SECTION 230900 - AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the automatic temperature control system indicated. The system shall be a direct digital control (DDC) system with web-based dynamic color graphics software to provide the sequences as described in these specifications. The Owner shall be provided with all necessary manuals, passwords and software licenses. The ATC system shall be complete with required components including, low voltage and line voltage control wiring and conduit. Wiring shall be in accordance with Division 16 of the specifications and NFPA 70, National Electrical Code.

1.2 ACCEPTABLE MANUFACTURERS / INSTALLERS

A. Honeywell, Inc., 2445 Congress Street, Portland, ME.
B. Siemens Industry, Scarborough, ME
C. Maine Controls, Presumpscot Street, Portland, ME.
D. IB Controls (Delta, Johnson).

1.3 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 230500 "COMMON WORK RESULTS FOR HVAC" are hereby made a part of the work of this section.

B. Section 230000 – HVAC.

1.4 SUBMITTALS

A. Substitutions: Your attention is directed to Section 230500 relative to competition and the (ONLY) notation. Familiarity with this section shall be achieved before reading the PRODUCTS section of this specification.

B. The items for which the shop drawings paragraph in Section 230500, Supplemental General Mechanical Requirements, apply are as follows:

1. Temperature control system schematic including variables, flow diagrams, ladder diagrams, and point to point wiring diagrams, indicating set points, reset ranges, throttling ranges, controller gains, differentials, operating ranges, normal positions, controller action, dial ranges, voltages, currents, mounting locations, indicators, and terminal strip points.

2. Sequence of operation for each system and function.

3. Generic, functional description of each control component indicated.

4. Equipment interlocks required by sequence of operation.

5. Automatic valve schedule showing flow, Cv, and pressure drop.

6. Manufacturer's Data:

   a. Dampers, valves and operators.
   b. Controllers, including wiring and connection diagrams.
   c. Thermostats, temperature sensors, including wiring and connection diagrams.
   d. Temperature and pressure indicators.
   e. Pressure sensors, including wiring and connection diagrams.
   f. Switches, relays, transmitters, transformers, including wiring and connection diagrams.

7. Dynamic color graphics software data, web-accessible, with customized remote notification of critical alarms by phone, text message or email.

PART 2 - PRODUCTS

2.1 CONTROL PANELS

A. In general, relays, transformers, or other control devices (not including room thermostats or duct-mounted instruments) shall be grouped and mounted in a factory-built cabinet enclosure.

2.2 AUTOMATIC CONTROL DAMPERS

A. Automatic dampers not furnished with equipment shall be furnished under this paragraph. Automatic dampers shall be constructed and installed in accordance with the following specifications:

1. Damper Blades: All automatic dampers, including dampers for static pressure control, shall be of the balanced type, factory-fabricated, with fully gasketed galvanized steel airfoil blades, mounted in welded frames. Damper blades shall be not more than 8 inches wide, shall have interlocking edges, edge and jamb seals and be capable of operation against 4" static pressure differential. Dampers shall be Arrow "Arrow-Foil" Model PBDAF-206, OBDAF-207, Ruskin Model CD-60 or Tamco Series 1000.

2. Modulating Dampers: All modulating dampers shall be of the opposed blade type.

3. Damper Size and Bearings: Damper blades shall have steel trunnions mounted in oil-impregnated bearings. Dampers shall be not more than 48 inches in length between bearings.

4. Frames: Damper frames shall be of welded channel or angle-iron, with heavy steel corner gussets and braces or stiffened with steel tie-rods where necessary. Frames shall be painted with aluminum paint to prevent rusting.

5. Dampers shall be guaranteed to close tightly, and shall provide substantially the full area of the opening when open. All outdoor air intakes and all exhaust ducts to outside and all fresh air, return air and exhaust air dampers in systems shall have damper blades with inflatable seals or other devices to guarantee low leakage, not to exceed 6 CFM/SF at 1 in. WG pressure differential.

6. Damper Linkages: Damper-operating links shall be cadmium plated steel or brass rods, adjustable in length with ball and socket joints and of such proportions that they will withstand, without appreciable deflection, a load equal to not less than twice the maximum operating force of the damper motor. Linkages shall be concealed in the frame.

B. Damper Actuators: For each automatically controlled damper, a suitable damper actuator or actuators shall be provided in accordance with the following specifications:

1. Actuator: Damper actuators shall be electronic, direct-coupled, spring-return type and have a rating of not less than twice the torque needed for actual operation of the damper.

