glycol to system through Glycol Fill Tank.

.4 Provide antifreeze solution lost from the systems from any cause other than neglect by the City during the first year of operation.

3.2 Air Vents

.1 Provide manual type at system high points and convection type heating units.

.2 Where large air quantities can accumulate, provide enlarged air collection standpipe.

.3 Provide automatic air vents where shown on Drawings.

3.3 Inline Air Separator

.1 Provide where shown on Drawings.

.2 Size inline air separator to match pipe size.

3.4 Relief Valve

.1 Provide one (1) relief valve on glycol system and where indicated.

.2 Drain relief valve to glycol collection tanks. Do not waste glycol to floor drains.

.3 System relief valve capacity shall equal make-up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment.

.4 Where one line vents several relief valves, cross sectional areas shall exceed sum of individual vent areas.

3.5 Glycol Solution

.1 Provide one (1) five-USG pail of pre-mixed 50% propylene glycol solution at project completion.

3.6 Circuit Balancing Valves

.1 Install valves up to 50 mm five pipe diameters downstream from a fitting or if a valve is located downstream from a circulation pump, allow ten pipe diameters from pump discharge.

.2 Install valves 65 mm to 150 mm five pipe diameters downstream from a fitting or if a valve is located downstream from a circulation pump, allow ten pipe diameters from pump discharge end. In both situations provide two pipe diameters downstream from the valve.

3.7 Bypass Filter

.1 Install between pump's suction and discharge. Provide isolation valves and sight glass as indicated.

.2 New systems - Install a 50 micron cartridge in the filter housing. Open inlet valve. Slowly open outlet valve to obtain the movement of ball in sight glass of the flow indicator. When the flow has decreased such that the ball in the flow indicator is motionless, the filter should then be replaced.

.3 Install 10 micron cartridge after five, 50 micron turnovers for final system cleaning. Regular filter replacement must be carried out to maintain the system in its final clean condition.

3.8 Glycol Fill Tank package

.1 Provide one (1) tank package for each glycol system.

3.9 Expansion Tanks

.1 Provide air lines, checks, charging valves and pressure gauges for expansion tanks and glycol fill tanks.

END OF SECTION

HYDRONIC PUMPS

1. GENERAL

1.1 Scope

.1 All pumps except where integral with a manufactured piece of equipment.

1.2 Submittals

.1 Submit with Shop Drawings certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Show pump weights, motor and pump operating or efficiencies and electrical power characteristics.

1.3 Quality Assurance

.1 Pumps shall be aligned by qualified millwright and alignment certified.

.2 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, operate within 25% of midpoint of published maximum efficiency curve.

.3 Motors shall be high efficiency only as per NEMA Standards.

2. PRODUCTS

2.1 General

.1 Statically and dynamically balance rotating parts.

.2 Pumps shall operate at 1750 rev/min unless specified otherwise.

.3 Pump connections shall be flanged.

2.2 In-Line Pump

.1 Type: Centrifugal, single stage, close coupled in-line, back pullout design, suitable for horizontal operation.

.2 Casing: Cast iron, rated for minimum of 1200 kPa (175 psi) working pressure. Suction and discharge gauge port, air vent, wear rings, seal flush connection, drain plug, flanged suction and discharge.

.3 Impeller: Brass or bronze with steel lock nut and capscrew.

.4 Shaft: Stainless steel or carbon steel with bronze or stainless steel sleeve through seal chamber.

.5 Seals: Buna-Carbon/Ceramic.

.6 Motor: Open drip proof unless noted otherwise in pump schedule.

3. EXECUTION

3.1 Installation

.1 Provide air cock and drain connection on horizontal pump casings.

.2 Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 100 mm and over.

.3 Check and align pumps prior to start-up.

3.2 Performance

.1 Refer to the Pump Schedule in Section 23 06 00 - Schedules for HVAC.

END OF SECTION

STEAM AND CONDENSATE PIPING SYSTEMS

1. GENERAL

1.1 Scope

.1 Remove existing steam piping, insulation and accessories as per drawings.

.2 Cap existing steam piping per drawings and specifications.

1.2 Submittals

.1 Shop Drawings: Flanges, fittings and seals/gaskets.

2. PRODUCTS

2.1 Pipe, Fittings and Joints

.1 Black Steel - Screwed Joint: Mild black carbon steel, Grade B, ASTM A53, complete with Class 125 or Class 250 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.

