

## SECTION 230900.13 - STAND ALONE HVAC CONTROLS

### PART 1 - GENERAL

#### 1.1 SUBMITTAL REQUIREMENTS

##### A. Product Data

1. DDC sensors.
2. Thermostats.
3. Pressure stats.
4. Humidistats.
5. Terminal control units.
6. Protection devices.

##### B. Shop Drawings

###### 1. Coordination Drawings

- a. Provide separate diagrams for each system, including piping, motor starting and interlock wiring, push buttons, control wiring, interior electrical circuits of control instruments with terminal designations, control motors, colors of wires, locations of instruments and remote elements, and normal position of valves, dampers, relays and control points list.
- b. A detailed description of the operation of the control system including device designations shall accompany the drawings. Schedule of dampers including size, leakage, and flow characteristics and a schedule of valves including close-off and flow characteristics shall also be furnished for the entire project.
- c. Provide the actual physical proposed room thermostat/temperature sensor and guards, at the time of submittal review, to both the Engineer and Owner for approval.
- d. Complete field wiring diagram with terminals labeled as they will be marked on the equipment, including sensors, control and power wiring for each sensor.
- e. Floor plans locating DDC terminal control units coordinated with work of other trades.

##### C. Training

###### 1. Provide (4) 4-hour training sessions

- a. General
  - 1) Conduct formal instruction sessions for operating personnel.
  - 2) Obtain direction from the Owner on which operating personnel shall be instructed in each system.

- b. Training
    - 1) Such training session shall include but not be limited to:
      - a) Basic instruction
      - b) Operation and use of advanced features
      - c) Optimization and energy management features.
    - 2) The session shall be conducted by factory-trained personnel. Provide materials and training for up to 3 operators per session to be designated by the Owner.
  - 2. Provide CD-ROM format recording of training sessions.
    - a. CD shall include an easy to use index of training segments with extensive description for quick, easy references. CD segments shall be created on the owners actual installed system. CD segments shall be established for each independent task that is covered in the training to reduce the owner's review time.
  - 3. Training confirmation
    - a. Obtain and submit a receipt acknowledging completion of each item of instruction.
- D. Samples
- 1. Provide (1) sample of a thermostat.
- 1.2 SCOPE
- A. General
- 1. The HVAC controls systems shall be supplied and installed completely under this Contract. Components shall be mounted and wired by the HVAC contractor.
  - 2. The engineering, installation, calibration, programming, and checkout necessary for complete and fully operational systems, as specified hereafter, shall be provided by the HVAC contractor.
  - 3. The HVAC contractor shall provide low voltage power wiring as required for wiring each individual control component. Power wiring shall be located within the same room as the equipment or within 20 feet of the connection. Electrical contractor shall install line voltage (above 100 volts AC) wiring according to Division 26.
- B. System Description
- 1. Furnish all labor, materials, equipment, and service necessary for a complete and operating HVAC control systems, utilizing electronic interfaces and actuation devices, as shown on the drawings and as described herein.
  - 2. HVAC control system to be completely DDC with electronic sensors and electronic actuation of valves and dampers.

C. Work by Others

1. The Electrical Sub-Contractor shall install conduit and connect power wiring. Power wiring and conduit shall be defined as follows:
  - a. Wiring of power feeds through all disconnect starters and variable speed controllers to electric motors.
  - b. Wiring of line voltage emergency power feeds to junction boxes in locations of temperature control panels.
  - c. Power wiring to line voltage motors shown on Electrical Plans and specified in the Electrical Sections.
  - d. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by the HVAC Contractor.
  - e. Conduit for routing temperature control wiring where shown on electrical plans.
  - f. Raceways where shown on electrical plans which shall be utilized for temperature control wiring.

