
SECTION 15900 - 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 dynamic color graphics software 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 and conduit. Wiring shall be in accordance with Division 16 of the specifications and NFPA 70, National Electrical Code. See "System Point Lists" for additional requirements and information.

1.2 RELATED DOCUMENTS

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

1.3 ACCEPTABLE MANUFACTURERS

- A. Johnson.
- B. Siebe.
- C. Siemens.
- D. Alerton.

1.4 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.
7. Dynamic color graphics software data.

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. Panels shall be mounted in accessible locations at 54" AFF.

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°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-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 modulating (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 Elements, accuracy of $\pm 0.1\%$ at 70°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 54 inches above the floor, and shall not be mounted on exterior walls if other locations are possible. If located on an exterior wall, it shall have an insulated base. 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.
- B. Room temperature sensors shall be equal to Vaisala or Honeywell, with setpoint adjustment and override button, digital LCD display and LED override status indication. Provide tamperproof cast aluminum guards, where indicated. Thermostats / sensors with guards shall have blank covers.

2.5 CO₂ SENSORS

- A. Duct mounted: CO₂ sensors shall be Vaisala Carbocap Series, Model GMD20, and utilize Non-Dispersive Infrared Detection (NDIR) or Photo-Acoustic Sensing and be capable of daily self-calibration during "unoccupied" periods.
- B. Wall-mounted room sensors: Shall be equal to Vaisala Carbocap Series, Model GMW20 combination temperature and CO₂ with LCD display. Provide tamperproof cast aluminum guards, where indicated.

2.6 SEQUENCE OF CONTROL

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

1. Hot Water Reset: Reset the supply water temperature from outside air temperature by controlling the burners. The minimum hot water supply temperature shall 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.
2. Heating Hot Water Circulators (CP-1, 2, 5, 6): Shall operate in a “Lead-Lag” sequence. Pumps shall be controlled from the outside air temperature to operate continuously when the outside temperature is below 60⁰F. and remain off above 60⁰F. The “lead” and “lag” pumps shall be alternated based on runtime.
3. Chilled Water Circulators (CP-3A & CP-3B): Operate Lead/Lag - if lead circulator fails the Lag circulator shall run. The lead-lag pumps shall be alternated based on runtime. The chilled water pumps shall be interlocked with the chiller via a flow switch with an adjustable programmed time delay per the chiller manufacturers requirements to start and stop the chiller in sequence with the pumps.
4. ERV-1, ERV-2:
 - a. Occupied Mode:
 - 1) The supply and exhaust fans shall operate continuously on 100% make-up and exhaust airflow.
 - 2) Discharge Air Temperature Control: The discharge air temperature setpoint shall be reset inversely from the room air temperature to provide 95°F air at 68°F room temperature and 55°F air at 78°F room temperature. The reset temperature values shall be adjustable. The discharge air temperature shall be controlled by sequencing the hot water (2-way) and chilled water (3-way) control valves.
 - 3) Ventilation: During “occupied” periods, the outside / recirculation air damper shall be open to 100% outside air. An enthalpy economizer control shall stop the heat recovery wheel when in economizer operation.
 - 4) Frost / Freeze Protection: A manual reset freezestat shall shut down the fans and close the outside air damper and move the hot water control valve to the full coil heat position if the discharge supply temperature falls below 45°F (adjustable). A frost sensor shall reduce the speed of the wheel to prevent frost formation.
 - 5) Smoke detectors in the discharge and return air shall de-energize the unit and close the outside air dampers. The smoke detectors shall be wired to interface with the building fire alarm system.
 - 6) The motorized exhaust dampers shall close when the units are not operating.
 - 7) The heat recovery wheel speed shall be controlled from the manufacturers packaged control system.

