DIVISION 23

HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Part 1 General

1.1 SUMMARY

.1 Balance, adjust, and test air and liquid systems and equipment and submit reports using identical units to those shown on contract documents.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Work specified in this section shall be performed by an Independent Agency by provide documentation confirming qualifications and successful experience in air and hydronic system balancing.

.2 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Canadian Associated Air Balance Council, (CAABC) National Standards for Total System Balance, MN-1 – 2002.

.2 National Environmental Balancing Bureau (NEBB) TAB STANDARDS, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems – 1998.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), SMACNA 1780, HVAC Systems – Testing, Adjusting and Balancing – 2002.

.3 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.4 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.5 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.6 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.7 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (CAABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 DEFINITION

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC system.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.4 APPROVED AGENCIES

.1 CAABC

1.5 SITE VISITS

.1 Total of 3 site visits shall be made to correspond with the general monthly site meetings held by the Contractor. After each site visit, a written report shall be submitted to the Contractor and Contract Administrator. Site visits shall commence after the start of air and liquid distribution work and be spread over the construction period to the start of the balancing work.

.2 A review of the installation and access to all valves, dampers, and equipment shall be made at the specified site visits and any additional dampers or valves required for proper balancing shall be forwarded in writing to be reviewed by the Contract Administrator.

.3 Begin balancing after equipment start-up and testing and after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of balancing.

1.6 BALANCING AGENDA

.1 General: Submit balancing agenda to the Contract Administrator and commissioning contractor for review at least thirty (30) days prior to the start of balancing work. Start balancing work only after agenda has been approved. Include descriptive data, procedure data, and sample forms in agenda.

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

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

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

1.7 BALANCE REPORT

.1 Submit (2) copies of rough balancing reports to the Contract Administrator for review, prior to on-site verification and acceptance of Project.

.2 Provide four (4) copies of final reports to contractor for inserting in Operating and Maintenance Manuals.

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

1.8 SYSTEM DATA

.1 Fan Equipment for both supply and exhaust air

.1 Designed Data:

.1 Fan total static pressure;
.2 System static pressure;
.3 Motor kW (HP), r/min, amps, Volts, Phase;
.4 Air flow rate L/s (cfm);
.5 Fan wheel r/min;
.6 Fan/kW (HP);
.7 Inlet and outlet, dry and wet bulb temperatures.

.2 Installation Data:

.1 Manufacturer and model;
.2 Size;
.3 Arrangement discharge and class;

.4 Motor type, kW (HP), r/min, voltage, phase, cycles, and load amperage;
.5 Location and local identification data.

.3 Recorded Data:
.1 Both Supply and Exhaust Fan
.1 Air flow rate;
.2 Fan total static pressure;
.2 Fan wheel rpm with drive motor @ 60Hz;
.3 Motor operating amperage;
.4 Inlet and outlet, dry and wet bulb temperatures.

.2 Duct Air Quantities - All mains supplying more than 10% of Volume, outside air and exhaust (maximum and minimum) major return air openings back to duct shafts.
.1 Duct sizes;
.2 Number of pressure readings;
.3 Sum of velocity measurements;
.4 Average velocity;
.5 Duct recorded air flow rate;
.6 Duct design air flow rate.

.3 Air Inlet and Outlets:
.1 Outlet identification location and designation;
.2 Manufacturers catalogue identification and type;
.3 Design and recorded velocities;
.4 Design and recorded air flow rates;
.5 Deflector vane or diffuser cone settings.

.4 Pumps (Existing P-2)
.1 Design Data
.1 Fluid flow rate;
.2 Total Head;
.3 r/min;
.4 kW (HP), r/min, amps, volts, phase.
.5 Manufacturer and model;
.6 Size;
.7 Type drive;
.8 Motor type, kW (HP), r/m, voltage, phase, and full load amperage.
.2 Recorded Data:
.1 Discharge and suction pressures with secondary systems on both bypass and full circulation (full flow and no flow);
.2 Operating head;
.3 Operating water flow rate (from pump curves if metering not provided);
.4 Motor operating amps (full flow and no flow);
.5 r/min.

.5 Heating Equipment (Unit heater, duct heater)
.1 Design Data:
.1 Heat transfer rate;
.2 Air flow rate;
.3 Entering and leaving air temperatures;
.4 Fluid pressure drop.
.2 Installation Data:
.1 Manufacturer, Model, Type;
.2 Entering and leaving fluid temperatures;
.3 Capacity;

.4 Pressure drops;
.5 Flow rates.

.3 Recorded Data:
.1 Element type and identification (location and designation);
.2 Entering and leaving air temperature (for varying outdoor temperatures);
.3 Fluid pressure drop;
.4 Fluid flow rate.

.6 Snow Melt Pad (for Existing and New Pad)

.1 Design Data:
.1 Heat transfer rate;
.2 Fluid flow rate;
.3 Entering and leaving fluid temperatures;
.4 Fluid pressure drop.
.5 Slab Temperature

.2 Installation Data:
.1 Heat transfer rate;
.2 Fluid flow rate;
.3 Entering and leaving fluid temperatures;
.4 Fluid pressure drop.
.5 Slab Temperature

.3 Recorded Data:
.1 Heat transfer rate;
.2 Fluid flow rate;
.3 Entering and leaving fluid temperatures;
.4 Fluid pressure drop.
.5 Slab Temperature
.6 Outside air Temperature
.7 Wind speed and direction
.8 Slab condition

Part 2 Products

2.1 INSTRUMENTS

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

Part 3 Execution

3.1 GENERAL PROCEDURE

.1 Permanently mark, by stick-on labels and/or fluorescent paint, settings on valves, splitters, dampers, and other adjustment devices.

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

.3 Where vane anemometer is used to measure supply, return or exhaust air grilles, AK factors shall be determined as follows:
.1 Determine and tabulate similar sized grilles being balanced for AK schedule.
.2 Traverse all ducts serving grilles (outlined in AK schedule) to verify AK factors.

.3 AK factor from schedule, must be approved by C. A during initial review with balancer on site. (Balancer shall include written procedure for determination of AK factors).

.4 No flow hoods are to be used for measurement of exhaust or return air grilles.

.4 Balancing shall be performed to the following accuracies:

.1	Air - terminal outlets	±10% (outlets less than 200 L/s (425 cfm)
.2	Air - terminal outlets	±5% (outlets greater than 200 L/s (425 cfm)
.3	Air - central equipment	±5%

.5 Balancing contractor shall advise mechanical contractor of required revised pulleys, sheaves and impeller shavings to allow proper balancing of systems.

.6 Where axial fans require blade pitch changes, this shall be the responsibility of the balancing contractor.

.7 Where pump impellers require shaving, this shall be the responsibility of the mechanical contractor. All adjustments shall be by qualified millwright. All changes shall be documented and included as part of the balancing report.

3.2 AIR SYSTEM PROCEDURE

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

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

.1 Ensure dampers or volume control devices are in fully open position.
.2 Balance central apparatus to ±5% air flow.
.3 Balance branches and mains in accordance with 3.1.4.
.4 Recheck central apparatus.
.5 Balance all terminal air outlets in accordance with 3.1.4.
.6 Re-balance central apparatus to ±5%.
.7 Recheck all air outlets.

.3 When balancing air outlets:

.1 Rough balance furthest outlets and then balance sequentially back to source.
.2 Fine balance furthest outlet back to source.

.4 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. Take minimum of 16 for rectangular ducts, and 10 on each vertical and horizontal axis for round ducts, traverse readings. If readings are inconsistent across duct, try to obtain straight run of six (6) diameters widths upstream and re-do traverse.

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

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

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

.8 Verify all terminal unit factory settings for maximum air flow (and minimum if applicable). Adjust terminal unit controller if required. Record adjusted units.

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

3.3 BALANCING REPORT

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

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

.3 Record test data on a white print made from the latest available revised set of mechanical drawings and submit three (3) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.

.4 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.

