SECTION 25 35 16
SENSORS AND TRANSMITTERS

GENERAL

1.1 SUMMARY

A. Section includes instrumentation for the following Sensors and Transmitters for building control systems
   1. Air and liquid temperature sensors
   2. Humidity sensors
   3. Occupancy sensors
   4. CO2 sensors
   5. I/P Transducers
   6. P/E Transmitters
   7. Vibration sensors

B. Products supplied but not installed under this section
   1. Sensor wells

C. See section 25 33 13 for thermal utility metering sensors and transmitters.

D. See section 25 35 17 for air and gas pressure and flow measurement

E. See section 25 35 18 for liquid pressure and flow measurement

F. Related Sections:
   1. 25 00 00 Integrated Automation
   2. 25 05 13 Conductors & Cables
   3. 25 05 28 Pathways
   4. 25 05 53 Identification

1.2 REFERENCES

A. DIN-IEC -751 Standard for platinum sensors

B. UL 773A – Non-Industrial Photoelectric Switches for Lighting Controls.

C. NEMA WD7 – Occupancy Motion Sensors.

D. Refer to section 25 00 00 for additional references.

1.3 DEFINITIONS

A. Refer to 25 06 11 Integrated Automation Definitions

1.4 SYSTEM DESCRIPTION

A. Section includes sensors and transmitters for the accurate measurement of environmental conditions associated with HVAC and process systems.

B. HVAC and process systems vary in degree of sensitivity and criticality. Therefore, instrumentation capability and quality requirements will also vary. Stanford defines three tiers of instrumentation quality.
1. Tier 1 – Industrial grade requirements. Typically used for utility interface, revenue transactions, or critical safety applications.

2. Tier 2 – High quality commercial requirements. Typically used for key processes like control of AHUs, large exhaust fans, and process cooling water. These processes have a significant impact on occupant comfort, safety, and energy costs.

3. Tier 3 – Standard quality commercial requirements. Typically used for terminal unit monitoring and control. These processes have relatively low risk to overall building operations.

C. Wiring shall be done in accordance with all local and national codes.

D. Coordinate installation of instrumentation, including but not limited to:
   1. System interface (Delta V or DDC)
   2. Power requirements
   3. Panel locations
   4. Mounting requirements
   5. Calibration
   6. Commissioning
   7. Test and Balance
   8. Equipment start-up
   9. User access

1.5 SUBMITTALS
   A. Refer to section 25 00 00.

1.6 QUALITY ASSURANCE
   A. Coordinate timely delivery of materials.
   B. Order Tier 2 temperature transmitters with factory scale to match design documents.
   C. Coordinate installation activities of inline devices such as immersion wells, and related items.
   D. Install control devices in an accessible location.
   E. Refer to section 25 0000 for additional requirements.

Note: Section specific quality requirements should be defined here but not repeated from other sections.

PRODUCTS

2.1 TIER 2 AND TIER 3 TEMPERATURE SENSORS

A. Tier 2 temperature sensors use a 100 Ohm platinum RTD with a 4500H 2 wire, 4-20 mA current output signal proportional to specified temperature span of transmitter
   1. Accuracy: .......................... ± 0.12% at 32°F (Class B)
   2. Temperature Operating Range: -20 to 170°F
   3. Humidity Operating Range: ................................. 0 to 99% RH
   4. Conformance: ................................. DIN-IEC 751
   5. Range: ................................ Consult with Owner before ordering

B. Tier 3 temperature sensors use a 10K Ohm thermistor wire directly to the controller input.
   1. Thermistors will provide an accuracy within tolerance of ± 0.9°F between 32°F and 150°F
C. SPACE / ROOM THERMOSTAT (TIER 3)
   1. Manufacturers: Distech model EC-Smart-Vue unless another brand of thermostat is specified to match brand of controller installed
   2. Accuracy at Calibration point: +0.5°F
   3. Room thermostats shall feature LCD space temperature display (Do not display setpoint) and an occupancy override with LCD indicator.
   4. Unless otherwise indicated, private offices shall have thermostats with adjustable setpoints. Setpoint adjustment shall not indicate temperature setpoints and range of temperature override shall be limited by programming of the control system.
   5. Up to ten thermostats, location to be determined by the Owner, shall have an onboard LAN jack and bus pulls to controller for access to the LON network for commissioning and balancing. The number of thermostats, specified by owner to have LON connectivity, shall in no case exceed the maximum number allowed by manufacturer.
   6. Wall mount on a low voltage wall plate or junction box with an air tight insulation base.