.2 Black Steel - Welded Joint: Mild black carbon steel, Grade B, ASTM A53, mill or site bevelled, complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB with a wall thickness to match the pipe, and welded joints.

2.2 Piping Unions

.1 Screwed Low Pressure Steam Piping: Dart Union Co. of Canada Ltd. or approved equivalent in accordance with B6, malleable iron, ground joint, brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).

.2 Screwed Condensate Piping: Malleable iron, ground joint, factory tested "RAILROAD" type screwed unions and union elbows with a brass to iron seat and a minimum pressure rating of 4140 kPa (600 psi) WOG (non-shock).

.3 Welded Low Pressure Steam Piping: Forged carbon steel slip-on raised face welding flange unions to ASTM A105, 150 lb. Class.

.4 Welded Condensate Piping: Welding flange unions as specified above for welded low pressure steam piping butt 300 lb. Class.

2.3 Gaskets

.1 Non-asbestos, Garlock 1/8” thick compressed fiber type.

3. EXECUTION

3.1 Demolition

.1 At the proper time and the reviewed schedule of Work, disconnect (mechanically) and remove existing obsolete piping, equipment and accessories.

.2 In general the steam systems must continue to run until new systems are in place, tested, cleaned and ready for switch-over.

3.2 Steam and Condensate Piping Installation Requirements

.1 Provide all required steam and condensate piping to properly decommission steam systems at project site.

.2 Piping, unless otherwise specified, is to be mild black steel, screwed for pipe to and including 50 mm (2 inch) diameter, screwed or welded for pipe 65 mm (2½ inch) diameter and larger, and as follows:

.1 Low pressure steam – screwed: Schedule 40, complete with Class 125 screwed fittings.

.2 Condensate, all pressures – screwed: Schedule 80, complete with Class 250 screwed fittings.

.3 Low pressure steam – welded: Schedule 40 with butt weld fittings.

.4 Condensate, all pressures welded: Schedule 80 with butt weld fittings.

3.3 Installation of Flanges

.1 Provide weld-on flanges at all remaining steam piping ends where shown on drawings. Blind flange with proper seals/gaskets.

END OF SECTION

METAL DUCTS

1. GENERAL

1.1 Scope

.1 Ductwork and plenums

.2 Fasteners

.3 Sealants

1.2 Definitions

.1 Low Pressure: static pressure in duct less than 500 Pa (2 in.wg.) and velocities less than 10 m/s (2000 fpm).

.2 Duct sizes shown on plans are inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

1.3 Quality Assurance

.1 Ductwork shall meet the requirements of NFPA No. 90A - Air Conditioning and Ventilating Systems; and NFPA No. 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.2 Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks.

.3 Flexible air duct shall conform to NFPA 90A and UL181 standard for factory made air duct materials and air duct connectors.

1.4 Submittals

.1 Submit Shop Drawings and samples of duct fittings for approval, including particulars such as gauge sizes, welds and configurations prior to start of work.

1.5 Alternatives

.1 Obtain written permission from the Contract Administrator prior to making variations in duct configuration or sizes. Size alternatives using ASHRAE table for circular equivalents of rectangular ducts.

2. PRODUCTS

2.1 Materials

.1 Ducts: G60 or G90 galvanized steel lock forming quality, having galvanized coating on both sides.

.2 Fasteners: use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts. Weld kitchen exhaust ducts.

.3 Sealant: water resistant, fire resistive, compatible with mating materials.

.4 Flexible Duct - Low Pressure: flexible air duct shall be used where shown on Drawings. Length of flexible duct shall not exceed 900 mm. Flexible duct shall be polymetric liner banded to a steel wire helix, wrapped with fiberglass insulation and outer fiberglass reinforced metalled vapour barrier jacket. Flexible duct rated for 12 m/s (2400 fpm) velocity and pressure rated for 500 Pa (2 in.wg.) positive and 500 Pa (2 in.wg.) negative.

.1 Standard Acceptance: Thermaflex M-KE.

3. EXECUTION

3.1 Plenum Gauges

.1 Fabricate fan plenums and plenums downstream of fan in accordance with SMACNA manual.

.2 Fabricate plenums between fan and upstream apparatus of 1.6 mm (16 ga) thick material.

.3 Fabricate plenums between filters and upstream apparatus of 1.3 mm (18 ga) thick material.