D. Related Work

1. Provide all line size and non-line size automatic valves and separable wells.
2. Provide all necessary piping connections, taps and wells required for flow, pressure or temperature devices.
3. Provide dampers, if so indicated, under Equipment Specifications.
4. Assemble multiple section dampers with required interconnecting linkages, shafts and brackets and extend the required number of shafts through the ducts for externally-mounted damper motors. Jack shafts will be assembled with sealed roller or ball bearings of stainless steel construction.
5. HVAC contractor shall coordinate and remain on site with the balancing contractor to operate the facility management system during balancing. The HVAC contractor shall manipulate the system as instructed by the balancing contractor. This shall include but not limited to changing damper positions, valve positions, fan speeds, pump speeds and set points as required to complete the balancing procedures.
6. The installation of motor starters that are not factory installed, thermal overload switches, and power wiring to motors, starters, thermal overload switches, contactors, and electric heating coils is specified in another Division. This Section includes installation of controls plus wiring for automatic controls, electric damper and valve operators, terminal control units, interlocks, starting circuits, and wiring to power consuming control devices.
7. Area smoke detectors are furnished, installed and wired under another Division. Duct smoke detectors shall be installed under this Division but furnished and wired into the fire alarm system under another Division. This Section includes wiring alarm signal relays, provided and installed under another Division.

### 1.3 SEASONAL ADJUSTMENTS

- A. Visit each Building during the first heating or cooling season approximately 6 months after the date of substantial completion to make repairs and adjustments to provide uniform conditions throughout. Each visit shall consist of a minimum of one (1) day. Schedule the visit for the heating cycle during the months of October through November, and for the cooling cycle during May through June.
- B. During each visit:
  - 1. Check and calibrate temperature control devices and thermostats.
  - 2. Test and verify control sequences for proper operation for the season.
  - 3. Modify the system based on the owner's direction.
  - 4. Assist the owner in understanding and clearing any alarms.
- C. Prepare and submit a report for each visit documenting conditions found and corrective action taken.
- D. Have the Owner sign the report acknowledging the visit.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide Automatic Temperature Control systems manufactured and installed by one of the following:
  - 1. From HVAC equipment manufacturer
  - 2. Invensys
  - 3. Honeywell
  - 4. Siemens
  - 5. Delta Controls
  - 6. Schneider TAC
  - 7. Alerton

### 2.2 GENERAL

- A. Provide a complete system of direct digital controls (DDC) and monitoring points as specified herein. The DDC system shall interface with the electric and electronic systems to provide control outputs and monitoring inputs to the DDC systems as specified in other Division 23 sections.
- B. The HVAC controls system shall allow full user operation with a minimum of training. It shall have an English language display.

## 2.3 CONTROL UNITS GENERAL

- A. Provide an adequate number of control units to achieve monitoring and control of all points specified and necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. Provide a minimum of one controller for each AHU or other HVAC system. Multiple DDC controllers may control one system provided that all points associated with individual control loops are assigned to the same DDC controller. If multiple controllers are furnished, the contractor must make sure that corresponding outputs and inputs are on the same controller. Extra controllers will be required to ensure that all control outputs are controlled by a controller that has the control inputs directly connected to it. Points used for control loop reset such as outside air or space temperature are exempt from this requirement. When multiple controllers are used for controlling one system, the controllers shall be identical. To minimize the number of spare parts that the owner will need to stock in the future, the same part number controller shall be used for all major system applications (i.e. AHUs, heating water system, chilled water system, pump systems, etc.). All analog outputs shall be true AO (4-20mA or 0-10Vdc). Floating, pulse-width or phase-cut modulating outputs will not be acceptable for this project. Each of the following panel types shall meet the following requirements.
- B. Controllers shall be suitable for the anticipated ambient conditions.
  - 1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non-condensing.
  - 2. Controllers used in conditioned ambient space shall be mounted in dust-proof enclosures, and shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non-condensing.
- C. Serviceability: All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
- F. Automatic staggered restart of field equipment after restoration of power and short cycle protection is required.

## 2.4 MISCELLANEOUS

- A. Materials

1. All materials and equipment used shall be standard components, of regular manufacture for this application.
2. All systems and components shall have been thoroughly tested and proven in actual use.

