Part 1 General

1.1 SECTION INCLUDES

.1 Single phase electric motors.

.2 Three phase electric motors.

1.2 REFERENCES

.1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

.2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

.3 IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

.4 NEMA MG 1 - Motors and Generators.

1.3 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

.3 Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 15 Kw (20 horsepower).

.4 Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

1.4 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation Data: Include instructions for safe operating procedures.

.3 Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacture of electric motors and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

1.6 REGULATORY REQUIREMENTS

.1 Conform to applicable electrical code.

.2 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.8 WARRANTY

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide five year warranty.

.3 Warranty: Include coverage for motors larger than 20 horsepower.

Part 2 Products

2.1 MANUFACTURERS

.1 Baldor.

.2 Toshiba.

.3 WEG

.4 Substitutions: Refer to Section 21 05 00.

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

.1 Motors less than 250 Watts, for intermittent service: Equipment manufacturer's standard and need not conform to these specifications.

.2 Electrical Service:

.1 The following are required electrical characteristics unless otherwise indicated in the drawings and schedules.

.2 Motors 0.5 kW (3/4 hp) and smaller: 115 volts, single phase, 60 Hz.

.3 Motors Larger than 0.5 kW (3/4 hp): 575 volts, three phase, 60 Hz.

.3 Type:

.1 Open drip-proof except where specifically noted otherwise.

.2 Motors: Design for continuous operation in 40 degrees C environment.

.3 Design for temperature rise to NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

.4 Motors with frame sizes 254T and larger: Energy Efficient Type.

.4 Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

.5 Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

.6 Wiring Terminations:

.1 Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code, threaded for conduit.

.2 For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

2.3 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

.1 Starting Torque: Exceeding one fourth of full load torque.

.2 Starting Current: Up to six times full load current.

.3 Multiple Speed: Through tapped windings.

.4 Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.4 SINGLE PHASE POWER – ELECTRONIC COMMUTATED MOTORS (ECM)

.1 Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications.

.2 Permanently lubricated with ball bearings.

.3 Motor shall be a minimum of 85% efficient.

.4 Internal motor circuitry shall convert AC power supplied to the fan to DC power.

.5 Motor shall be speed controllable down to 20% of full speed.

.6 Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.

2.5 THREE PHASE POWER - SQUIRREL CAGE MOTORS

.1 Starting Torque: Between 1 and 1-1/2 times full load torque.

.2 Starting Current: Six times full load current.

.3 Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

.4 Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

.5 Insulation System: NEMA Class B or better.

.6 Testing Procedure: To IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

.7 Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

.8 Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 29 23 - Variable Frequency Controllers.

.9 Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

.10 Sound Power Levels: To NEMA MG 1.

.11 Part Winding Start where indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

.12 Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

.13 Nominal Efficiency: As scheduled at full load and rated voltage when tested to IEEE 112.

.14 Nominal Power Factor: As scheduled at full load and rated voltage when tested to IEEE 112.

2.6 MOTORS CONTROLLED BY VARIABLE FREQUENCY DRIVES

.1 Motors controlled by variable frequency drives (VFDs) shall comply with requirements of CSA Specification C22.2 No. 100-95, Clause 12.4 and shall be permanently marked with the following in addition to the normal marking requirements:

- .1 Machine Application (Inverter Duty);
- .2 Speed range over which the machine is designed to operate;
- .3 Type of torque application for which the machine is designed (eg. VT (variable torque), CT (constant torque), Chp (constant horsepower) or equivalent;
- .4 Type(s) of inverter(s) with which the machine is intended to be used (eg.: VSI or VVI (6-step voltage source), CSI (6-step current source), VPWM (voltage-source pulse width modulated), LCI (load commutated), cyclonverter, or equivalent).

Part 3 **Execution**

3.1 APPLICATION

.1 Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, dust collection systems: Totally enclosed type.

3.2 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

.3 Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Positive displacement meters.

.2 Flow metres.

.3 Pressure gauges and pressure gauge taps.

.4 Thermometers and thermometer wells.

.5 Static pressure gauges.

.6 Filter gauges.

1.2 REFERENCES

.1 ASME B40.100 - Pressure Gauges and Gauge Attachments.

.2 ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.

.3 ASTM E1 - Specification for ASTM Thermometers.

.4 ASTM E77 - Inspection and Verification of Thermometers.

.5 AWWA C700 - Cold Water Meters - Displacement Type, Bronze Main Case.

.6 AWWA C701 - Cold Water Meters - Turbine Type, for Customer Service.

.7 AWWA C702 - Cold Water Meters - Compound Type.

.8 AWWA C706 - Direct-Reading, Remote Registration System for Cold-Water Meters.

.9 AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

.10 ISA RP 3.2 - Flange Mounted Sharp Edged Orifice Plates for Flow Measurement.

.11 UL 393 - Indicating Pressure Gauges for Fire-Protection Services.

.12 UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.3 SUBMITTALS FOR REVIEW

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide list which indicates use, operating range, total range and location for manufactured components.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

.1 Section 21 05 00: Submittals for project closeout.

.2 Project Record Documents: Record actual locations of components and instrumentation.

1.5 ENVIRONMENTAL REQUIREMENTS

.1 Section 21 05 00: Environmental conditions affecting products on site.

.2 Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.6 EXTRA MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide two bottles of red gauge oil for static pressure gauges.

Part 2 Products

2.1 PRESSURE GAUGES

.1 Manufacturers:

.1 Winters.
.2 Trerice.
.3 Ashcroft.
.4 Substitutions: Refer to Section 21 05 00.

.2 Gauge: ASME B40.1, stainless steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

.1 Case: Steel with bronze or brass bourdon tube.
.2 Gauges shall be dry – no glycerine or silicone fill.
.3 Size: 102 mm (4 inch) diameter dial - thermometers located up to 3000 mm (10'-0") above finished floor.
.4 Size: 152 mm (6 inch) diameter dial - thermometers located above 3000 mm (10'-0") above finished floor.
.5 Range: gauges shall be selected based on the application to show twice the normal operating pressure with indicating needle at 12 o'clock position for normal operating pressure.
.6 Mid-Scale Accuracy: One percent (1%) of full span.
.7 Scale: Both psi and kPa with psi prominent figure.

2.2 PRESSURE GAUGE TAPPINGS

.1 Gauge Cock: Tee or lever handle, brass for maximum 1034 kPa (150 psig).

.2 Needle Valve: Brass 6 mm (1/4 inch) NPT for minimum 1034 kPa (150 psig).

.3 Pulsation Damper: Pressure snubber, brass with 6 mm (1/4 inch) connections.

.4 Syphon for gauges on steam systems: Stainless-steel shut-off ball valve complete with ¼" NPT stainless-steel coil siphon rated minimum 1723 kPa (250 psig) working pressure.

2.3 STEM TYPE THERMOMETERS

.1 Manufacturers:

.1 Winters.

.2 Trerice.

.3 Ashcroft.

.4 Substitutions: Refer to Section 21 05 00.

.2 Thermometer: ASTM E1, adjustable angle, blue organic fluid, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

.3 Choice of stem types shall not be made until piping and equipment, etc., has been erected. Stem type must be approved by Contract Administrator.

.1 Size: 225 mm (9 inch) scale.

.2 Window: Clear heavy-duty strength glass or acrylic.

.3 Stem: Minimum length 152 mm (6 inch).

.4 Accuracy: ASTM E77 2 percent. Calibration: Both degrees F and degrees C.

2.4 DIAL THERMOMETERS

.1 Manufacturers:

.1 Winters.

.2 Trerice.

.3 Ashcroft.

.4 Substitutions: Refer to Section 21 05 00.

.2 Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.

.3 Choice of stem types shall not be made until piping and equipment, etc., has been erected. Stem type must be approved by Contract Administrator.

.1 Size: 75 mm (3 inch) diameter dial - thermometers located up to 1500 mm (5'-0") above finished floor.

.2 Size: 125 mm (5 inch) diameter dial - thermometers located above 1500 mm (5'-0") above finished floor.

.3 Lens: Clear heavy-duty strength glass.

.4 Accuracy: 1 percent.

.5 Calibration: Both degrees F and degrees C.

2.5 THERMOMETER SUPPORTS

.1 Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

.2 Flange: 75 mm (3 inch) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

.1 Test Plug: 6 mm (1/4 inch) or 13 mm (1/2 inch) brass or stainless steel (depending on system) fitting and cap for receiving 3 mm (1/8 inch) outside diameter pressure or temperature probe with neoprene core for temperatures up to 93 degrees C (200 degrees F), Nordel core for temperatures up to 176 degrees C (350 degrees F), Viton core for temperatures up to 204 degrees C (400 degrees F).

.2 Test Kit: Carrying case, internally padded and fitted containing two 60 mm (2-1/2 inch) diameter pressure gauges, two gauge adapters with 3 mm (1/8 inch) probes, two 38 mm (1-1/2 inch) dial thermometers.

2.7 STATIC PRESSURE GAUGES

.1 90 mm (3-1/2 inch) diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

.2 Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.

.3 Accessories: Static pressure tips with compression fittings for bulkhead mounting, 6 mm (1/4 inch) diameter tubing.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

.3 Install pressure gauges with pulsation dampers. Provide needle valve to isolate each gauge. Provide syphon on gauges in steam systems. Extend nipples and syphons to allow clearance from insulation.

.4 Gauges subject to vibration shall have copper tube extension and shall be located away from source of vibration; preferably on an adjacent wall or other stable mounting surface.

.5 Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 60 mm (2-1/2 inch) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

.6 Install thermometers with back or bottom inlet stems, depending on which is better for ease of reading.

.7 Brass separable wells to have insulation extensions, where mounted on insulated piping or equipment, to ensure dials are clear. Stems and wells to be immersed in liquid flow, minimum length of stems to be 152mm.

.8 Where a separable well is mounted in pipe 38mm diam. or less, enlarge pipe to 50mm diam. for well length plus 76mm.

.9 Install thermometers in air duct systems on flanges.

.10 Dial thermometers to be installed on air handling units on outside-air ducts, mixed air ducts, and supply-air ducts.

.11 Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 25 50 01 and/or 25 50 02.

.12 Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.

.13 Install static pressure gauges at all built-up filter banks, unitary filter sections, and supply fan discharge.

.14 Coil and conceal excess capillary on remote element instruments.

.15 Provide instruments with scale ranges selected according to service with largest appropriate scale.

.16 Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

.17 Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

.18 Locate test plugs adjacent to control device sockets.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Expansion tanks.

.2 Air vents.

.3 Air-sediment separators.

.4 Strainers.

.5 Flow indicators, controls, meters.

.6 Relief valves.

1.2 REFERENCES

.1 ASME - SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

.2 ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

.3 NBCC 2010 - National Building Code of Canada

.4 NPCC 2010 – National Plumbing Code of Canada

.5 NFCC 2010 – National Fire Code of Canada

1.3 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

.3 Submit inspection certificates for pressure vessels from authority having jurisdiction.

.4 Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.4 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittal Procedures.

.2 Record actual locations of hydronic specialties.

1.5 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Submittal Procedures.

.2 Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept valves on site in shipping containers with labeling in place. Inspect for damage.

.3 Provide temporary protective coating on cast iron and steel valves.

.4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

.5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 MAINTENANCE SERVICE

.1 Provide service and maintenance of glycol system for one (1) year from date of substantial completion.

.2 Provide a monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

Part 2 Products

2.1 DIAPHRAGM-TYPE EXPANSION TANKS

.1 Manufacturers:

.1 Bell and Gossett
.2 Armstrong
.3 Armtrol
.4 Expanflex
.5 Substitutions: Refer to Section 21 05 00

.1 Provide pre-charged, diaphragm expansion tanks meeting current ASME and CSA code requirements designed for a minimum working pressure of 860 kPa (125 psi).

.2 Tanks to be constructed of mild steel with finish painted surface and complete with all necessary tappings in combination with fill valve and automatic vent, angle cocks and guards.

.3 Air charging valve connection to be standard Schrader tire valve.

.4 Diaphragm to be Heavy Duty Butyl Rubber.

.5 Sizes to be as shown on the drawings and as specified.

.6 Expansion tanks shall be finish painted

.7 Hot Water Heating and Chilled Water Systems:

.1 Select expansion tank pressure relief valve as noted in schedule.

.2 Set pressure reducing valve as noted in schedule.

2.2 AIR VENTS

.1 Manual Type:

.1 Manufacturers:

.1 Dole

.2 Bell and Gossett

.3 Maid O'Mist

.4 Watts

.5 Substitutions: Refer to Section 21 05 00

.2 Short vertical sections of 50 mm (2 inch) diameter pipe to form air chamber, with 3 mm (1/8 inch) brass needle valve at top of chamber.

.2 Float Type:

.1 Manufacturers:

.1 Maid O'Mist

.2 Watts

.3 Bell and Gossett

.4 Armstrong

.5 Armtrol

.6 Substitutions: Refer to Section 21 05 00

.2 Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.3 AIR SEPARATORS

.1 Tangential/vortex style In-line Air Separators:

.1 Manufacturers:

.1 Bell and Gossett

.2 Armstrong

.3 Substitutions: Refer to Section 21 05 00

.2 Tangential/vortex style in-line separator; steel body; tested and stamped to ASME SEC 8-D; for 862 kPa (125 psig) operating pressure.

.3 Unit shall be complete with threaded air vent connection and threaded blowdown connection.

2.4 STRAINERS

.1 Manufacturers:

.1 Spirax-Sarco

.2 Watts

.3 Crane

.4 Mueller

.5 Substitutions: Refer to Section 21 05 00.

.2 All high pressure steam shall be Y pattern and shall have a gate valve, nipple and cap to allow in service blow down.

.3 On Liquid heat transfer services,

.1 50 mm (2 inch) and under:

.1 Screwed brass or iron body for 1200 kPa (175 psig) working pressure, Y pattern with stainless steel or Monel perforated screen.

.2 Mesh:

.1 0.8 mm (1/32 inch) serving all temperature control valves, automatic flow control devices,

2.5 AUTOMATIC FLOW CONTROLS

.1 Manufacturers:

.1 Griswold Controls

.2 Hays.

.3 Substitutions: Refer to Section 21 05 00.

.2 Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.

.3 Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance.

.4 All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale.

.5 Up to and including 50mm (2 inch):

.1 Cast brass body, rated at no less than 1900 kPa (275 psi) at 120 degrees C (250 degrees F),

.2 shall be constructed in a one-piece body to include a handle ball valve, a flow control cartridge assembly, dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes

combined with a manual air vent, and a union end which will accept various end pieces,

.3 shall include a removable 20 mesh stainless steel strainer,

.4 available flow rates shall be from 0.25 GPM to 160.0 GPM,

.5 the body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections.

.6 the body design shall allow inspection or repair of handle operated stem without disturbing piping connections. The repairable stem shall include two Teflon seals and one EPDM O-ring for protection against chemicals and modulating temperature,

.7 the valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.

.6 50mm to 500mm (2 inch to 20 inch):

.1 Class 150 Flange End Valves:

.1 Shall consist of steel pipe with flange ends, and stainless steel flow control cartridge assembly;

.2 rated assembly at 1585 kPa (230 psi) at 150 degrees C (300 degrees F);

.3 shall be supplied with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes;

.4 shall have flange ends compatible with ANSI B 16.5-1968 150 lb. Steel flanges;

.5 shall be permanently marked to show direction of flow, shall have body tag to indicate model number and flow rate;

.6 shall be available in 50mm through 500mm (2 inch through 20 inch) sizes with flow rates from 0.8 L/s to 430 L/s (14.0 GPM to 6,800.0 GPM).

.7 Automatic flow control valve cartridges shall automatically control flow rates with 5-10 percent accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Four operating pressure ranges shall be available with the minimum range requiring less than 20 kPa (3 PSID) to actuate the mechanism.

2.6 RELIEF VALVES

.1 Manufacturers:

.1 Kunkle

.2 Spiraz-Sarco

.3 Watts

.4 Bell and Gossett

.5 Substitutions: Refer to Section 21 05 00.

.2 AMSE Section VIII rated valve:

.1 Carbon steel body, resilient EPDM or EPR soft seat, stainless steel stem and springs, packed leaver with gag. All wetted parts on leaver and gag screw to be stainless steel.

.2 Must be rated and stamped for ASME Section VIII.

.3 On 63mm (2 ½ inch) and larger connections, provide 150# flanges.

.3 Non-ASME rated valve:

.1 Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated.

.2 Designed for liquid service.

Part 3 Execution

3.1 INSTALLATION

.1 Install specialties to manufacturer's written instructions.

.2 Adjust expansion tank pressure to suit design criteria and as directed by the Contract Administrator.

.3 Install pressure gauge at inlet to tank.

.4 Provide valved drain connection on tank side of expansion tank isolation valve.

.5 Provide union connection and isolation valve at each tank to allow removal of tank without disrupting service.

.6 Where large air quantities can accumulate, provide enlarged air collection standpipes.

.7 Provide manual air vents at system high points and as indicated.

.8 For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

.9 Provide air separator on suction side of system circulation pump and connect to expansion tank.

.10 Provide valved drain and hose connection on strainer blow down connection.

.11 Supply and install strainers ahead of all steam traps, temperature control valves, pressure reducing valves, pump suctions and where indicated on the drawings. Strainers not required on steam traps if strainer is integral part of steam trap.

.12 Support pump fittings with floor mounted pipe and flange supports.

.13 Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.

.14 Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

.15 Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

.16 Pipe relief valve outlet to nearest floor drain.

.17 Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Pipe and equipment hangers and supports.

.2 Equipment bases and supports.

.3 Sleeves and seals.

.4 Flashing and sealing equipment and pipe stacks.

1.2 REFERENCES

.1 ASME B31.1 - Power Piping.

.2 ASME B31.2 - Fuel Gas Piping.

.3 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.

.4 ASME B31.9 - Building Services Piping.

.5 ASTM F708 - Design and Installation of Rigid Pipe Hangers.

.6 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

.7 MSS SP69 - Pipe Hangers and Supports - Selection and Application.

.8 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

.9 NFPA 13 - Installation of Sprinkler Systems.

.10 NFPA 14 - Installation of Standpipe, Private Hydrants, and Hose Systems.

.11 UL 203 - Pipe Hanger Equipment for Fire protection Service.

1.3 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

.3 Product Data: Provide manufacturers catalogue data including load capacity.

.4 Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

.5 Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.4 REGULATORY REQUIREMENTS

.1 Conform to applicable code for support of plumbing, hydronic, steam and steam condensate piping.

.2 Supports for Sprinkler Piping: To NFPA 13.

.3 Supports for Standpipes: To NFPA 14.

Part 2 Products

2.1 PIPE HANGERS AND SUPPORTS

.1 Manufacturers:

.1 Anvil.

.2 Grinnel.

.3 Substitutions: Refer to Section 21 05 00.

.2 Fire Protection Piping:

.1 Conform to NFPA 13.

.2 Hangers for Pipe Sizes 13 to 38 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 75 mm (3 inches): Cast iron hook.

.6 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.3 Plumbing Piping - DWV:

.1 Conform to ASME B31.9.

.2 Cast Iron DWV Piping:

.1 Hangers for Pipe Sizes 13 to 38 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.

.2 Hangers for Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.

.3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.4 Wall Support for Pipe Sizes to 75 mm (3 inches): Cast iron hook.

.5 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.

.6 Vertical Support: Steel riser clamp.

.7 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.8 Clamping for MJ couplings: Socket-pipe clamps with washers, threaded rod, and nuts (Anvil Fig. 594 & 595 or equal).

.3 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.4 PVC DWV Pipe Support: to manufacturer's requirements.

.4 Plumbing Piping - Water:

.1 Conform to ASME B31.9.

.2 Perforated strap or wire hangers are not permitted.

.3 Hangers to be adjustable after pipe is in place.

.4 Clevis hangers shall be oversized to suit the outside diameter of insulation and jacket to maintain the integrity of insulation and vapour barrier.

.1 Protection Saddles

.1 On piping 2" and smaller, carry insulation over pipe hangers. On all domestic cold water piping over 1-1/4", use oversized clevis hangers and GSS insulation protection shield to maintain integrity of vapour barrier.

.2 On copper piping over 2", use at each hanger or support Grinnell Fig. 167 protection shield or equal. Shields shall have a minimum length of 12" (305mm) to spread weight. Rectangular solid wood blocks, cut to suit the insulation thickness, shall be installed at hanger locations. Wedges are not permitted.

.5 Hangers for Pipe Sizes 15 to 40 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.

.6 Hangers for Cold Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.

.7 Hangers for Hot Pipe Sizes 50 to 100 mm (2 to 4 inches): Carbon steel, adjustable, clevis.

.8 Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable steel yoke, cast iron pipe roll, double hanger.

.9 Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

.10 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.

.11 Wall Support for Pipe Sizes to 80 mm (3 inches): Cast iron hook.

.12 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.

.13 Wall Support for Hot Pipe Sizes 150 mm (6 inches) and over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.

.14 Vertical Support: Steel riser clamp.

.15 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.16 Floor Support for Hot Pipe Sizes to 100 mm (4 inches): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

.17 Floor Support for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.

.18 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.19 Isolation: Copper piping shall be isolated from steel supports by appropriate use of copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators.

.5 Hydronic Piping:

.1 Conform to ASME B31.9.