3.2 Duct Sealing

.1 All supply, return and exhaust duct joints, longitudinal as well as transverse, should be sealed using:

.1 Low Pressure Ductwork:

.1 Slip Joints: apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm (0.06 in) use heavy mastic type sealant.

.2 Flanged Joints: soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.

.3 Other Joints: heavy mastic type sealant.

.2 Duct tapes as sealing method are not permitted.

.3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.

.4 Prior to sealing all ductwork, demonstrate sealing of a section of each type of duct and obtain approval from the Contract Administrator.

.5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application.

3.3 Installation

.1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.

.2 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with

metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.3 Interrupt duct linings at fire, balancing backdraft and smoke dampers so as not to interfere with operation of devices. Provide sheet metal edge protection over linings on both sides of damper device.

.4 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty at no extra cost to the Contract.

.5 Protect carbon steel ductwork exposed to weather by painting or coating with suitable weather resistant material.

.6 Do not use flexible duct to change direction.

.7 Minimize stress on flexible duct by aligning ductwork on both sides of the flexible duct connection.

.8 Prove that ductwork is substantially airtight before covering or concealing.

.9 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters or bypass during cleaning.

.10 Fabricate ductwork from field measurements and not from plans and Shop Drawings exclusively. Failure to do so will not constitute an extra to the Contract.

.11 Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 450 mm, cross brace for rigidity. Open corners are not acceptable.

.12 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.13 Construct tees, bends and elbows with radius of not less than 1-1/2 times width of cut on centre line. Where not possible and where rectangular elbows are specified, provide double wall air foil type turning vanes. Where acoustical lining is provided, provide turning vanes of perforated metal type with fibreglass inside.

.14 Increase duct sizes gradually, not exceeding 15° divergence wherever possible. Maximum divergence upstream of equipment to be 30° and 45° convergence downstream.

.15 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled. Seal seams on fresh air and exhaust ducts watertight with mastic or low velocity duct sealant.

.16 Set plenum doors 150 mm above floor. Arrange door swings so that fan static holds door in closed position.

END OF SECTION

FIRE DAMPERS

1. GENERAL

1.1 Scope

.1 Duct Fire Dampers

.2 Duct Access Doors

1.2 Quality Assurance

.1 Fire dampers shall be ULC listed and constructed in accordance with ULC Standard S 112 “Fire Dampers”.

.2 Fusible links on fire dampers shall be constructed to ULC Standard S 505.

.3 Demonstrate re-setting of fire dampers to authorities having jurisdiction and City’s Representative.

.4 Access doors shall be ULC labelled.

.5 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with ASHRAE Handbooks and SMACNA Duct Manuals.

.6 Prove all dampers to inspector at job completion.

1.3 Submittals

.1 Submit Shop Drawings of factory fabricated assemblies.

2. PRODUCTS

2.1 Duct Access Doors

.1 Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices. Duct access panels with screws are not acceptable. Install minimum 25 mm thick insulation with suitable sheet metal cover frame for insulated ductwork.

.2 Fabricated with two (2) butt hinges and two sash locks for sizes up to 450 mm two (2) hinges and two (2) compression latches with outside and inside handles for sizes up to 600 mm x 1200 mm and an additional hinge for larger sizes.

2.2 Duct Fire Dampers

.1 Fabricate of galvanized steel or prime coated black steel weighted to close and lock in closed position when released by fusible link.

.2 Fire dampers shall be 1-1/2 hour rated, curtain type with damper blades retained out of air stream in a recess so free area of connecting ductwork is not reduced.

.3 Fusible links shall be set for 71°C (160°F).

3. EXECUTION

3.1 Application

.1 Provide access door minimum 450 mm x 350 mm or 50 mm smaller than duct dimension for cleaning and inspection at positions indicated by Drawings and as follows:

.1 At each fire damper location.

.2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.3 All fire dampers and fire stop flaps are to be left in the closed position for balancing contractor to fix open.

END OF SECTION

PANEL AIR FILTERS

1. GENERAL

1.1 Scope

.1 Panel filters

.2 Filter Racks

1.2 Quality Assurance

.1 Filters shall be product of and supplied by one Manufacturer.

.2 Filter media shall be ULC listed, Class I or Class II.

.3 Filter components assembled to form filter banks shall be products of same Manufacturer.

.4 All filters except HEPA shall be in accordance with ASHRAE Standard 52.76.