.5 Report shall be indexed as follows:

- .1 Air
  - .1 Summary
  - .2 Procedure
  - .3 Instrumentation
  - .4 Drawings
  - .5 Equipment Summary
  - .6 Fan Sheets
  - .7 Fan Curves
  - .8 Fan Profile Data
  - .9 Static Data
  - .10 Traverse Data and Schedule
  - .11 Terminal Unit Summary
  - .12 Outlet Data Summary and Schematics (per system)
  - .13 Building Schematic
  - .14 Building Pressurization Data
  - .15 Weather Conditions at Time of Test
  - .16 Diagnostic
  - .17 Millwright Reports
- .2 Liquid
  - .1 Summary
  - .2 Procedure
  - .3 Instrumentation
  - .4 Drawings
  - .5 Pump Data
  - .6 Pump Curves
  - .7 Coils
  - .8 Equipment Data
  - .9 Element Data Summary and Schematics (per system)
  - .10 Diagnostic

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Duct thermal insulation.

.2 Duct acoustic insulation.

.3 Adhesives, tie wires, tapes.

.4 Recovery.

1.2 RELATED SECTIONS

.1 Entire Specification – All areas of common work.

1.3 REFERENCES

.1 American Society for Testing and Materials (ASTM International)

- .1 ASTM C335-05ae1, Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- .2 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .3 ASTM C449-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .4 ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- .5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553-08, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.2 Canadian General Standards Board (CGSB)

- .1 CGSB 51-GP-52MA-89, Vapor Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

.3 Thermal Insulation Association of Canada (TIAC)

- .1 National Insulation Standards 1992 (R1999).

1.4 QUALITY ASSURANCE

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

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

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit shop drawings which indicate complete material data, "K" value, temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

.3 Submit samples of proposed insulating and recovering materials.

1.6 JOB CONDITIONS

.1 Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.7 ALTERNATIVES

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

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

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

2.2 GENERAL

.1 Insulation Materials, Recovery Jackets, Vapor Barrier Facings, Tapes and Adhesives shall be In accordance with CAN/ULC-S102:
- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

.2 Insulating materials and accessories shall withstand service temperatures without smoldering, glowing, smoking or flaming.

.3 All insulation materials shall meet Building Code Standards, and packages or containers of such materials shall be appropriately labeled.

2.3 MATERIALS

.1 Exposed Rectangular Ducts: Rigid fibrous glass or mineral fiberboard insulation, "K" value maximum 0.035 W/m. °C at 24°C (0.24 btu in/hr/ft2 at 75°F). Factory applied reinforced aluminum foil vapor barrier for cold ducts. Hot duct service temperature 20°C (68°F) to 65°C (149°F). Cold ducts service temperature -40°C (-40°F) to 65°C (149°F).

.2 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass or mineral fiber insulation, "K" value maximum 0.035 W/m. °C at 24°C (0.24 btu in/hr/ft2 at 75°F). Factory applied reinforced aluminum foil vapor barrier for cold ducts. Hot duct service temperature 20°C to 65°C (68°F to 149°F). Cold duct service temperature -40°C (-40°F) to 65°C (149°F).

.3 Acoustic Lining: Fibrous glass or mineral fiberboard insulation with "K" value maximum 0.035 W/m. °C, at 24°C (0.24 btu in/hr/ft2 at 75°F). Absolute roughness of exposed surface not to exceed 0.58 mm (26 gauge), coated to prevent fiber erosion at air velocities up to 25.4 m/s, 24 kg/m2 (5000 ft/m, 5 lb/ft2) minimum density for ductwork and plenums. Substrate must not be dark in color. Service temperature -40°C (-40°F) to 65°C (149°F).

.4 Recovery Jackets: Polyvinyl Chloride (PVC)
- .1 One-piece moulded type and sheet to CAN/CGSB 51.53 with pre-formed shapes as required.
- .2 Colours: white (not painted)
- .3 Minimum service temperatures: -20 degrees C.
- .4 Maximum service temperature: 65 degrees C.
- .5 Moisture vapour transmission: 0.02 perm.
- .6 Thickness: 0.020 mm.

Part 3 Execution

3.1 PREPARATION

.1 Do not install covering before ductwork and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions, where possible.

3.2 INSTALLATION

.1 Ensure insulation is continuous through floor and wall sleeves etc. Pack around ducts with fireproof self-supporting insulation materials, properly sealed.

.2 Finish insulation neatly at hangers, supports and other protrusions.

.3 Locate insulation or cover seams in least visible locations. Locate seams on ductwork in ceiling spaces on the underside of the duct.

.4 Provide recovering jackets on exposed insulation throughout, including equipment rooms. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Make smooth any uneven insulated surface before recovering.

.5 Cover insulation exposed to outdoors with aluminum jacket secured with aluminum bands on 200 mm (8”) centre. Longitudinal slip joints, lap circumferential joints 75 mm (3”) minimum and seal all joints with compatible waterproof lap cement.

.6 Exposed Rectangular Ducts: Secure rigid insulation with galvanized anchors, or weld pins on 400 mm (16”) centre. Secure in place with retaining clips. Seal all insulation joints and breaks with joint tape. Use vapor barrier tape for insulation joints or breaks on cold ducts.

.7 Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 150 mm (6”) wide strips on 400 mm (16”)centers. Provide annealed tie wire tied at 400 mm (16”) centers for securing duct insulation. Butt insulation and seal joints and breaks with lap seal adhesive; cover joints with joint tape. Use vapor barrier tape for cold ducts.

.8 Acoustic Lining: Apply to interior of ducts where shown. Secure to ductwork with adhesive using 50% coverage and anchors or weld pins on 400 mm (16") centers. Secure in place with retaining clips. Cut off excess fastener length and cover with brush coat of mastic over protrusions and all raw edges. Use 25 mm (1") thick insulation unless otherwise noted. Provide vapor barrier located on the warm side for outside air intakes. Bevel corners at joints and butt together. Install acoustic gauze over all cut corners and joints and brush coat with lap seal adhesive.

.9 Where duct velocities exceed 10 m/s (2000 ft/m), cover insulation with 0.8 mm perforated galvanized steel with 24% free area.

.10 Fasten aluminum recovery jacket in place with aluminum banding on 200 mm (8") centre or screws or rivets on 150 mm (6") centre. Longitudinal slip joints and 50 mm (2") lap joints.

3.3 INSULATION INSTALLATION THICKNESS SCHEDULE

	Ducts & Equipment	Insulation Thickness mm (in)	Recovery Jacket
.1	Exhaust Ducts within 3 m (10'-0") of Exterior Walls or Openings.	25 (1")	PVC
.2	Outside Air Intake Ducts	50 (2")	PVC
.3	Ductwork exposed to outdoors	50 (2")	Aluminum
.4	Supply Ducts (Heating System)	25 (1")	PVC
.5	Supply Ducts Ventilation Systems	25 (1")	PVC
.6	Ventilation Equipment Casings	25 (1")	PVC
.7	Acoustic Lining (where indicated)	25 (1")	-

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Commissioning of mechanical equipment and systems operations.

.2 Demonstration of mechanical equipment and systems to City personnel.

1.2 GENERAL

.1 This section describes the commissioning of the mechanical system and outlines the duties.

.2 It is the full responsibilities of the Contractor to perform the commissioning and satisfied the City.

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

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

.5 This section is to be used as a guide by the Contractor to allow and include for the necessary co-ordination.

.6 Contract Administrator may review the commissioning procedure and witness the commissioning performance upon request.

Part 2 Product

2.1 COMMISSIONING

.1 Commissioning shall be as per Section 01 98 13 - General Commissioning (Cx) Requirements.

.2 Prepare a detailed plan identifying the orderly progression of the prestart commissioning check and subsequent commissioning performance check of each system, leading up to the ultimate commissioning of entire systems.

.3 Prepare a schedule for the commissioning phase of the work. This schedule shall show:

- .1 Completion dates for each major section of the building.
- .2 Timing of the various phases of the commissioning, testing, balancing and demonstration process.
- .3 Prepare a commissioning statement in which each of the four (4) phases that the process is perceived to be worked through. In sequence, the phases are expected to be:
  - .1 Phase 1 - System Readiness.
  - .2 Phase 2 - System Start-up, Testing, Balancing, Etc.
  - .3 Phase 3 - Verification of System Commissioning.
  - .4 Phase 4 - Demonstration and Instruction.
- .4 With the commissioning schedule noted above, prepare a copy of all commissioning worksheets to be used during the commissioning process.
- .5 Each phase is applicable to each major and separate system making up the work in Section 21, 22, 23 including controls and Section 26 interface as applicable.