.2 Perforated strap or wire hangers are not permitted.

.3 Hangers to be adjustable after pipe is in place.

.4 Clevis hangers shall be oversized to suit the outside diameter of insulation and jacket to maintain the integrity of insulation and vapour barrier.

.1 Protection Saddles

.1 On piping 2" and smaller, carry insulation over pipe hangers. On all chilled water piping, and domestic cold water piping over 1-1/4”, use oversized clevis hangers and GSS insulation protection shield to maintain integrity of vapour barrier.

.2 On insulated steel pipe over 2" use at each hanger or support, Grinnell Fig. 160, 161 or 162 to suit pipe size and insulation thickness. Pack space between saddle and pipe with insulation.

.3 On copper piping over 2", use at each hanger or support Grinnell Fig. 167 protection shield or equal. Shields shall have a minimum length of 12" (305mm) to spread weight. Rectangular solid wood blocks, cut to suit the insulation thickness, shall be installed at hanger locations. Wedges are not permitted.

.5 Where pipe expansion in excess of 12mm (1/2") axially occurs or where indicated to be installed on the drawings, provide Grinnell Fig. 171 Adjustable Pipe Roll or Grinnell Fig. 271 Pipe Roll Stand.

.6 Hangers for Pipe Sizes 13 to 38 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.

.7 Hangers for Cold Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.

.8 Hangers for Hot Pipe Sizes 50 to 100 mm (2 to 4 inches): Carbon steel, adjustable, clevis.

.9 Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable steel yoke, cast iron roll, double hanger.

.10 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.11 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Steel channels with welded spacers and hanger rods, cast iron roll.

.12 Wall Support for Pipe Sizes to 76 mm (3 inches): Cast iron hook.

.13 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.

.14 Wall Support for Hot Pipe Sizes 150 mm (6 inches) and over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

.15 Vertical Support: Steel riser clamp.

.16 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.17 Floor Support for Hot Pipe Sizes to 100 mm (4 inches): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.18 Floor Support for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

.19 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.20 Isolation: Copper piping shall be isolated from steel supports by appropriate use of copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators.

.21 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

.22 Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

.6 Refrigerant Piping:

.1 Conform to ASME B31.5.

.2 Hangers for Pipe Sizes 13 to 38 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 75 mm (3 inches): Cast iron hook.

.6 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

.1 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

.1 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

.1 Metal Flashing: 0.5 mm thick (26 gauge) galvanized steel.

.2 Metal Counterflashing: 0.8 mm thick (22gauge) galvanized steel.

.3 Flexible Flashing: 1.2mm (47 mil) thick sheet butyl; compatible with roofing.

.4 Caps: Steel, 0.8 mm (22 gauge) minimum; 1.5 mm (16 gauge) at fire resistant elements.

2.5 SLEEVES

.1 Sleeves for Pipes Through Non-fire Rated Floors: 1.2 mm thick (18 gauge) galvanized steel.

.2 Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 1.2mm thick (18 gauge) galvanized steel.

.3 Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed refer to Section 07 84 00.

.4 Where pipes pass through floors, walls or ceilings, in finished areas and where exposed to view, supply and install chrome-plated pressed steel floor plates.

.5 Sleeves for Round Ductwork: Galvanized steel.

.6 Sleeves for Rectangular Ductwork: Galvanized steel or wood.

.7 Firestopping Insulation: Glass fibre type, non-combustible; refer to Section 07 84 00.

.8 Sealant: Acrylic; refer to Section 07 92 00.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

3.2 INSERTS

.1 Provide inserts for placement in concrete formwork.

.2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

.3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over100 mm (4 inches).

.4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

.5 Install galvanized oversize pipe sleeves on all pipes passing through walls or partitions, for building into wall construction by other trades.

.6 All sleeves are to be large enough to accommodate pipe insulation as specified.

.7 The Mechanical Division shall include in tender price all cost of drilling for sleeves up to 175 mm (7") in precast sections relative to work under Mechanical Division. Prior to drilling all openings/locations must be checked by the Contract Administrator. Drilling shall be done using diamond core drilling machinery.

.8 All sleeves in mechanical rooms, janitors closets and washrooms shall extend 100 mm (4") above the finished floor level to prevent water seeping down.

.9 Caulk the space between pipes and floor sleeves or openings, to prevent water seeping down, with an approved caulking compound. The caulking compound and method of application shall be to the Contract Administrator's approval.

.10 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

3.3 PIPE HANGERS AND SUPPORTS

.1 Install to manufacturer's written instructions.

.2 Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9.

.3 Perforated strap or wire hangers will not be permitted.

.4 Support horizontal piping as scheduled.

.5 Hangers in new concrete structural floor systems shall be supported by inserts placed prior to pouring of concrete. Inserts shall be Grinnell cast iron or wrought steel adjustable type.

.6 Where hangers must be installed in existing concrete slabs, approved expansion type inserts shall be used, or if heavy weights must be supported, a hole shall be drilled through the slab and a 50 mm x 50 mm (2" x 2") washer and nut installed above rough slab before the floor finish is poured.

.7 Where the structural system is open web steel joists, piping shall be supported by means of angles spanning the bottom or top chords of adjacent joists. The number of joists to be spanned in this way shall be determined by the incident load of piping.

.8 In no case shall the hanging of piping directly from roof decking be allowed, unless special permission is obtained from the Contract Administrator.

.9 Copper hot water piping in long runs, where expansion may be significant and where hanger rods are less than 600 mm (2") in length may require roller hangers. Any such cases which cannot be avoided shall be referred to the Contract Administrator for a decision. If necessary, roller hangers shall be installed as directed with protection saddles as specified. Expansion and contractions of domestic H.W. piping should not be a problem, as wide fluctuations in temperature are not normal. Piping shall be hung from slabs, rather than from the bottom of beams, in order to keep hanger rods sufficiently long to take up any movement.

.10 Install hangers to provide minimum 13 mm (1/2 inch) space between finished covering and adjacent work.

.11 Place hangers within 300 mm (12 inches) of each horizontal elbow.

.12 Use hangers with 38 mm (1-1/2 inch) minimum vertical adjustment.

.13 Support horizontal cast iron pipe adjacent to each hub, with 1.5 m (5 feet) maximum spacing between hangers.

.14 Support all pipe with MJ couplings on both sides of the joint. At multiple fittings or short lengths, support every 300 mm (12”).

.15 Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub or with pipe clamps on hubless pipe.

.16 Storm water piping:

.1 All pipe supports, anchors, clamping, and thrust supports shall support the weight of the pipe and its contents.

.2 Provide all necessary support to restrain thrust forces resulting from internal pipe pressures. Refer to CISPI 301 & 310.

.3 Install restraint clamps across all no-hub MJ couplings on piping 125 mm (5”) and larger for all horizontal piping, including elbows at the base of a vertical pipe. Clamps shall be socket clamps on either side of the coupling connected with suitably sized threaded rod.

.4 Restrain all joints on piping 125 mm (5”) and larger to prevent horizontal movement. Use sway bracing as needed to restrain sideways movement of the system. Install blocks, rods, bracing or other suitable methods at each branch opening or change in direction.

.5 Storm water piping below grade including in the crawlspace shall be adequately supported with thrust blocks or suitable anchors to restrain all sideways movement and thrust forces.

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

.18 Support riser piping independently of connected horizontal piping.

.19 Provide copper plated hangers and supports for copper piping.

.20 Design hangers for pipe movement without disengagement of supported pipe.

.21 All hanger rods shall have sufficient threaded length to allow for vertical adjustment of hangers after pipe is in place. Use 2 nuts on each rod, one above the clevis or angle iron and one below.

.22 Where pipes or equipment are supported from floors or walls, structural steel supports shall be fabricated, using welded joints except where provision is made for adjustment. Where details of construction are not indicated, drawings shall be submitted to Contract Administrator for approval before fabrication.

.23 Clamps should be located immediately below a coupling if possible. Risers up to 50 mm (2") size shall be braced at intervals not over 2100 mm (7').

.24 Vertical piping other than risers through floors shall be provided with suitable supports, sway braces, etc.

.25 Vertical piping shall be supported at the base in an approved manner.

.26 On insulated piping supported by roller supports or trapeze supports (angle iron) provide at each hanger or support a protection saddle of 16 ga. galvanized sheet steel, rolled to match the outside diameter of the insulation. The saddle shall cover approximately the bottom one third of the circumference of the insulation. The length shall be at least as long as that recommended by the insulation manufacturer as published in their data.

.27 On insulated pipe up to and including 50 mm (2") pipe, clevis hangers shall be sized to suit the O.D. of the pipe. On insulated pipe of 63 mm (2½") and above, the hangers shall be sized to suit the O.D. of the insulation and protection saddles, as described above shall be installed.

.28 Prime coat exposed steel hangers and supports. [Refer to Section 09 91 10.] Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

.1 Provide housekeeping pads of concrete, minimum 100 mm (4 inches) thick and extending 150 mm (6 inches) beyond supported equipment. Refer to Section 03 30 00.

.2 Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

.3 Construct supports of steel members. Brace and fasten with flanges bolted to structure.

.4 Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

.1 Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

.2 Provide copper flashing for sleeves passing through exterior surfaces or waterproof assemblies.

.3 Flash floor drains in floors with topping over finished areas with lead, 250 mm (10 inches) clear on sides with minimum 910 x 910 mm (36 x 36 inch) sheet size. Fasten flashing to drain clamp device.

.4 Seal floor, shower, & mop sink drains watertight to adjacent materials.

.5 Provide curbs for mechanical roof installations 350 mm (14 inches) minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

.6 Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

.1 Set sleeves in position in formwork. Provide reinforcing around sleeves.

.2 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

.3 Extend sleeves through floors 25mm (1 inch) above finished floor level. Caulk sleeves.

.4 All sleeves in mechanical rooms, janitors closets and washrooms shall extend 100 mm (4") above the finished floor level to prevent water seeping down.

.5 Install galvanized oversize pipe sleeves on all pipes passing through walls or partitions, for building into wall construction by other trades.

.6 All sleeves are to be large enough to accommodate pipe insulation as specified.

.7 The Mechanical Division shall include in tender price all cost of drilling for sleeves up to 175 mm (7") in precast sections relative to work under Mechanical Division. Prior to drilling all openings/locations must be checked by the Contract Administrator. Drilling shall be done using diamond core drilling machinery.

.8 Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with insulation and caulk, air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

.9 Install stainless steel escutcheons at finished surfaces.

3.7 SCHEDULES

.1 Maximum spacing between pipe supports:

.1 Hangers shall be installed not more than 12” (300mm) from each change in direction of pipes.

.2 Where there are concentrations of valves and fittings, closer spacing will be necessary.

.3 Steel Pipe:

.1	Up to 50mm (2")	2.4m (8 ft.)
.2	65mm (2½”) to 150mm (6”)	3.6m (12 ft.)
.3	200mm (8”) to 300mm (12”)	5.4m (18 ft.)
.4	350mm (14”) to 450mm (18”)	7.2m (24 ft.)
.5	500mm (20”) to 600mm (24”)	9.0m (30 ft.)

.4 Copper Tubing (Hard):

.1	Up to 25mm (1")	1.8m (6 ft.)
.2	32mm (1½”) to 50mm (2”)	2.4m (8 ft.)
.3	63mm (2 ½”) to 75mm (3”)	3.0m (10 ft.)
.4	100mm (4”) to 150mm (6”)	3.6m (12 ft.)

.5 200mm (8”) to 300mm (12”) 4.8m (16 ft.)

.5 Cast Iron Pipe

.1 Maximum spacing – maximum 5 ft. (1.5m)

.2 Support M.J. pipe on both sides of joint. Provide with sway braces and anchors to Contract Administrator’s approval. At multiple fittings, or short lengths, support every 300mm (12”).

.6 Plastic (PVC, CPVC, PEX)

.1 As recommended by manufacturer for corresponding sizes and materials.

.2 All sizes – do not exceed 1.2m (4 ft).

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Nameplates.

.2 Tags.

.3 Stencils.

.4 Pipe Markers.

1.2 REFERENCES

.1 ASME A13.1 - Scheme for the Identification of Piping Systems.

.2 CAN/CGSB 24.3 – Identification of Piping Systems

1.3 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.

.3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

.4 Product Data: Provide manufacturers catalogue literature for each product required.

.5 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.4 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of tagged valves.

Part 2 Products

2.1 NAMEPLATES

.1 Description: Laminated three-layer plastic with engraved black letters on light contrasting background colour.

2.2 TAGS

.1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 40 mm (1-1/2 inch) diameter.

.2 Chart: Typewritten letter size list in anodized aluminum frame.

2.3 STENCILS

.1 Stencils: With clean cut symbols and letters of following size:

.1 20-30 mm (3/4 to 1-1/4 inch) Outside Diameter of Insulation or Pipe: 200 mm (8 inch) long colour field, 15 mm (1/2 inch) high letters.

.2 40-50 mm (1-1/2 to 2 inch) Outside Diameter of Insulation or Pipe: 200 mm (8 inch) long colour field, 20 mm (3/4 inch) high letters.

.3 65-150 mm (2-1/2 to 6 inch) Outside Diameter of Insulation or Pipe: 300 mm (12 inch) long colour field, 30 mm (1-1/4 inch) high letters.

.4 200-250 mm (8 to 10 inch) Outside Diameter of Insulation or Pipe: 600 mm (24 inch) long colour field, 65 mm (2-1/2 inch) high letters.

.5 Over 250 mm (10 inch) Outside Diameter of Insulation or Pipe: 800 mm (32 inch) long colour field, 90 mm (3-1/2 inch) high letters.

.6 Ductwork and Equipment: 65 mm (2-1/2 inch) high letters.

.2 Stencil Paint: As specified in Section 09 91 10, semi - Painting.1.

2.4 PIPE MARKERS

.1 Colour: Conform to ASME A13.1.

.2 Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

.3 Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

.4 Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum 150 mm (6 inches) wide by 0.10 mm (4 mil) thick, manufactured for direct burial service.

2.5 CEILING TACKS

.1 Description: Steel with 20 mm (3/4 inch) diameter colour coded head.

.2 Colour code as follows:

.1 Yellow - HVAC equipment

.2 Red - Fire dampers/smoke dampers

.3 Green - Plumbing valves

.4 Blue - Heating/cooling valves

Part 3 Execution

3.1 PREPARATION

.1 Degrease and clean surfaces to receive adhesive for identification materials.

.2 Prepare surfaces to Section 09 91 10 for stencil painting.

3.2 INSTALLATION

.1 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

.2 Install tags with corrosion resistant chain.

.3 Apply stencil painting to Section 09 91 10.

.4 Install plastic pipe markers to manufacturer's written instructions.

.5 Install plastic tape pipe markers complete around pipe to manufacturer's written instructions.

.6 Install underground plastic pipe markers 150 to 200 mm (6 to 8 inches) below finished grade, directly above buried pipe.

.7 Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

.8 Identify control panels and major control components outside panels with plastic nameplates.

.9 Identify thermostats relating to terminal boxes or valves with nameplates.

.10 Identify valves in main and branch piping with tags.

.11 Identify air terminal units and radiator valves with numbered tags.

.12 Tag automatic controls, instruments, and relays. Key to control schematic.

.13 Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 20 mm (3/4 inch) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 6 m (20 feet) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

.14 Identify ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

.15 Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

.16 At a minimum, equipment, piping, and ductwork shall be clearly labeled as to their function and direction of flow in accordance with CAN/CGSB 24.3.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Testing, adjustment, and balancing of air systems.

.2 Fire and smoke damper testing & verification.

.3 Testing, adjustment, and balancing of hydronic systems.

.4 Measurement of final operating condition of HVAC systems.

1.2 ALLOWANCES

.1 Section 01 21 00: Cash Allowance Sum applicable to this section.

.2 Allowance includes testing, adjusting, and balancing of mechanical systems.

.3 Work is included in this section and is part of the Contract Sum/Price.

1.3 REFERENCES

.1 AABC - National Standards for Total System Balance.

.2 ADC - Test Code for Grilles, Registers, and Diffusers.

.3 ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

.4 CSA B149.1 - Natural gas and propane installation code

.5 NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

.6 SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

.3 Submit draft copies of report for review prior to final acceptance of Project. Draft copies shall be submitted in electronic format (Adobe Acrobat PDF file). Provide final copies for Contract Administrator and for inclusion in operating and maintenance manuals.

.4 Provide final reports in letter size, soft cover or 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Also submit an electronic copy (PDF file) of the same. Include set of reduced drawings with air outlets

and equipment identified to correspond with data sheets, and indicating thermostat locations.

.5 Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data in either S.I. Metric or IP units to match the primary units used on the drawings and schedules.

1.5 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of flow measuring stations, balancing valves, balancing dampers, and fire dampers.

1.6 QUALITY ASSURANCE

.1 Perform total system balance to AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

1.7 QUALIFICATIONS

.1 Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience, and certified by AABC.

.2 Perform Work under supervision of AABC Certified Test and Balance Supervisor.

1.8 PRE-BALANCING CONFERENCE

.1 Convene one week prior to commencing work of this section, to Section 21 05 00.

1.9 SEQUENCING

.1 Sequence work to Section 01 10 00.

.2 Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.10 SCHEDULING

.1 Schedule work to Section 21 05 00.

.2 Schedule and provide assistance in final adjustment and test of life safety, smoke evacuation, and/or smoke control system with Fire Authority.

1.11 PROJECT CLOSE-OUT

.1 The Testing, Adjusting and Balancing agency as part of its contract shall act as authorized inspection agency, responsible to list all items that are installed incorrectly, require correction or have not been installed in accordance with contract drawings and/or specifications, pertaining to the air distribution, cooling and heating systems. The Mechanical Mechanical subcontractor shall make good these items.

.2 Final payment on the building will not be issued until the final air balance report has been submitted to the Contract Administrator and has been approved by the Contract Administrator.

Part 2 Products

.1 Not used

Part 3 Execution

3.1 AGENCIES

.1 Air Movement Services Ltd.

.2 Airdronics Inc.

.3 D.F.C. Mechanical Testing & Balancing Ltd.

.4 AHS Testing & Balancing.

3.2 EXAMINATION

.1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:

- .1 Systems are started and operating in a safe and normal condition.
- .2 Temperature control systems are installed complete and operable.
- .3 Proper thermal overload protection is in place for electrical equipment.
- .4 Final filters are clean and in place. If required, install temporary media in addition to final filters.
- .5 Duct systems are clean of debris.
- .6 Fans are rotating correctly.
- .7 Fire and volume dampers are in place and open.
- .8 Air coil fins are cleaned and combed.
- .9 Access doors are closed and duct end caps are in place.
- .10 Air outlets are installed and connected.
- .11 Duct system leakage is minimized.
- .12 Hydronic systems are flushed, filled, and vented.
- .13 Pumps are rotating correctly.
- .14 Proper strainer baskets are clean and in place.
- .15 Service and balance valves are open.

.2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

.3 Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

.1 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Contract Administrator to facilitate spot checks during testing.

.2 Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

.1 Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

.2 Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

.3 Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 ADJUSTING

.1 Ensure recorded data represents actual measured or observed conditions.

.2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

.3 Make any changes in pulleys and belts, and add any manual dampers as required for correct balance, at no additional cost to the The City.

.4 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

.5 Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.6 AIR SYSTEM PROCEDURE

.1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

.2 Test and record motor full load amperes.

.3 Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

.4 Measure air quantities at air inlets and outlets.

.5 Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

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

.7 All outlets shall be adjusted to provide proper throw and directional distribution in accordance with the requirements on the drawings and/or schedules.

.8 Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

.9 Provide system schematic with required and actual air quantities recorded at each outlet or inlet. Each grille, diffuser and register shall be identified as to location and area.

.10 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

.11 Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Any re-adjustments of controls as deemed necessary, shall be made in co-operation with the Control Submechanical subcontractor.

.12 Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

.1 Test and record entering air temperatures (D.B. heating and cooling).

.2 Test and record entering air temperatures (W.B. cooling).

.3 Test and record leaving air temperatures (D.B. heating and cooling).

.4 Test and record leaving air temperatures (W.B. cooling).

.13 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. Refer to the maximum and minimum rates on the drawings and schedules.

.14 Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 12.5 Pa (0.05 inches) positive static pressure near the building entries.

.15 Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

.16 For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

.17 All pitot-tube openings shall have plastic plugs of proper size in uninsulated or internally insulated ductwork. Insulated ductwork shall be provided with rubber plugs that extend to the face of the insulation. Cover the plugs on insulated ductwork with strip of grey tape.

.18 After completion of final balance, the Balance Mechanical subcontractor shall permanently fix the damper operator with a strip of contact tape and spray the quadrant with bright paint to permanently mark its balanced position.

3.7 FIRE & SMOKE DAMPER TESTING & VERIFICATION

.1 Testing of Fire Dampers, Ceiling Fire Stops and/or Fire/Smoke Dampers

.1 General

.1 The Testing, Adjusting and Balancing agency shall test this equipment after installation.

.2 Test and verify operation of all fire dampers and ceiling fire stops in this project.

.3 Test shall include manually releasing fusible link; allowing damper to close to ensure that it has tight-fit closing operation without binding; opening fire damper and/or closing ceiling fire stop and resetting fusible link connection.

.4 Instruct Sections 23 31 00 and 23 33 00 to repair all fire dampers and/or ceiling fire stops that have been identified as being faulty.

