SECTION 15900 - AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.01 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 electric/electronic to provide the sequences as described in these specifications. The ATC system shall be complete including required components including low voltage and line voltage wiring. Wiring shall be installed in accordance with division 16 of the specifications and the National Electric Code.

1.02 ACCEPTABLE MANUFACTURERS

A. Honeywell, Inc.
B. Siebe
C. Siemens
D. Johnson

1.03 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 15000 "SUPPLEMENTAL MECHANICAL GENERAL REQUIREMENTS" and SECTION 16000 “ELECTRICAL” are hereby made a part of the work of this section.

1.04 SUBMITTALS

A. Substitutions: Your attention is directed to Section 15000 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 15000, 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.

PART 2 PRODUCTS

2.01 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.

2.02 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 4 to 20 ma input.

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

A. 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. Heating valves shall fail to the "normally-closed" position with a manual override switch..

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

F. Actuator: 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 valve.

2.04 THERMOSTATS

A. Honeywell T87F1859 or equal room thermostats shall have a range of 40^{o} to 90^{o}F adjustable sensitivity with a minimum sensitivity of not less than one degree plus or minus, and shall have bi-metal or vapor- pressure-sensitive elements. Thermostats shall be securely attached to a suitable base mounted on the wall or other building surface. Each thermostat shall be located where shown or, if not shown, where it will respond to the average temperature in the room. Thermostats, generally, shall be mounted 54 inches above the floor, and shall not be mounted on outside walls, over light dimmers, or partitions between rooms if other locations are possible. If located on outside wall, it shall have an insulated base. Thermostats, where indicated, shall have locked or concealed adjustment devices, by means of which the operating points can be adjusted through a range of not more than 10 degrees above and below the operating points specified. Room thermostats shall be provided with thermometers.

2.05 SEQUENCE OF CONTROL

A. Provide and install electronic/electric components (NOT PNEUMATIC) to enable the

mechanical system to operate in the following sequences:

1. Hot Water Reset: Reset the supply water temperature via boiler reset from outside air temperature. The minimum temperature to be 120 Deg. F. at 60 Deg. F. outside air temperature (adjustable). The maximum shall be 200 deg F at 0 deg F outside air temperature. On a call for domestic hot water, 3-way valve (V-1) shall assume HWS/R reset control and the boiler reset shall be overridden to provide 200°F water to the water heater.

2. Main Heating Hot Water Circulators (CP-1 & CP-2): Operate Lead/Lag - if lead circulator fails the Lag circulator shall run. The lead-lag pumps shall be alternated based on runtime. At outside air temperatures above 60oF, CP-1 and CP-2 shall be de-energized. At outside air temperatures below 60oF, CP-1 and CP-2 shall operate continuously.

3. Secondary Heating Hot Water Circulators (CP-6 & CP-7): Shall operate in a "Lead-Lag" sequence. Both pumps shall be interlocked with a flow switch in the main heating circuit. If flow is proven, on a call for heat from the reset controller the "lead" pump shall start and the respective burner shall operate on "low fire". On a further call for heat the burner shall go to "high fire". The "lag" pump and respective burner shall sequence on in the same manner until the hot water supply setpoint is satisfied. A time delay shall keep the pumps operating for approximately one (1) minute after the respective burner stops firing. The "lead" and "lag" pumps shall be alternated based on runtime. A time delay shall prevent the "lag" boiler from firing for 5 minutes after the "lead" boiler fires on high fire. If, after 5 minutes of the"lead" boiler running on high fire, additional heat is required the "lag" boiler shall sequence to fire.

4. Domestic Hot Water Pump (CP-3): shall be cycled from immersion temperature sensors located in the domestic hot water supply leaving the domestic water heating tanks.

