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PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- .1 All drawings and all sections of these specifications apply to and form an integral part of this section.

1.2 RELATED WORK

- .1 Mechanical General Provisions: Section 15010
- .2 Plumbing Section 15430
- .3 Ventilation and Air Conditioning Section 15800
- .4 TAB
- .5 Electrical Section 16 Series

1.3 WORK INCLUDED

- .1 Provide a complete system of Electronic/Pnumatic Controls.
- .2 System control shall include:
 - .1 Provide all necessary compliant hardware to meet the system's functional specifications. Prepare individual hardware layouts, interconnection drawings, and configuration from project design data.
 - .2 Design, provide, and install all equipment Listed cabinets, listed panels and all associated hardware.
 - .3 Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
 - .4 Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
 - .5 Provide a comprehensive operator and technician training program as described herein.
 - .6 Provide sensors, dampers, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.
 - .1 Space (mezzanine) mounted control panel(s): Occupied unoccupied cycle, status, alarm, operating times supply return set point, operating temperatures, outdoor temperature shut down, low limit high limit temperatures with adjustment capability, mixed air and mixed air low limit over ride, all fan system static pressures, filter monitoring, mechanical component failure, pressure differential control.
 - .1 Supply/Return/Relif Fan(s).
 - .1 Includes:
 - .1 Hard wire inter-lock.
 - .1 Where required carry the cost of Div. 16. See (1.6 – [5.3]).
 - .2 Condensing Units, Electric Heating Coil – Preheat, Motorized Dampers and Actuators.
 - .1 Either as a hard wired inter-lock or as a lockout.
 - 1 Where required carry the cost of Div. 16. See (2.4.3 and .4).
 - .3 Main Lobby: Static Pressure.

1.4 REFERENCE STANDARDS

- .1 Conform with the requirements of the plans and specifications, the local authorities having jurisdiction and the National Building Code. In the case of conflicting requirements be governed by the more severe regulations.
- .2 Use latest edition of all referenced codes, standards, regulations, etc.
- .3 Electric equipment must bear CSA label and shall bear ULC label attesting to test standards of agencies and being listed on their approved lists.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with the General Conditions of all items requiring coordination into the work.

1.6 COORDINATION

- .1 Section 15800 shall mount all motorized dampers supplied by this section in their respective locations in the duct work. Section 15800 shall also be responsible for distribution of dampers to the various locations on the job site.
- .2 All electrical control wiring including interlock wiring required for the equipment supplied in this section, except where otherwise noted, shall be supplied and installed by the contractor.
- .3 All temperature control wiring 50 volts or more shall be a minimum of #14 gauge wire. All temperature control wiring less than 50 volts shall be minimum #18 gauge wire. All wiring shall be run in conduit, including low voltage control wiring.
- .4 All temperature control wiring installed by the contractor shall conform with the requirements of the local electrical authority and the specifications Division 16 - Electrical.
- .5 Division 16 - Electrical shall provide the following:
 - .1 All power wiring to equipment
 - .2 Control circuits as indicated by Division 16.
 - .3 Provide a cost to this Division 15 – Controls, to wire as required responsibility assigned to Division 15 that must be wired by Division 16.
 - .1 Division 15 accepts the responsibility to obtain pricing prior to submitting a bid.

1.7 MAINTENANCE DATA

- .1 Provide maintenance data in English for incorporation into maintenance manual, including diagrams, specifications sheets and maintenance and repair instructions.
- .2 Supply control diagrams mounted permanently on hardboard and plasticized. Install adjacent to the equipment in each mechanical room.

1.8 OPERATING INSTRUCTIONS

- .1 Provide operating instructions for the temperature control system in accordance with the General Conditions of the contract and include a description of the sequence of operation and "as-built" drawings of the system schematics.
 - .1 See Section 15010: Part 2 Schedules

PART 2 - PRODUCTS

2.1 THERMOSTATS/SENSORS AND MISCELLANEOUS DEVICES

- .1 General
 - .1 All to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as per Sequence of Operation. Mount 48 inches about finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.
- .2 Wall Thermostat/Sensor
 - .1 Standard wall thermostat/sensor shall use solid-state sensor with adjustable override function, warmer/cooler lever for set point adjustment.