.2 Identification of Fire Dampers and Ceiling Fire Stops

.1 At all fire dampers and ceiling fire stops, supply and install tags as approved by the Contract Administrator.

.2 Tags shall be mechanically fastened to duct fire damper access door, or onto or on structure near fire dampers or ceiling fire stops which have no connecting ductwork.

.3 After each fire damper has been tested and has been proven to operate satisfactorily as noted in previous clause, a representative of the Testing, Adjusting and Balancing agency shall label unit number and mark date and signature on tag. Tags shall have space for minimum size further dates and signatures for future checking of damper operation by The City's staff.

.3 Test Report for Fire Dampers and Ceiling Fire Stops

.1 The Testing, Adjusting and Balancing agency shall provide a Test Report.

.2 The report shall include following for each fire damper:

.1 Verification that the unit is fully accessible.

.2 Verification that the unit has been successfully tested.

.3 Verification that the unit has been reset.

.4 Name of tester.

.5 Date that the unit tested successfully.

.6 Location schedule of all dampers i.e. each damper must be labelled.

.3 Provide one copy of completed report to Contract Administrator. After the Contract Administrator has reviewed report, provide to the Mechanical Subtrade sufficient copies of report to insert one in each Maintenance/Operating Manual.

.4 Testing of Fire/Smoke Dampers

.1 Provide all testing, tagging, and Test Report for all Fire/Smoke Dampers.

.2 Follow instruction noted in previous clause as noted for Fire Dampers and Ceiling fire stops.

3.8 WATER SYSTEM PROCEDURE

.1 Adjust water systems to provide required or design quantities.

.2 Use calibrated fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

.3 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

.4 Effect system balance with automatic control valves fully open to heat transfer elements.

.5 Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

.6 Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.9 SCHEDULES

.1 Equipment requiring testing, adjusting and balancing:

- .1 Plumbing Pumps
- .2 HVAC Pumps
- .3 Air Cooled Refrigerant Condensers
- .4 Air Coils
- .5 Terminal Heat Transfer Units
- .6 Air Handling Units
- .7 Fans
- .8 Air Filters
- .9 Air Terminal Units
- .10 Air Inlets and Outlets

.2 Report Forms

- .1 Title Page:
  - .1 Name of Testing, Adjusting, and Balancing Agency
  - .2 Address of Testing, Adjusting, and Balancing Agency
  - .3 Telephone number of Testing, Adjusting, and Balancing Agency
  - .4 Project name
  - .5 Project location
  - .6 Contract Administrator
  - .7 Project Mechanical subcontractor
  - .8 Project altitude
  - .9 Report date

.2 Summary Comments:
- .1 Design versus final performance
- .2 Notable characteristics of system
- .3 Description of systems operation sequence
- .4 Summary of outdoor and exhaust flows to indicate amount of building pressurization
- .5 Nomenclature used throughout report
- .6 Test conditions

.3 Instrument List:
- .1 Instrument
- .2 Manufacturer
- .3 Model number
- .4 Serial number
- .5 Range
- .6 Calibration date

.4 Electric Motors:
- .1 Manufacturer
- .2 Model/Frame
- .3 HP/BHP
- .4 Phase, voltage, amperage; nameplate, actual, no load
- .5 RPM
- .6 Service factor
- .7 Starter size, rating, heater elements
- .8 Sheave Make/Size/Bore

.5 V-Belt Drive:
- .1 Identification/location
- .2 Required driven RPM
- .3 Driven sheave, diameter and RPM
- .4 Belt, size and quantity
- .5 Motor sheave diameter and RPM
- .6 Centre to centre distance, maximum, minimum, and actual

.6 Pump Data:
- .1 Identification/number
- .2 Manufacturer
- .3 Size/model
- .4 Impeller
- .5 Service
- .6 Design flow rate, pressure drop, BHP
- .7 Actual flow rate, pressure drop, BHP
- .8 Discharge pressure
- .9 Suction pressure
- .10 Total operating head pressure

.11 Shut off, discharge and suction pressures
.12 Shut off, total head pressure

.7 Air Cooled Condenser:
.1 Identification/number
.2 Location
.3 Manufacturer
.4 Model number
.5 Serial number
.6 Entering DB air temperature, design and actual
.7 Leaving DB air temperature, design and actual
.8 Number of compressors

.8 Heating Coil Data:
.1 Identification/number
.2 Location
.3 Service
.4 Manufacturer
.5 Air flow, design and actual
.6 Water flow, design and actual
.7 Water pressure drop, design and actual
.8 Entering water temperature, design and actual
.9 Leaving water temperature, design and actual
.10 Entering air temperature, design and actual
.11 Leaving air temperature, design and actual
.12 Air pressure drop, design and actual

.9 Air Moving Equipment
.1 Location
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Arrangement/Class/Discharge
.6 Air flow, specified and actual
.7 Return air flow, specified and actual
.8 Outside air flow, specified and actual
.9 Total static pressure (total external), specified and actual
.10 Inlet pressure
.11 Discharge pressure
.12 Sheave Make/Size/Bore
.13 Number of Belts/Make/Size
.14 Fan RPM

.10 Return Air/Outside Air Data:
.1 Identification/location
.2 Design air flow

.3 Actual air flow
.4 Design return air flow
.5 Actual return air flow
.6 Design outside air flow
.7 Actual outside air flow
.8 Return air temperature
.9 Outside air temperature
.10 Required mixed air temperature
.11 Actual mixed air temperature
.12 Design outside/return air ratio
.13 Actual outside/return air ratio

.11 Exhaust Fan Data:
.1 Location
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Air flow, specified and actual
.6 Total static pressure (total external), specified and actual
.7 Inlet pressure
.8 Discharge pressure
.9 Sheave Make/Size/Bore
.10 Number of Belts/Make/Size
.11 Fan RPM

.12 Duct Traverse:
.1 System zone/branch
.2 Duct size
.3 Area
.4 Design velocity
.5 Design air flow
.6 Test velocity
.7 Test air flow
.8 Duct static pressure
.9 Air temperature
.10 Air correction factor

.13 Flow Measuring Station:
.1 Identification/number
.2 Location
.3 Size
.4 Manufacturer
.5 Model number
.6 Serial number
.7 Design Flow rate

.8 Design pressure drop
.9 Actual/final pressure drop
.10 Actual/final flow rate
.11 Station calibrated setting

.14 Terminal Unit Data:
.1 Manufacturer
.2 Type, constant, variable, single, dual duct
.3 Identification/number
.4 Location
.5 Model number
.6 Size
.7 Minimum static pressure
.8 Minimum design air flow
.9 Maximum design air flow
.10 Maximum actual air flow
.11 Inlet static pressure

.15 Air Distribution Test Sheet:
.1 Air terminal number
.2 Room number/location
.3 Terminal type
.4 Terminal size
.5 Area factor
.6 Design velocity
.7 Design air flow
.8 Test (final) velocity
.9 Test (final) air flow
.10 Percent of design air flow

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Duct work insulation.

.2 Duct Liner.

.3 Insulation jackets.

1.2 REFERENCES

.1 Section 01 43 00: Requirements for references and standards.

.2 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

.3 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.

.4 ASTM C553 - Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.

.5 ASTM C612 - Standard Specification for Mineral Fibre Block and Board Thermal Insulation.

.6 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

.7 ASTM C1071 - Fibrous Glass Duct Lining Insulation(Thermal Sound Absorbing Material).

.8 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

.9 ASTM E96 - Water Vapour Transmission of Materials.

.10 ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

.11 ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.12 NAIMA National Insulation Standards.

.13 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

.14 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.15 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS FOR REVIEW

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.4 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Applicator Qualifications: Company specializing in performing the work of this section minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS

.1 Materials: Flame spread/smoke developed rating of 25/50 to NFPA 255 / UL 723.

1.6 DELIVERY, STORAGE, AND PROTECTION

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

.3 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Section 21 05 00: Environmental conditions affecting products on site.

.2 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

.3 Maintain temperature during and after installation for minimum period of 24 hours.

Part 2 Products

2.1 VAPOUR BARRIER EXTERNAL DUCT WRAP, GLASS FIBRE, FLEXIBLE

.1 Manufacturers:

.1 Johns Manville Microlite XG

.2 Owens Corning SoftR Duct Wrap.

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: ASTM C553; flexible, noncombustible blanket.

.1 'ksi' ('K') value: ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).

.2 Maximum service temperature: 121 degrees C (250 degrees F).

.3 Maximum moisture absorption: 0.20 percent by volume.

.4 Density 72 kg/cu. meter (4.5 lb/cu. Foot).

.3 Vapour Barrier Jacket:

.1 Kraft paper with glass fibre yarn and bonded to aluminized film (FRK).

.2 Moisture vapour transmission: ASTM E96; 0.02 perm.

.3 Secure with pressure sensitive tape.

.4 Vapour Barrier Tape:

.1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

.5 Outdoor Vapour Barrier Mastic:

.1 Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.

.6 Tie Wire: Annealed steel, 1.5 mm (16 gauge).

2.2 VAPOUR BARRIER EXTERNAL GLASS FIBRE RIGID INSULATION BOARD

.1 Manufacturers:

.1 Johns Manville 800 Series

.2 Owens Corning Series 700

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: ASTM C612; rigid, noncombustible blanket.

.1 ‘ksi’ (‘K’) value : ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).

.2 Maximum service temperature: 121 degrees C (250 degrees F).

.3 Maximum moisture absorption: 0.20 percent by volume.

.4 Density: 72 kg/cu m (4.5 lb/cu ft).

.3 Vapour Barrier Jacket:

.1 Kraft paper with glass fibre yarn and bonded to aluminized film.

.2 Moisture vapour transmission: ASTM E96; 0.04 perm.

.3 Secure with pressure sensitive tape.

.4 Vapour Barrier Tape:

.1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

.5 Indoor Vapour Barrier Finish:

.1 Cloth: Untreated; 305 g/sq m (9 oz/sq yd) weight, glass fabric.

.2 Vinyl emulsion type acrylic, compatible with insulation, black colour.

2.3 JACKETS

.1 Canvas Jacket: UL listed.

.1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.

.2 Lagging Adhesive:

.1 Compatible with insulation.

2.4 GLASS FIBRE DUCT LINER, FLEXIBLE

.1 Manufacturers:

.1 Johns Manville LinaTex

.2 Owens Corning QuietR Textile Duct Liner.

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: ASTM C1071; flexible, noncombustible blanket with poly vinyl acetate polymer impregnated surface and edge coat,

.1 'ksi' ('K') Value: ASTM C518, maximum 0.045 at 24 degrees C (0.31 at 75 degrees F).

.2 Maximum Service Temperature: 121 degrees C (250 degrees F).

.3 Maximum Velocity on Coated Air Side: 30.5 m/s (6,000 fpm).

.4 Minimum Noise Reduction Criteria: ASTM C1071 0.30 for 13 mm (1/2 inch) thickness; 0.45 for 25 mm (1 inch) thickness; 0.60 for 40 mm (1-1/2 inches) thickness; 0.70 for 50 mm (2 inch) thickness.

.5 Minimum 55% Certified Recycled Content.

.3 Adhesive:

.1 Waterproof, ASTM E162 fire-retardant type.

.4 Liner Fasteners: Galvanized steel, with press-on head.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 70 00 - Examination and Preparation: Verification of existing conditions before starting work.

.2 Verify that duct work has been tested before applying insulation materials.

.3 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

.1 Section 01 43 00 - Quality Assurance: Manufacturer's written instructions.

.2 Install to NAIMA National Insulation Standards.

.3 All duct sizes on the drawings refer to inside duct dimensions. On all acoustically lined ductwork, the external duct dimensions shall be increased by the thickness of the lining.

.4 Insulated duct work conveying air below ambient temperature:

.1 Provide insulation with vapour barrier jackets.

.2 Finish with tape and vapour barrier jacket.

.3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.

.4 Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

.5 Insulated duct work conveying air above ambient temperature:

.1 Provide with or without standard vapour barrier jacket.

.2 Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

.6 Duct Work Exposed in Mechanical Equipment Rooms or Finished Spaces below 3 metres (10 feet) above finished floor: Finish with canvas jacket sized for finish painting.

.7 Where ducts are acoustically lined to the equivalent R-value, no exterior duct insulation is required, except where exposed to outside temperature and weather.

.8 External Duct Insulation Application:

.1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.

.2 Secure insulation without vapour barrier with staples, tape, or wires.

.3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.

.4 Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.

.5 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

.9 Duct and Plenum Liner Application:

.1 Adhere insulation with adhesive for 90 percent coverage.

.2 Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.

.3 Seal and smooth joints. Seal and coat transverse joints.

.4 Seal liner surface penetrations with adhesive.

.5 Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

.10 Install Elastomeric Cellular Thermal Duct Liner as per manufacturer’s recommendations.

3.3 SCHEDULES

.1 Duct insulation shall follow the Schedules below as a minimum requirement. These requirements shall apply regardless of whether or not duct insulation is shown on the drawings.

.2 Where duct insulation is shown on the drawings (either with the hatching convention or by means of a key note) and exceeds the requirements of the schedules below, the additional insulation requirements shall be met.

3.4 EXTERNAL DUCT WRAP, GLASS FIBRE, FLEXIBLE

DUCT SERVICE	**DUCT SIZE <Inch><mm>**	**THICKNESS <mm><Inch>**
All conditioned air supply ductwork in return plenums or un-conditioned space .	=< 400 mm (16”) per side, or round duct	29mm (1 1/8") Installed 38mm (1 ½”) Nominal
Combustion Air ductwork	all	38mm (1 1/2") Installed 50mm (2") Nominal
Round exhaust ducts, relief ducts from external wall or roof back for length of 3000mm (10 feet) or to insulated damper, whichever is greater	All	57mm (2 1/4") Installed 75mm (3") Nominal
Round outdoor air ducts located in conditioned space to the air handler or mixed air plenum.	All	95mm (3 3/4") Installed 125mm (5") Nominal

3.5 EXTERNAL GLASS FIBRE RIGID INSULATION BOARD

DUCT SERVICE	**DUCT SIZE <Inch><mm>**	**THICKNESS <mm><Inch>**
Air conditioning supply plenums, before, including, and after cooling coils	all	50mm (2")
All conditioned air supply ductwork in return plenums or un-conditioned space	> 400 mm (16”) per side	25mm (1")
Rectangular exhaust ducts, relief ducts from external wall or roof back for length of 3000mm (10 feet) or to insulated damper, whichever is greater	All	75mm (3")
Outdoor air ducts located in conditioned space from the intake louver at outside wall or roof to the air handler or mixed air plenum	All	75mm (3")

3.6 GLASS FIBRE DUCT LINER, FLEXIBLE

DUCT SERVICE	**DUCT SIZE** **<Inch><mm>**	**THICKNESS** **<mm><Inch>**
Rectangular air supply and return air ductwork where indicated on drawings by acoustic hatching symbol.	All	25mm (1")

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Equipment insulation.

.2 Covering.

1.2 REFERENCES

.1 Section 01 42 00: Requirements for references and standards.

.2 ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.3 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

.4 ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

.5 ASTM C195 - Mineral Fibre Thermal Insulating Cement.

.6 ASTM C240 - Testing Cellular Glass Insulation Block.

.7 ASTM C449/C449M - Mineral Fibre Hydraulic-Setting Thermal Insulating and Finishing Cement.

.8 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.

.9 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

.10 ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

.11 ASTM C552 - Cellular Glass Thermal Insulation.

.12 ASTM C553 - Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.

.13 ASTM C592 - Mineral Fibre Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).

.14 ASTM C612 - Mineral Fibre Block and Board Thermal Insulation.

.15 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

.16 ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

.17 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

.18 ASTM E96 - Water Vapour Transmission of Materials.

.19 NAIMA National Insulation Standards.

.20 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

.21 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS FOR REVIEW

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

1.4 SUBMITTALS FOR INFORMATION

.1 Section 21 05 00: Procedures for submittals.

.2 Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

.1 Materials: Flame spread/smoke developed rating of 25/50 to NFPA 255 //UL 723.

1.7 DELIVERY, STORAGE, AND PROTECTION

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

.3 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Section 21 05 00: Environmental conditions affecting products on site.

.2 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

.3 Maintain temperature during and after installation for minimum period of 24 hours.

Part 2 Products

2.1 GLASS FIBRE, FLEXIBLE

.1 Manufacturers:

.1 Johns Manville Microlite XG

.2 Owens Corning SoftR Duct Wrap.

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: ASTM C553; flexible, noncombustible blanket.

.1 'ksi' ('K') value: ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).

.2 Maximum service temperature: 121 degrees C (250 degrees F).

.3 Maximum moisture absorption: 0.20 percent by volume.

.4 Density 72 kg/cu. meter (4.5 lb/cu. Foot).

.3 Vapour Barrier Jacket:

.1 ASTM C921, Kraft paper reinforced with glass fibre yarn and bonded to aluminized film.

.2 Moisture vapour transmission: ASTM E96; 0.02 perm.

.3 Secure with self-sealing longitudinal laps and butt strips.

.4 Secure with outward clinch expanding staples and vapour barrier mastic.

.4 Tie Wire: 1.22 mm (0.048 inch) stainless steel with twisted ends on maximum 300 mm (12 inch) centres.

2.2 GLASS FIBRE, RIGID

.1 Manufacturers:

.1 Johns Manville 800 Series

.2 Owens Corning Series 700

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: ASTM C612; rigid, noncombustible blanket.

.1 'ksi' ('K') value : ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).

.2 Maximum service temperature: 121 degrees C (250 degrees F).

.3 Maximum moisture absorption: 0.20 percent by volume.

.4 Density: 72 kg/cu m (4.5 lb/cu ft).

.3 Vapour Barrier Jacket:

.1 Kraft paper with glass fibre yarn and bonded to aluminized film.

.2 Moisture vapour transmission: ASTM E96; 0.04 perm.

.3 Secure with self-sealing longitudinal laps and butt strips.

.4 Secure with outward clinch expanding staples and vapour barrier mastic.

.4 Facing: 25 mm (1 inch) galvanized steel hexagonal wire mesh stitched on one face of insulation.

.5 Vapour Barrier Lap Adhesive:

.1 Compatible with insulation.

.6 Insulating Cement/Mastic:

.1 ASTM C195; hydraulic setting on mineral wool.

2.3 CELLULAR FOAM

.1 Insulation: ASTM C534; flexible, cellular elastomeric, moulded or sheet.

.1 'ksi' ('K') Value: ASTM C177; 0.032 at 24 degrees C (0.25 at 75 degrees F).

.2 Minimum Service Temperature: -40 degrees C (-40 degrees F).

.3 Maximum Service Temperature: 104 degrees C (220 degrees F).

.4 Maximum Moisture Absorption: ASTM D1056; 1.0 percent by volume.

.5 Moisture Vapour Transmission: ASTM E96; 0.05 perm-inches.

.6 Connection: Waterproof vapour barrier adhesive.

.2 Elastomeric Foam Adhesive:

.1 Air dried, contact adhesive, compatible with insulation.

2.4 JACKETS

.1 PVC Plastic:

.1 Jacket: ASTM C921, Sheet material, off-white colour.

.1 Minimum Service Temperature: -40 degrees C (-40 degrees F).

.2 Maximum Service Temperature: 66 degrees C (150 degrees F).

.3 Moisture Vapour Transmission: ASTM E96; 0.002 perm-inches.

.4 Thickness: 0.25 mm (10 mil).

.5 Connections: Brush on welding adhesive.

.2 Covering Adhesive Mastic:

.1 Compatible with insulation.

.2 Canvas Jacket: UL listed.

.1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.

.2 Lagging Adhesive:

.1 Compatible with insulation.

.3 Aluminum Jacket: ASTM B209.

.1 Thickness: 0.40 mm (0.016 inch) sheet.

.2 Finish: Smooth.

.3 Joining: Longitudinal slip joints and 50 mm (2 inch) laps.

.4 Fittings: 0.4mm (0.016 inch) thick die shaped fitting covers with factory attached protective liner.

.5 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.015 mm thick aluminum.

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 70 00 - Examination and Preparation: Verification of existing conditions before starting work.

.2 Verify that equipment has been tested before applying insulation materials.

.3 Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

.1 Section 01 43 00: Manufacturer's written instructions.

.2 Factory Insulated Equipment: Do not insulate.

.3 Exposed Equipment: Locate insulation and cover seams in least visible locations.

.4 Apply insulation close to equipment by grooving, scoring, and bevelling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

.5 Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapour barrier cement.

.6 Insulated equipment containing fluids below ambient temperature: Insulate entire system.

.7 Apply insulation to pump casings to match form of pump.

.8 Fibre glass insulated equipment containing fluids below ambient temperature: Provide vapour barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapour barrier adhesive.

.9 For hot equipment containing fluids 60 degrees C (140 degrees F) or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

.10 For hot equipment containing fluids over 60 degrees C (140 degrees F), insulate flanges and unions with removable sections and jackets. Jackets to be suitable for the service temperature.

.11 Fibre glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapour barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

.12 Inserts and Shields:

.1 Application: Equipment 50 mm (2 inches) diameter or larger.

.2 Shields: Galvanized steel between hangers and inserts.

.3 Insert location: Between support shield and equipment and under the finish jacket.