2.2 COMMISSIONING PHASES

.1 Phase 1 - Before starting any of the separate systems, provide written verification stating that the specific system is ready for start-up and the following conditions have been met:
- .1 All safety controls installed and fully operational (dry run test).
- .2 Flushing, chemical cleaning (as required), charging, fluid operating (as required), are complete.
- .3 Equipment lubrication and pre-start checks are complete.
- .4 Air system cleaning complete.
- .5 Filter systems installed and sealed in place.
- .6 Adjusting vibration isolation completed.
- .7 Alignment of drives (direct and belt) completed.
- .8 Control functional checks, including all alarms performed.
- .9 Start-up verification checks by manufacturers representatives completed.
- .10 All deficiencies and OHS related issues to be recorded, subsequently corrected before proceeding to the next phase, Phase 2.

.2 Phase 2 - System Commissioning shall include but not necessarily be limited to:
- .1 Activation of all systems.
- .2 Testing and adjustment of all systems.
- .3 Phase 2 is concluded when the installation is in full working order and acceptable for use. The work will include the following:
  - .1 Position all balance dampers in ductwork.
  - .2 Position all balance valves in piping systems.
  - .3 Make provisions for testing air pressures and flow rates.
  - .4 Set up air diffusers, registers and grilles.
  - .5 Set up all automatic temperature control devices.
  - .6 Set up constant volume and variable volume fans.
  - .7 Plug all air pressure and flow measuring holes.
  - .8 Adjust vibration isolators as necessary.
  - .9 Air and water balance complete.
- .4 Fine Tuning:
  - .1 Setting up automatic controls for accurate response and precise sequencing.
  - .2 Correction of problems revealed by Balancing Agency and change of fan speed and pitch as necessary.

.3 Phase 3 - Verification of Commissioning.
- .1 Verification of commissioning shall not commence until the commissioning process, Phase 2, has been totally completed. The verification process will include the demonstration of the following:
  - .1 Location of and opening and closing of all access panels.
  - .2 Operation of all automatic control dampers and automatic temperature/volume adjustment controls.
  - .3 Proper response of all variable air volume valves to thermostats and volume adjustment controls.
  - .4 Operation of all equipment and systems, under each mode of operation, including:
    - .1 DCS control features.
    - .2 Automatic controls.
    - .3 Exhaust fans.
    - .4 Pumps.
    - .5 Unit heaters.
    - .6 Air handling systems.

.7 Coils.
.8 Tanks-expansion.

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

Part 3 Execution

3.1 GENERAL

.1 The Contractor shall arrange presentation and demonstration of mechanical equipment and systems appropriate specialists and shall ensure that required manufacturer's representatives are in attendance.

3.2 THE FOLLOWING SYSTEMS ARE TO BE COMMISSIONED:

.1 Plumbing
- .1 Domestic hot and cold water systems - system pressure tests, flush and clean lines, system pressures at fixtures, water delivery at each fixture; identification of piping systems.
- .2 Domestic hot water heater - capacity flow tests, combustion controls verification.
- .3 Sanitary drainage - system pressure tests, pipe identification.
- .4 Fixtures - cleaning, test hot and cold water and drain, installation.

.2 Fire protection systems
- .1 Confirm fire extinguisher location and charge. Verify that all tags are filled out and signed.

.3 HVAC Systems
- .1 Hydronic Systems - piping, pressure test, temperature sensors, water conditioning.
- .2 Pumps - alignment, rotation, motor current draw, piping connections, flow and pressure test.
- .3 Piping System - pressure tests, insulation, identification, water balance, hangers, and expansion.
- .4 Duct System - pressure tests, insulation, identification, air balance identification.
- .5 Exhaust Fans - installation, rotation, motor current draw, accessories dampers, etc., air balance, identification.
- .6 Air Handling Units - installation vibration isolation, water and duct connections, motor rotation, and air balance, filters, capacity identification, controls.
- .7 Control Valves - installation, controls, capacity modulation, connection to BMS, identification.
- .8 Control Dampers - installation, operation, identification, capacity modulation, connection to DCS.
- .9 Controls-commissioning of controls by Controls Contractor under the supervision of the commissioning co-coordinator.

3.3 DEMONSTRATIONS

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

.2 Refer to Section 0179 00 – Demonstration and Training.

.3 Demonstrate the following systems and contractor-guided tour of the facility.

- .1 Hydronic Heating Systems;
- .2 Air Systems;
- .3 Fire Protection Systems;
- .4 Plumbing Systems;
- .5 Control Systems;

.4 Demonstrate the following pieces of equipment:

- .1 Fans/Air Handling Unit;
- .2 Unit Heaters;
- .3 Domestic Water Heater;
- .4 Pumps;

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes the following equipment for HVAC systems:
- .1 Temperature Sensors
- .2 Temperature Transmitters
- .3 Differential Pressure Transmitters
- .4 Control Panels
- .5 Wire
- .6 Conduit and Cables
- .7 Related Accessories
- .8 Control Dampers
- .9 Electric Control Damper Operators
- .10 Control Valves
- .11 Electronic actuators

.2 Related Sections:
- .1 Section 23 09 93 - Sequence of Operations for HVAC Controls

1.2 REFERENCES

.1 Winnipeg Sewage Treatment Program - Electrical and Instrumentation Standardization Summary
- .1 Provide equipment in accordance with the summary.

1.3 GENERAL

.1 Complete and fully operational system of automatic controls, including all materials and labor.

.2 Submissions of technical system data.

.3 Demonstration of proposed installed controls system.

1.4 QUALITY ASSURANCE

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

.2 The equipment manufacturer shall have trained service representatives resident in the Province where project is located.

1.5 SHOP DRAWINGS

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

.2 Provide operating and maintenance manuals with complete description of installation and operation specified in Section 01 78 00 – Closeout Submittals.

Part 2 Products

2.1 GENERAL

.1 Provide control system components consisting of thermostats, control valves, dampers, actuators, indicating devices, and interface equipment required to operate mechanical equipment and perform functions specified.

.2 Provide all materials and labor required to connect control components.

.3 No splicing or extending of wiring will be accepted.

.4 Maintain integrity of all fire protection and smoke evacuation systems.

.5 Equipment shall be CSA or cUL approved and marked

2.2 ROOM THERMOSTATS

.1 General: Room Thermostat to the following requirements:
- .1 Measure room temperature
  - .1 Measuring element: NTC resistance sensor
  - .2 Measuring range: 0…40°C
  - .3 Measuring accuracy: ±0.5K
- .2 Buttons or dial for room setpoint adjustment
  - .1 Setpoint adjustment: Default ±3 K (max. 10°K)
- .3 LCD display
  - .1 Room temperature
  - .2 Setpoint adjustment
- .4 Environmental conditions of operation to IEC 721-3-3 Class 3k5
- .5 Environmental conditions of transport and storage to IEC 721-3-2 class 2K3
- .6 Wall mounting, in slotted type covers.

2.3 IMMERSION TEMPERATURE SENSORS

.1 General:
- .1 RTD 1K Pt (385) platinum element
- .2 Range: -40°C to 120°C
- .3 Accuracy: ±0.4°C
- .4 Housing Material: metal (cast zinc)
- .5 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm as indicated.

2.4 TEMPERATURE TRANSMITTERS

.1 The sensor may be either real time data or thermistor type providing the following minimum performance requirements are met:
- .1 Input circuit: to accept 3-lead, 1000 ohm at, platinum resistance detector type sensors.
- .2 Power supply: 24 V DC polarity protected
- .3 Output signal: analog , 4 - 20 mA
- .4 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
- .5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
- .6 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
- .7 Integral zero and span adjustments

.8 Product shall be Siemens by TransWest in accordance with the Winnipeg Sewage Treatment Program - Electrical and Instrumentation Standardization Summary.

2.5 DIFFERENTIAL PRESSURE SENSORS

.1 Internal materials: suitable for air and non-combustible gases.

.2 Output signal: 4-20 mA into 1250 ohm maximum load.

.3 Output variations: less than 1% full scale.

.4 Integral zero and span adjustment.