.5 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

1.3 Alternatives

.1 Size, media face area, material, test efficiency, initial and final air resistance of alternative manufacturers shall be as specified.

1.4 Submittals

.1 Provide Shop Drawings of all filters, and filter racks/housings.

2. PRODUCTS

2.1 Panel Filters

.1 Frame: One-piece moisture resistant chipboard.

.2 Media: non-woven synthetic.

.3 Support Grille: diamond shaped expanded metal.

.4 Pleat design: v-pleat.

.5 The efficiency shall be minimum MERV 6 unless otherwise specified.

.6 Filters shall be 50 mm (2 inch) thick unless otherwise specified.

2.2 Filter Racks

.1 Prefabricated filter rack and supporting structures of galvanized steel or extruded aluminum with hinged door and fully gasketed to ensure tight seal all around. Construction to be 1.6 mm (16 ga).

.2 Provide standard size frames to provide interchangeability of filter media of other Manufacturers.

3. EXECUTION

3.1 Installation

.1 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place. Replace filters every three (3) months if equipment is used during construction and install new pre-filters at the time of air balancing.

.2 Provide two (2) complete spare sets of new filters and for all air handling equipment at take-over by the City (i.e. at Total Performance).

.3 Provide filter banks in arrangement shown with removal and access indicated.

END OF SECTION

CONDENSING BOILERS

1. GENERAL

1.1 Scope

.1 Boilers, Control and Trim

.2 Hot Water Connections

.3 Fuel Connections

.4 Electrical connections, Controls and Power

.5 Venting

1.2 Quality Assurance

.1 Boilers to comply with Provincial Regulations and bear the CSA Approval Stamp/Seal.

.2 Boilers shall each have a Canadian Registration Number (CRN) and shall be approved and labelled by the UL/ULC.

1.3 Start-up

.1 Provide the services of a factory trained representative to start up the boiler(s), test the efficiency and train the operators.

1.4 Submittals

.1 Submit Shop Drawings indicating capacity rating, physical dimensions, wiring diagrams, materials of construction, code compliance, etc.

.2 Venting: include sizing calculations.

2. PRODUCTS

2.1 Boiler Construction

.1 Boiler shall be natural gas fired high efficiency (95%+) condensing boiler with lower NOx emission not exceeds of 10 ppm.

.2 The burner design has a capable of modulation down to 20% of full fire (5:1 turndown) without loss of combustion efficiency. Sealed combustion chamber shall incorporate for a pre-mix stainless steel burner with 100 mm air intake connection.

.3 Stainless steel heat exchanger with welded construction shall be ASME “H” stamped for a working pressure not less than 1103 kPa (160 psig). The boiler shall have an ASME approved relief valve with a setting of 689 kPa (100 psig).

.4 Exhaust manifold shall be of corrosion resistant with a 100 mm diameter vertical flue connection.

.5 Built-in condensation trap with drain valve and trap outlet not lower than 330 mm from the bottom.

.6 The boiler shall be supplied with boiler circulation pump mounted and wired inside jacket and pump control shall be equipped with delay.

2.2 Boiler Trim

.1 The boiler shall be supplied safeguard system utilising spark ignition, temperature and pressure gauge, water flow switch, low water cut-off and burner site glass.

.1 Water flow switch shall be external type.

.2 Supply with a relief valve sized in accordance with ASME Boiler and Pressure Vessel Code.

.3 Provide a neutralization kit for each boiler sized for average life of one year.

2.3 Boiler Controls

.1 The boiler shall be supplied electronic PID modulation control with large user-interface, display, alarm outputs, and external input for outdoor air reset boiler water temperature control.

.2 The boiler shall be equipped to communicate with the existing Johnson Controls Metasys system.

2.4 Boiler Air Intake and Exhaust Venting

.1 Positive pressure vent shall be of the single wall, factory-built type, designed for use in conjunction with Category II, or IV condensing gas fired appliances, condensing oil fired appliances or as specified by the heating equipment manufacturer.

.2 Maximum continuous flue gas temperature shall not exceed 248 degrees F (120 degrees C).

.3 Vent shall be listed for a maximum positive pressure rating of 20” w.c.

.4 The vent system shall be continuous from the appliance’s flue outlet to the vent termination outside the building. All systems components shall be cUL listed and supplied by the same manufacturer.