.4 Insert configuration: Minimum 150 mm (6 inches) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

.5 Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

.13 Finish insulation at supports, protrusions, and interruptions.

.14 Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish unless otherwise indicated.

.15 For exterior piping applications, provide vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

.16 Insulation on all diesel exhaust piping, silencers and breeching shall be covered with aluminum jacket. All adhesives shall be suitable for the service temperatures. Installation of the insulation and jacket shall allow for thermal expansion. Fittings shall be insulated with mitred sections of the same insulation.

.17 Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

.18 Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.3 SCHEDULES

.1 Heating Systems:

.1 Shell & Tube Heat Exchangers/Converters: Calcium Silicate Insulation: 50 mm (2 inches) thick.

.2 Plate-type heat exchanger: not required.

.3 Air Separators: Glass Fibre, Flexible Insulation: 25 mm (1 inches) thick.

.4 Hot Thermal Storage Tanks: Glass Fibre, Flexible Insulation: 50 mm (2 inches) thick.

.2 Cooling Systems:

.1 Pump Bodies: Cellular Foam Insulation: 12 mm (1/2 inch) thick.

.2 Air Separators: Cellular Foam Insulation: 12 mm (1/2 inch) thick.

.3 Chiller remote evaporator.

.4 Cold Surfaces (Not Factory Insulated): Cellular Foam Insulation: Minimum 19 mm (3/4 inch) thick, or match chiller supplier’s specific requirements if more stringent.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Piping insulation.

.2 Jackets and accessories.

1.2 REFERENCES

.1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

.2 ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

.3 ASTM C195 - Mineral Fibre Thermal Insulating Cement.

.4 ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

.5 ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.

.6 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.

.7 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

.8 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

.9 ASTM C547 - Mineral Fibre Pipe Insulation.

.10 ASTM C552 - Cellular Glass Thermal Insulation.

.11 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.

.12 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

.13 ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.

.14 ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.

.15 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

.16 ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

.17 ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).

.18 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

.19 ASTM E84 - Surface Burning Characteristics of Building Materials.

.20 ASTM E96 - Water Vapour Transmission of Materials.

.21 CAN/ULC-S102-M88 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.22 NFPA 255 - Surface Burning Characteristics of Building Materials.

.23 UL 723 - Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

.1 Materials: Flame spread/smoke developed rating of 25/50 or less to ASTM E84: NFPA 255; UL 723.

1.4 QUALIFICATIONS

.1 Applicator: Company specializing in performing the work of this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

.3 Store insulation in original wrapping and protect from weather and construction traffic.

.4 Protect insulation against dirt, water, chemical, and mechanical damage.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

.2 Maintain temperature during and after installation for minimum period of 24 hours.

Part 2 Products

2.1 GLASS FIBRE PRE-FORMED PIPE INSULATION WITH ALL-SERVICE JACKET

.1 Manufacturers:

.1 Johns Manville Micro-Lok.

.2 Knauf Earthwool 1000.

.3 Owens Corning FIBREGLAS.

.4 Substitutions: Refer to Section 21 05 00.

.2 Insulation: ASTM C547; rigid moulded, non-combustible.

.1 'ksi' ('K') value : ASTM C335, 0.035 at 24 degrees C (0.24 at 75 degrees F).

.2 Minimum Service Temperature: -28.9 degrees C (-20 degrees F).

.3 Maximum Service Temperature: 454 degrees C (850 degrees F).

.4 Maximum Moisture Absorption: 0.2 percent by volume.

.3 Vapour Barrier Jacket

.1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.

.2 Moisture Vapour Transmission: ASTM E96; 0.03 ng/(Pa s sq m) (0.02 perm inches).

.3 Secure with self sealing longitudinal laps and butt strips.

.4 Secure with outward clinch expanding staples and vapour barrier mastic.

.4 Tie Wire: 1.3 mm (18 gauge) stainless steel with twisted ends on maximum 300 mm (12 inch) centres.

.5 Vapour Barrier Lap Adhesive

.1 Compatible with insulation.

2.2 CELLULAR FOAM

.1 Manufacturers:

.1 Armacell AP Armaflex.

.2 Substitutions: Refer to Section 21 05 00.

.2 Insulation: ASTM C534; flexible, cellular elastomeric, moulded or sheet.

.1 'ksi' ('K') Value: ASTM C177 or C518; 0.04 at 24 degrees C (0.27 at 75 degrees F).

.2 Minimum Service Temperature: -40 degrees C (-40 degrees F).

.3 Maximum Service Temperature: 104 degrees C (220 degrees F).

.4 Maximum Moisture Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.

.5 Moisture Vapour Transmission: ASTM E96; 0.20 perm inches.

.6 Maximum Flame Spread: ASTM E84; 25.

.7 Maximum Smoke Developed: ASTM E84; 50.

.8 Connection: Waterproof vapour barrier adhesive.

.3 Elastomeric Foam Adhesive

.1 Manufacturers:

.1 Armstrong 520 adhesive.

.2 Air dried, contact adhesive, compatible with insulation.

.3 Outdoor insulation shall be covered with Armstrong Armaflex finish.

2.3 JACKETS

.1 PVC Plastic

.1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material, off white colour.

.1 Minimum Service Temperature: -40 degrees C (-40 degrees F).

.2 Maximum Service Temperature: 66 degrees C (150 degrees F).

.3 Moisture Vapour Transmission: ASTM E96; 0.002 perm inches.

.4 Maximum Flame Spread: ASTM E84; 25.

.5 Maximum Smoke Developed: ASTM E84; 50.

.6 Connections: installed in accordance with manufacturer's recommendations using PVC adhesive to seal joints, and tape or butt strips where joined to adjacent pipe covering. Use staples and insulation coating as specified at circumferential joints.

.2 Covering Adhesive Mastic

.1 Compatible with insulation.

.2 Canvas Jacket: UL listed

.1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.

.2 Lagging Adhesive

.1 Bakelite 120-18 white fire retardant lagging adhesive.

.3 Coating

.1 Finish with two full brush coats of Bakelite 120-09 white fire retardant paint.

.3 Aluminum Jacket: ASTM B209.

.1 Thickness: 0.40 mm (0.016 inch) sheet.

.2 Finish: Embossed.

.3 Joining: Longitudinal slip joints and 50 mm (2 inch) laps.

.4 Fittings: 0.4 mm (0.016 inch) thick die shaped fitting covers with factory attached protective liner.

.5 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.38 mm (0.015 inch) thick aluminum.

Part 3 Execution

3.1 EXAMINATION

.1 Verify that piping has been tested before applying insulation materials.

.2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

.1 Install materials to manufacturer's written instructions.

.2 On exposed piping, locate insulation and cover seams in least visible locations.

.3 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:

.1 Provide vapour barrier jackets, factory applied or field applied.

.2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.

.3 Finish with glass cloth and vapour barrier adhesive.

.4 PVC fitting covers may be used.

.5 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.

.6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

.4 For insulated pipes conveying fluids above ambient temperature:

.1 Provide standard jackets, with or without vapour barrier, factory applied or field applied.

.2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.

.3 Finish with glass cloth and adhesive.

.4 PVC fitting covers may be used, except on steam and condensate piping systems.

.5 For hot piping conveying fluids 60 degrees C (140 degrees F) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

.6 For hot piping conveying fluids over 60 degrees C (140 degrees F), insulate flanges and unions at equipment.

.5 Inserts and Shields:

.1 Application: Piping 40 mm (1-1/2 inches) diameter or larger.

.2 Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

.3 Insert Location: Between support shield and piping and under the finish jacket.

.4 Insert Configuration: Minimum 150 mm (6 inches) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

.5 Insert Material: hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

.6 Finish insulation at supports, protrusions, and interruptions.

.7 Pipe supports:

.1 All piping shall be supported in such a manner that neither the insulation nor the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier shall be continuous, including material covered by the hanger saddle.

.2 Piping systems 3" (75 mm) in diameter or less may be supported by placing saddles of the proper length and spacing under the insulation as designated by the insulation manufacturer.

.3 For hot or cold piping systems larger than 3" (75 mm) in diameter, operating at temperatures less than +200F (93C) and insulated with fiber glass, high density inserts such as fiberglass or foam with sufficient compressive strength shall be

used to support the weight of the piping system. At temperatures exceeding +200F (93C), high temperature pipe insulation shall be used for high density inserts.

.4 Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.

.5 On vertical runs, insulation support rings shall be used as required.

.8 For pipe exposed in mechanical equipment rooms or in finished spaces below 3 metres (10 feet) above finished floor, finish with canvas jacket sized for finish painting.

.9 For all pipe in exposed in occupied areas, finish with Canvas Jacket.

.10 For exterior piping applications, provide vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

.11 On outdoor chilled water and refrigerant lines, the insulation system shall be completely vapor sealed before the weather-resistant jacket is applied. The outer jacket shall not compromise the vapor barrier by penetration of fasteners, etc. Vapor stops at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion. Piping 38mm (1-1/2 inches) and less shall have UV resistant PVC jacket. Pipes larger than 38mm (1-1/2 inches) shall have aluminium jacket.

.12 Insulate all roof hoppers and storm drain pipe in ceiling spaces or walls of finished areas, and all vent piping and exposed horizontal and vertical storm drain pipe within 3000 mm (10'-0") developed length from roof opening or located in vented attics and soffits.

.13 Fittings and Valves

.1 Shall be insulated with pre-formed fiberglass fittings, fabricated sections of fibreglass pipe insulation. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings.

.2 Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low-density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with suitable weather or vapor resistant mastic as dictated by the system location and service. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.

.3 On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems shall be sealed with caulking to allow free movement of the stem but provide a seal against moisture incursion. Valve handle extensions are recommended.

.14 ACCESSORY MATERIALS

.1 All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Mechanical subcontractors Association (MICA) "Commercial & Industrial Insulation Standards."

3.3 TOLERANCE

.1 Substituted insulation materials: Thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 FIBROUS GLASS INSULATION SCHEDULE

	PIPING SYSTEMS	PIPE SIZE <Inch><mm>	THICKNESS <Inch><mm>
Plumbing Systems			
	Domestic Hot Water Supply & Domestic Hot Water Recirc	=< 2" (50mm)	1" (25mm)
	Domestic Cold Water,	=< 2" (50mm)	1" (25mm)
	Roof Drain Bodies	all	2" (50mm)
	Roof Drain piping above floor within 10 Feet (3 Metres) of the Exterior	all	2" (50mm)
	Plumbing Vents Within 10 Feet (3 Metres) of the Exterior	all	2" (50mm)
Heating & Cooling Systems			
	Heating water & glycol supply and return	=< 2" (50mm)	1" (25mm)
	Heating water & glycol supply and return	> 2" (50mm)	1-1/2" (38mm)
Cooling Systems			
	Dual Temperature Water	all	Match heating water
	Chilled water & glycol	all	1" (25mm)
	Cold Condensate Drains	all	1" (25mm)
	Condensate Drains from Cooling Coils	all	1" (25mm)
Other Systems			
	Humidifier Piping (Condensate)	all	1" (25mm)
	Humidifier Piping (Steam)	all	2" (50mm)

3.5 CELLULAR FOAM PIPE INSULATION SCHEDULE

	PIPING SYSTEMS	PIPE SIZE <Inch><mm>	THICKNESS <Inch><mm>
	Refrigerant Suction	all	3/4" (19mm)

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Pipe and pipe fittings for:

- .1 Heating water piping system.
- .2 Chilled water piping system.
- .3 Radiant floors
- .4 Equipment drains and overflows.

.2 Valves:

- .1 Ball valves.
- .2 Butterfly valves.
- .3 Check valves.

1.2 REFERENCES

.1 ASME -Welding and Brazing Qualifications.

.2 ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.

.3 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

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

.5 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.

.6 ASME B31.9 - Building Services Piping.

.7 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

.8 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

.9 ASTM B32 - Solder Metal.

.10 ASTM B88 - Seamless Copper Water Tube.

1.3 SYSTEM DESCRIPTION

.1 Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

.2 All valves must be installed with stems upright or horizontal; not inverted.

.3 Valve body materials shall be compatible with piping system materials. Valves shall meet all pressure, temperature, and fluid handling requirements of the system.

.4 A valve drain shall be provided at the base of each riser and at the low points of the system. Manual air vents shall be provided at the top of each riser and at the high points of the system.

.5 Supply and install check valves on condensate pump discharges and also where indicated on the drawings.

.6 All valves installed in concealed locations, i.e., ceiling spaces, shall be compactly arranged so that they are easily accessible through common access plates or doors.

.7 On cooling coils supply and install drain valves with hose end connections at the top of the coil header of headers to allow the coils to be filled with glycol.

.8 Use grooved mechanical couplings and fasteners only in accessible locations.

.9 Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

.10 Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

.11 Provide pipe hangers and supports to ASTM B31.9 unless indicated otherwise.

.12 Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

.13 Use globe or butterfly valves for throttling, bypass, or manual flow control services.

.14 Use spring loaded check valves on discharge of pumps.

.15 Use butterfly valves in in heating, chilled and condenser water systems interchangeably with gate and globe valves providing they meet the pressure, temperature, and fluid handling requirements of the system.

.16 Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

.17 Use lug end butterfly valves to isolate equipment.

.18 Use 3/4 inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

1.4 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

.3 Welders Certificate: Include welders certification of compliance with ASME SEC 9 and applicable provincial labour regulations.

.4 Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.5 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of valves.

1.6 OPERATION AND MAINTENANCE DATA

.1 Submit to Section 21 05 00.

.2 Include valve schedule complete with valve tags, location, service, normally open/normally closed.

.3 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.7 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 All carbon steel pipe and fittings shall be manufactured in Canada or the United States of America. This does not include stainless steel.

.3 Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.

.4 Welders: Certify to ASME SEC 9 and applicable provincial labour regulations.

1.8 REGULATORY REQUIREMENTS

.1 All pressure piping systems for use in Manitoba shall be designed and constructed in accordance with the applicable ANSI/ASME Piping Codes and the Manitoba Labour and Immigration, Steam and Pressure Plants Act.

.2 Conform to ASME B31.9 code for installation of piping system.

.3 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.

.4 Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept valves on site in shipping containers with labeling in place. Inspect for damage.

.3 Provide temporary protective coating on cast iron and steel valves.

.4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

.5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS

.1 Do not install underground piping when bedding is wet or frozen.

1.11 EXTRA MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide two repacking kits for each size and valve type.

Part 2 Products

2.1 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND

.1 Steel Pipe: ASTM A53, Schedule 40, black.

.1 Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.

.2 Joints: Threaded, or AWS D1.1, welded.

.3 Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

.2 Copper Tubing: ASTM B88, Type L hard drawn. Up to 50mm (2”) diameter only.

.1 Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.

.2 Joints: Up to 50mm (2”) diameter: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C (430 to 535 degrees F).

2.2 RADIANT FLOOR HEATING

.1 Heating Piping

.1 Copper Tubing: ASTM B88, Type L, annealed.

.1 Fittings: ASME B16.22, wrought copper.

.2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C(430 to 535 degrees F).

.2 Polyethylene Pipe: ASTM F876 and ASTM F877, cross-linked polyethylene with aluminum liner, 690 kPa(100 psig) operating pressure at 82 degrees C(180 degrees F).

.1 Fittings: Brass and copper.

.2 Joints: Mechanical compression fittings.

.2 Manifolds

.1 For system compatibility, use 1" standard or Hi-Flow 1½" (25 – 38mm) Watts Stainless Steel manifolds offered by the tubing manufacturer.

.2 Manifolds shall provide individual flow control for each loop of the manifold through valve actuators available from the manifold supplier.

.3 Manifolds shall feature manual flow balancing capability within the manifold body for balancing unequal loop lengths across the manifold.

.4 Manifolds shall incorporate a combination flow indicator/shut off valve

.5 Manifolds accommodate ⅜ - ¾" (9.5 – 19 mm) RadiantPEX tubing.

.6 Each manifold location shall have the ability to vent air manually from the system.

.7 Stainless Steel 1" (25 mm) Manifolds

.1 Heavy-duty, DIN Standard, 304 stainless steel

.2 Matching fittings and accessories are made of solid brass and are heavily plated with nickel to match the appearance of the manifold trunk.

.3 Internal balancing valves

.4 0 - 2gpm (0 – 0.13 L/sec)flow meters

.5 Manifold brackets

.6 All connections are BSP (British Standard Pipe) or straight thread and require the use of the included gasket.

.7 Tube connectors shall be T-20 ¾" euro cone compression style fittings

.8 2⅛" (55 mm) OC circuit spacing

.9 12 gpm (.75 L/sec) maximum flow rate

.10 194°F (90°C) maximum operating temperature

.11 87 psi (600 kPa) maximum operating pressure

.12 2 gpm (0.16 L/sec) per circuit maximum flow rate

.13 Each manifold location shall include a vent and purge assembly consisting of a 1/2" drain valve and 3/8" manual air vent.

.14 Each manifold location shall include a 1" trunk isolation valve set with one red handle and one blue handle nickel plated brass ball valve FBSP x FNPT and two water temperature gauges.

.3 Manifold Mounting Boxes

.1 Sizes –Radiant manifold mounting boxes come in 3 sizes:

.1 15¾" by 28½" by 4¼" (400mm by 724 mm by 108 mm) For maximum 3-loops

.2 24½" by 28½" by 4⅜" (622mm by 724 mm by 111 mm) For maximum 7-loops

.3 39½" by 28½" by 4⅜" (1003mm by 724 mm by 111 mm) For maximum 12-loops

.2 Each box shall be designed to be recessed into a 4" or 6" (102 mm or 152 mm) stud wall.

.3 Each manifold box is constructed of powder-coated sheet metal, providing increased resistance to corrosion and job-site abuse.

.4 Fittings

.1 For system compatibility, use fittings offered by the tubing manufacturer.

.1 The fitting assembly shall comply with ASTM F877 and CAN/CSA B137.5 requirements.

.2 Fittings shall be designed to work with either ASTM F1807 CrimpRings or ASTM F2098 CinchClamps or a Compression ferrule, and are designed to be used with ASTM F876 (SDR-9) rated PEX tubing.

.3 Available connections:

.1 Sweat

.2 NPT

.3 BSP

.4 Material:

.1 UNS 31400 Copper Alloy

.2 UNS 36000 Copper Alloy

.3 UNS 37700 Copper Alloy

.5 Accessories

.1 For tubing that exits the slab in a 90-degree bend, use metal or PVC bend supports.

.2 Use accessories associated with the installation of the radiant floor heating system as recommended by or available from the PEX tubing manufacturer.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

.1 Steel Pipe: ASTM A53, Schedule 40 galvanized.

.1 Fittings: Galvanized cast iron, or ASTM B16.3 malleable iron.

.2 Joints: Threaded, or grooved mechanical couplings.

.2 Copper Tubing: ASTM B88, Type L, annealed.

.1 Fittings: ASME B16.22, wrought copper.

.2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C (430 to 535 degrees F).

2.4 UNIONS, FLANGES, AND COUPLINGS

.1 Unions for Pipe 50 mm(2 inches) and Under:

.1 Ferrous Piping: 1034 kPa (150 psig) malleable iron, threaded.

.2 Copper Pipe: Bronze, soldered joints.

.2 Flanges for Pipe Over 50 mm(2 inches):

.1 Ferrous Piping: 1034 kPa (150 psig) forged steel, slip-on.

.2 Copper Piping: Bronze.

.3 Gaskets: 1.6 mm(1/16 inch) thick preformed neoprene.

.3 Grooved and Shouldered Pipe End Couplings:

.1 Housing Clamps: Malleable iron to engage and lock, designed to permit some angular deflection, contraction, and expansion.

.2 Sealing Gasket: C-shape elastomer composition for operating temperature range from -34 degrees C (-30 degrees F) to 110 degrees C (230 degrees F).

.3 Accessories: Steel bolts, nuts, and washers.

.4 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 BALL VALVES

.1 Up To and Including 50 mm(2 inches):

.1 Manufacturers:

.1 MAS

.2 Red-White/Toyo

.3 Kitz

.4 Substitutions: Refer to Section 21 05 00.

.2 Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle solder ends.

2.6 BUTTERFLY VALVES

.1 Manufacturers:

.1 Demco

.2 Kitz

.3 Mueller

.4 Substitutions: Refer to Section 21 05 00.

.2 Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.

.3 Disc: Stainless Steel.

.4 Operator: 10 position lever handle. Valves 8” and larger shall have gear operator with position indicator.

2.7 SWING CHECK VALVES

.1 Up To and Including 50 mm(2 inches):

.1 Manufacturers:

.1 Red-White/Toyo

.2 Kitz

.3 Substitutions: Refer to Section 21 05 00.

.2 Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

.2 Over 50 mm (2 inches):

.1 Manufacturers:

.1 Red-White/Toyo

.2 Kitz

.3 Substitutions: Refer to Section 21 05 00.

.2 Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.8 SPRING LOADED CHECK VALVES

.1 Manufacturers:

.1 Mueller 71 Series

.2 Moygro W12A-I6V (single plate)

.3 Substitutions: Refer to Section 21 05 00.

.2 Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

Part 3 Execution

3.1 PREPARATION

.1 Ream pipe and tube ends. Remove burrs.

.2 Remove scale and dirt on inside and outside before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

.4 Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

.5 After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

3.2 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install heating water, glycol, chilled water, and condenser water piping to ASME B31.9.