.5 Temperature effects: not to exceed ±0.02% FS/°F (±0.012% FS/°C).

.6 Over-pressure input protection to at least twice rated input pressure.

.7 Barbed, dual size to fit 1/8" and 3/16" (3.12 mm and 4.76 mm) I.D. rubber or vinyl tubing.

.8 Dwyer 616KD-00 or approved equal in accordance with B7.

2.6 CURRENT SENSING RELAYS

.1 Requirements:
- .1 Suitable to detect belt loss or motor failure.
- .2 Trip point adjustment, output status LED.
- .3 Split core for easy mounting.
- .4 Induced sensor power.
- .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
- .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
- .7 Adjustable latch level.

2.7 SLAB TEMPERATURE SENSOR

.1 NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) ß=3892

.2 Sensor material : HDPE sleeve. 40’ (12 m) HDPE jacketed wire

.3 Operating range: (-60 to 140°F) -51 to 60°C

.4 Water resistant

.5 Remote convertor with 4-20mA output, configurable to suit the input range of interest.

2.8 SNOW / ICE SENSOR

.1 In-slab installation

.2 Loading: 15,000 lb (66,723 N) distributed load, non-impact

.3 Operating range: (-30 to 170°F) -34 to 77°C

.4 Dry contact output suitable for 24VAC or 120VAC.

2.9 CONTROL PANELS

.1 Wall mounted, polyester powder paint inside and outside

.2 Seams continuously welded and ground smooth; no holes or knockouts

.3 Gasketed overlapping doors with no centerpost

.4 3-point latch mechanism operated by oil-tight key-lock handle

.5 cUL Listed per CSA C22.2 No. 94; Type 12;

.6 NEMA/EEMAC Type 12, gasketed, nonventilated

.7 IEC 60529, IP55

2.10 WIRE

.1 Control wiring for digital functions shall be 20 AWG minimum with 300 Volt insulation.

.2 Control wiring for analog functions shall be 20 AWG minimum with 300 Volts insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.3 Sensor wiring shall be 20 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.4 Transformer current wiring shall be 16 AWG minimum.

.5 Identify all wiring and cabling by means of stamped markings on heat shrinkable tubing that is permanently fastened to wiring.

2.11 CONDUITS AND CABLES

.1 All wiring shall be in conduit, cable, or trays. Flexible conduit may be used for final connection of control devices. Maximum length of flexible conduit to be 1 m. Conform to Section 26 requirements for conduit, cable, trays, and supports specifications.

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

.3 In the field panel, run low level signal lines in separate conduit from high level signal and power transmission lines.

.4 Identify each cable and wire at every termination point by means of stamped markings on heat shrinkable tubing that is permanently fastened to wiring.

.5 Provide instrumentation complete with standard electrical conduit box for termination unless otherwise noted.

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

.7 Color code all conductors and conduits by permanently applied color bands. Color code shall follow base building schedule.

.8 All wiring for terminal equipment controllers including network communications, sensors and actuator wiring must be in conduit.

2.12 RELATED ACCESSORIES

.1 It is the responsibility of the Contractor to identify, prior to tender submission, all additional items not specified that are required to meet the operational intent specified.

2.13 CONTROL DAMPERS

.1 Refer to Section 23 33 00 – Air Duct Accessories.

2.14 ELECTRONIC CONTROL DAMPER ACTUATORS

.1 Provide electronic proportional damper actuators with spring return to “fail-safe” in normally open or normally closed position.

.2 Damper operator’s spring return shall have sufficient torque to provide tight shut off in the most extreme expected operating condition.

.3 Damper actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. All actuators shall provide a 2 to 10 VDC position feedback signal.

.4 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one damper operator per damper section. The damper area driven by each damper operator shall not exceed 1.6 meters.

.5 Positioning time for full closed to full open not to exceed 90 seconds.

.6 Positioning time for full open to full closed not to exceed 45 seconds.

.7 Where multiple damper actuators are utilized for one damper or multiple damper sections, or where multiple dampers are controlled in unison, all damper actuators shall be controlled by one DCS analog output signal.

.8 Where possible do not mount actuators outdoors or in the air stream.

.9 Where damper operators are located in battery rooms and OWSB, an explosion proof enclosure shall be provided.

.10 Provide end switches for fan actuation and/or status indication.

.11 Standard of Acceptance – Belimo, Johnson Control

2.15 CONTROL VALVE (GLOBE 3-WAY)

.1 Construction:
- .1 Body: Bronze
- .2 Seat: Stainless steel
- .3 Stem: Stainless steel
- .4 Plug: Stainless steel
- .5 Packing: Spring loaded TFC

.2 Media temperature 20°F to 250°F (-7°C to 120°C)

.3 Ambient temperature 32°F to 122°F (0°C to 50°C)

.4 Maximum fluid pressure 35 psi (241kPa)

2.16 ELECTRONIC VALVE ACTUATORS

.1 Spring return, electronic actuator

.2 Power supply: 24 VAC/VDC.

.3 Control signal: 2-10 VDC or 4-20 mA.

.4 Positioning time: to suit application. 90 sec maximum.

.5 Fail open for heating, and fail-closed for cooling

.6 Scale or dial indication of actual control valve position.

.7 Size actuator to meet requirements and performance of control valve specifications.

.8 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.

.9 Supplied with open/close limit switches.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.4 Verify location of thermostats and other exposed control sensors with drawings before installation. Locate thermostats 1500 mm above floor.

.5 Install damper motors on outside of ducts.

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

.7 Fans that are to start in tandem with intake or discharge dampers through a single output point shall be wired such that operation of damper end switches will be required to start the fans.

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

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

.10 Safety devices including but not limited to freeze stats and pressure switches shall be hardwired to trip fan starters on alarm condition. Auxiliary contacts shall be wired back to the control system for monitoring where identified on the points list.

3.2 TEMPERATURE SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills

3.3 PANELS

.1 Mount controllers in control panels and field interface equipment (i.e. relays, transducers, etc.) in separate field interface control panels.

.2 Control panels are to be of unitized cabinet type construction, fabricated from 2.5 mm rolled sheet metal sheet with baked enamel finish, flush fitting, gasketted doors hung on piano type hinges and three point latches and locking handles. CSA approved for line voltage applications.

.3 Mount pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

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

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

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

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

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

.9 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position. "Hand-Off-Auto" selector switches shall be provided for all ventilation fans and sump pumps.

.10 Install bonding conductor between main control and auxiliary panels complete with grounding lugs, in addition to CSA grounding requirements.

.11 When fabrication of first panel is completed arrange for inspection and approval by Contract Administrator before proceeding with further panel construction.

.12 Provide panel heaters in the panel used in humid and exterior locations

3.4 IDENTIFICATION

.1 Equipment and wiring tags and labeling shall conform to City of Winnipeg Water and Waste Department guidelines.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes:

- .1 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.
- .2 The relationships between the points, systems and building are described in the control sequences.
- .3 Review with the Contract Administrator during the shop drawing stage to finalize the control sequences for each system.

Part 2 Products

.1 Not Applicable

Part 3 Execution

.1 Provide data base for all hardware points listed for system operation to meet specification operating sequences.

.2 Control Sequences:

- .1 Fans (F-X691 and F-X692)
  - .1 F- X691 and F-2 shall operate in tandem. Manual override timer will start the fans. Timer maximum setting will be 1 hour.
  - .2 Fans will start on command from the PLC in the event of manual override at the HMI or on high H2S level or high LEL level in the space.
  - .3 Fan start sequence begins by opening intake and exhaust motorized damper. When dampers are fully open, damper end switches will provide power to the fans. Damper shall close when fan is not running.
  - .4 Provide a differential pressure sensor to measure pressure difference across upstream filter for fan F- X691.
  - .5 Provide low temperature low limit switch safety that will shut the fans down when room temperature is below low-limit setpoint 12°C (adj.).
  - .6 Provide fan speed adjuster on wall for manual adjustment.
  - .7 Monitor and control points:
    - .1 Digital Input for the status of F- X691
    - .2 Digital Input for the status of F- X692
    - .3 Digital Input for the status of manual timer switch
    - .4 Analog input for the filter pressure difference
    - .5 When status of the switch and either one or both fans have opposite states, a fault alarm is generated
    - .6 When pressure difference is greater than 74 pa (adj.), fault alarm is generated
    - .7 If either fan has an overload or fault, an alarm is generated.
- .2 Electric Duct Heaters (DH-X693, DH-X694)

.1 Duct heaters to be supplied with built-in air flow sensor and air temperature sensor. Duct heater DH-X693 shall automatically turn on when airflow is detected and the outside air temperature is below 13°C (adj.). Duct heaters shall have built-in SCR controller to modulate heating elements and maintain a discharge temperature of 13°C (adj.) from DH- X693 and 17°C (adj.) from DH- X694. DH- X694 will be controlled as Stage 1 from a programmable two stage heating thermostat where the unit heater will be controlled as Stage 2. In the event where the outside air temperature is above the first duct heater temperature setpoint, heat will only be provided by the second duct heater (Stage 1).