B. Motor Operated Dampers

1. General:
  - a. Blades shall be 16 gauge minimum and 6 " wide maximum and frame shall be of welded channel iron. Dampers with both dimensions under 18" may have strap iron frames. Dampers over 48" wide shall be equipped with a jack shaft to provide sufficient force throughout the intended operating range.
  - b. Dampers shall be black enamel finish or galvanized, with nylon bearings.
  - c. Blade edge, tip and jamb seals shall be included for all dampers. Leakage through the damper shall not exceed 10 CFM per square foot at 4" w.g. (based on a 48" x 48" test sample).
  - d. Motor operated dampers shall be parallel blade for two-position control and opposed blade for proportional control applications.
  - e. All low voltage motor operated dampers throughout the project shall be wired by the HVAC Contractor. Refer to the fan and mechanical schedules, drawings, and control specifications for quantity of motor operated dampers.
2. Damper Actuators
  - a. Electronic damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range. All actuators operating in series or parallel to another actuator or in an open loop, such as minimum percentage outside air, shall be equipped with a positive positioning device. Provide spring return type actuators on outside air (close), return air (open), and relief air (close) dampers.
  - b. Actuators for all dampers and AHU and VAV valves shall be manufactured by Invensys (Duradrive), Siemens (OpenAir) or Belimo. The manufacturer must include a five year warranty from the manufactured date for the actuator.
3. Manufacturer:
  - a. Dampers shall be manufactured by Ruskin, Greenheck or Tamco.

C. Thermostats

1. The thermostat shall be located where shown on the drawings. Provide a thermostat with digital readout of temperature with integral room setpoint adjustment. The thermostat shall contain a push-button for override of

- unoccupied conditions, up and down arrows to scroll through attributes and enter key to make changes.
2. The thermostat display shall be capable of full programmability of the unit controller without the use of a portable editing device. The thermostat shall be capable of showing the unit controller time and day of week. The display shall be capable of displaying setpoints & temperatures in either 1-degree increments or 0.1-degree increments and space temperature an accuracy of  $\pm 1/2$  degrees. The thermostat shall provide unoccupied override with cancel. The override time shall be user settable from 1 minute up to 7 days. For 1 minute to 16 hours the user shall be able to select any one minute interval.
  3. Thermostats shall be RTD or Thermistor type, providing a linear OHM per degree F characteristic change, and shall be housed as required for the application.
  4. Temperature ranges shall be selected as required for the application and all sensors shall be  $\pm 1$  deg. F.

## PART 3 - EXECUTION

### 3.1 CONTROL DEVICES AND WIRING

#### A. Low Voltage Temperature Control Devices

1. Low voltage thermostats shall be furnished, installed and wired by the HVAC contractor.
2. The electrical contractor shall provide 4" square by 1-1/2" deep wall outlet boxes (with single-gang rings) for all thermostats/sensors. The electrical contractor shall provide one 3/4" empty conduit from each thermostat/sensor location, turned out above accessible ceilings (in joist space or against overhead slab/deck).
3. The HVAC Contractor shall provide all other necessary conduit, raceway and wiring related work. Conduit shall be identified in ceiling cavity and shall be provided with sweep bends, bushings and drag line.
4. The HVAC Contractor shall coordinate with the General Contractor to ensure thermal envelope is maintained at these locations.

#### B. General Control Wiring Requirements and Installation Methods

1. Except where specifically indicated otherwise herein or within Division 23 specifications, the HVAC Contractor shall provide all low voltage electrical work as required for all temperature control related wiring (i.e. conduit, raceway, outlet boxes, junction boxes, wiring, etc.) in accordance with Division 26 requirements. All conduit shall be 3/4" minimum.
2. Coordinate all thermostat/sensor locations in field (case by case) with Architect, Owner and Electrical Contractor to ensure that they are placed in locations that will not interfere with furniture, equipment, artwork, wall-hung specialties, room finishes, etc. All thermostat/sensor wall locations indicated on HVAC drawings are schematic only and must be verified case-by-case prior to rough-in.
3. All electrical work as described in this specification shall be per the latest edition of the National Electrical Code (NEC) and per applicable state and local codes.

Refer to Division 26 specifications for required installation methods and follow Division 26 requirements as related to low voltage and communication technology system cables.