D. ROOM TEMPERATURE SENSORS
   1. Tier 2
      a. Manufactures: Ultra Electronics (Model 753)
      b. Wall mount on a low voltage wall plate or junction box with an air tight insulation base.
   2. Tier 3
      a. Manufacturers: Distech, Mamac, Veris
      b. Wall mount on a low voltage wall plate or junction box with an air tight insulation base.

E. DUCT MOUNTED SINGLE POINT TEMPERATURE SENSORS
   1. Tier 2
      a. Manufactures: Ultra Electronics (Model 733)
      b. Includes junction box, mount directly to duct
   2. Tier 3
      a. Manufacturers: Mamac, Veris
      b. Order with junction box for wire connections, or wires long enough to terminate directly to controller without splices. Mount directly to duct.

2.2 DUCT MOUNTED TEMPERATURE AVERAGING SENSORS
   1. Tier 2
      a. Manufactures: Ultra Electronics (Model 713)
      b. Includes junction box, mount directly to duct
   2. Tier 3
      a. Manufacturers: Mamac, Veris
      b. Order with junction box for wire connections, mount directly to duct.

2.3 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS
   1. Tier 3
      a. Manufacturers: Mamac, Veris
      b. Option 1: Order with junction box for wire connections, mount directly to duct.
      c. Option 2: Order with long leads to connect directly to controller without splices.

2.4 OUTSIDE AIR TEMPERATURE SENSORS
   1. Tier 2
      a. Manufactures: Ultra Electronics (Model 743)
      b. Includes sensor, sun shield, utility box and watertight gasket
   2. Tier 3
a. Manufacturers: Mamac, Veris
b. Provide sensor, sun shield, utility box and watertight gasket.

2.5 LIQUID TEMPERATURE SENSORS/TRANSMITTERS:
A. Tier 2 Requirements
   a. These shall be 100 Ohm platinum, spring loaded RTD type temperature instruments with thermo-well.
B. Tier 3 Requirements (No known applications)

2.6 SENSOR WELLS
A. By same manufacturer of Sensor/Transmitter or approved alternate.
B. Well shall be compatible with the application service.

2.7 SPACE HUMIDITY SENSORS/TRANSMITTERS
A. Tier 2 Requirements
1. Manufacturers: Vaisala
2. Space humidity sensors shall be wall mounted & may incorporate temperature sensors.
3. Sensing element shall be resistive bulk polymer, or thin film capacitive type.
   Sensor/transmitter shall have the following minimum performance:
4. Accuracy: ± 3% RH at 25°C over range of 20-95% RH including hysteresis, linearity and repeatability
5. Sensitivity: 0.1% RH
6. Operating Range: 0-99% RH, non-condensing, sensor
7. Output: 4-20mA or 0-10VDC 0-100% linear, proportional
8. Power: 2 wire, loop powered
B. Tier 3 Requirements
1. Manufacturers: Distech or to match controller installed.
2. Combination “Smart Stat” including temperature and humidity communicating to BAS.

2.8 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS
A. Manufacturer: Vaisala
B. Probe type, temperature compensated, resistive bulk polymer or thin film capacitive type.
C. Sensor/transmitter shall have the following minimum performance.
   1. Accuracy: ± 3% RH at 25°C over 20-95% RH including hysteresis, linearity and repeatability
   2. Sensitivity: 0.1% RH
   3. Operating Range: 0-99% RH, non-condensing, sensor
   4. Output: 4-20 mA, proportional
   5. Power: 2 wire, loop powered

2.9 OCCUPANCY SENSORS (TIER 2 AND 3)
A. Manufacturers: Leviton, Wattstopper
B. 24 VAC, dual technology (passive infrared and ultrasonic) sensors with no obstructions.
C. Have LED to indicate occupant detection.
D. Have adjustable time delays from 15 seconds to 30 minutes and adjustable sensitivity.

E. Shall provide a separate dry contact point for interface to the DDC (where required).

F. Tier 3 (If integrated)
   1. Manufacturers: Distech or to match controller installed.
   2. Combination “Smart Stat” including temperature and Occupancy communicating to BAS.