.3 Electric Unit Heater (UH-X603)

.1 The wall mounted thermostat will cycle unit heater on and off to meet room setpoint (Stage 2).

.2 Room Thermostat shall have a default setting of 17°C (adj.). The thermostat will have the ability for a manual override of room temperature setpoint. When the thermostat programming reaches the next timing stage, it will revert back to the default programming for room temperature.

.3 Monitor and control points:

.1 Digital Input for the status of UH- X603

.1 Analog Input for room temperature setpoint

.2 Analog Input for room temperature

.3 When room temperature s is below room temperature setpoint and the UH- X603 is still off after 1 minute lag time, a fault alarm is generated

.4 A fault alarm shall be generated when room temperature is below 10°C (adj.).

.4 Snow Melting Control

.1 Snow melting control for existing Pad-3 for MH-4 and new Pad-4 for MH-7 shall be upgraded.

.2 Existing Pad-3 and new Pad-4 shall be controlled as one pad. New snow/ice sensor will be provided for Pad-4. Existing slab temperature sensor for Pad-3 shall be re-used.

.3 Existing controls for the 3-way control valve (TV-Y660) shall be replaced with an actuator compatible with the PLC system. Existing pump (P-2) shall be retained but re-wired to new controls.

.4 Enable P-2 when outside air temperature is between 2°C and -15°C (adj.).

.5 On a call for melting from the snow/ice sensor or manual activation, the slab temperature ramp up will start and slowly drive up to the slab temperature setpoint 3°C(adj.).

.6 Slab temperature ramp up shall be based on rate of temperature increase per unit time to prevent concrete slab thermal shock. Control valve (TV-Y660) shall modulate to maintain slab ramp-up schedule.

.7 Provide alarms when:

.1 Slab temperature is 2 degrees above setpoint

.2 Pump (P-2) failure
.3 Snow /Ice detector feedback exceeds a preset time 3hours (adj.)
.4 Glycol water return temperature from either pad is greater than 2 degrees (adj.) from the slab temperature

.8 Monitor and control points:
.1 Analog Input for the temperature of concrete slab for Pad-3
.2 Analog Input for the temperature of concrete slab for Pad-4
.3 Analog Input for the supply glycol temperature going to the slabs.
.4 Analog Input for the return glycol temperature from Pad 3.
.5 Analog Input for the return glycol temperature from Pad 4.
.6 Digital Input for the status of P-2.
.7 Digital input for snow/melt sensor
.8 Digital Output for pump P-2 command
.9 Analog output for CV-3 position command
.10 Analog output for supply glycol temperature setpoint
.11 Analog output for slab temperature setpoint for both pad.
.12 All alarms

.3 Control/Monitor System
.1 Provide input/outputs on all controls and wire to the building PLC terminal panel. Display basic information on local HMI. Signals shall be communicated to the remote DCS from the PLC and integrated into the DCS.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Piping and Fitting

.2 In Floor Heating Package

.3 Specialty

1.2 RELATED SECTIONS

.1 Entire Specification – All areas of common work.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).
- .1 ANSI/ASME Boiler and Pressure Vessel Code-2007.

.2 American Society for Testing and Materials, (ASTM).
- .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A278/A278M-01(2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
- .3 ASTM A516/A516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
- .4 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
- .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .7 ASTM A105/A105M-05, Standard Specification for Carbon Steel Forgings, for Piping Applications.
- .8 ASTM F876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing
- .9 ASTM F877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
- .10 ASTM F2165 Standard Specification for Flexible Pre-Insulated Piping

.3 American National Standards Institute (ANSI)/National Sanitation Foundation (NSF)
- .1 ANSI/NSF Standard 14 Plastics Piping System Components and Related Materials
- .2 ANSI/NSF Standard 61 Drinking Water System Components - Health Effects

.4 Canadian Standards Association (CSA International).
- .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.
- .2 National Standard of Canada CAN/CSA-B149.1-05 Natural Gas and Propane Installation Code.

.5 Manitoba Gas Notices-2007

1.4 GENERAL REQUIREMENTS

.1 Provide materials, equipment and labor to install Air Handling Unit as required by Provincial and Local Codes as specified herein.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit shop drawings indicating capacity rating, physical dimensions, wiring diagrams, materials of construction, code compliance, etc. As indicated on schedules.

.3 Provide operating and maintenance manuals with complete description of product for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.6 QUALITY ASSURANCE

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

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 In Floor Heating Package: Uponor, Wirsbo, Rehau, Kitec, Heatlink

2.2 PIPING AND FITTINGS

.1 Hydronic inside building:
- .1 Pipe: Schedule 40, ASTM A53, Grade B.
- .2 Fitting: 15 mm dia. to 50 mm diameter screwed malleable iron or steel, 65 mm dia. and over, welded steel with same schedule of pipe.

.2 In Slab Heating:
- .1 1/2" HePEX plus tubing and fitting in pad
- .2 Ecoflex Flexible Pre-Insulated Piping and fitting between building and pad

2.3 IN FLOOR HEATING PACKAGE

.1 HePex Plus Coil

.2 TruFLOW Manifold Supply and Return Ball Valves,

.3 Manifold bushing

.4 Q & E FTG Assembling

.5 Quick & Easy Ring

.6 50 VA Transformer

.7 Climate Control - Multifunction

.8 Boiler Control, On-Off

.9 Dual Sensor, Supply and Return

.10 3-way modulating control valve

.11 Pump Relay Box

.12 Snow Melting Control

.13 Automatic Snow/Ice Sensor (Include cup & sensor)

.14 PVC Bend Support

.15 Cat5 patch cables

.16 Ecoflex Flexible Pre-Insulated Piping System (Between buildings and manhole pads)

.17 Ecoflex Connection Vault

2.4 AIR VENT

.1 Automatic
- .1 Standard float vent: brass body and 3mm connection and rated at 690 kPa working pressure.
- .2 Industrial float vent: cast iron body and 15mm connection and rated at 860 kPa working pressure.
- .3 Float: solid material suitable for 115 degrees C working temperature.

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

2.5 RELIEF VALVE

.1 Provide ASME rated direct spring loaded type, lever operated non-adjustable factory set discharge pressure as indicated.

2.6 GLYCOL SOLUTION

.1 Provide a 50% DOWFROST HD pre-mixed propylene glycol solution to be suitable for heating complete with appropriate corrosion inhibitors.

2.7 BALANCE VALVES

.1 Body and Bonnet: Brass alloy CW617.

.2 Stem and Disc: Brass alloy B16.

.3 Elastomers: EPDM.

.4 Handwheel: Reinforced nylon ABS.

.5 Y-pattern and equal percentage globe-style with three functions:

.6 Precise flow measurement.

.7 Precision flow balancing.

.8 Positive drip-tight shut-off.

.9 Maximum working pressure: 2070 kPa.

Part 3 Execution

3.1 GENERAL INSTALLATION

.1 Install all as indicated and to manufacturer's recommendations and instructions.

.2 Insulate all piping as per Section 22 07 19.

.3 Run drain lines and blow off connections with minimum 2% grade to terminate above nearest floor drain.

.4 Maintain proper clearance to permit piping removal, service and maintenance.

.5 All in floor piping shall be pressure tested for a 24 hour period at 500 kPa and witnessed by Contract Administrator, prior to the concrete pour.