4. Where “free-air” installation methods (either exposed above the ceilings, in bridle rings or in cable trays) are permitted under Division 26 above ceilings, provide plenum-rated cables wherever plenum ceilings (if any) exist and install as defined under Division 26. Install low voltage circuits, located in concrete slabs and masonry walls, or exposed in occupied areas, in electrical conduit regardless of what wiring methods are permitted under Division 26.
5. Where cable trays or bridle rings are provided by the electrical contractor for low voltage cables, these raceways may be utilized for control wiring by this contractor (provide special color coded jackets, label cable jackets per Division 26 and group control wiring cables together). Provide conduit drops from cable tray/bridle ring paths to wall outlet boxes and equipment unless directed otherwise under Division 26.
6. Regardless of permitted methods in Division 26, all cables/wiring installed concealed by gypsum board, masonry or other inaccessible materials in walls or above ceilings shall be installed in conduit, ¾” minimum.
7. All conduit, bridle rings, raceway, outlet boxes, etc. necessary for complete operational installation of control wiring shall be provided (furnished and installed) by the temperature control contractor in strict compliance with Division 26 documents. Coordinate all work with all other applicable trades including the electrical contractor.
8. Provide all required conduit work to and between equipment in a manner compliant with that described above (i.e. between VAV boxes, to boilers, starters, condensing units, etc. as applicable).
9. Install control wiring without splices between terminal points, color-coded. Where a splice is required, install within junction box. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code and per Division 26.
10. Install circuits over 25 volt with color-coded No. 12 wire in electrical metallic tubing, per Division 26. Install circuits under 25 volt with color-coded No. 18 wire with 0.031" high temperature (105 degrees F) plastic insulation on each conductor and plastic sheath over all. Install electronic circuits with color-coded No. 22 wire with 0.023" polyethylene insulation on each conductor with plastic-jacketed copper shield over all.
11. All control cabling shall be labeled at both ends with descriptive information of control device.

### 3.2 OPERATING AMBIENTS

- A. Electronic controls mounted in unconditioned space shall be rated for ambient operating conditions of -40 degree F to +140 degree F.
- B. Controls not meeting these limits shall be mounted in an accessible location within conditioned space.



### 3.3 COMMISSIONING

#### A. Automatic Temperature Controls

1. Wiring and tubing shall be identified with the same numbers and symbols as used on the corrected, approved record diagrams.
2. Label control apparatus with nameplates or valve tags bearing the functional designations shown on approved control diagrams.

#### B. Operation and Maintenance Manuals

1. Submit on disk in electronic format using Adobe PDF version 7 or higher
  - a. Include marking or tagging of specific models and options used on the project.
  - b. All schedules shall be submitted in Microsoft Excel or comma delimited format.
  - c. All drawings be submitted in AutoCAD DWG or DXF format.
2. Submit manuals 1 month before systems start-up and commissioning.
3. General Contents
  - a. Title page with project name, contractor's and subcontractors' names, addresses and telephone numbers.
4. Index Sheet
  - a. Manufacturers' operating and maintenance manuals, including parts lists for each piece of equipment and accessories requiring service or maintenance, the warranty period, and the name, address, and telephone number of the nearest sales and service organization for each item.
  - b. Complete description of functions and operation of each piece of equipment including descriptions of how equipment operates in conjunction with automatic control systems, and instruction for cleaning, lubrication, and maintenance.
  - c. Descriptive information:
    - 1) Function or service.
    - 2) Classification.
    - 3) Design capability.
    - 4) Performance characteristics.
    - 5) Principal components.
    - 6) Distribution arrangement.
    - 7) Schematic diagram.
    - 8) Control diagram.
  - d. Equipment data:
    - 1) Materials of construction.
    - 2) Parts designation.