.3 Route piping in orderly manner, parallel to building structure, and maintain gradient. Grade hydronic piping up in flow direction or as noted.

.4 Install piping to conserve building space, and not interfere with use of space.

.5 Group piping whenever practical at common elevations.

.6 Sleeve pipe passing through partitions, walls and floors.

.7 Slope piping and arrange to drain at low points.

.8 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

.9 Install drain valves (ball valves) c/w hose and cap and chain on each pump (pipe to nearest floor drain), at system low points so that entire system can be drained, and at each zone or branch / riser isolation valve so branch or riser can be drained down completely.

.10 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.

.11 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.

.12 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

.13 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

.14 Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 10.

.15 Install valves with stems upright or horizontal, not inverted.

3.3 Pressure Testing

.1 Do not insulate pipe prior to pressure testing. Pressure test in sections if necessary before concealing or insulating pipe.

.2 Do not introduce water for testing where freezing conditions exist or where piping systems being tested are located above sensitive areas or equipment that may be damaged or contaminated by water leakage.

.3 Hydraulically test all pipe. Pneumatic testing not permitted without prior approval from the Contract Administrator and the Authority Having Jurisdiction.

.4 Hydronic pipe testing shall be in accordance with the applicable ASME piping code, the Mechanical subcontractor's registered Quality Assurance Program (for systems where applicable), and all requirements of the Department of Labour .

.5 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings and equipment. Pipe dope, caulking, tape, lead wool, dresser couplings, etc. shall not be used to correct deficiencies. The mechanical subcontractor shall be responsible for all cleanup related to leakage during flushing, testing, and chemical treatment of piping, including original building piping if included in the testing.

.6 Test piping system in sections as required by the progress of work.

.7 Subject piping to a hydrostatic pressure of at least that 1-½ times the operating pressure of the system for a period of at least 12 hours. If leaks are detected, such leaks shall be repaired and the test started over. Record results and submit witnessed (by Contract Administrator or The City's representative) reports to the Contract Administrator.

.8 Register pressures at the highest system point.

.9 Provide at least 48 hours (during working days) notice to Contract Administrator or The City's Representative prior to testing to allow the tests to be witnessed.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 In-line circulators.

1.2 REFERENCES

.1 UL 778 - Motor-Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

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

1.4 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

.3 Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

.4 Millwright's Certificate: Certify that base mounted pumps have been aligned.

1.5 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Procedures for submittals.

.2 Record actual locations of hydronic pumps.

1.6 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Procedures for submittals.

.2 Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three (3) years documented experience.

.2 Alignment: Align base mounted pumps by qualified millwright.

.3 Impeller trimming: Trimming of impeller by qualified millwright

1.8 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by UL or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 EXTRA MATERIALS

.1 Section 21 05 00: Procedures for submittals.

.2 Provide one set of mechanical seals for each pump.

Part 2 Products

2.1 MANUFACTURERS

.1 Bell & Gossett

.2 Substitutions: Refer to Section 21 05 00.

2.2 SYSTEM LUBRICATED CIRCULATORS (Cast Iron Heating and Cooling)

.1 Type: Horizontal shaft, single stage, direct connected with speed controlled wet rotor motor for in-line mounting, for 1207 kPa (175 psig) maximum working pressure, 110 degrees C (230 degrees F) maximum water temperature.

.2 Casing: Cast iron with flanged pump connections.

.3 Impeller: Stainless Steel

.4 Shaft : Stainless Steel

.5 Bearings: Metal Impregnated carbon sleeve

.6 Motor:

.1 Synchronous, permanent-magnet (PM) motor and tested with the pump as one unit.

.2 Class F insulation

.3 Integrated motor protection shall be verified by UL to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).

.4 On-board thermal overload protection.

.7 Control

.1 MODBUS
BACnet
Analog inputs

.8 Performance:

.1 See Schedule

.9 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.

Part 3 Execution

3.1 PREPARATION

.1 Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Provide the necessary access space around components to allow for servicing, repair, replacement as well as for the balancing technician to take proper readings. Provide no less than minimum as recommended by manufacturer

.3 Pumps shall be sized on the capacities, heads, motor sizes and RPM specified, impeller size selected shall not be greater than 85% of the maximum size impeller.

.4 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. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 102 mm (4 inches) and over.

.5 Provide line sized shut-off valve, and strainer on pump suction, and line sized soft seat and check valve on pump discharge.

.6 Provide a minimum of 5x suction diameter of pipe on pump suction of pipe size shown on drawings

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

.8 Provide drains for bases and seals, piped to and discharging into floor drains or, in the case of glycol, to a suitable container.

.9 Provide drain lines with ball valves from strainers and filters to nearest floor drain or, in the case of glycol, to a suitable container.

.10 Provide flow measurement ports as shown on drawings, on piping schematics, and in locations as directed by the water balancing specialist.

.11 Provide any pump impeller modifications as recommended by Division 23 05 93 – Testing Adjusting and Balancing.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Cleaning of pipe and fittings.

.2 Chemical feed equipment.

.3 Chemical treatment.

1.2 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

.3 Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

.4 Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

.5 Manufacturer's Field Reports: Submit to Section 01 44 00.

.6 Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

.7 Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

1.3 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

1.4 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.5 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. Company to have local representatives with water analysis laboratories and full time service personnel.

.2 Installer: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

.1 Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.

.2 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 MAINTENANCE SERVICE

.1 Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.

.2 Provide regular technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

.3 Provide laboratory and technical assistance services during this maintenance period.

.4 Include a training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.

.5 Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

1.8 MAINTENANCE MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide sufficient chemicals for treatment and testing during warranty period.

Part 2 Products

2.1 MANUFACTURERS

.1 GE Water and Process Technologies.

.2 Substitutions: Refer to Section 21 05 00.

2.2 MATERIALS

.1 Closed Hot Water, Chilled Water and Glycol Systems Cleaner:

.1 Ferroquest FQ7103 (neutral pH cleaner to remove oil, grease, rust and mill scale)

2.3 BY-PASS (POT) FEEDER

.1 Closed Hot Water, Chilled Water and Glycol Systems: Neptune DBF-2HP 2 gallon chemical pot feeder

2.4 SIDE STREAM FILTER

.1 Closed Hot Water, Chilled Water and Glycol Systems: Pal LMO-10 ¾" filter housing, STS ¾" Filtermate flow indicator, provide (40) 10 micron filter cartridges

2.5 TEST EQUIPMENT

.1 Closed System (Hot or Chilled Water): Provide a L6213 molybdate test kit.

Part 3 Execution

3.1 PREPARATION

.1 Systems to be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

.2 Place terminal control valves in open position during cleaning.

.3 Section 23 25 00 shall provide

.4 Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

.1 Concentration:

.1 As recommended by manufacturer.

.2 Hot Water, Chilled Water, Glycol Systems

.1 All systems must be chemically cleaned and flushed before water treatment is added. This includes partial or complete filling for pressure testing.

.2 After all components of the piping system have been pressure tested and proven to be in full operational condition and leak free, flush entire system with fresh clean make-up water to remove loose mill scale, sediment and construction debris.

.3 Provide drain connections to drain system in one hour. Install totalizing water meter to record capacity in each system

.4 All drains for chemical treatment shall be piped to the nearest floor drain.

.5 After initial flushing has been completed, clean all strainer screens.

.6 Add cleaner to closed systems at concentration levels recommended by the water treatment specialist.

.7 After cleaning, drain system as rapidly as possible. Flush system by opening drain valves and opening bypass valve on water make-up to system. Continue flushing until tests show pH, iron, TDS and chloride levels of water leaving

system are the same as entering the system. Refill and immediately add water treatment to proper level.

3.3 INSTALLATION

.1 Install to manufacturer's written instructions.

3.4 CLOSED SYSTEM TREATMENT

.1 Provide one bypass feeder and one side stream filter on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

.2 Introduce closed system treatment through bypass feeder when required or indicated by test.

.3 Change side stream filter cartridges as required or indicated by the flow indicator.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Metal duct work.

.2 Nonmetal duct work.

.3 Duct cleaning.

1.2 REFERENCES

.1 ASTM A36/A36M - Carbon Structural Steel.

.2 ASTM A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

.3 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.4 ASTM A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

.5 ASTM A568/A568M - General Requirements for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

.6 ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.7 ASTM A1008/A1008M - Steel, Sheet, Cold-Rolled Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.

.8 ASTM A1011/A1011M - Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.

.9 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

.10 AWS D9.1 - Sheet Metal Welding Code.

.11 NBS PS 15 - Voluntary Product Standard for Custom Contact-Moulded Reinforced-Polyestor Chemical Resistant Process Equipment.

.12 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

.13 NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems.

.14 NFPA 91 - Exhaust Systems for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particulate Solids.

.15 NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Operations.

.16 SMACNA - HVAC Air Duct Leakage Test Manual.

.17 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.18 UL 181 - Factory-Made Air Ducts and Connectors.

.19 ASTM C14/C14M - Concrete Sewer, Storm Drain, and Culvert Pipe.

.20 ASTM C443 - Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

1.3 PERFORMANCE REQUIREMENTS

.1 No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.5 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

.1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.2 Maintain one copy of document on site.

1.7 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

.2 Installer: Company specializing in performing the work of this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

.1 Construct commercial kitchen exhaust duct work to NFPA 96 standards.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

.2 Maintain temperatures during and after installation of duct sealants.

Part 2 Products

2.1 MATERIALS

.1 Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating of to ASTM A90.

.2 Steel Ducts: ASTM A1008, A568.

.3 Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

.4 Insulated Flexible Ducts:

.1 Manufacturers:

.1 Thermaflex G-KM

.2 Substitutions: Refer to Section 21 05 00.

.2 Thermally insulated flexible duct with acoustically rated black CPE core permanently bonded to a coated spring steel wire helix, with fibreglass insulation over fibreglass scrim and polyethelyne vapour barrier. Pressure rating of 6" W.G. (positive) for 4" – 20" I.D. Temperature range -20 ºF to 200 ºF continuous, R-value R-4.2.

.3 The ductwork shall meet NFPA Pamphlet 90A paragraph 113 (a) for flame spread and smoke rating and to meet Underwriter's Laboratories of Canada requirements.

.4 Flexible air ducts shall conform to UL-181 Standard and NFPA 90A. Flexible air ducts shall have a fire rating of at least one-half hour as measured by UL-181 Standard, paragraph No. 7, Flame Penetration Test.

.5 Fasteners: Rivets, bolts, or sheet metal screws.

.6 Sealant:

.1 Manufacturers:

.1 Duro-Dyne

.2 Substitutions: Refer to Section 21 05 00.

.2 Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

.7 Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 DUCT WORK FABRICATION

.1 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Unless otherwise indicated fabrication shall conform to standards for duct pressure class rating of +2" w.g. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

.2 Construct T's, bends, and elbows with radius of not less than one times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air-foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.

.3 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

.4 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 100 mm (4 inch) cemented slip joint, brazed or electric welded. Prime coat welded joints.

.5 Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

.6 All rectangular ducts shall be constructed by breaking the corners and grooving the longitudinal seams using Pittsburgh seam or other approved airtight seam.

.7 All elbows and transformation pieces shall be constructed using Pittsburgh corner seams or double seam corners. All transverse joints shall be constructed using S-slips, Bar Slips, Drive Slips, etc. where recommended in ASHRAE guide. All slips shall be not less than one gauge heavier than duct material. Open corners will not be accepted.

2.3 MANUFACTURED DUCT WORK AND FITTINGS

.1 Manufacture to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.

.3 Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

.4 No variation of duct sizes will be permitted except by written permission of the Contract Administrator. In the event that additional offsets and changes in direction are required in the duct system, these changes shall be made by the Sheet Metal Trade without additional cost to the The City. All ductwork shall be to the recommended practices as laid down by the Sheet Metal and Air Conditioning Mechanical subcontractors National Association (SMACNA).

.5 Where the width of the duct exceeds 450 mm (18") in its largest dimension such ductwork shall be suitably stiffened by breaking the sheets diagonally.

.6 If ductwork is insulated, cross breaking may be omitted providing the ducts are 2 gauges heavier than shown on the above schedule.

.7 All laps shall be in the direction of air flow. Rivets and bolts shall be used throughout. All edges and slips shall be hammered down to leave a smooth interior duct.

.8 Where low pressure ductwork conflicts with mechanical and electrical piping and it is not possible to divert the ductwork or piping to stay within allowable space limitation, provide duct easements.

.9 Easements are not required on pipes 100 mm (4") and smaller outside dimension, unless this exceeds 20% of the duct area. Any irregular or flat shaped intrusions require a duct easement. Hangers and straps in the ductwork shall be parallel to air flow. If this is not possible, provide an easement. If the easement exceeds 25% of the duct area, the duct shall be split into two ducts with the original duct area being maintained. All easements shall be approved by the Contract Administrator before installation.

.10 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot 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 duct work, install insulation material inside a metal ring.

.11 Locate pitot tube test openings in ductwork at supply fan discharges, on intake of exhaust/and return air fans, in major duct branches and everywhere pitot tube openings are required for proper balancing of air conditioning, ventilation and exhaust systems. Do not place closer than 1829mm (72 inches) to elbows. Space every 150mm (6 inches) across air stream at each location. Refer to drawings for additional opening requirements.

.12 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.13 Use crimp joints with or without bead for joining round duct sizes 200 mm (8 inch) and smaller with crimp in direction of air flow.

.14 Use only threaded rod for duct support in exposed areas. Strapping not allowed.

.15 Use double nuts and lock washers on threaded rod supports.

.16 Flexible ductwork: Maximum installed length: One continuous length at 1500 mm (5'-0"). Use standard sheetmetal elbows at drop points to outlets.

.17 Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

.18 Where interior of duct is visible through grilles, registers or diffusers, paint interior of duct with flat black Tremco paint formulated for galvanized surfaces.

.19 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.

.20 Seal ductwork so that it is sufficiently airtight to ensure economical and quiet performance of the system. All ductwork, except where otherwise indicated, shall have

seams and joints sealed with Duro-Dyne S-2 duct sealer. Apply duct sealer and duct tape in strict accordance with manufacturer's recommendations, to joints and seams to provide an airtight, watertight installation. Prior to application, ductwork to be dry and free of grease, etc. Use 6mm bead of material along joints. Material, when dry, to have 3.2mm depth extending 25mm on each side of joint or seam.

.21 Install ductwork free from pulsation, chatter, vibration or objectionable noises.

.22 Should any of these defects appear after the system is in operation, correct problems by removing, replacing, or reinforcing the work as directed by the Contract Administrator.

3.2 CLEANING

.1 Clean duct system 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 temporary filters, or bypass during cleaning.

.2 Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into duct work for cleaning purposes.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Duct silencers.

1.2 REFERENCES

.1 AABC - National Standards for Total System Balance.

.2 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.4 AMCA 302 - Application of Sone Ratings for Non-Ducted Air Moving Devices.

.5 AMCA 303 - Application of Sound Power Level Ratings for Fans.

.6 ANSI S1.1 - Acoustical Terminology.

.7 ANSI S1.8 - Preferred Reference Quantities for Acoustical Levels.

.8 ANSI S1.13 - Measurement of Sound Pressure Levels in Air.

.9 ARI 270 - Sound Rating of Outdoor Unitary Equipment.

.10 ARI 575 - Measuring Machinery Sound Within an Equipment Space.

.11 ASA 16 (ANSI S1.36) - Survey Methods for Determination of Sound Power Levels of Noise Sources.

.12 ASA 47 (ANSI S1.4) - Specification for Sound Level Meters.

.13 ASA 49 (ANSI S12.1) - Preparation of Standard Procedures to Determine the Noise Emission from Sources.

.14 ASHRAE 68 - Laboratory Method of Testing to Determine the Sound Power in a Duct.

.15 ASHRAE Handbook - Systems Volume, Chapter "Sound and Vibration Control".

.16 ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission loss of Building Partitions and Elements.

.17 ASTM E477 - Method of Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

.18 ASTM E596 - Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures.

.19 NEBB - Procedural Standards for Measuring Sound and Vibration.

.20 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3 DEFINITIONS

.1 Submittals and Report: Conform to ANSI S1.1.

1.4 PERFORMANCE REQUIREMENTS

.1 Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.

.2 Maintain rooms at following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE Handbook.

1.5 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate assembly, materials, thicknesses, dimensional data, pressure losses, acoustical performance, layout, and connection details.

.3 Product Data: Provide catalogue information indicating, materials, dimensional data, pressure losses, and acoustical performance. Acoustical performance shall be obtained in accordance with ASTM E477.

.4 Design Data: Provide engineering calculations, referenced to specifications and noted standards indicating that maximum room sound levels are not exceeded.

.5 Manufacturer's Installation Instructions: Indicate installation requirements which maintain integrity of sound isolation.

.6 Manufacturer's Field Reports: Indicate installation is complete and to instructions.

1.6 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

1.7 QUALITY ASSURANCE

.1 Perform Work to AMCA 300 standards and recommendations of ASHRAE 68.

.2 Maintain one copy of each document on site.

1.8 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.

1.9 REGULATORY REQUIREMENTS

.1 Conform to applicable code for sound levels at property line.

Part 2 Products

2.1 ABSORPTIVE DUCT SILENCERS

.1 Manufacturers:

.1 Price.
.2 VAW Industries
.3 Vibro-Acoustics
.4 Vibron Limited
.5 Substitutions: Refer to Section 21 05 00.

.2 Description: Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction. Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible.

.3 Configuration: Rectangular with lined splitters with radiused nose and contoured tails. Contour and radius to be designed for flow velocity requirements (low, medium, high velocity as noted in schedule).

.4 Materials:

.1 Outer Casing: Minimum 1.3 mm (18 gauge) thick galvanized steel stiffened as required, with welded seams, slip joints on both ends. Screws or other mechanical fastening systems not acceptable.
.2 Inner Casing and Splitters: Minimum 0.5 mm (26 gauge) thick perforated galvanized steel.
.3 Fill: shot-free inorganic glass fibre with long, resilient fibers, bonded with thermosetting resin. Glass fibre shall be packed with a minimum 10% compression to eliminate voids and settling; 64 kg/cu m (4 lb/cu ft) density.
.4 Fill Liner: Bonded glass fibre matting.

.5 Performance ratings as per the schedule.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Support duct silencers independent of duct work with flexible duct connections, lagged with leaded vinyl sheet on inlet and outlet.

3.2 MANUFACTURER'S FIELD SERVICES

.1 Prepare and start systems to Quality Assurance clauses in Section 21 05 00.

.2 Inspect installation periodically to Quality Assurance clauses in Section 21 05 00.

.3 Provide services of AABC testing agency to take noise measurement. Use meters meeting requirements of ASA 47 (ANSI S1.4).

.4 After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations, as directed.

.5 Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements.

.6 Submit complete report of test results including sound curves.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Air turning devices/extractors.

.2 Backdraft dampers.

.3 Combination fire and smoke dampers.

.4 Duct access doors.

.5 Duct test holes.

.6 Fire dampers.

.7 Flexible duct connections.

.8 Volume control dampers.

.9 Ceiling Fans

1.2 REFERENCES

.1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 92A - Smoke-Control Systems.

.3 NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Operations.

.4 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.5 CAN/ULC-S112 Standard Method of Fire Test of Fire-Damper Assemblies

.6 UL 33 - Heat Responsive Links for Fire-Protection Service.

.7 UL 555 - Fire Dampers.

.8 UL 555S - Smoke Dampers.

1.3 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

1.4 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of access doors.

1.5 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., and testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Protect dampers from damage to operating linkages and blades.

Part 2 Products

2.1 AIR TURNING DEVICES/EXTRACTORS

.1 Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.2 BACKDRAFT DAMPERS.

.1 Gravity Backdraft Dampers, Size 450 x 450 mm (18 x 18 inches) or smaller, provided with Air Moving Equipment: Air moving equipment manufacturers standard construction.

.2 Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 1.5 mm (16 gauge) thick galvanized steel, with centre pivoted blades of maximum 150 mm (6 inch) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 DUCT ACCESS DOORS

.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated duct work, install minimum 25 mm (one inch) thick insulation with sheet metal cover.

.1 Less than 300 mm (12 inches) Square: Secure with sash locks.

.2 Up to 450 mm (18 inches) Square: Provide two hinges and two sash locks.

.3 Up to 600 x 1200 mm (24 x 48 inches): Three hinges and two compression latches.

.4 Larger Sizes: Provide an additional hinge.

.3 Access doors with sheet metal screw fasteners are not acceptable.

.4 Doors in insulated ductwork to be double panel construction with a 25mm (1") insulating filler.

.5 In certain locations where it is inconvenient to swing access doors, removable doors with 4 cam locks will be accepted. However, all such locations shall be approved by the Contract Administrator prior to installation.

.6 Grease duct access doors shall match the materials used for the grease duct. Manufacture and installation of duct access doors on grease ducts shall comply with all requirements of NFPA 96.

2.4 DUCT TEST HOLES

.1 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

.2 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation;

2.5 FIRE DAMPERS

.1 Manufacturers:

.1 Price.
.2 Nailor.
.3 Ruskin.