.6 A pressure of 400 kPa shall be maintained in the underslab piping system during the concrete pour of 400 kPa. If pressure loss is observed during the concrete pour, the leak shall be located and corrected before the concrete hardens.

.7 Install expansion joints with cold setting. Make record of cold settings.

.8 Install expansion joints and flexible connections where necessary.

.9 Install pipe anchors and guides. Anchors to withstand 150% of axial thrust.

.10 Provide minimum 100 mm concrete housekeeping pads or primer and epoxy painted steel frames for all equipment mounted on the floor.

3.2 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.3 RELIEF VALVES

.1 Provide relief valves on pressure tanks, low pressure side of reducing valves, expansion tanks and where indicated.

.2 Drain relief valve in glycol line to glycol fill tank. Do not waste glycol to floor drains.

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

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

3.4 BALANCE VALVES

.1 Install balance valve as indicated.

3.5 GLYCOL SOLUTION

.1 Thoroughly clean and flush system before glycol solution is filled.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Ductwork and plenums.

.2 Fasteners.

.3 Sealants.

1.2 RELATED SECTIONS

.1 Duct Insulation - Section 23 07 13

.2 Air Duct Accessories - Section 23 33 00

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A480/A480M-08b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .2 ASTM A635/A635M-08, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
- .3 ASTM A653/A653M-08, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 National Fire Protection Association (NFPA).
- .1 NFPA (Fire) 90A-2009, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .2 NFPA (Fire) 90B-2009, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 NFPA (Fire) 96-2008, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
- .1 SMACNA 1966-2005, HVAC Duct Construction Standards – Metal and Flexible, 3rd Edition.
- .2 SMACNA 1143-1985, HVAC Air Duct Leakage Test Manual, 1st Edition.
- .3 IAQ Guideline for Occupied Buildings Under Construction 2007, 2nd Edition.

1.4 DEFINITIONS

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

.2 Medium Pressure: Static pressure in duct less than 1500 Pa (6 in WG) and velocities greater than 10 m/s (2000 fpm).

.3 High Pressure: Static pressure over 1500 Pa (6 in WG) and less than 2500 Pa (10 in WG) and velocities greater than 10 m/s (2000 fpm).

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

1.5 QUALITY ASSURANCE

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

.2 Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks as a minimum where more stringent requirements are not identified in the contract documents. Straight tap fittings and dovetail joints are not permitted.

1.6 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit shop drawings and samples of duct fittings for approval, including particulars such as gauge sizes, welds and configurations prior to start of work.

1.7 ALTERNATIVES

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

Part 2 Products

2.1 MATERIALS

.1 Ducts: stainless steel Type 304 lock forming quality of 380 g/m2 for both sides.

.2 Fasteners: Use rivets and bolts throughout and material to match duct.

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

.4 Gauges as per SMACNA for pressure rating.

.5 Joints: to ASHRAE and SMACNA and/or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class a seal.

2.2 DUCTWORK

.1 Construction – round:
- .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
- .2 Transverse joints up to 900 mm: slip type with tape and sealants.
- .3 Transverse joints over 900 mm: Vanstone.
- .4 Fittings:
- .5 Elbows: smooth radius. Centreline radius: 1.5 x diameter.
  - .1 Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.

.2 Construction – rectangular:
- .1 Ducts: to SMACNA.
- .2 Transverse joints: SMACNA seal Class A and B.
- .3 Fittings:
  - .1 Elbows: smooth radius; centreline radius 1.5 x width of duct without vanes or rectangular connection with turning vanes.
  - .2 Branches: with conical branch at 45 degrees and 45 degrees elbow.

2.3 PLENUM GAUGES

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

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

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

2.4 DUCT SEALING

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

.1 Low Pressure Ductwork:

.1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm (16 gauge) use heavy mastic type sealant.

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

.3 Other Joints: Heavy mastic type sealant.

.2 Medium and High Pressure Ductwork: Combination of woven fabrics and sealing compound followed by an application of high pressure duct sealant.

.2 Duct tapes as sealing method are not permitted.

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

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

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

.6 Seal classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
2500	A
1500	A
1000	A
750	B
500	C
250	C
125	C

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant and tape.

.3 Class C: transverse joints and connections made air tight with gaskets, sealant and tape. Longitudinal seams unsealed.

Part 3 Execution

3.1 INSTALLATION

.1 Fabricate ductwork from field measurements and not from plans and shop drawings exclusively. Failure to do so will not constitute an extra to the Contract.

.2 Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 450 mm (18") crossbrace for rigidity. Open corners are not acceptable.

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

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

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

.6 Set plenum doors 150 mm (6") above floor. Arrange door swings so that fan static holds door in closed position.

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

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

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

.10 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment. Refer to Section 23 33 00 "Air Duct Accessories."

.11 Do not use flexible duct to change direction. Provide a minimum of three (3) duct diameters of straight metal duct between box inlet and flexible connector.

.12 Prove that ductwork is substantially air tight before covering or concealing.

.13 Lap metal ducts in direction of air flow. Hammer down all edges and slips to leave smooth duct interiors.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 When the duct systems are completed and before any fan systems are operated, all ductwork, plenums, coils and air handling equipment shall be cleaned by compressed air and mechanical equipment; or compressed air and high power suction equipment. No special cleaning is required for general exhaust ductwork systems that convey air directly to the outside at all times without recirculation. A letter shall be submitted by the cleaning company certifying that all systems have been completely cleaned, and all access doors, access ports and covers are in place.

.2 After approval of duct cleaning, the complete system shall be disinfected with a chemical directly applied to the ductwork.

.3 After approval of duct cleaning, the operating ductwork system shall be disinfected with an approved chemical directly applied to the ductwork, grilles, diffusers and registers downstream from the supply box and upstream from the exhaust box.

1.2 RELATED SECTIONS

.1 Duct Insulation - Section 23 07 13

.2 Air Duct Accessories - Section 23 33 00

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 Department of Justice Canada (Jus).
.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
.1 Material Safety Data Sheets (MSDS).

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
.1 IAQ Guideline for Occupied Buildings Under Construction 2007, 2nd Edition.

1.4 QUALITY ASSURANCE

.1 Firms to be specialists in this field. Submit list of equipment, capacities, method and sequence of cleaning to the Contract Administrator for approval prior to beginning work.

.2 Any ductwork delivered to the site which in the Contract Administrator's opinion is dirty, shall be removed from the site and cleaned by the sheet metal contractor.

.3 Approved Agencies: Don’s Power Vac, Modern PowerVac, Carson Pow.R.Vac.

Part 2 Products

2.1 MATERIALS

.1 The sheet metal subtrade shall provide all necessary access doors to facilitate efficient ductwork cleaning as listed under installation.

.2 Provide approved filters to protect equipment during cleaning operation. Submit shop drawings indicating which type of filters are to be utilized to protect equipment during construction and cleaning operation.

.3 The Contractor shall sample and analyze the contamination in the ductwork as requested by the Contract Administrator. The results may be verified by an independent laboratory, paid for by the Contractor, specializing in this type of work.

Part 3 Execution

3.1 INSTALLATION

.1 Ductwork access doors for ductwork cleaning and inspection, shall be installed as follows:
- .1 At 10 m (30’-0”) intervals or as required in all applicable duct systems.

.2 Ductwork access doors for ductwork cleaning and inspection, shall be installed as follows
- .1 At the base of all duct risers.
- .2 Both sides of turning vanes in all ducts.
- .3 At each fire damper location.
- .4 At each side of all heating or cooling coils.
- .5 At all locations of internally duct mounted equipment or devices including balancing dampers, automatic dampers, damper motors and controls.

.3 Access doors shall be as specified in Section 23 33 00 Air Duct Accessories. Access panels with screws are <u>not acceptable</u>.

.4 Access door size shall be minimum 450 mm x 350 mm or 50 mm18” x 14” or 2” smaller than duct dimension for inspection and 150 mm x 150 mm6” x 6” for cleaning equipment.

.5 For duct cleaning system utilizing compressed air and mechanical brush, suitably sized access ports with positive locking cover and zero flame spread rating, shall be installed at 3 m (10’-0”) intervals in the duct work and on both sides of dampers, coils, turning vanes, etc.