- 3) Manufacturer and model number.
  - 4) Size and rating.
  - 5) Pressure, speed, and temperature limitations.
- e. Inspection and maintenance information:
    - 1) Inspection schedule and checklist.
    - 2) Schedules and procedures for lubrication, replacement, adjustment, cleaning, painting, protection and testing.
    - 3) Standard forms for compiling inspection and maintenance records.
    - 4) Inspection during operation.
    - 5) Adjustment and regulation.
    - 6) Operational test procedures.
    - 7) Detection of malfunction.
    - 8) Precautions.
    - 9) Troubleshooting.
  - f. Step-by-step procedure for starting, stopping, and operating each system:
    - 1) Starting and stopping procedures.
    - 2) Adjustment and regulation.
    - 3) Seasonal changeover.
    - 4) Seasonal shut down.
    - 5) Seasonal start-up.
    - 6) Logs and records.
  - g. Copies of inspection certificates provided by the city, county, state and insurance companies.
  - h. Approved start and completion dates of the guarantee period.
  - i. Valve schedules and diagrams.
  - j. Point to point document for all control and monitoring points.

## C. HVAC

### 1. Control System

- a. Control diagrams including electric and interlock wiring.
- b. Final installed control software listings and flow charts. Listings shall include English comment lines documenting purpose of each group of executable statements and relationship to control sequence for ease of future troubleshooting and modification.
- c. Record data base information.
- d. Point identification and sensor characteristics.
- e. As-built wiring diagrams.
- f. Contents shall be type written.

## D. Documentation

- 1. Submit the following certificates, statements, receipts, and reports as specified herein:

- a. Record drawings.
- b. Submittals.
- c. Operation and maintenance manuals.
- d. Certification of controls calibration and testing.
- e. Receipts for controls training.
- f. Receipt acknowledging no controls failures during test period.

E. Record Drawings

1. Record drawings shall include the manufacture and model number of equipment indicated in schedules on the Drawings.
2. Reproductions of design drawings shall not be used in the preparation of record drawings.
3. All record drawing information (drawings and cut sheets) shall be furnished in an electronic format.

3.4 MAINTENANCE

- A. Equipment operated prior to the date of substantial completion shall be maintained in accordance with manufacturer's recommendations.

3.5 EQUIPMENT START-UP AND CHECK-OUT

A. General

1. Verify readiness for start-up of each item of equipment on the basis of inspection.

B. Automatic Temperature Controls

1. The system manufacturer shall provide the services of control technicians at start-up to check-out the system, input data supplied by the Owner, and place the system in operation. Manufacture shall verify proper operation of each item in the sequences of operation, including hardware and software.
2. Check-out each system for control function through the entire sequence. Check actuator travel on dampers and valves for action and extent. Check calibration of instruments.
3. Verify that control dampers open and close completely.
4. Calculate and verify instrument setpoints.

C. Controls Acceptance Conditions

1. Calibration and testing: Calibrate equipment and verify operation before the system is placed on-line. Check each control point, within the system by making a comparison between the control command at the operator console and field-controlled device. HVAC control loops, interlocks, sequences, energy management programs, and alarms shall be tested and stable operation verified. Control loop parameters and tuning constants shall be adjusted to produce accurate, stable control system operation. Before obtaining permission to

schedule the acceptance test, provide written certification that the installed complete system has been calibrated, tested and is ready to begin acceptance testing.

2. Acceptance test: Conduct final acceptance test, with the Owner on site, on the complete and total installed and operational automation system to demonstrate that it is functioning in accordance with requirements specified herein. Demonstrate the correct operation of monitored and controlled points as well as the operation and capabilities of sequences, reports, specialized control algorithms, diagnostics, and software.
3. Final system acceptance will be based on the following items:
  - a. Completion of the installation of hardware and software items. Demonstrate complete operation of the system, including hardware and software, with no failures during a 14 consecutive day period. Obtain receipt from the Owner acknowledging no failures within the test period. Submit a daily log documenting failures.
  - b. Satisfactory completion of the record drawings, and operating and maintenance manuals.
  - c. Satisfactory completion of training programs.

### 3.6 ACCEPTANCE PROCEDURE

- A. Upon completion of the calibration, contractor shall start-up the system and perform all necessary testing and run diagnostic tests to ensure proper operation.
- B. Contractor shall be responsible for generating all software and entering all database information as necessary to perform the sequence of control and specified software routines.
- C. An acceptance test in the presence of the Owner's representative or engineer shall be performed.

END OF SECTION 230900.13