2.2 MOTORIZED DAMPERS

- .1 All motorised dampers shall be supplied by the Contractor.
 - .1 All direct drive electronic unless otherwise indicated.
 - .1 Install positioners on all outside intake and outside relief and discharge dampers for additional power and accuracy under frosted conditions.
 - .2 All air dampers shall come complete with insulated blades Johnson CD-1320).
 - .3 Damper Operators – All Modulating Opposed Blade
 - .4 Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc & nickel-plated steel and furnished as follows:
 - .1 Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
 - .2 Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For Single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.
 - .3 Damper manufacturer shall supply alignment plates for all multi-section dampers.
- .5 Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general:
 - .1 Damper section shall not exceed 24 ft-sq. with face velocity £ 1500 FPM.
 - .2 Damper section shall not exceed 18 ft-sq. with face velocity £ 2500 FPM.
 - .3 Damper section shall not exceed 13 ft-sq. with face velocity £ 3000 FPM.
- .6 Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
- .7 Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8" wide by 6" deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Open side of channel shall be faced down stream of the airflow, except for exhaust air dampers.
- .8 Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal standout collars. Sheet metal collars (12" minimum) shall bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.
- .9 All systems shall be wired to be fail-safe in case the system loses programming or power.
 - .1 Fail closed:
 - .1 Outside air
 - .3 Relief
 - .4 Exhaust discharge.
 - .2 Fail opened:
 - .1 Return

2.3 ELECTRONIC ACTUATORS

- .1 Quality Assurance for Actuators and Valves
 - .1 UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
 - .2 NEMA 4 rated enclosures for inside mounting, provide with weather shield for outside mounting.
 - .3 Five-year manufacturers warranty. Two-year unconditional and three-year product defect from date of installation.
- .2 Damper Actuators:
 - .1 Damper Actuators: Shall not be installed in the air stream
 - .2 Outside Air Exhaust Air Relief, shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed

- positions of the damper as required.
 - .3 Electric damper actuators shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
 - .4 One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
 - .5 Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section.
- .3 Actuator Mounting for Damper arrangements shall comply to the following:
- .1 A weather shield shall be used if actuators are located outside. For Damper Actuators use clear plastic enclosure.
 - .2 Damper or valve actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary
 - .3 Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.

2.4 WIRING

- .1 All electrical control wiring, including interlock wiring below 50 V required for the Work to be supplied by the Contractor.
- .2 Wire all safety controls in series with both "Hand" and "Auto" starter positions to ensure that systems are properly protected.
 - .1 Use 18 ga twisted shielded pairs, unless otherwise approved.
 - .2 Multi conductors may be utilized, each pair being shielded.
 - .3 All wiring to be fastened in place and not be allowed to sag or lie on floors, ceiling tiles, etc.
 - .4 Control components shall not be used to support wiring.
 - .5 Wiring to be fastened at control components and not be allowed to hang from equipment.
 - .6 Match existing cable markers at both ends, and in junction boxes, for all wires.
- .3 Contractor shall carry the cost of Division 16 for electrical wiring above 50 V as describes as part of the control sequence only. Example:
 - .1 Power and wire includes conduit: hard wired line voltage interlocks, at locations required by 15900.
 - .1 Division 15 accepts the responsibility to obtain pricing prior to submitting a bid.
- .4 Division 16 shall provide: (at a cost to Division 15)
 - .1 Power wiring to Mechanical equipment (e.g., fans, electric heating coils, control circuits etc.)
 - .2 A cost to Division 15 – Controls, to wire as required responsibility assigned to Division 15.

2.5 BUILDING STATIC PRESSURE CONTROL

- .1 Material 18-8 stainless steel
 - .1 Multiple sensing ports, pressure impulse suppression, field connection fitting, mounting hardware and signal connection fittings.
 - .1 Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator.
- .2 Accuracy:

- .1 Tracking $\pm 0.1\%$ of span
- .2 Linearity $\pm 1\%$ of span
- .3 Repeatability Within 0.2% of output

2.6 ENCLOSURES

- .1 All enclosures provided as part of the Work are to meet with the approval of CSA and/or D.O.L. Contractor is responsible for all costs associated with obtaining this approval.
- .2 All controllers, power supplies and relays shall be mounted in enclosures.
 - .1 Install in locations approved by Contract Administrator. Mount on free standing plywood back boards where required.
 - .1 Provide intermediary enclosures,
 - .1 Provide an un-switched duplex outlet and a power switch to disconnect all transformers in the listed panel.
 - .2 Interface panels are to be as above supplied through a RFI filter.
- .3 Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- .4 Enclosures shall have hinged, locking doors.
- .5 Provide laminated plastic nameplates for all enclosures in any mechanical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- .2 Do not begin work until all unsatisfactory conditions are resolved.

3.2 INSTALLATION (GENERAL)

- .1 Install in accordance with manufacturer's instructions.
- .2 Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.
 - .1 The points shall be sorted alphabetically by label using the existing convention.