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- b. Unoccupied Mode:
 - 1) Outside air dampers and exhaust dampers shall close, recirculation air damper shall open and the supply fan shall cycle to maintain the unoccupied heating setpoint (60°F adjustable).
 - 2) Occupied/unoccupied mode shall be determined by the programmable electronic time switch.
 - c. Remote Control Panel:
 - 1) Coordinate wiring requirements with the equipment manufacturer.
5. ERV-3:
- a. Occupied Mode:
 - 1) The supply and exhaust fans shall operate continuously on 100% make-up and exhaust airflow.
 - 2) Discharge Air Temperature Control: The discharge air temperature setpoint shall be reset inversely from the room air temperature to provide 95°F air at 68°F room temperature and 55°F air at 78°F room temperature. The reset temperature values shall be adjustable. The discharge air temperature shall be controlled by sequencing the hot water control valve (2-way) and DX cooling.
 - 3) Ventilation: During “occupied” periods, the outside / recirculation air damper shall be open to 100% outside air. An enthalpy economizer control shall stop the heat recovery wheel when in economizer operation.
 - 4) Freeze Protection: A manual reset freezestat shall shut down the fans and close the outside air damper and move the hot water control valve to the full coil heat position if the discharge supply temperature falls below 45°F (adjustable).
 - 5) Smoke detectors in the discharge and return air shall de-energize the unit and close the outside air dampers. The smoke detectors shall be wired to interface with the building fire alarm system.
 - 8) The motorized exhaust damper shall close when the unit is not operating.
 - b. Unoccupied Mode:
 - 1) Outside air dampers and exhaust dampers shall close, recirculation air damper shall open and the supply fan shall cycle to maintain the unoccupied heating setpoint (60°F adjustable).
 - 2) Occupied/unoccupied mode shall be determined by the programmable electronic time switch.

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- c. Remote Control Panel:
 - 1) Coordinate wiring requirements with the equipment manufacturer.
 - 6. SF-1:
 - a. SF-1 shall be cycled by a room cooling thermostat.
 - 7. Air-Cooled Chiller (ACH-1):
 - a. The DDC control system shall send an “enable-disable” signal to the chiller to be enabled during “occupied” periods when the outside air temperature is above 55°F. The chiller shall remain off during “unoccupied” periods.
 - 8. Exhaust Fans, EF-1, 2, 3, 4:
 - a. Fans EF-1, 2, 4 shall be controlled to operate continuously during “occupied” periods and remain off during “unoccupied” periods.
 - b. Fan EF-3 shall be controlled from a room cooling thermostat.
 - 9. Unit Heaters and Cabinet Unit Heaters:
 - a. On a call for heating by the electric room thermostat, the fan shall operate subject to the pipe mounted aquastat to satisfy the heating setpoint (68°F).
 - 10. Exterior Lighting:
 - a. Not applicable.
 - 11. Fintube Radiation:
 - a. Room sensors shall cycle the 2-way (or 3-way) zone valves as required to maintain the “occupied-unoccupied” setpoint.
 - 12. Domestic Water Heaters (EWH):
 - a. The water heaters and domestic recirculation pumps (CP-4, 7) shall be “enabled” during “occupied” periods and “disabled” during “unoccupied” periods.
 - 13. Electric Heat Trace:
 - a. The electric heat trace at all locations shall be de-energized at outside air temperatures above 35°F.
 - 14. Wall Heaters (WH):
 - a. The wall heaters shall be controlled by a wall-mounted thermostat, 2-way control valve and be subject to a pipe-mounted aquastat.

15. Air-Cooled Condensing Unit:
 - a. The condensing unit shall be enabled during “occupied” periods if the outside air temperature is above 55⁰F. The unit shall remain off during “unoccupied” periods.
16. Radiant Floor Heat (Receiving Building):
 - a. The radiant floor heating system shall receive an “occupied-unoccupied” signal from the DDC system.
17. Electric Heat:
 - a. Provide electric line-voltage thermostats to control electric heating equipment, as indicated.
18. Emergency Generator:
 - a. When the emergency generator starts, the intake and exhaust dampers shall open 100%.
19. Combustion Air Dampers:
 - a. When the respective burner is firing or cooling is required, the dampers shall be 100% open.

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 and 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 and Division 16 of the Project Manual.
- 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 SMOKE DETECTORS

- A. The Fire Alarm Contractor shall furnish smoke detectors under that section, installation shall be accomplished by the mechanical contractor and wired by the Fire Alarm Contractor.