.2 Depending on the rating of fire separation, rating, construction and testing of the fire damper will conform to most recent issue of all of following:

.1 N.B.C.
.2 ULC S 112
.3 NFPA 252
.4 ULC or ULI 10(b)

.3 Use type 'B' fire dampers, i.e. blades out of air stream, to be used in all ducts passing through fire separations. Combination fire damper-balancing damper, with blades in air stream shall be used on sidewall or return, or floor mounted supply, up to maximum size of 0.372 sq.m (576 sq.in.). For sidewall return above 0.372 sq.m (576 sq.in.) in size, use a type 'A' fire damper, i.e. blades in air stream.

.4 Ceiling Dampers: Galvanized steel, 0.76 mm(22 gauge) frame and 1.5 mm (16 gauge) flap, two layers 3.2 mm (0.125 inch) ceramic fibre on top side with locking clip.

.5 Horizontal Dampers: Galvanized steel, 0.76 mm (22 gauge) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

.6 Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air

stream except at all locations unless otherwise indicated on the drawings, and for 250 Pa (1.0 inch) pressure class ducts up to 300 mm (12 inches) in height.

.7 Multiple Blade Dampers: 1.5 mm (16 gauge) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 3.2 x 12.7 mm (1/8 x 1/2 inch) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

.8 Fire dampers in stainless steel exhaust duct systems shall have #316 stainless steel blades, shafts, linkage and casing. Refer to clause 'Stainless Steel Exhaust Ductwork' in this section.

2.6 FLEXIBLE DUCT CONNECTIONS

.1 Manufacturers:

.1 Duro-Dyne.

.2 Substitutions: Refer to Section 21 05 00.

.2 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.3 Connector: Fabric crimped into metal edging strip.

.1 Fabric: UL listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m (30 oz per sq yd).

.2 Net Fabric Width: Approximately 75mm (3 inches) wide.

.3 Metal: 75 mm (3 inch) wide, 0.6 mm thick (24 gauge) galvanized steel.

2.7 VOLUME CONTROL DAMPERS.

.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Splitter Dampers:

.1 Material: Same gauge as duct to 600 mm (24 inches) size in either direction, and two gauges heavier for sizes over 600 mm(24 inches).

.2 Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.

.3 Operator: Minimum 6 mm (1/4 inch) diameter rod in self aligning, universal joint action, flanged bushing with set screw.

.3 Single Blade Dampers: Fabricate for duct sizes up to 150 x 760 mm (6 x 30 inch).

.4 Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 200 x 1825 mm (8 x 72 inch). Assemble centre and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

.5 End Bearings: Except in round duct work 300 mm (12 inches) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

.6 Quadrants:

.1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.

.2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

.3 Where rod lengths exceed 750 mm (30 inches) provide regulator at both ends.

Part 3 Execution

3.1 PREPARATION

.1 Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

.1 Install accessories to manufacturer's written instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

.2 Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

.3 Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96. Provide minimum 300 x 300 mm (12 x 12 inch) size for all fire dampers. Enlarge duct if necessary to accommodate properly sized access door.

.4 Generally access doors at heating coils shall approximate width of coil for ease of cleaning.

.5 At smoke detectors, provide 450mm x 450mm (16 x 16 inch) access doors.

.6 Provide duct test holes where indicated and required for testing and balancing purposes.

.7 Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.8 Demonstrate re-setting of fire dampers to The City's representative.

.9 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators. Refer to Section 23 05 48. For fans developing static pressures of 1250 Pa (5.0 inches wg) and over, cover connections with leaded vinyl sheet, held in place with metal straps.

.10 Use splitter dampers only where indicated.

.11 Provide balancing dampers on high velocity systems where indicated. Refer to Section 23 36 00.

.12 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

.13 Do not locate single blade volume dampers immediately behind diffusers and grilles. This application does not allow uniform airflow across the outlet face.

.14 To minimize generated duct noise, locate volume dampers at least two duct diameters from a fitting and as far away as possible from the outlet or inlet.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 General Fan Components:

- .1 Wheels and Inlets:
- .2 Housings
- .3 Bearings and Drives
- .4 Electrical Components

.2 Cabinet and Ceiling Exhaust Fans

1.2 REFERENCES

.1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

.2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

.3 AMCA 99 - Standards Handbook.

.4 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.5 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

.6 AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

.7 ISO 1940 – Mechanical Vibration. Balance quality requirements for rotors in a constant (rigid) state.

.8 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.9 UL/cUL 762 - Power Roof Ventilators For Restaurant Exhaust Appliances

.10 UL/cUL 705 – Power Ventilators

.11 UL/cUL 793 - Automatically Operated Roof Vents for Smoke and Heat

1.3 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

.3 Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

.4 Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Submittals for project closeout.

.2 Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 .Protect motors, shafts, and bearings from weather and construction dust.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

1.7 EXTRA MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

Part 2 Products

2.1 GENERAL FAN COMPONENTS

.1 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

.2 Sound Ratings: AMCA 301, tested to AMCA 300 ,and bear AMCA Certified Sound Rating Seal.

.3 Fabrication: Conform to AMCA 99.

.4 Performance Base: Sea level conditions.

.5 Temperature Limit: Maximum 150 degrees C (300 degrees F).

.6 Static and Dynamic Balance: Balance all wheels to balance grade G6.3 per ANSI S2.19 (ISO 1940). Eliminate vibration or noise transmission to occupied areas.

.7 Performance Requirements on Schedules.

.8 Wheel And Inlet: Refer to individual sections.

.9 Housing

.1 Heavy gauge steel, spot welded for AMCA 99 Class I and II fans, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut-off.

.2 Factory finish before assembly with enamel or prime coat.

.10 Bearings And Drives

.1 Shafts: Hot rolled steel, ground and polished, with key- way, protectively coated with lubricating oil, and shaft guard.

.2 V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 11.2 kW(15 hp) and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 15 kW(20 hp) and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

.3 Belt Guard: Fabricate to SMACNA Standard; of 2.8 mm(12 gauge) thick, 20 mm(3/4 inch) diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

.11 Electrical Characteristics And Components

.1 Refer to schedule

.2 Motor: Refer to Section 23 05 13.

2.2 CABINET AND CEILING EXHAUST FANS

.1 Manufacturers:

.1 Greenheck

.2 Loren Cook

.3 Broan

.4 Fan Tech

.5 Substitutions: Refer to Section 21 05 00

.2 Centrifugal Fan Unit: Direct driven with galvanized steel housing resilient mounted motor, gravity backdraft damper in discharge.

.3 Electrical Characteristics and Components

.1 Electrical Characteristics:

.1 See Schedule.

.2 Motor: Refer to Section 23 05 13.

.3 UL/cUL listed for above bathtub/shower with GFCI branch protected circuit.

.4 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.

.5 Disconnect Switch: Cord and plug in housing for thermal overload protected motorsolid state speed controller.

.4 Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

.5 Fan Accessory - Speed controller

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install fans with resilient mountings and flexible electrical leads. Refer to Section 23 05 48.

.3 Install flexible connections specified in Section 23 33 00 between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm(one inch) flex between ductwork and fan while running.

.4 Provide safety screen where inlet or outlet is exposed.

.5 Provide backdraft dampers on discharge of exhaust fans and as indicated. Refer to Section 23 33 00.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Variable volume terminal units.

.2 Integral sound attenuator.

1.2 REFERENCES

.1 ADC 1062 - Air Distribution and Control Device Test Code.

.2 NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

.3 UL 181 - Factory-Made Air Ducts and Connectors.

.4 UL 1995 / CSA 236 - Standard of Safety for Heating and Cooling Equipment

.5 AHRI 880 – Performance Rating of Air Terminals

.6 AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets

.7 ASHRAE 130 - Methods of Testing Air Terminal Units

.8 AHRI 410 Air Cooling and Heating Coils

1.3 PERFORMANCE TOLERANCES

.1 Base performance on tests conducted to ADC 1062.

.2 AHRI 880 – Performance Rating of Air Terminals

.3 AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets

1.4 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

.3 Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalogue performance ratings which indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.

.4 Include schedules listing discharge and radiated sound power level for each of second through seventh octave bands at inlet static pressures of 125 to 750 Pa (.05 to 3 inch wg).

.5 Manufacturer's Installation Instructions: Indicate support and hanging details, and service clearances required.

1.5 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of units.

1.6 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.7 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 WARRANTY

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide one year warranty.

.3 Warranty: Include coverage of system powered control systems, operating controls, and electric motors.

1.10 EXTRA MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

Part 2 Products

2.1 MANUFACTURERS

.1 Price Industries

.2 Other acceptable manufacturers offering equivalent products.

.1 Nailor Industries

.2 Titus

.3 Substitutions: Refer to Section 21 05 00.

2.2 MANUFACTURED UNITS

.1 Variable air volume & constant supply air control terminals for connection to single duct, central air systems, with digital variable volume controls & constant volume control, hot water heating coils.

.2 Identify each terminal unit with clearly marked identification label and air flow indicator. Include unit nominal air flow, maximum factory set airflow, minimum factory set air flow, and coil type.

2.3 SINGLE DUCT VARIABLE VOLUME UNITS

.1 Basic Assembly:

.1 Casings: Minimum 0.8 mm (22 gauge) galvanized steel.

.2 Lining: Minimum 13 mm (1/2 inch) vinyl coated fibrous glass insulation, 24 g/L(1.5 lb/cu ft) density, meeting NFPA 90A requirements and UL 181 erosion requirements..

.3 Plenum Air Inlets: Round stub connections for duct attachment.

.4 Plenum Air Outlets: slip and drive connections.

.5 Face liner: Refer to schedule

.2 Basic Unit:

.1 Configuration: Air volume damper assembly inside unit casing. Locate control component inside protective metal shroud.

.2 Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 2 percent of design air flow at 0.75 kPa (3 inches) inlet static pressure.

.3 Mount damper operator to position damper normally open.

.3 Attenuator Section: Integral to the VAV adding a length of 900mm (36 inches) lined attenuator sections with matching air terminal liner. Unit and liner length shall be one continuous piece.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Provide a minimum of three duct diameters of straight inlet duct, the same size as the inlet, between the inlet and any transition, takeoff or fitting.

.3 Provide ceiling access doors or locate units above easily removable ceiling components.

.4 Support units individually from structure. Do not support from adjacent ductwork.

.5 Connect to ductwork to Section 23 31 00.

.6 Provide minimum of 1.5 m (5 ft) of additional lined ductwork, matching the air terminal liner, directly downstream of units.

.7 Verify that electric power is available and of the correct characteristics.

3.2 ADJUSTING

.1 Adjust work to Section 21 05 00.

.2 Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to scheduled minimum flow. Set units with heating coils for minimum 40 percent full flow.

3.3 SCHEDULES

.1 Refer to the drawing for air terminal schedules.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Diffusers.

.2 Registers/grilles.

.3 Louvers.

1.2 REFERENCES

.1 ADC 1062 - Air Distribution and Control Device Test Code.

.2 AMCA 500 - Method of Testing Louvers for Ratings.

.3 AMCA 511 – Certified Ratings Program

.4 AMCA 5000 - Method of Testing Dampers for Ratings.

.5 ARI 650 - Air Outlets and Inlets.

.6 ASHRAE 70 - Method of Testing for Rating the Performance of Outlets and Inlets.

.7 SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

.8 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.4 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

.1 Test and rate air outlet and inlet performance to ADC Equipment Test Code 1062 and ASHRAE 70.

.2 Test and rate louver performance to AMCA 500

.3 Certified AMCA 511 – Certified Ratings Program

1.6 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

Part 2 Products

2.1 MANUFACTURERS

.1 Unless otherwise listed:

.1 Price Industries.
.2 Nailor Industries
.3 Titus
.4 Ventex.

.2 Substitutions: Refer to Section 21 05 00.

2.2 SQUARE CEILING DIFFUSERS

.1 Type: Square, stamped diffuser to discharge air in 360 degree pattern.

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.3 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

.1 Type: Fixed grilles of 13 x 13 x 13 mm (1/2 x 1/2 x 1/2 inch) louvers.

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.4 HEAVY DUTY LINEAR FLOOR GRILLES

.1 Type: Extruded aluminum heavy duty pressed core construction. 11mm (7/16”) Spacing, 5mm (3/16”) Bars

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.5 AIR NOZZLE DIFFUSERS

.1 Type: Aluminum Constructions, directional air pattern control.

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.6 WALL EXHAUST AND RETURN REGISTERS/GRILLES

.1 Type: Streamlined blades, 19 mm (3/4 inch) minimum depth, 19 mm (3/4 inch) maximum spacing, horizontal face.

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.7 LOUVERS

.1 150 mm (6 inch) Fixed Blade Louver:

.1 Type: 150 mm (6 inch) deep with blades on 45 degree slope with centre baffle and return bend, heavy channel frame, aluminum birdscreen with 13 mm (1/2 inch) square mesh for exhaust and 19 mm (3/4 inch) for intake.

.2 Fabrication: 2.0 mm (0.81 inch) extruded aluminum, welded assembly, with factory baked enamel finish - custom colour to be selected by the architect.

.3 Mounting: Refer to schedules for mounting options.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

.3 Install diffusers to duct work with air tight connection.

.4 All diffusers, grilles and registers shall be free of fluttering, chattering and vibration. A felt or sponge rubber gasket shall be provided behind each outlet or inlet and adequate fastenings provided to prevent leakage between the outlet and duct, wall or ceiling.

.5 In all cases where linear diffusers are required to run continuous from one wall to another or between bulkheads, beams or other fascia the schedule size of the diffuser shall be confirmed by site measurements prior to final assembly.

.6 Floor grilles to be set flush with floor coverings except carpet.

.7 Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

.8 Paint ductwork visible behind air outlets and inlets matte black.

.9 Care should be taken to install diffusers as per the reflected ceiling plans where available so that the diffusers will fit properly in the ceiling suspension system. The sheet metal submechanical subcontractor shall co-ordinate this work with the General Mechanical subcontractor, the suspended ceiling subtrade and electrical subtrade.

.10 Should there be any conflict in the location of grilles, registers and diffusers with lights, etc. the matter shall be referred to the Contract Administrator for directive. If requested by the Contract Administrator, the submechanical subcontractor shall relocate grilles, diffusers and registers and ductwork attached, within two feet of locations as indicated on the drawings, without extra cost to the The City.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Boilers.

.2 Controls and boiler trim.

.3 Hot water connections.

.4 Fuel connection.

.5 Controls

.6 Venting

1.2 REFERENCES

.1 AGA - Directory of Certified Appliances and Accessories.

.2 AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.3 ASME SEC 4 - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.

.4 ASME SEC 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.

.5 HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

.6 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

.7 NFPA 54 (AGA Z223.1) - National Fuel Gas Code.

.8 NFPA 58 - Liquified Petroleum Gas Code.

.9 UL 726 - Oil-Fired Boiler Assemblies.

.10 UL - Gas and Oil Equipment Directory.

.11 Manitoba Gas Notices 2010

.12 CSA B149.1 Natural Gas and Propane Installation Code

1.3 SUBMITTALS FOR REVIEW

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide data indicating general layout, dimensions, and size and location of water, gas, and vent connections, and electrical characteristics and connection requirements.

1.4 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for information.

.2 Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

.3 Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

1.5 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

.2 Test and inspect boilers according to the ASME Boiler and Pressure Vessel Code, Section IV.

.3 Boilers shall be test fired in the factory with a report attached permanently to the exterior cabinet of the boiler for field reference.

1.7 REGULATORY REQUIREMENTS

.1 Conform to NFPA 70 for internal wiring of factory wired equipment.

.2 I=B=R Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.

.3 Conform to ASME SEC 4 for boiler construction.

.4 Units: ULC labeled. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction. and tested to UL 795 Commercial-Industrial Gas Heating Equipment.

.5 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.9 WARRANTY

.1 Section 21 05 00: Submittals for project closeout.

.2 Warranty Period: Manufacturer's standard, but not less than 10 years from date of Substantial Completion on the heat exchanger. Additional 21-year thermal shock warranty on heat exchanger.

Part 2 Products

2.1 MANUFACTURERS

.1 Advanced Thermal Hydronics Model KN Series.

.2 Substitutions: Not permitted.

2.2 MANUFACTURED UNITS

.1 Hot Water Boilers:

.1 CSA design certified as a condensing boiler.

.2 5:1 continuous turn down with constant CO2 over the turndown range.

.3 Natural gas and have a CSA International certified input rating as noted on the drawings, and a

.4 Thermal efficiency rating up to 99% at minimum input.

.5 Symmetrically air-fuel coupled such that changes in combustion air flow or flue flows affect the BTUH input without affecting combustion quality.

.6 Proven pilot interrupted spark ignition system.

.7 UL approved flame safeguard ignition control system

.8 Silent burner ignition and operation.

.9 Down fired counter flow.

.10 An aluminum corrosion resistant condensate drain.

.11 Venting performance horizontal distance:

.1 80 equivalent feet with a vent diameter equivalent to the combustion chamber outlet diameter.

.2 120 equivalent feet with a vent diameter equivalent to the combustion chamber outlet diameter for KN-16/26/30.

.2 Electrical Characteristics:

.1 Refer to Section 26 05 80.

2.3 FABRICATION

.1 Assembly: Cast iron sections with 690 kPa (100 psig) water ASME Boilers and Pressure Vessels Code rating.

.1 Hydrostatic pressure test of 250 PSIG at the factory before shipment and they shall be marked, stamped or cast with the A.S.M.E. Code symbol.

.2 Water ports will be sealed with steel push nipple connectors.

.3 Machined for metal to metal sealing of the gas side surfaces

.4 Iron shall have a minimum thickness of ¼"(6mm).

.5 Heat exchanger

.1 No limitations on temperature rise

.2 No restrictions to inlet water temperature

.2 Access covers for all serviceable components.

.3 Jacket: Stainless Steel

.4 Boiler Blower:

.1 Motor: Externally mounted

2.4 HOT WATER BOILER TRIM

.1 ASME rated pressure relief valve,

.1 Refer to drawing schematic.

.2 Combination water pressure and temperature shipped factory installed. LCD outlet temperature readout to be an integral part of the front boiler control panel display to allow for consistent easy monitoring of temperatures factory mounted and wired.

.3 Low water cut-off to prevent burner operation when boiler water falls below safe level.

.4 High Limit: Temperature control with manual-reset limits boiler water temperature in series with the operating control. Factory mounted and senses the outlet temperature of the boiler through a dry well.

.5 Provide the following standard trim:

.1 Stainless Steel Condensate Receiver Pan
.2 Low Air Pressure Switch
.3 Blocked Flue Detection Switch
.4 Modulation Control
.5 Temperature/Pressure Gauge (loose)
.6 Manual Reset High Limit (CSD-1 Factory Mounted and Wired)
.7 Low Gas Pressure Safety Switch
.8 Low Water Cutoff with Manual Reset (CSD-1 Factory mounted and wired)
.9 Supply Outlet Temperature Display
.10 Full Digital Text Display for all Boiler Series of Operation and Failures
.11 Air Inlet Filter
.12 Combustion Air Fan with Safety Interlock
.13 Condensate Drain
.14 Flow Switch Mounted & Wired
.15 Relief Valve (loose)

.6 Provide the following job specific trim and features:

.1 Valve Proving Switch

.2 Isolation valve wiring with mounted box in rear of boiler

2.5 FUEL BURNING SYSTEM

.1 Burner Operation: modulating with low fire position for ignition.

.2 Gas Burner: Metal fiber mesh construction. A window view port shall be provided for visual inspection of the boiler during firing. The gas distribution components and burner shall be enclosed with a cast-aluminum housing. 99% efficiency without exceeding a NOx reading above 11ppm.

.3 Gas Burner Safety Controls: Alumina ceramic insulated ignition electrodes and UV sensing tube permanently arranged to ensure proper ignition electrode and UV alignment.

.4 The burner and gas train:

.1 Burner Firing: Full modulation with 5:1 turndown @ Continuous CO2

.2 Burner Ignition: Intermittent spark

.3 Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.

.4 Flue-Gas Collector: Enclosed combustion chamber with integral combustion-air blower and single venting connection.

.5 Gas Train: Manual ball type gas valves (2), main gas valve, manual leak test valve, pilot gas pressure regulator, and automatic pilot gas valve. All components to be factory mounted and CSD-1 compliant.

.6 Safety Devices: Low gas pressure switch, air-flow switch, and blocked flue detection switch, low water cutoff (manual reset), high temperature manual reset. All safeties to be factory mounted.

.5 Rated Capacity: Rated capacity with pressures as low as 3" W.C. at the inlet to the burner gas valve.

.6 Burner Controls: Honeywell RM7800 series digital flame safe guard with UV rectification. The flame safe guard shall be capable of both pre and post purge cycles.

2.6 PERFORMANCE

.1 Refer to schedule

2.7 VENTING

.1 The exhaust vent must be UL Listed for use with Category II, III and IV appliances and compatible with operating temperatures up to 230°F, positive pressure, condensing flue gas service. UL listed vents are PVC, CPVC, Polypropylene and AL 29-4C stainless steel.

.2 Follow guidelines specified in manufacturer’s venting guide.