3.3 LOCATION AND INSTALLATION OF COMPONENTS

- .1 Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from Contract Administrator's prior to installation.
- .2 All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture and high or low temperatures.
- .3 Identify all equipment and panels. Provide permanently mounted tags for all panels.
- .4 Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections—sized to suit pipe diameter without restricting flow.

3.4 INTERLOCKING AND CONTROL WIRING

- .1 Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.
 - .1 Where required carry the cost of Div. 16. See (2.4.3 and .4)
- .2 Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- .3 Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the Contract Administrator prior to rough-in.
- .4 Provide auxiliary pilot duty relays on motor starters as required for control function.
- .5 Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings—coordinate with electrical contractor.
- .6 All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed neatly and inconspicuously per local code requirements.

3.5 FIELD SERVICES

- .1 Prepare and start logic control system under provisions of this section.
- .2 Start-up and support commission of systems. Allow sufficient time for start-up and support commissioning prior to placing control systems in permanent operation.

3.6 AS-BUILT DOCUMENTATION REQUIRED

.1 See Section 15010.

3.7 TRAINING

.1 See Section 15010.

PART 4 – SEQUENCE OF OPERATION

4.1 GENERAL

- .1 Provide a complete and operational temperature control and building automation system based on the following points and sequence of operation. The system shall be complete as to sequences and standard control practices. The determined point list is the minimum amount of points that are to be provided. If additional points are required to meet the sequence of operation, they will be provided.

4.2 SPACE STATIC PRESSURE CONTROL

- .1 Adjustable
 - .1 Lobby
 - .2 Supply Return Relief Fan System(s).
 - .1 Recessed behind high security cover plate using Torx Pin screws.
 - .1 Cover by contractor.

4.3 AIR FILTER MONITOR, SF-2

- .1 Δ P monitoring across each filter.
- .2 Digital readout as part of a scale.
- .3 Adjustable pressure setting.
 - .1 Alarm
 - .1 High Δ P, differential pressure exceeds high limit setting (adjustable).

4.4 SUPPLY FAN RETURN RELIEF FAN, CONDENSING UNIT

- .1 Supply Fans SF- 2 and RF- 2 (powered relief fan*s) arrangement.
 - .1 Occupied Cycle:
 - .1 The supply fan, return/relief fan (hard wired inter-lock) shall run continuously. With a failure of the supply fan, return/relief fan, condensing unit, the system shall go into alarm. Digital static pressure sensor within space.
 - .1 Summer lock out:
 - .1 Preheat/reheat coil
 - .2 Winter lock out:
 - .1 Condensing unit.
 - .2 Static pressure control.
 - .1 Each damper shall operate independently of each other.
 - .1 Backdraft sensor shall over ride the static pressure and modulate the discharge damper with automatic reset.
 - .3 Heating Mode:
 - .2 The outside air, return air, relief air and exhaust discharge air motorized dampers shall modulate open providing a fixed ventilation rate to the applicable zone (each to modulate as per building pressure differential).
 - .1 Positions to be documented with TAB.
 - .1 The electric preheat coil shall modulate according to: (1) as a multi-stage heating/cooling thermostat (lobby). The electric preheat coil supplier to turn over additional preheat controls for the contractor to wire.
 - .1 Adjustable controlling high limit mounted in the supply air shall limit the supply air temperature.
 - .2 Adjustable controlling low limit shall be provided in the supply air to shut down the fan system should the temperature drop below 40°F. Provide also mix air low limit over ride.
 - .1 Adjustable controlling low limit over ride shall be provided in the supply air to shut down the fan system should the temperature drop below 35°F.
 - .4 Cooling Mode:
 - .1 Automatic master adjustable outdoor temperature controller:
 - .1 Heating, free cooling and mechanical cooling.

.1 Dampers re-position according to mode and static pressure.

TABLE 13 - SUPPLY RELIEF FANS

Mark	Status	Start Stop	Enable	Alarm	Supplit air temp	Fire Alarm	Filter Monitoring	Static Pressure	High Low temp	Rm. temp	Space Humidity	SA,MA. temp	SA Temp after reheat
Relief/Exhaust Fan(s)	✓	✓	✓	✓		✓		✓					
Supply Fan(s)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Condensing Unit(s)	✓	✓	✓	✓									

Remarks:

A Provide a control/monitoring panel for fan system at mezzanine space.

TABLE 14 – MOTORIZED DAMPER SCHEDULE

Mark	Outside Air	Discharge/Relief Air	Return Air
Return/Relief Fan		✓	✓
Supply Fan(s)	✓		

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