5. Fintube Radiation (V-2): The zone valve shall cycle as required to satisfy the zone temperature setpoint.

6. Hot Water Recirculation Pump (CP-5): Pump shall operate continuously.

7. Supply Fans:

    a. SF-1 shall operate based on a wall mounted thermostat, see drawings. Combustion air dampers shall be open when the supply fan is energized.

    b. SF-2 and SF-3 shall operate continuously.

    c. Exhaust Fans:

        1. EF-1, EF-2, EF-3, EF-4, EF-5, EF-6 shall be operated by a switch mounted on the wall.

        2. EF-7 and EF-8 shall operate continuously.

        3. EF-9 shall operate based on a wall mounted thermostat to maintain a room temperature of 80°F. At space temperatures below 80°F the fan shall be de-

energized. The motor operated dampers on the elevator machine room supply and exhaust shall open prior to starting the fan and shall be closed when the fan is de-energized.

d. Unit Heaters/Cabinet Unit Heaters/Wall Heaters: On a call for heating by the room thermostat, the fan shall operate subject to the pipe mounted aquastat to satisfy the heating setpoint (68? F, adjustable).

8. Unit Ventilators:

a. Occupied Mode:

1) Supply Fan: The supply fan shall run continuously.
2) Warm-up: The outside air damper shall be closed and the unit shall operate on 100% return air until the occupied room temperature setpoint is reached. Upon reaching setpoint the outside air damper shall go to the 50% minimum open position.
3) Economizer Cooling: On a call for cooling from the space sensor, the outside air damper shall proportion toward the 100% open position.
4) Heating: On a call for heating from the room temperature sensor the outside air damper shall go to the minimum position and the face-and-bypass dampers shall control the unit heating capacity.
5) Cooling: On a call for cooling when outside air is not suitable for economizer cooling, condensing unit CU-1 shall cycle to maintain the room cooling setpoint.
6) Ventilation: During "occupied" periods, the outside air damper shall be open to the minimum position.
7) Freeze Protection: A manual reset freezestat shall shut down the fan and close the outside air damper and move the face-and-bypass dampers to full coil heat if the discharge supply temperature falls below 45oF (adjustable).
8) Low Limit Discharge Control: A temperature sensor in the unit discharge shall prevent air colder than 55? F. from being delivered to the space.

b. Unoccupied Mode:

1) Outside air damper shall close, return air damper shall open, the supply fan shall cycle to maintain the unoccupied heating setpoint (60^{o}F adjustable).

c. Occupied/unoccupied mode shall be determined by the DDC system timeclock.

9. Energy Recovery Ventilator:

a. The supply and exhaust fans shall operate continuously.

b. The energy recovery wheel shall operate continuously.

10. Heating:

a. Valve V-3 shall modulate to maintain a supply air temperature of 70^{o}F.

b. At outside air temperatures above 65^{o}F, circulating pump CP-4 shall be de-

energized.

11. Freeze protection: A manual reset freezestat shall shutdown the fans and close the outside air and exhaust air dampers. Valve V-3 shall be positioned to prevent return water from re-entering the coil.

12. Wheel Rotation Sensor: A wheel rotation sensor shall shutdown the fans and close the outside air and exhaust dampers if the wheel stops rotating.

13. Motorized Dampers: Outside air and exhaust air dampers shall close upon unit shutdown.

14. Combustion Air Dampers:

    a. MOD-1, MOD-2 and MOD-3 shall be normally closed, SF-1 de-energized.

    b. Prior to firing either burner, MOD-1 and MOD-2 shall open.

    c. At space temperatures above 85°F (adjustable), MOD-1 and MOD-3 shall open, MOD-2 shall close and SF-1 shall start.

PART 3 - EXECUTION

3.01 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 and system may be installed in strict accordance with pertinent codes and regulations and the reviewed Shop Drawings.

3.02 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.

3.03 ADJUSTMENTS

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

3.04 INSTRUCTING OPERATING PERSONNEL

A. Upon completion of the work and when designated by the Architect, 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 8-hour working days and shall include videotape demonstration of controllers.

3.05 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 Architect 14 calendar days advance written notice prior to the date of the field acceptance testing. If the Architect witnesses tests, such tests shall be subject to approval. If the Architect 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 ATC system is to be tested, what variables will be monitored

during test, names of individuals performing tests, and what criteria for acceptance should be used. Indicate how operation of 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 *