3.5 INSTRUCTING OPERATING PERSONNEL

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

3.6 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 the Resident 14 calendar days advance written notice prior to the date of the field acceptance testing. If the Resident witnesses tests, such tests shall be subject to approval. If the Resident 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.



Ocean Gateway
Portland, Maine
Specification Section 15900
SYSTEM POINT LIST

Job No: 2287
Job File No: na
Prepared by: SPD
Issue Date: 10/27/2004
Revision: 0

Point Description	Hardware										Software									
	Inputs					Alarms					Energy Management Control Strategies					Control Strategies				
	Digital	Analog	Digital	Analog	Digital	Analog	Digital	Analog	Digital	Analog	Digital	Analog	Digital	Analog	Digital	Analog	Digital	Analog		
Control Relay																				
Solenoid																				
Contractor																				
On/Off																				
Pneumatic Transducer																				
Electrical Transducer																				
0-10 V																				
Pneumatic																				
Pressure Switch																				
Flow Switch																				
Switch Closure																				
Auxiliary Contact																				
Open/Closed																				
Temperature	X																			
Relative Humidity		X																		
PSIG/TNW																				
Position																				
Flow																				
CO2/O2								X												
Equipment Status									X											
Maintenance										X										
Run Time											X									
High Limit												X								
Low Limit													X							
Start/Stop														X						
Optimum Start/Stop															X					
Thermostat																X				
Demand Limiting																	X			
Day/Night setback																		X		
Economizer																		X		
Ventilation/Recirculation																		X		
Temperature Controls																		X		
Enthalpy																		X		
Supply Air Reset																		X		
Steam Boiler Optimization																		X		
H V Boiler Optimization																		X		
Hot Water O A Reset																	X			
Chiller Optimization																	X			
Chilled Water Reset																		X		
Condenser Water Reset																		X		
Relative Humidity Control																		X		
DC Controllable																		X		
Enable / Disable																		X		

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Point Description	Hardware				Software																			
	Outputs		Inputs		Alarms		Energy Management Control Strategies																	
	Digital	Analog	Digital	Analog	Digital	Analog	Digital	Analog	Demand Limiting	Day/Night Setback	Economizer	Ventilation/Restriction	Temperature Controls	Enthalpy	Supply Air Reset	Steam Boiler Optimization	Hot Water O A Reset	Chiller Optimization	Chilled Water Reset	Condenser Water Reset	Relative Humidity Control	DDC Controllable	Open/Closed	
ERV-1, ERV-2																								
Night setback dampers																								
Discharge Temperature																								
Duct smoke detectors																								
OA																								
VFD's (supply / return)																								
CO2																								
Motorized backdraft dampers																								
3-way valves (V-1A, V-2A)																								
2-way valves (V-1B, V-2B)																								
Room temperature																								

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Portland, Maine
Specification Section 15900
SYSTEM POINT LIST



Job No: 2287
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Point Description	Hardware						Software																																	
	Output			Input			Digital						Analog																											
	Digital	Analog	Pneumatic	Digital	Analog	Pneumatic	Switch Closure	Flow Switch	Pressure Switch	Pneumatic Transducer	Electrical Transducer	0/10 V	Maintenance	Run Time	High Limit	Low Limit	Start/Stop	Optimum Start/Stop	Tunelock	Demand Limiting	Day/Night setback	Economizer	Ventilation/Rectification	Temperature Controls	Energy	Supply Air Reset	Steam Boiler Optimization	H W Boiler Optimization	Hot Water O A Reset	Chiller Optimization	Chilled Water Reset	Condenser Water Reset	Relative Humidity Control	DDC Controllable	Open/Closed					
Control Relay																																								
Exhaust fans (EF-1,2,3,4)																																								
CHWS/R																																								
F intube radiation																																								
Radiant Floor																																								
Domestic water temperature 1																																								
Domestic water temperature 2																																								
Force main temperature 1																																								
Force main temperature 2																																								