2.8 CONDENSATE NEUTRALIZER

.1 Provide refillable neutralization unit. Neutralization condensate released by the unit will be non-corrosive, and a safe pH level above 6.5. Standard of Acceptance is AXIOM NC-1

.2 Low profile design for appliances with a near floor condensate drain

.3 All corrosion resistant materials

.1 ACCESSORIES

.1 NM-1 Replacement LipHter neutralization media

2.9 CONTROLS

.1 The boiler control package shall be a MTI Heat-Net or equivalent, integrated boiler management system. The control system must be integral to each boiler, creating a control network that eliminates the need for a “wall mount” stand-alone boiler system control. Additional stand-alone control panels, independent of a Building Management System (BMS), shall not be allowed to operate the boiler network.

.2 The Heat-Net control shall be capable of operating in the following ways:

.1 As a stand-alone boiler control system using the Heat-Net protocol, with one “Master” and multiple “Member” units.

.2 As a boiler network, enabled by a Building Management System (BMS), using the Heat-Net protocol, with one “Master” and multiple “Member” units.

.3 As “Member” boilers to a Building Management System (BMS) with multiple input control methods.

.4 Failsafe mode – When a Building Automation System is controlling set point, if communications are lost, the boiler/system will run off the Local set point..

.5 Adaptive Modulation – Lowers the modulation rate of all currently operating boilers before a newly added boiler enters operation.

.6 Priority Firing – Allows mixing of condensing, non-condensing base-load and/or other combination of (2) functional boiler types utilizing (2) priority levels.

.7 Available priority start/stop qualifiers shall be done using any combination of: A) Modulation Percentage B) Outdoor Air Temperature or C) Return Water Temperature.

.8 Base Loading – Provides the ability to control (1) base load boiler with enable/disable and 4-20mA modulating signal (if required).

.3 Each Heat-Net control in the boiler network shall have the following standard features:

.1 Digital Communications Control.

.1 Boiler to Boiler: Heat-Net

.2 Building Management System (BMS): MODBUS standard protocol. (BACnet, LON-WORKS and N2 optional protocols)

.2 Analog 4:20 and 0-10vdc also supported.

.3 Distributed control using Heat-Net protocol for up to 16 total boilers.

.4 System/Boiler operating status in English text display.

.5 Interlock, Event, and System logging with a time stamp.

.6 Advanced PID algorithm optimized for specific boilers (KN-Series).

.7 Four dedicated temperature sensor inputs for: Outside Air Temperature, Supply (Outlet Temperature, Return Temperature (Inlet), and Header Temperature.

.8 Automatically detects the optional temperature sensors on start up.

.9 Menu driven calibration and setup menus with a bright 4-line Vacuum Fluorescent Display.

.10 (8) Dedicated 24vac interlock monitors and 8 dedicated 120vac system monitors used for diagnostics and providing feedback of faults and system status.

.11 Multiple boiler pump or motorized boiler valve control modes.

.12 Combustion Air Damper control with proof time.

.13 Optional USB/RS485 network plug-in to allow firmware updates or custom configurations.

.14 Optional BACnet, LONWORKS and N2 interface.

.15 Alarm contacts.

.16 Runtime hours.

.17 Outdoor Air Reset with programmable ratio.

.18 Time of Day clock to provide up to four (4) night setback temperatures.

.19 Failsafe mode when a Building Management System (BMS) is controlling setpoint. If communications is lost, the boiler/system shall run off the Local Setpoint.

.20 Support for domestic hot water (DHW) using a 10k sensor or a dry contact input from a tank thermostat and a domestic hot water relay (pump/valve)

.21 Continuous Daily Runtime Restart feature that monitors the runtime of each boiler and if any in the network have exceeded 24 hours of continuous runtime, the boiler is restarted to protect the UV flame scanner.

.22 Allows for selection of any boiler in the network to act as Lead Boiler.

.23 Adaptive Modulation feature in which the Master boiler adjusts the system modulation rate to a lower value when a new boiler in the network is started to compensate for the added BTU’s to the system. Once the newly added boiler fi res and the adjustable timer expire, the Master resumes control of the system modulation to maintain setpoint temperature.

.24 Priority firing – Allows mixing of condensing and non-condensing, base load and/or other combination of (2) functional boiler types utilizing (2) priority levels.

.25 Available priority start/stop qualifiers shall be done using any combination of: A) modulation percentage B) outdoor air temperature (or) C) return water temperature.

.26 Base Loading – Provides the ability to control (1) base load boiler with enable/disable and 4-20mA modulating signal (if required).

Part 3 Execution

3.1 EXAMINATION

.1 Examine area to receive boiler for compliance with requirements for installation tolerances and other conditions affecting boiler performance. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install to NFPA 54.

.3 Install boiler on concrete housekeeping base, sized minimum 100 mm(4 inches) larger than boiler base. Refer to Section 03 30 00.

.4 Provide connection of natural gas service to NFPA 54 (AGA Z223.1).

.5 Provide piping connections and accessories as indicated.

.6 Provide piping connections and accessories as indicated.

.7 Pipe relief valves to nearest floor drain.

.8 Provide for connection to electrical service. Refer to Section 26 05 80.

.9 Ground equipment.

.1 Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer’s Field Service: Engage a factory-authorized service representative to supervise the field assembly of components and installation of boilers, including piping and electrical connections. Report results in writing.

.1 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Boiler shall be commissioned by factory-authorized technician. Contact local representative for factory authorized technician information.

.2 Manufacturer’s representative shall supply a factory authorized service technician to start up the boilers.

3.4 CLEANING

.1 Flush and clean boilers on completion of installation, according to manufacturer’s written instructions.

.2 After completing boiler installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes including chips, scratches, and abrasions with manufacturer's stainless steel polish.

3.5 MANUFACTURER'S FIELD SERVICES

.1 A. Engage a factory-authorized service representative to provide start up service. Start up to be performed only after complete boiler room operation is field verified to offer a substantial load, and complete system circulation. One-year warranty shall be handled by factory authorized tech. Instruct operating personnel in operation and maintenance of units.

.2 Verify that installation is as indicated and specified.

.1 Verify that electrical wiring installation complies with manufacturer’s submittal and installation requirements in Division 16 Sections. Do not proceed with boiler start up until wiring installation is acceptable to equipment Installer.

.3 Complete manufacturer’s installation and start up checklist and verify the following:

.1 Boiler is level on concrete base.

.2 Flue and chimney are installed without visible damage.

.3 No damage is visible to boiler jacket, refractory, or combustion chamber.

.4 Pressure-reducing valves are checked for correct operation and specified relief pressure. Adjust as required.

.5 Clearances have been provided and piping is flanged for easy removal and servicing.

.6 Heating circuit pipes have been connected to correct ports.

.7 Labels are clearly visible.

.8 Boiler, burner, and flue are clean and free of construction debris.

.9 Pressure and temperature gages are installed.

.10 Control installations are completed.

.4 Ensure pumps operate properly.

.5 Check operation of gas pressure regulator device on gas train, including venting.

.6 Check that fluid-level, flow-switch (optional), and high-temperature interlocks are in place.

.7 Start pumps and boilers, and adjust burners to maximum operating efficiency.

.1 Fill out start up checklist and attach copy with Mechanical subcontractor Start-up Report.

.2 Check and record performance of factory-provided boiler protection devices and firing sequences.

.3 Check and record performance of boiler fluid-level, flow-switch (optional), and high-temperature interlocks.

.4 Operate boilers as recommended or required by manufacturer.

.8 Perform the following tests for maximum and minimum firing rates for modulating burner. Adjust boiler combustion efficiency at maximum and minimum modulation rates. Perform combustion flue gas test at minimum and maximum modulation rate. Measure and record the following:

.1 Differential pressure across air / gas orifice.

.2 Combustion-air temperature at inlet to burner.

.3 Flue-gas temperature at boiler discharge.

.4 Flue-gas carbon dioxide, oxygen, and carbon monoxide concentration.

.5 Flue gas NOx emissions where applicable.

.6 Natural flue draft.

.9 Measure and record temperature rise through each boiler.

3.6 DEMONSTRATION

.1 Engage a factory-authorized service representative to train The City's maintenance personnel as specified below. Training to take place during boiler start up with manufacturer's factory authorized personnel.

.1 Operate boiler, including accessories and controls, to demonstrate compliance with requirements.

.2 Train The City's maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

.3 Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."

.4 Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

.5 Schedule training with The City with at least 7 days' advance notice.

END OF SECTION

General

1.1 SECTION INCLUDES

.1 Chiller package.

.2 Charge of refrigerant and oil.

.3 Controls and control connections.

.4 Chilled water connections.

.5 Starters.

1.2 REFERENCES

.1 ARI 550/590: Water Chilling Packages Using the Vapor Compression Cycle.

.2 CAN/CSA-B52 – Mechanical refrigeration Cod.

.3 ASME SEC 8 - Boiler and Pressure Vessel Code.

1.3 SUBMITTALS FOR REVIEW

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate valves, strainers, and thermostatic valves required for complete system.

.3 Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

1.4 SUBMITTALS FOR INFORMATION

.1 Section 21 05 00: Submittals for information.

.2 Submit manufacturer's installation instructions.

.3 Manufacturer's Certificate: Certify that components of package not provided by manufacturer have been selected to manufacturer's requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.7 REGULATORY REQUIREMENTS

.1 Provide certification of inspection for conforming authority having jurisdiction approval.

.2 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc.,or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Comply with manufacturer's installation written instructions for rigging, unloading, and transporting units.

.3 Protect units from physical damage.

1.9 WARRANTY

.1 Section 21 05 00: Submittals for project closeout.

.2 Standard Warranty (Canada): The refrigeration equipment manufacturer's warranty shall be for a period of one (1) year from date of equipment start up, but not more than 18 months from shipment. It shall cover replacement parts having proven defective within the above period.

.3 1st Year Labor Warranty: included

.4 Extended Compressor Warranty: Four (4) years extended compressor warranty, parts only.

1.10 MAINTENANCE SERVICE

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide service and maintenance of complete assembly for one year from Date of Substantial Completion.

1.11 MAINTENANCE MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

1.12 EXTRA MATERIALS

.1 Section 21 05 00.

Part 2 Products

2.1 MANUFACTURERS

.1 McQuay Product: AGZ

.2 Trane Product: CGAM

.3 Carrier Product: 30RAP

.4 Substitutions: Refer to Section 21 05 00

2.2 MANUFACTURED UNITS

.1 Provide factory assembled and tested outdoor air cooled liquid chillers consisting of compressors, condenser, evaporator, thermal expansion valve, refrigeration accessories, and control panel. Construction, testing, and ratings to ARI 550/590.

.2 Conform to ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of reciprocating water chillers.

.3 Conform to CAN/CSA-B52 code for construction, operation, and installation of water chillers.

2.3 HERMETIC SCROLL COMPRESSORS

.1 Unit: Direct drive, high torque hermetic, , fixed compression, scroll motor-compressor , two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads.

.2 Features: Centrifugal oil pump, sump oil heater, oil level sight glass, oil charging valve, two point lubrication for each motor bearing, flooded lubrication for the journal and thrust bearings, check valve on scroll discharge port.

.3 Motor: Suction gas cooled, hermetically sealed, squirrel cage induction.

2.4 EVAPORATOR

.1 The evaporator shall be a compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates.

.1 The evaporator shall be protected with an electric resistance heater (heat trace tape) and insulated with 3/4" (19mm) thick closed-cell polyurethane insulation. This combination shall provide freeze protection down to -20°F (-29°C) ambient air temperature.

.2 The water-side working pressure shall be a minimum of 653 psig (4502 kPa). Vent and drain connections shall be provided in the inlet and outlet chilled water piping by the installing mechanical subcontractor. Evaporators shall be designed and constructed according to, and listed by, Underwriters Laboratories (UL).

.2 Provide water drain connection and thermometer wells for temperature controller and low temperature cutout.

2.5 CONDENSERS

.1 Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits with liquid accumulators. Air test under water to 2900 kPa (425 psig).

.2 Provide vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Provide factory mounted, PVC coated steel coil guard panels.

.3 Provide fan motors with permanently lubricated ball bearings and built-in current and overload protection. Refer to Section 23 05 13.

2.6 ENCLOSURES

.1 House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.

.2 Mount starters and disconnects in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

2.7 REFRIGERANT CIRCUIT

.1 Provide refrigerant circuits, factory supplied and piped.

.2 Provide for each refrigerant circuit:

.1 Liquid line solenoid valve.

.2 Thermal expansion valve sized for maximum operating pressure.

.3 Insulated suction line.

2.8 CONTROLS

.1 On chiller, mount weatherproof steel control panel, containing starters power and control wiring, factory wired with single point power connection.

.2 For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection.

.3 DDC microprocessor unit controller with liquid crystal display provides the operating and protection functions. The controller shall take pre-emptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:

.4 Equipment Protection

.1 The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.

.5 Shutdown Alarms

.1 No evaporator water flow (auto-restart)

.2 Sensor failures
.3 Low evaporator pressure
.4 Evaporator freeze protection
.5 High condenser pressure
.6 Outside ambient temperature (auto-restart)
.7 Motor protection system
.8 Phase voltage protection (Optional)

.6 Limit Alarms

.1 Condenser pressure stage down, unloads unit at high discharge pressures.
.2 Low ambient lockout, shuts off unit at low ambient temperatures.
.3 Low evaporator pressure hold, holds stage #1 until pressure rises.
.4 Low evaporator pressure unload, shuts off one compressor.

.7 Unit Enable Selection

.1 Enables unit operation from either local keypad, digital input, or BAS

.8 Unit Mode Selection

.1 Selects standard cooling, ice, glycol, or test operation mode

.9 Analog Inputs:

.1 Reset of leaving water temperature, 4-20 mA
.2 Current Limit

.10 Digital Inputs

.1 Unit off switch
.2 Remote start/stop
.3 Flow switch
.4 Ice mode switch, converts operation and setpoints for ice production
.5 Motor protection

.11 Digital Outputs

.1 Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
.2 Evaporator pump; field wired, starts pump when unit is set to start

.12 Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

.13 Building Automation System (BAS) Interface

.1 Factory mounted DDC controller(s) shall support operation on a BACnet®, network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.
.2 BACnet MS/TP master (Clause 9)
.3 BACnet IP, (Annex J)
.4 BACnet ISO 8802-3, (Ethernet)

.5 The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.

.6 All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.9 OPTIONS AND ACCESSORIES

.1 Ground Fault Protection: Factory installed circuit breaker to protect equipment from damage from line-to-ground fault currents less than those required for conductor protection.

.2 Phase loss with under/over voltage protection and with LED indication of the fault type to guard against compressor motor burnout.

.3 BAS interface module to provide interface with the BACnet Ethernet protocol..

.4 Compressor Sound Reduction - Acoustic reduction blankets shall be factory installed on each compressor.

2.10 PERFORMANCE

.1 Air Cooled Water Chiller:

.1 Refer to schedule

2.11 ELECTRICAL CHARACTERISTICS AND COMPONENTS

.1 Electrical Characteristics:

.1 Refer to schedule

.2 Motor: Refer to Section 23 05 13.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Align chiller package on steel or concrete foundations.

.3 Install units on vibration isolation.

.4 Connect to electrical service.

.5 Connect to chilled water piping.

.1 On return water pipe, provide:

.1 Thermometer well for temperature controller.

.2 Thermometer well for temperature limit controller.

.3 Install a field-supplied strainer in the chilled water return line at the evaporator inlet; 40-mesh on units with brazed-plate evaporators or 20-mesh on shell-and-tube evaporators.

.4 Flexible pipe connecter.

.5 Shut-off valve.

.2 On supply water pipe provide:

.1 Flexible pipe connecter.

.2 Shut-off valve.

.6 Arrange piping for easy dismantling to permit tube cleaning.

.7 Coordinate controls with control mechanical subcontractor.

3.2 MANUFACTURER'S FIELD SERVICES

.1 Section 21 05 00: Prepare and start systems.

.2 Supply service of factory trained representative to supervise testing, dehydration and charging of machine, start-up, and instruction on operation and maintenance to The City.

.3 Supply initial charge of refrigerant and oil.

3.3 DEMONSTRATION AND INSTRUCTIONS

.1 Section 21 05 00: Demonstrating installed work.

.2 Demonstrate system operation and verify specified performance. Refer to Section 23 05 93.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Reversing core energy recovery ventilators

1.2 REFERENCES

.1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

.2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

.3 AHRI Standard 1060 - Performance rating of Air-to-Air Heat Exchangers for Energy Recovery Equipment.

.4 AMCA 99 - Standards Handbook.

.5 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.6 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

.7 AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

.8 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.9 UL 723 – Test for Burning Characteristics of Building Materials (ASTM E84/NFPA 255)

1.3 SUBMITTALS

.1 Section 21 05 00: Common Work for Mechanical.

.2 Shop Drawings: Indicate assembly of heat recovery units and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

.3 Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Common Work for Mechanical.

.2 Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Section 21 05 00: Common Work for Mechanical.

.2 Protect motors, shafts, and bearings from weather and construction dust.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Do not operate equipment for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

1.7 EXTRA MATERIALS

.1 Section 21 05 00: Common Work for Mechanical.

.2 Provide two sets of filters.

Part 2 Products

2.1 REVERSING CORE ENERGY RECOVERY VENTILATORS

.1 Manufacturers

.1 Tempeff

.2 BKM

.2 Substitutions: Not Permitted

.3 General

.1 Configuration: Fabricate as detailed on drawings.

.2 Performance: Conform to ARI 430. Refer to schedules on drawings.

.3 Acoustics: Sound power levels (dB) for the unit shall not exceed levels specified in the schedule. The manufacturer shall provide the necessary sound treatment to meet these levels if required.

.4 Where the unit arrangement differs from the drawings, the mechanical mechanical subcontractor is responsible for any additional structural, architectural, electrical and mechanical work that may be required and ensuring that intakes and outlets are arranged to meet code requirements.

.4 Unit Construction

.1 Fabricate unit with extruded aluminum channel posts and galvanized panels secured with mechanical fasteners.

.2 Unit shall be capable of having all panels remove simultaneously for servicing without affecting the structural integrity of the unit.

.3 The unit structure shall be self-supporting.

.4 All access doors shall be sealed with permanently applied gaskets.

.5 Panels and access doors shall be constructed as a 2-inch (50-mm) nominal thick; thermal broke double wall assembly, with 3.0 lb mineral wool insulation.

.6 The outer panel shall be constructed of G90 galvanized 18-gauge steel. The inner liner shall be constructed of 22 gauge G90 galvanized steel.

.7 Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 6 inches of negative static pressure or 5 inches of positive static pressure. Deflection shall be measured at the midpoint of the panel height.

.8 Module to module assembly shall be accomplished with gaskets.

.9 Access Doors shall be flush mounted to cabinetry, with minimum of two hinges, locking latch and full size handle assembly.

.10 Unit shall be provided with base. Base of unit shall be designed to support the weight of the unit.

.5 Fans

.1 Provide direct-drive ECM airfoil plenum supply and exhaust fan(s). Fan assemblies including fan, motor shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Manufacturer must ensure maximum fan RPM is below the first critical speed.

.2 Bearings shall be self-aligning, grease lubricated, ball or roller bearings. Grease fittings shall be attached to the fan base assembly near access door.

.3 Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on spring vibration type isolators inside cabinetry.

.6 Bearings And Drives

.1 Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards, L-50 life at 200,000 hours – heavy duty pillow block type, self-aligning, grease-lubricated ball bearings.

.2 Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

.7 Electrical

.1 Single point power connection.

.2 The ventilators(s) components shall be CSA, UL or CE listed as applicable.

.3 Wherever possible controls shall be located on the side of the unit for ease of servicing. Units which come with controls on roof must come with a permanently installed ladder to access controls, meeting all applicable codes.

.4 Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. All wires shall be number tagged and cross-referenced to the wiring diagram for ease of troubleshooting.

.5 Fan motors shall be 1800 rpm, open drip-proof (ODP) type. Motors shall be high efficiency to meet EPAct requirements. Electrical characteristics shall be as shown in schedule.

.6 Motors shall be rated for use with variable frequency drives (VFD)

.7 Air handler manufacturer shall provide and mount a damper hand-off-auto (HOA) switch.

.8 Particulate Filters

.1 Filter section with filter racks and guides with hinged and latching access doors on either, or both sides, for side loading and removal of filters.

.2 Filter media shall be UL 900 listed, Class I or Class II.

.3 See schedule for pre-filter and final filter requirements.

.9 Energy Recovery

.1 Reverse Flow Energy Recovery

.1 Unit shall be equipped with Dual Core energy recovery technology. The unit shall be 90% temperature efficient (+-5%) in winter and up to 80% in summer. It shall also provide up to 70% latent recovery. Unit shall accomplish this recovery without a defrost cycle that will reduce the effectiveness of the device.

.2 Devices employing defrost cycles that bypass the heat recovery device, or reduce the effectiveness are not acceptable. Heat recovery device shall not require frost protection in applications down to -40 degrees.

.3 Cores shall be comprised of precisely corrugated high grade aluminum.

.4 Recovery cycles shall be controlled by internal programmed thermostats measuring both supply and exhaust air, and optimizing performance of both heat recovery and free cooling modes.

.2 Dampers

.1 Switchover damper section shall be comprised of low leakage dampers operated by electric damper motors complete with DC braking.

.2 Each damper shall control one of the 4 airways, upper-horizontal, lower-horizontal, forward-vertical and rear-vertical. Dampers shall be capable of orienting to close off outside air to the building without needing external shut off dampers.