.6 Access port system shall be reusable to allow for future inspection or cleaning.

.7 All ductwork outlets shall be sealed with suitable cover after ductwork has been cleaned. All plenums to be sealed after plenums have been cleaned.

.8 Prior to any work being started on the system, filter media shall be installed behind every supply grille or diffuser and on inlet side of duct or box reheat coils. This will act as a safety net for contamination which may be disturbed during cleaning. After a settling down period of two to five days, the filter media will be removed.

.9 Each aspect of a system shall be cleaned regardless of the size, type or configuration. Dirt clinging to the sides or top of ducting must be removed and left as clean as the bottom. Spiral ducting should be as clean as flat.

.10 After completion of cleaning and approval by the Contract Administrator, the noted systems shall be disinfected with a chemical directly applied to the ductwork. The chemical shall be applied using compressed air and spray wand that emits a 360° spray pattern. Mist or fog applications will not be allowed. Chemical to be used shall be submitted to the Contract Administrator for review and approval.

.11 The cleaning contractor shall be responsible for removing and replacing filter media in the pre-filter.

.12 The cleaning contractor shall mark damper positions before cleaning and return them to their original position when cleaning is completed, unless the system is still to be balanced.

.13 One sample air system shall be cleaned first prior to commencement of overall work, to determine standard of acceptance. The Contract Administrator and all representatives, mechanical and general contractors, having jurisdiction to inspect and accept completed work shall be present during this pre-quality acceptance inspection.

.14 The duct cleaning agent shall supply a minimum of 5% or 50 (which ever is less) replacement access port caps to the Contract Administrator.

.15 Once an air system is started after final cleanliness inspection and acceptance, for testing purposes, balancing and/or fine tuning, the maintaining of cleanliness is the responsibility of the Mechanical Contractor. Prior to substantial performance, the cleanliness of all ventilation systems shall be re-inspected. If the cleanliness is not acceptable, the Mechanical Contractor shall be responsible for recleaning.

.16 If the cleanliness of ventilation systems can be jeopardized due unclean and dusty conditions, the cleaning and start-up of ventilation system shall not be allowed.

.17 The contractor shall sample and analyze the contamination in the ductwork as requested by the Contract Administrator. The results will be verified by an independent laboratory, paid for by the Contractor, specializing in this type of work.

3.2 INSPECTION

.1 The cleanliness of ductwork shall be inspected using a borescope supplied by the contractor. This shall be made available to the City's request.

.2 Any ductwork found to be dirty shall be redone through its entire length.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Access doors.

.2 Motorized Dampers

.3 Flexible connections.

.4 Backdraft dampers.

1.2 RELATED SECTIONS

.1 Entire Specification – All areas of common work.

1.3 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
- .1 SMACNA 1966-2005, HVAC Duct Construction Standards – Metal and Flexible, 3rd Edition.

.2 National Fire Protection Association (NFPA).
- .1 NFPA (Fire) 90A-2009, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .2 NFPA (Fire) 90B-2009, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

1.4 QUALITY ASSURANCE

.1 Access doors shall be ULC labeled.

.2 Fire dampers shall be ULC listed and constructed in accordance with ULC Standard S 112 "Fire Dampers".

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

.4 Demonstrate re-setting of fire dampers to authorities having jurisdiction and Contract Administrator.

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

.6 Products shall be product of manufacturer regularly engaged in production of such items who issues complete catalogue data on such products.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Access Doors : Controlled Air, Nailor, Air-O-Metal, Titus.

.2 Dampers : Tamco

.3 Flexible Connections : Thermaflex M-HKE

2.2 DUCT ACCESS DOORS

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

.2 Fabricated with two butt hinges and two sash locks for sizes up to 450 mm (18"), two hinges and two compression latches with outside and inside handles for sizes up to 600 mm x 1200 mm (24" x 48") and an additional hinge for larger sizes.

2.3 MOTORIZED DAMPERS

.1 Extruded 100 mm (4") deep aluminum frame with lower leak polystyrofoam insulated blades on four sides. Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.

.2 Blade and frame seals shall be of extruded silicone and be secured in an integral slot within the aluminum extrusions.

.3 Bearings are to be composed of a Celcon inner bearing fixed to aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

.4 Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.5 Dampers are to be designed for operation in temperatures ranging between -40°C (-40°F) and 85°C (185°F).

.6 Dampers shall be available with either opposed blade modulating action or parallel blade open/close action.

.7 Standard acceptance: Tamco series 9000BF.

.8 Operator: Refer to Section 23 09 13 – Instrumentation and Control Devices For HVAC.

2.4 FLEXIBLE CONNECTIONS

.1 Fabricate of ULC approved neoprene coated flameproof glass fabric approximately 150 mm (6") wide tightly crimped into metal edging strip and attached to ducting and equipment by screws or bolts at 150 mm (6") intervals. Flexible connection airtight at 500 Pa (2 in WG).

.2 Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.

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

Part 3 Execution

3.1 APPLICATION

.1 Provide access door minimum 450 mm x 350 mm or 50 mm (18" x 14" or 2") smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:

.1 At 6.0 m (20’-0”) intervals on all horizontal ducts.
.2 At 12.0 m (40’-0”) intervals in all vertical duct systems.
.3 At the base of all duct risers.
.4 Both sides of turning vanes in all ducts.
.5 At each fire damper location.
.6 At each side of all heating or cooling coils.
.7 At all locations of internally duct mounted devices including automatic dampers, damper motors, duct mounted smoke detectors and heat detectors, and control sensors and devices.

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

.3 Provide manual dampers at locations shown on drawings.

.4 Coordinate with other traders for correct size openings and proper fire guard sleeving for fire damper penetration.

.5 At each point where ducts pass through partitions, the opening around the duct shall be sealed with non-combustible material.

.6 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger ducts.

.7 Provide balancing dampers on medium and high pressure systems where indicated. Splitter dampers shall not be used on medium and high pressure system.

.8 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and/or where indicated on drawing.

.9 For connections to medium and high pressure fans, install 15 mm (½”) thick neoprene pad over fabric and hold in place with additional metal straps.

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

.11 Support ceiling fire stops from the structure above the fire stop and not from air outlets on associated ductwork.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Exhaust Fans

1.2 RELATED SECTIONS

.1 Entire Specification – All areas of common work.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

.2 ANSI/AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.

1.4 GENERAL REQUIREMENTS

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

.2 Conform to requirements NFPA (Fire) 90A-2009, Standard for the Installation of Air Conditioning and Ventilating Systems and Provincial and Municipal Codes.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit shop drawings indicating capacity rating, physical dimensions, wiring diagrams, materials of construction, code compliance, etc. As indicated on schedules.

.3 Provide operating and maintenance manuals with complete description of product for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.6 QUALITY ASSURANCE

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

.2 Fans shall bear AMCA certified rating seal and CSA label

.3 Conform to AMCA Bulletins regarding construction and testing

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 HVAC fans: Greenheck, Loren Cook, Twin City, Northern Blower

2.2 GENERAL

.1 Base fan performance at standard conditions (density 0.075 Lb/ft3)

.2 Ceiling mounted applications

.3 Maximum operating temperatures is 130 Fahrenheit (54.4 Celsius)

.4 Fans are UL/cUL listed 507 - Electric Fans

.5 Each fan shall bear a permanently affixed manufacture's nameplate containing the model number and individual serial number.

2.3 DIRECT DRIVE INLINE FANS

.1 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

.2 Housing Construction:
- .1 Constructed of heavy gauge galvanized steel
- .2 Interior shall be lined with 0.5 inches of acoustical insulation
- .3 Profile as low as 10 ½ inches.

.3 Impeller Construction:
- .1 Forward curved centrifugal wheel
- .2 Constructed of galvanized steel or calcium carbonate filled polypropylene
- .3 Statically and dynamically balanced in accordance to AMCA Standard 204-05.

.4 Motor:
- .1 Motor enclosures shall be open driproof (ODP), opening in the frame body and or end brackets
- .2 Motors are permanently lubricated sleeve bearing type to match with the fan load and furnished at the specific voltage and phase
- .3 Motor shall be mounted on vibration isolators and be accessible for maintenance
- .4 Compatible for use with speed controls
- .5 Thermal overload protection.