.5 The vent shall be constructed from Flame Resistant Polypropylene, with a min. wall thickness of:

Diameter			Wall Thickness Extruded Pipes		
Diameter (mm)	**Diameter (inch)**	**Min (mm)**	**Max (mm)**	**Min (inch)**	**Max (inch)**
DN 60	2"	1.7	2.2	0.0669	0.0866
DN 80	3"	1.8	2.4	0.0709	0.0945
DN 110	4"	2.4	3.2	0.0945	0.1260
DN 125	5"	2.7	3.7	0.1063	0.1457
DN 160	6"	2.9	4.5	0.1142	0.1772
DN 200	8"	3.5	4.5	0.1378	0.1772

.6 All systems components such as vent supports, roof or wall penetrations, terminations, appliance connectors and drain fittings required to install the vent system shall be cUL listed and provided by the vent manufacturer.

.7 All systems components shall include a factory- installed gasket in their female-end to render the vent air and water tight when the male/female ends are pushed together as per manufacturer's instructions. Vent systems requiring field installed sealants or compounds shall not be acceptable.

.8 Vent layout shall be designed and installed in compliance with manufacturers installation instructions and all applicable local codes.

.9 Standard of Acceptance: InnoFluel® manufactured by Centrotherm.

3. EXECUTION

3.1 Installation

.1 Follow Manufacturers recommended installation guidelines.

.2 The relief pressure of the PRV shall be set at 689 kPa (100 psig).

.3 Provide a discharge pipe for the PRV and route pipe to nearest funnel floor drain. Discharge pipe cross-sectional area shall not be less than the area of the boiler PRV outlet.

.4 Flow switch shall be located external of the boiler on the pipe.

.5 Provide condensate drainage piping to neutralization system.

.6 Boiler shall be leveled and anchored to floor.

.7 Venting:

.1 The intake piping shall be insulated from the exterior wall up to 3 feet from the boiler to minimize external sweating.

.2 The flue exhaust pipe shall be insulated a minimum of 5 feet from the exterior wall toward the interior of the building to minimize external sweating.

.3 Insulation per Section 23 07 19 - HVAC Piping Insulation.

.4 The vent system shall be routed for zero clearance to combustibles as specified by the manufacturer.

.5 Vent Installation shall conform to the manufacturer's installation instructions, its cUL listing and state/local codes

.6 The vent system and breechings shall be inspected and cleaned before the final connection to the appliances.

.7 If dampers or fans are installed in conjunction with the vent system, such equipment shall be supported independently from the vent system. Protect vent system from twisting or movement due to fan torque or vibration.

3.2 Performance

.1 Refer to Section 23 06 00 - Schedules for HVAC.

3.3 Warranty

.1 Provide minimum twelve (12) years warranty on boilers.

.2 Venting: The manufacturer shall warrant the Positive Pressure Vent System against defects in material and workmanship for a period of 10 years from the date of the original installation. Any portion of the vent repaired or replaced under the warranty shall be warranted for the remainder of the original warranty period.

END OF SECTION

PLATE AND FRAME HEAT EXCHANGERS

1. GENERAL

1.1 Scope

.1 Heat exchanger

.2 Relief and drain valves

.3 Instrumentation

.4 Piping connections

.5 Steel supports

1.2 Quality Assurance

.1 Conform to requirements of CGA, CSA, Provincial and Municipal Codes and be CSA listed.

.2 Design and construction shall meet requirements of ASME code for unfired pressure vessels and provincial codes.

.3 To comply with AHRI 400: Liquid to liquid heat exchanger.

1.3 Submittals

.1 Provide Shop Drawings including dimensions, locations and size of tapping, and performance data to match Specification.

2. PRODUCT

2.1 General

.1 Units shall be suitable for 1,034 kPa (150 psig) working pressure and 110°C (230°F) working temperatures.

.2 Prime coat exterior of units.

2.2 Plate and Frame Heat Exchanger

.1 Frame: Carbon steel frame consisting of one stationary plate cover with inlet and outlet NPT female connections, moveable plate cover, upper carrying bar, lower guiding bar, and support column.

.2 Plate material and thickness: AISI 316 stainless steel with thickness of 0.5 mm (0.02 inch).

.3 Plate mixture: TKTL-30.

.4 Nitril gaskets and groove seals.

.5 ASME approved with “U” stamp.

2.3 Flush Connections

.1 Provide a flush connection for the inlet and outlet of the hot and cold sides of the heat exchanger piping as detailed on Drawings. Each flush connection shall have a shut-off valve with NPT female connection and capped.