.3 Dampers of other arrangements need to receive approval from Contract Administrator.

.4 Dampers shall also be capable of orienting to allow 100% recirculation of air without using heat recovery device for off peak or unoccupied heating modes.

.5 Damper blades, rods and axles shall be galvanized for long life expectancy.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Where units are mounted on roof they shall be installed on manufacturer supplied insulated roof curbs.

.3 Install flexible connections specified in Section 23 33 00 between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm (one inch) flex between ductwork and fan while running.

.4 Provide backdraft dampers on discharge of exhaust fans and as indicated. Refer to Section 23 33 00.

.5 Pipe condensate drains to nearest floor drain.

.6 All heat recovery system to be tested as noted in Specification Section 23 05 93 – Testing, Adjusting, And Balancing.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Fans Sections

.2 Heating coils.

.3 Cooling coils.

.4 Mixing boxes/economizer.

.5 Combination filter/mixing boxes.

.6 Humidifiers.

1.2 REFERENCES

.1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

.2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

.3 AMCA 99 - Standards Handbook.

.4 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.5 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

.6 AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

.7 AMCA 500 - Method of Testing Louvres for Ratings.

.8 AMCA 5000 - Method of Testing Dampers for Ratings.

.9 ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

.10 ARI 430 - Fabrication of Central Station Air Handling Units.

.11 ARI 435 - Application of Central-Station Air-Handling Units.

.12 ARI 610 - Central System Humidifiers for Residential Applications.

.13 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.14 UL 900 - Air Filter Units.

.15 Manitoba Energy Code for Buildings

.16 NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

.17 ASHRAE 90.1 Energy Code.

.18 ASTMB117 - Standard Practice for Operating Salt Spray Apparatus.

.19 NEMA MG1 - Motors and Generators.

.20 UL 723 - Test for Surface Burning Characteristics of Building Materials.

.21 UL 900 - Test Performance of Air Filter Units.

.22 UL 94 - Test for Flammability of Plastic Materials for Parts in Devices and Appliances.

.23 AHRI Standard 1060 - Rating Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.

1.3 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements. Computer generated fan curves for each air handling unit shall be submitted with specific design operating point noted. A computer generated psychometric chart shall be submitted for each cooling coil with design points and final operating point clearly noted. Sound data for discharge, radiated and return positions shall be submitted by octave band for each unit. Calculations for required baserail heights to satisfy condensate trapping requirements of cooling coil shall be included..

.3 Product Data:

- .1 Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
- .2 Provide data of filter media, filter performance data, filter assembly, and filter frames.
- .3 Provide fan curves with specified operating point clearly plotted.
- .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.
- .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

.4 Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Submittals for project closeout.

.2 Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

.3 Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.7 EXTRA MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide one set for each unit of fan belts and filters.

Part 2 Products

2.1 MANUFACTURERS

.1 Daikin – Vision

.2 Substitutions: Refer to Section 21 05 00

2.2 GENERAL DESCRIPTION

.1 Configuration: Fabricate with fan and coil section plus accessories, including:

.1 Mixing box section.
.2 Combination Filter section.
.3 Cooling coil / Heating coil section.
.4 Humidifier.

.2 Performance Base: Sea level conditions.

.3 Fabrication: Conform to AHRI 430.

.4 Performance: Refer to schedules on plans.

2.3 CASING

.1 Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.

.1 Outside Casing:
  .1 G90 Galvanized Steel: 1.2 mm (18 gauge).
.2 Inside Casing:
  .1 G90 Galvanized Steel: 1.2 mm (18 gauge).
.3 Floor Plate:

.1 G90 Galvanized Steel: 3.3 mm (10 gauge).

.2 Panels and access doors shall be constructed as a 50mm (2-inches) nominal thick; thermal broke double wall assembly, injected with foam insulation with an R-value of not less than R-13

.3 Finish: Baked enamel.

.4 Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 1245 Pa (5 inches water gauge) of positive or 1450 Pa (6 inches water gauge) of negative static pressure. Deflection shall be measured at the panel midpoint.

.5 The casing leakage rate shall not exceed .0.24 L/s per square meter (5 cfm per square foot) of cabinet area at 1245 Pa (5 inches water gauge)of positive static pressure or1450 Pa (6 inches water gauge) of negative static pressure.

.6 Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.

.7 Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

.8 A 6-inch formed G60 galvanized steel base rail shall be provided by the unit manufacturer for structural rigidity and condensate trapping.. The base rail shall be constructed with 12-gauge nominal for unit sizes 003 - 035 and 10-gauge nominal for unit sizes 040 - 090. The following calculation shall determine the required height of the baserail to allow for adequate drainage. Use the largest pressure to determine base rail height.

.9 Lights: Provide in accessible sections suitable for damp locations with wire guards, factory wired to switch and pilot light mounted on casing exterior. In humidifier sections, provide lights suitable for wet locations.

.10 Drain Pans: refer to coils section below.

2.4 FANS

.1 Supply Fan :

.1 Type: Acceptable fan assembly shall be a centrifugal plenum fan, class II, belt-drive type housed airfoil fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Copper lubrication lines shall be provided and extend from the bearings and attached with grease fittings to the fan base assembly near access door. If not supplied at the factory, mechanical subcontractor shall mount copper lube lines in the field. Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door.

.2 Return Fan :

.1 Type: Acceptable fan assembly shall be a double width, double inlet, class II, belt-drive type housed forward curved fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Copper lubrication lines shall be provided and extend from the bearings and attached with grease fittings to the fan base assembly near access door. If not supplied at the factory, mechanical subcontractor shall mount copper lube lines in the field. Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door.

.3 Performance Ratings: Conform to AMCA 210

.4 Sound Ratings: AMCA 301; tested to AMCA 300

.5 Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with copper tube and grease fitting rigidly attached to casing.

.6 Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door.

.7 Flexible Connection: Separate fan and coil sections.

2.5 BEARINGS AND DRIVES

.1 Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be designed for service with an L-50 life of 200,000 hours and shall be a heavy duty pillow block, self-aligning, grease-lubricated ball or spherical roller bearing type.

.2 Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil. Hollow shafts are unacceptable.

.3 Drives: V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Fixed sheaves, matched belts, and drive rated based on motor horsepower. Minimum of 2 belts shall be provided on all fans with 10 HP motors and above. Standard drive service factor minimum shall be 1.1 S.F. for 1/4 HP – 7.5 HP, 1.3 S.F. for 10 HP and larger, calculated based on fan brake horsepower

2.6 ELECTRICAL CHARACTERISTICS AND COMPONENTS

.1 Motor:

.1 Refer to 23 05 13 Motors for additional information

.2 Refer to schedules for motor sizes

.2 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.7 COILS

.1 Water cooling, water heating, steam, and refrigerant coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Forced Circulation Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410

.2 Casing: Provide access to coils. Enclose heating coils with headers and return bends exposed outside and cooling coils fully contained within casing. Unit shall be provided with coil connections that extend a minimum of 125mm (5 inches) beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Mechanical subcontractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

.3 Drain Pans: Stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section and humidifier sections. Drain connection centerline shall be a minimum of 75mjm (3 inches) above the base rail to aid in proper condensate trapping. Drain connections that protrude from the base rail are not acceptable. There must be a full 50mm (2 inches) thickness of insulation under drain pan.

.4 Fabrication:

.1 Tubes: 16 mm (5/8 inches) OD seamless copper, nominal 0.5mm (0.020 inches) tube wall thickness, expanded into fins, brazed joints.

.2 Fins: Aluminum, 0.19mm (0.0075 inches) thickness.Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.

.3 Casing: Die formed channel frame of galvanized steel.

.5 Water Coils:

.1 Headers: Seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.

.2 Configuration: Fully drainable, with threaded plugs for drain located at the bottom of the header and vent at the top of the header; serpentine type with return bends on smaller sizes and return headers on larger sizes.

2.8 HUMIDIFIER

.1 Humidifiers: Certify capacities and selection to ARI 610.

.2 Steam Grid Humidifier: Stainless steel distribution tube with evenly spaced orifices extended full width of unit, factory mounted in plenum with drain pan for draw-thru units. Refer to Section 23 84 15.

2.9 FILTERS

.1 Filter Box: Section with filter guides, access doors from both sides, for side loading.

.2 Filter Media: UL 900 listed, Class I or Class II.

.3 Furnish combination filter section with 50mm (2 inches) pleated MERV 8 flat pre-filter with microbial resistant coating and 300mm (12 inches) SH cartridge 95% efficient (MERV 13) final filter.

.4 Filter Gauges: 90 mm (3-1/2 inches) diameter diaphragm actuated dial in metal case, with static pressure tips. Refer to 23 05 16 Gages and Meters.

2.10 DAMPERS

.1 Mixing Boxes/Economizer: Section with factory mounted outside, return air, relief air dampers of parallel low leak airfoil damper blades. Dampers shall be hollow core galvanized steel airfoil blades, fully gasketed and have continuous vinyl seals between damper blades in a galvanized steel frame. Dampers shall have stainless steel jamb seals along end of dampers. Linkage and ABS plastic end caps shall be provided when return and outside air dampers sized for full airflow. Return and outside air dampers of different sizes or very large dampers and exhaust dampers must be driven separately.]

.2 Damper Leakage: Maximum 2 percent at 0.5 kPa (2 inch wg) differential pressure in accordance with AMCA Standard 500.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install to ARI 435.

.3 Install assembled unit on vibration isolators. Refer to Section 23 05 48.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Air conditioning units.

.2 Controls and control panels.

1.2 REFERENCES

.1 ASHRAE 52.1 – Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

.2 ASHRAE 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 ASHRAE/IESNA 90.1 - Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

.4 ASME SEC 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.

.5 CAN/CSA B52 - Mechanical Refrigeration Code.

.6 NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

1.3 SUBMITTALS FOR REVIEW

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate manufactured products and assemblies. Indicate water, drain, refrigeration, rough-in connections, and electrical characteristics and connection requirements.

.3 Product Data: Provide for manufactured products and assemblies. Indicate water, drain, refrigeration, rough-in connections, and electrical characteristics and connection requirements.

1.4 SUBMITTALS FOR INFORMATION

.1 Section 21 05 00: Submittals for information.

.2 Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

.3 Manufacturer's Field Reports: Indicate conditions at initial start-up including date, and initial set points.

1.5 SUBMITTALS FOR CLOSEOUT

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years experience approved by manufacturer.

.3 Fabricate and label refrigeration system to CAN/CSA B52.

.4 The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210 and bear the ARI Certification label.

.5 Energy-Efficiency Ratio: Minimum prescribed by ASHRAE/IESNA 90.1.

.6 Coefficient of Performance: Minimum prescribed by ASHRAE/IESNA 90.1 and NECB 2011 whichever is higher.

.7 Provide equipment to operate using HCFC-free refrigerants.

1.7 REGULATORY REQUIREMENTS

.1 Conform to NFPA 90A for the installation of computer room air conditioning units.

.2 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.8 WARRANTY

.1 Section 21 05 00: Submittals for project closeout.

.2 Warranty Period:

.1 Compressors: Manufacturer's standard, minimum seven (7) years from date of Substantial Completion.

.2 Parts and Defects: Manufacturer's standard, minimum five (5) years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

.1 Section 21 05 00: Submittals for project closeout.

1.10 EXTRA MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide one set of filters for each unit.

Part 2 Products

2.1 MANUFACTURERS

.1 Mitsubishi

.2 Diakin

.3 LG

.4 Substitutions: Refer to Section 21 05 00.

2.2 AIR CONDITIONING UNITS

.1 Description: Packaged, air cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, fans filters, humidifier, controls.

2.3 EVAPORATOR FANS AND MOTORS

.1 Fans: Multi speed, Double inlet, forward curved centrifugal fans, statically and dynamically balanced, on steel shaft with self-aligning permanently lubricated ball bearings, directly driven.

.2 Unit configuration shall be as scheduled on drawings.

2.4 COMPRESSORS

.1 Type: DC twin-rotor rotary compressor with Variable Speed Inverter Drive Technology up to 3 tons, Frame Compliant Scroll compressor with Variable Speed Inverter Drive Technology for larger than 3 tons, vibration isolators, accumulator and high pressure safety switch.

.2 To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.

.3 Compressors: Individually serviceable without dismantling other components [or removing unit from service].

.4 Refrigerant: R-410A.

2.5 FILTER

.1 Return air shall be filtered by means of an easily removable MERV 8 filter shall be furnished.

2.6 EVAPORATOR COILS

.1 The evaporator coil shall be of nonferrous construction with pre-coated aluminum fins on copper tubing. All tube joints shall be brazed with silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

2.7 CONDENSERS

.1 Air Cooled: The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up and allow maximum airflow. The coil shall be protected with an integral metal guard.

.2 Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be controlled by a microprocessor controlled step motor.

.3 The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.

.4 The outdoor unit shall be equipped with an electronic control board that interfaces with the indoor unit to perform all necessary operation functions.

.5 The outdoor unit shall be capable of cooling operation down to 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle shall be required).

.6 The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.

2.8 REFRIGERANT REHEAT COIL

.1 Hot gas refrigerant coil of seamless copper tubes expanded into aluminum fins with three way solenoid valve on first stage refrigerant circuit.

2.9 ELECTRICAL PANEL

.1 The electrical power of the unit shall be 208volts or 230 volts, single phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts.

.2 Power for the indoor unit shall be supplied from the outdoor unit via Mitsubishi Electric A-Control using three (3) fourteen (14) gauge AWG conductors plus ground wire connecting the units.

.3 The outdoor unit shall be controlled by the microprocessor located in the indoor unit.

.4 The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC.

.5 The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

.6 Disconnect Switch: Non-automatic moulded case circuit breaker with handle accessible with panel closed.

2.10 ELECTRONIC CONTROL SYSTEM

.1 The control system shall consist of a minimum of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from a wired or wireless controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. The indoor units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.

.2 A three (3) conductor 14 gauge AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. . If code requires a disconnect mounted near the indoor unit, a 3-Pole Disconnect shall be used – all three conductors must be interrupted.

.3 The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

.4 The indoor unit control board shall have auxiliary control contact connectors to provide:

.1 Back-up Heat
.2 Remote Switch
.3 Central control
.4 IT terminal
.5 Lossany Control

2.11 WIRED REMOTE CONTROLLER

.1 The Wired Remote Controller shall be wall mount. There shall be a built-in weekly timer with up to 8 pattern settings per day. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Auto/Fan/Dry mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C), and Temperature changes shall be by increments of 1°F (0.5°C). The controller shall have the capability of controlling multiple systems, as a group with the same mode and set-point for all, at a maximum developed control cable distance of 1,500 feet (500 meters).

.2 The control voltage from the wired controller to the indoor unit shall be 12/24 volts, DC. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices. Up to two wired controllers shall be able to be used to control one indoor unit.

2.12 OPTIONS

.1 An optional drain lift mechanism, capable of lifting condensate 23-5/8”(600mm) above the drain pan, shall be provided

2.13 PERFORMANCE

.1 See schedule on drawings

Part 3 Execution

3.1 EXAMINATION

.1 Section 01 10 00: Verification of existing conditions prior to beginning work.

.2 Verify that flooring system is ready to receive work and opening dimensions are as [indicated on shop drawings.] [instructed by the manufacturer.]

.3 Verify that proper power supply is available and of the correct characteristics.

3.2 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Coordinate installation of computer room air conditioning units with computer room raised floor installer; refer to Section 09 69 00.

.3 Provide adequate drainage connections for [water cooled units] [condensate] and humidifier flushing system.

.4 Provide shut-off valves in [water inlet and outlet piping to water-cooled units] [water inlet to humidifiers]; refer to Section 22 42 01.

.5 Provide shut-off valves in hot water heating inlet and outlet piping to reheat coils; refer to Section 23 05 20.

.6 Provide shut-off valves in steam inlet and steam trap in condensate outlet piping to heating coils, refer to Section 23 22 26.

.7 Provide service valves and piping from units to [condensing units] [and] refrigerant reheat coils]; refer to Section 23 23 00.

.8 Install [air-cooled condensers] [glycol coolers] on rubber-in-shear vibration isolators.

3.3 MANUFACTURER'S FIELD SERVICES

.1 Prepare and start systems to Section 01 43 00.

.2 Set initial temperature and humidity set points. Instruct operating personnel.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Unit heaters.

1.2 SUBMITTALS FOR REVIEW

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide typical catalogue of information including arrangements.

.3 Shop Drawings:

.1 Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.

.2 Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

.3 Indicate mechanical and electrical service locations and requirements.,

1.3 SUBMITTALS FOR INFORMATION

.1 Section 21 05 00: Submittals for information.

.2 Manufacturer's Instructions: Indicate installation instructions and recommendations.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

.1 Section 21 05 00: Submittals for project closeout.

.2 Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

.3 Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

.4 Warranty: Submit manufacturer warranty and ensure forms have been completed in The Citys name and registered with manufacturer.

1.5 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., and testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 WARRANTY

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide one year manufacturer's warranty for fin-tube radiation.

.3 Provide two year manufacturer's warranty for unit heaters.

1.8 EXTRA MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

Part 2 Products

2.1 UNIT HEATERS

.1 Manufacturer: Rittling Model Regency RH & RV series.

.2 Other acceptable manufacturers offering equivalent products.

.1 Sterling

.2 Substitutions: Refer to Section 21 05 20.

.3 Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.

.4 Casing: 1.2 mm (0.0478 inch) steel with threaded pipe connections for hanger rods.

.5 Finish: Factory applied textured gray epoxy powder coating.

.6 Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

.7 Air Outlet:

.1 RH - Adjustable pattern diffuser on projection models and two way louvres on horizontal throw models.

.2 RV – Truncone, allows for a broad air stream covering a larger area than possible with a cone-jet. Finished with epoxy-based powder coating to match unit

.8 Motor: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models.

.9 Control: Local disconnect switch.

.10 Capacity: As scheduled

.11 Electrical Characteristics:

.1 As scheduled.

.2 Refer to Section 26 05 80.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.

.3 Protection: Provide finished cabinet units with protective covers during balance of construction.

.4 Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

3.2 CLEANING

.1 After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

.2 Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials provided by manufacturer.

3.3 SCHEDULES

.1 Refer to schedules on drawings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Steam Jacketed Distribution Manifolds.

.2 Electrode Steam Humidifiers.

1.2 REFERENCES

.1 ARI 610 - Central System Humidifiers.

.2 ARI 630 - Selection, Installation and Servicing of Humidifiers.

1.3 SUBMITTALS FOR REVIEW

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide catalogue data indicating rated capacity, dimensions, duct and service connections, electric nameplate data and wiring diagrams.

.3 Shop Drawings: Indicate layout of system and components.

1.4 SUBMITTALS FOR INFORMATION

.1 Section 21 05 00: Submittals for information.

.2 Manufacturer's Instructions: Indicate installation instructions and recommendations.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

.3 Warranty: Submit manufacturer warranty and ensure forms have been completed in The Citys name and registered with manufacturer.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 WARRANTY

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide two year manufacturer warranty for humidifier unit except the cylinder

1.9 EXTRA MATERIALS

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide two humidifier cylinders.

Part 2 Products

2.1 ELECTRODE STEAM HUMIDIFIERS

.1 Manufacturer: Nortec Model NH-EL.

.2 Other acceptable manufacturers offering equivalent products.

.1 Substitutions: Refer to Section 21 05 00.

.3 Humidifier: ARI 610 self contained, disposable cylinder, microprocessor controlled electrode steam generating unit.

.4 Performance: refer to the schedule.

.5 Cylinders: Disposable, polypropylene plastic with field adjustable [stainless] steel electrodes.

.6 Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing. Incorporate water fill with 25 mm(1 inch) air gap and integral air gap on drain. Provide fill solenoid valve with built-in strainer, pressure reducing and flow regulating orifice.

.7 Cabinet: Steel, 1.5 mm(0.058 inches) with enamel finish, with hinged and lockable access door.

.8 Electric Service: Unit protected by internal fusing on line voltage leads and automatic emergency drain trigger. Incorporate electrical terminals for installation of humidistat, duct high-limit humidistat, interlock to fan or air flow switch.

.9 Control: Fully modulating control to provide gradual 20 to 100 percent capacity. Maximum capacity: field adjustable 20 to 100 percent. Prevent overfilling with high water probe. Provide duplicate internal control circuitry on multiple cylinder humidifiers for independent control of each cylinder.

.10 Drain Cycle: Drain interval automatically cycled from conductivity, with one drain valve for each generator.

.11 Steam Distributor: Stainless steel steam dispersion tube suitable for insertion in duct with condensate separator and return leg to remove condensate from distributor and pipe to drain. Steam hose from generator to dispersion tube: 40 mm(1-1/2 inch) diameter reinforced rubber.

.12 Display: Digital, providing select monitoring of unit amperage draw, percentage demand from humidistat, steam output, and manually set capacity adjustment. Lamps to indicate full cylinder.

.13 Electrical Characteristics:

.1 Refer to schedule

.2 Refer to Section 26 05 80.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install to ARI 630.

.3 Provide galvanized steel rods to support distribution manifolds and mount in air system plenums.

.4 Connect dry steam humidifiers to steam supply and to condensate piping. Provide gate valve, inlet strainer, and inverted bucket steam trap. Refer to Section 23 22 00 and Section 23 22 26.

END OF SECTION