2. Adjustments: Provide adjustable stops for the open and closed positions.

3. Mounting: Damper actuators shall be direct-coupled over the shaft. The damper actuators and mounting base shall not be mounted directly on cold or insulated ducts and casings, but shall be mounted outside the insulated covering in such a manner as to prevent sweating and interference with the insulation.

4. Where indicated, damper actuators shall be provided with an auxiliary switch rated at 120 V AC, and accept a 0 to 20 ma input.

2.3 AUTOMATIC CONTROL VALVES (HOT WATER, 250^{O}F MAX.)

A. Control valves shall be Belimo, or equal. Valves shall have removable composition discs with monel stem. Bodies two inches or smaller shall be bronze with screwed ends. Bodies 2-1/2 inches and larger shall be cast-iron with flanged ends. Valve bodies, trim and stuffing boxes shall be designed for not less than 125 psi working pressure. Valve packing shall be non-lubricated teflon packing suitable for hot water service, as required.

B. Modulating valves shall be sized for maximum pressure drop of 1.5 to 4.0 psi.

C. Automatic control valve differential shut-off pressure shall be a minimum of 35 psig.

D. Hot water valves shall fail to the "normally-open" position.

E. Valves shall have a clearly marked position indicator as part of the operating linkage.

F. Actuator: Shall be electronic, direct-coupled, pulse width modulation (PWM) or spring return type and have a rating of not less than twice the torque needed for actual operation of the valve.

2.4 TEMPERATURE SENSORS

A. Temperature Sensors: RTD or thermistor Elements, accuracy of $\pm$0.1% at 70^{o}F, sensors shall be securely attached to a single gang electrical box or other suitable base, securely mounted on the wall or other building surface. Each sensor shall be located where shown or, if not shown, where it will respond to the average temperature in the room. Sensors, generally, shall be mounted 48 inches above the floor, and shall not be mounted on outside walls if other locations are possible. If located on an outside wall, it shall have an insulated

base. Where indicated, sensors shall have locked or concealed adjustment devices, by means of which the operating points can be adjusted through a range of not less than 10 degrees above and below the operating points specified.

2.5 SEQUENCE OF CONTROL

A. Provide and install electronic/electric DDC components to enable the mechanical system to operate in the following sequences:

1. Wall Heaters (**WH#**): The control valve shall open and a pipe-mounted aquastat shall start the fan when hot water is present.

2. Radiant Floor Zones (**RFM**): 2 position zone valves shall cycle on a call for heat from the room sensor, subject to the slab sensor acting as a high limit. The radiant floor shall be the first stage of heat for each zone.

3. Indirect-fired Water Heaters (**IFWH-1, 2 / CP5, 6**):

   a. On call for domestic hot water, the domestic hot water circulating pumps shall operate and the boilers shall fire at their maximum firing rate until they reach their maximum operating temperature setpoint until the domestic hot water demand is satisfied. The boiler pumps shall shut down on a call for domestic hot water (priority).

4. Boilers **B1**, **B2**, Pumps (**CP1 / 2 and CP3 / 4**):

   a. The boilers and main heating pumps (CP3 and CP4) shall be enabled / disabled based on the outside air temperature (60F.). Boiler operation shall be controlled from their onboard control system with outside air temperature and system temperature sensors provided and wired, as required.

   b. Boiler pumps CP1 and CP2 shall operate to maintain the HWS temperature in the main heating loop. The main heating pumps, CP3 and CP4, shall operate on a “Lead-Lag” sequence and shall be alternated based on runtime. If the “Lead” pump fails, the “Lag” pump shall operate and an alarm shall be generated.

   c. A DDC system interface shall be provided to display all boiler operating parameters and alarms at the Building Automation System (BAS). Failure alarms shall be generated and displayed at the BAS.

   d. Provide electronic temperature sensors to display hot water supply and return temperatures at the BAS.

5. Domestic hot water recirculation pump (**CP7**):

   a. The pump shall operate continuously.

6. Energy Recovery Ventilators (ERV1, 2):

   a. The ERV’s shall operate continuously.

b. When the units are manually shut down, the motorized dampers shall close and end switches shall shut down the fan. Unit status shall be displayed at the BAS.

c. If the discharge temperature drops below 40F., a manual reset freezestat shall shut down the unit and an alarm shall be generated at the BAS.

7. Variable Refrigerant Volume Heat Pump System:

a. The variable refrigerant volume heat pump system shall operate from its own controls. Provide and Coordinate the wiring requirements with the Contract Documents and the equipment manufacturer. The heat pumps shall be the second stage of heat for each zone with the radiant floors as the first stage.