3. EXECUTION

3.1 Installation

.1 Provide welded structural steel stands for floor mounting of heat exchangers. Bolt stand to floor.

.2 Ensure installation permits removal of plates without disturbing installed equipment or piping. Provide installation clearances in accordance with Manufacturer's recommendations.

.3 Refer to Drawings for details of installation and piping connections.

3.2 Performance

.1 Refer to Section 23 06 00 - Schedules for HVAC.

END OF SECTION

AIR COILS

1. GENERAL

1.1 Scope

.1 Glycol coils

.2 Coil installation

.3 Coil piping and accessories

1.2 Quality Assurance

.1 Coils shall be the product of Manufacturer regularly engaged in production of coils who issues complete catalogue data on such Products.

.2 Coil capacities, pressure drops, and selection procedures shall be certified in accordance with AHRI Standards and bear AHRI seal.

1.3 Submittals

.1 Shop Drawings shall include dimensions, materials of construction and performance data to match Specifications.

.2 Submit coil selection sheets or computer calculations with Shop Drawings.

2. PRODUCTS

2.1 General

.1 Provide extended surface type coils with tubes of copper or brass, and plate of helical type fins of copper or aluminium.

.2 Space fins 14 fpi maximum. Helical fins may be crimped.

.3 Mount coil section in galvanized steel casing designed for bolting to other sections of ductwork.

2.2 Heating Coils

.1 Design for maximum operating limits of 1,724 kPa (250 psig) and 149°C (300°F).

.2 Provide cast iron coil headers, copper tube carbon steel connection pipe.

.3 Provide vent and drain plugs on the coil header.

.4 Face length shall not exceed 3 m.

3. EXECUTION

3.1 Installation

.1 Support coil sections on steel channel or double angle frames and secure to casings. Arrange supports for cooling coils so they do not pierce or short circuit drip pans. Level serpentine coils and install drainable tube coils with pitch within casing. Arrange galvanized steel casings for bolting to other section, ductwork or unit casings. Provide airtight seal between coils and duct or unit cabinets.

.2 Make necessary connections to coils, including valves, air vents, unions and connections from drip pans. Provide isolating valve on supply line and eccentric plug valve on return line to each water coil.

.3 Locate water supply at bottom of supply header and return water connection at top to provide self-venting and reverse return arrangement. Provide manual air vents at high points complete with stop valves. Ensure water coils are drainable and provide drain connection at low points.

.4 Protect coils so fins and flanges are not damaged. Replace loose and damaged fins. Comb out bent fins unless required to be replaced.

.5 Install in accordance with Manufacturer's recommendations.

3.2 Performance

.1 Refer to Section 23 06 00 - Schedules for HVAC.

END OF SECTION

UNIT HEATERS

1. GENERAL

1.1 Scope

.1 Electric Unit Heater

.2 Controls

.3 Supports

1.2 Quality Assurance

.1 Conform to requirements of CSA, Provincial and Municipal Codes, and be CSA listed.

.1 CSA C22.2 No.46-M1988, Electric Air-Heaters.

1.3 Submittals

.1 Shop Drawings shall include product characteristics, mounting methods, dimensions, electrical data, cabinet material thickness, colour and finish, and performance data to match Specifications.

2. PRODUCT

2.1 Unit Heaters - Electric

.1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.

.2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.

.3 Fan motor: totally enclosed, permanently lubricated ball bearing type with resilient mount.

.1 Built-in fan motor thermal overload protection.

.4 Hangers: as indicated.

.5 Elements: tubular stainless steel construction.

.6 Cabinet: steel, 1 mm thick, fitted with brackets for rod or wall mounting.

.1 Epoxy powder coated in almond colour.

.7 Wall mounted thermostats: line voltage.

3. EXECUTION

3.1 Installation

.1 Suspend unit heaters from ceiling or mount on wall as indicated.

.2 Install thermostats in locations indicated.

.3 Make power and control connections.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results – For Electrical.

.2 Test cut-out protection when air movement is obstructed.

.3 Test fan delay switch to assure dissipation of heat after element shut down.

.4 Test unit cut-off when fan motor overload protection has operated.

.5 Ensure heaters and controls operate correctly.

3.3 Performance

.1 Refer to Section 23 06 00 - Schedules for HVAC.

END OF SECTION