.5 External Electrical Access:
- .1 Eliminates removing the motor pack which saves time on installation.

.6 Mounting Brackets:
- .1 Fully adjustable for multiple installation conditions.

.7 Access Panel:
- .1 Once installed shall have easy access to internal components

2.4 DIRECT DRIVE SIDEWALL FANS

.1 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

.2 Wheel:
- .1 Propeller shall be aluminum blade riveted to steel hubl
- .2 A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft.
- .3 Statically and dynamically balanced in accordance to AMCA Standard 204-05.
- .4 The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

.3 Motor:
- .1 Motor enclosures shall be open driproof (ODP), opening in the frame body and or end brackets

.2 Motors are permanently lubricated sleeve bearing type to match with the fan load and furnished at the specific voltage and phase
.3 Motor shall be mounted on vibration isolators and be accessible for maintenance
.4 Compatible for use with speed controls
.5 Thermal overload protection.

.4 External Electrical Access:
.1 Eliminates removing the motor pack which saves time on installation.

.5 Mounting Brackets:
.1 Fully adjustable for multiple installation conditions.

Part 3 Execution

3.1 INSTALLATION

.1 Install fans with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Install fans complete with flexible electrical leads and flexible connections in accordance with Section 23 33 00 – Air Duct Accessories.

.3 Where inlet or outlet is exposed, provide safety screen.

.4 Supply and install sheaves as necessary for final air balancing.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Grilles and Diffusers

.2 Outside Louvers

1.2 RELATED SECTIONS

.1 Entire Specification – All areas of common work.

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

1.4 QUALITY ASSURANCE

.1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes, ASHRAE Standards and AMCA Standards.

.2 Unit rating shall be approved by ADC and AMCA.

.3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

.4 Outside louvers shall bear AMCA seal for free area and water penetration.

1.5 JOB CONDITIONS

.1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlets.

.2 Positions indicated are approximate only. Check locations of outlets and make necessary adjustments in position to conform to Architectural features, symmetry and lighting arrangement.

1.6 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit color selection charts of finishes, for approval prior to fabrication.

.3 Submit shop drawings with complete catalogue information, materials of construction, dimensions and accessories for all air outlets, louvers and components in this specification section, and as scheduled.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Diffusers, Grilles: Titus, EH Price, Nailor.

.2 Outside Louvers: EH Price, Aerolite, Westvent, Ruskin

2.2 GENERAL

.1 Refer to Grille and Diffuser Schedule and Louver Schedule on drawings.

2.3 GRILLES AND DIFFUSERS

.1 Base air outlet application on space noise level of NC 30 maximum.

.2 Provide grilles with sponge rubber seal around the edge.

.3 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.4 Provide plaster frame for diffusers located in plaster surfaces.

.5 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

.6 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.7 Frames: Full perimeter gaskets or plaster frames where set into plaster or gypsum board and as specified.

.8 Concealed fasteners: manual volume control damper operators

.9 Color: standard or as indicated.

2.4 OUTSIDE LOUVERS

.1 Louvers 100 mm (4") deep with blades on 40° slope with double drainable blade and drainable heavy channel frame, birdscreen with 15 mm (½") square mesh. Acceptable product: Ruskin ELF375DD 100 mm (4"), Ruskin ELF6811DD 150 mm (6") or approved equal in accordance with B7.

.2 Fabricate of 2.0 mm (14 gauge) extruded aluminum blades and frame. Where openings exceed 1800 mm (72") in height, jamb frames shall be 2.0 mm (14 gauge). Provide welded assembly.

.3 Finish in factory baked enamel finish.

.4 Fabricate louvered penthouses with mitered corners and sheet roof reinforced with structural angles.

Part 3 Execution

3.1 INSTALLATION

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Install in accordance with manufacturers instructions.

.3 Install with oval head, cadmium plated screws in countersunk holes where fastenings are visible, if required.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and application of electric duct heaters.

.2 Related Requirements

.1 Entire Specification – All areas of common work.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.2 No.46-M1998(R2001), Electric Air-Heaters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit product data and include:

.1 Element support details.
.2 Heater: total kW rating, voltage, phase.
.3 Number of stages.
.4 Rating of stage: rating, voltage, phase.
.5 Heater element watt/density and maximum sheath temperature.
.6 Maximum discharge temperature.
.7 Physical size.
.8 Unit support.
.9 Performance limitations.
.10 Clearance from combustible materials.
.11 Internal components wiring diagrams.
.12 Minimum operating airflow.
.13 Pressure drop [operating] [minimum] airflow.

1.4 QUALITY ASSURANCE

.1 Conform to requirements of CGA, CSA, Provincial and Municipal Codes and be CSA listed.

.2 Units shall be products of manufacturers who provide local service personnel from factory representative, franchised dealer or certified maintenance service shop.

.3 The unit shall be fully assembled, wired and tested prior to shipment. A detailed pre-shipment test report shall be provided to the Contract Administrator

Part 2 Products

2.1 Acceptable Manufacturers

.1 EH Price, Thermolec, Nailor, PM Wright

2.2 DUCT HEATERS

.1 Duct heaters: flange type

.2 Elements:

.1 Finned tubular

.3 Maximum temperature at discharge: See Duct Heater Schedule.

.4 Controls:

.1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.

.2 Controls mounted in a NEMA Type 12 enclosure and to include:

.1 Magnetic contactors.

.2 Control transformers.

.3 SCRcontroller.

.4 Automatic reset thermal cutout

.5 Fuses

.3 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.

.4 High temperature cutout and air proving switch.

.5 Refer to .

.5 Electrical:

.1 Duct heater rating:

.1 4 kW.

.2 600 voltage.

.3 3 phase.

.6 Heater element watt/density: 129 kW/ m^2 (12kW/ft^2).

.7 Main isolation disconnect switch.

Part 3 Execution

3.1 INSTALLATION

.1 Make power and control connections to CSA C22.2 No.46.

.2 Install duct heater in accordance with manufacturer's instructions and drawings.

.3 Make power and control connections.

.4 Coordinate location with all other disciplines.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Unit Heater

1.2 RELATED SECTIONS

.1 Entire Specification – All areas of common work.

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

1.4 QUALITY ASSURANCE

.1 Conform to requirements of CGA, CSA, Provincial and Municipal Codes and be CSA listed.

.2 Units shall be products of manufacturers who provide local service personnel from factory representative, franchised dealer or certified maintenance service shop.

.3 The unit shall be fully assembled, wired and tested prior to shipment. A detailed pre-shipment test report shall be provided to the Contract Administrator.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop drawings shall include all of the following information but not limited:
- .1 Product characteristics.
- .2 Performance criteria.
- .3 Mounting methods.
- .4 Physical size.
- .5 Output rating
- .6 kW rating, voltage, phase.
- .7 Cabinet material thicknesses.
- .8 Control
- .9 Limitations.
- .10 Color and finish.

.3 Provide operating and maintenance manuals with complete description of installation and operation specified in Section 01 78 00 – Closeout Submittals.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Ouellet, Trane, Dimplex, Ruffneck

2.2 UNIT HEATER

.1 Horizontal wall or ceiling mounted

.2 600V - 3 phase.

.3 Casing: Most cabinetry and trim pieces shall be fabricated of 18- 20-gauge material and painted with epoxy/polyester paint.

.4 Adjustable louvres to direct air flow

.5 High-limit temperature control with automatic reset

.6 Unit fan shall be of the propeller type:
- .1 Motor mounted in cold compartment
- .2 Thermally-protected motor
- .3 Totally enclosed and factory-lubricated ball bearing motor
- .4 Fan delay purges heater of residual heat

.7 Heating element:
- .1 Durable tubular heating elements; stainless steel
- .2 Concentric disposition of heating elements.
- .3 Factory sealed element upon request

.8 Controls:
- .1 All models have a factory-installed contactor.
- .2 Remote thermostat.
- .3 Refer to 23 09 93 Sequence of Operation

.9 Refer to Unit Heater Schedule for technical data.

Part 3 Execution

3.1 INSTALLATION

.1 Install unit heater in accordance with manufacturer's instructions and drawings.

.2 Make power and control connections.

.3 Coordinate location with all other disciplines.

END OF SECTION