8. Minisplit Air Conditioning Systems:

a. The Minisplit Air Conditioning systems shall operate from their own controls. Provide and Coordinate the wiring requirements with the equipment manufacturer.

9. Hot Water Duct Coils:

a. The proportioning 2-way control valves shall proportion to maintain the discharge air setpoint temperature (75F., adjustable).

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the automatic temperature control system may be installed in strict accordance with pertinent codes and regulations and the reviewed Shop Drawings.

3.2 INSTALLATION

A. Provide wiring, and conduit to connect the ATC components for an operational ATC system. Wiring and installation shall conform to NFPA 70.

B. Identification: Label or code each field wire at each end. Permanently label or code each point of field terminal strips to show the instrument or item served. Color-coded cable with annotated cable diagrams may be used to accomplish cable identification.

C. Temperature Sensors: Stabilize sensors to permit on-the-job installation that will require minimum field adjustment or calibration. Temperature sensor assemblies shall be readily accessible and adaptable to each type of application to allow quick, easy replacement and servicing without special tools or skills. Strap-on sensor mountings, using helical screw stainless steel clamps, shall be permitted on new piping for unit heater or other on-off operation only, after pipe is cleaned to bright metal. Strap-on bulb and pipe shall be insulated

after installation. Strap-on sensor mountings are also permitted for hot water piping sizes up to 2 inches. Other liquid temperature sensors shall be provided with wells.

D. Duct Sensors: Provide sensors in ductwork; specific location within duct shall be selected to accurately sense air properties. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Installation shall be within the vibration and velocity limits of the sensing element. Where an extended surface element is required to sense the average or lowest air temperature, position and securely mount sensor within duct in accordance with sensor manufacturer's recommendations. Temperature sensing elements shall be thermally isolated from brackets and supports. Provide separate duct flange for each sensing element; securely seal ducts where elements or connections penetrate duct. Seal penetrations of duct insulation vapor barrier with vapor barrier coating compound to provide a vapor-tight covering. Mount sensor enclosures to allow easy removal and servicing without disturbance or removal of duct insulation or vapor barrier. On downstream side of each sensor, provide access doors.

E. Pipe Sensors: Provide wells for sensors measuring temperatures in pressure vessels or in pipes. Wells shall be noncorrosive to the medium being measured and shall have sufficient physical strength to withstand the working and test pressures and velocities. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in the piping at elbows to effect proper flow across the entire area of the well. Wells may either look upstream or downstream. Provide thermal transmission material within the well to speed the response of temperature measurement. Provide wells with sealing nuts to contain the thermal transmission material and allow for easy removal. Wells shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area. Increase piping size as required to avoid restriction.

3.3 ADJUSTMENTS

A. Adjust controls and equipment to maintain the conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.4 INSTRUCTING OPERATING PERSONNEL

A. Upon completion of the work and when designated by the Engineer, furnish the services of a competent technician regularly employed by the temperature control manufacturer for the instruction of Owner in the operation and maintenance of each automatic space temperature control system. The period of instruction shall be for not less than two (2) 4-hour non-concurrent working days and shall include video tape demonstration of controllers.

3.5 FIELD INSPECTION AND TESTS

A. Tests shall be performed or supervised by employees of the ATC system or manufacturer of the ATC system, or by an authorized representative of the ATC manufacturer. Give Engineer 14 calendar days advance written notice prior to the date of the field acceptance testing. If the Engineer witnesses tests, such tests shall be subject to approval. If the Engineer does not witness tests, provide performance certification.

B. Plan for Inspections and Tests: Furnish a written inspections and tests plan at least 60 days prior to the field acceptance test date. This plan shall be developed by the manufacturer of the ATC system. The plan shall delineate the inspections and testing procedures required for

the ATC system to demonstrate compliance with the requirements specified. Additionally, the test plan shall indicate how the ATC system is to be tested, what variables will be monitored during the test, names of individuals performing tests, and what criteria for acceptance should be used. Indicate how the operation of the H&V system and ATC system in each seasonal condition will be simulated.

C. Field Acceptance Testing: Upon completion of 72 hours of continuous H&V and ATC systems operation and before final acceptance of work, test the automatic temperature control systems in service with the heating, ventilating and air conditioning systems to demonstrate compliance with contract requirements. Test controls through each cycle of operation, including simulation of each season insofar as possible. Test safety controls to demonstrate performance of required function. Adjust or repair defective or malfunctioning automatic space temperature control equipment or replace with new equipment. Repeat tests to demonstrate compliance with contract requirements.

* END OF SECTION *