2.10 CO2 SENSORS

A. Tier 1/2/3
   1. Manufacturers: Veris CWE, Visala GMW20

B. Tier 3 (If integrated)
   1. Manufacturers: Distech or to match controller installed.
   2. Combination “Smart Stat” including temperature and CO2 communicating to BAS.

2.11 ELECTRIC/PNEUMATIC TRANSDUCERS (I/P’S)

A. Manufacturer: Bellofram type 1000, Control Air type 500, Moore Industries type IPF or Fisher / Dezurik integral mount.

B. Transducer calibration or accuracy shall not be affected by mounting position change.
   1. Input Signal: ..........4-20 mA DC
   2. Output Signals: ........3-15 psig, or 6-30 matched to valve actuator or positioner requirements
   3. Accuracy: ..............Error <± 0.75% of calibrated span
   4. Linearity ...............1% of span

2.12 PRESSURE TO ELECTRIC TRANSMITTERS (P-E):

A. Manufacturers: Setra, Dwyer, Ashcroft

B. Units shall have the following characteristics:
   1. Input: ..........Pressure 0-15 psig, minimum
   2. Output Signal: ..........4-20 mA, 0-5 VDC, 1-5 VDC, 1-10 VDC
   3. Accuracy: ..............1% of span
   4. Power Requirements: ..........24 VDC (10-30 VDC)

2.13 VIBRATION SENSOR/TRANSMITTER

A. Manufacturers: Dwyer Series VBT, Metrix series VTS, Efector VTV Series

B. Performance Requirements
   1. Power ............9.6VDC – 32VDC loop power
   2. Output ............4-20mA
   3. Frequency Response ..........10-1000 HZ
   4. Range RMS..................0 – 25 mm/s
   5. Accuracy ..................+/- 3%

C. Enclosure shall be NEMA rated for the application.
EXECUTION

3.1 ROOM TEMPERATURE SENSORS
   A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.
   B. Coordinate mounting height prior to installation. Unless otherwise noted, mount sensors at 48” above finished floor.
   C. Recess mounting box unless otherwise indicated, or required by the building construction materials.
   D. Unless otherwise noted provide at minimum, 1/2” conduit from room sensors to corresponding controller.
   E. Mounted space thermostats/sensors, located on exterior walls, on thermally insulated sub-base.
   F. Relocate space thermostats/sensors if required due to draft, interferences with cabinets, chalkboards, etc., or improper sensing.
   G. Label, inside cover, with tag number of equipment serving the area.

3.2 SINGLE POINT TEMPERATURE SENSORS
   A. Provide single point duct mounted probes where ducts are too small for averaging elements.

3.3 AVERAGING TEMPERATURE SENSORS
   A. Provide flexible averaging element for air ducts where prone to temperature stratification or where ducts are larger than 9 square feet.
   B. Provide rigid averaging probe for air ducts smaller than 9 square feet.
   C. Provide multiple averaging type sensors as required for sufficient duct or coil coverage. At minimum provide appropriate number of sensors as necessary to provide 1 linear foot of sensing for every 1 sq. ft of coil.

3.4 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS
   A. Provide single point duct mounted sensors at air terminal downstream of coils.

3.5 OUTSIDE AIR TEMPERATURE SENSORS
   A. Locate on north wall of the building and install with standoffs.
   B. On 100% outside air systems, locate the sensor in the outside air plenum.

3.6 SENSOR WELLS
   A. Furnish wells for installation.
   B. Coordinate with piping contractor.
      1. Wells mounted in pipe 3” and larger may be installed in horizontal or vertical lines provided that element is always in the flow, (for condensate and other gravity return lines, install in bottom of pipe).
      2. Wells mounted in pipe 2-1/2” and smaller shall be installed at elbow tee fittings with well pointed upstream. Minimum of 2” pipe size for elbow tee installation.
3.7 SPACE HUMIDITY SENSORS/TRANSMITTERS
   A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.
   B. Mount sensors at 48” above finished floor.
   C. Recess mounting box unless otherwise indicated, or required by the building construction materials.

3.8 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS
   A. Provide duct humidity sensors and transmitters where indicated, and as required to perform specified control sequences, and as directed to meet job site conditions.

3.9 AIR Differential Pressure Transmitters
   A. Locate static pressure transmitters and transducers in control panel where possible.
   B. Select instrument for intended usage range, maximum pressure/temperature.
   C. For indicating type instruments, locate indicating element with 6 ft of floor with readout easily visible from floor level.

3.10 CO2 Sensors
   A. Provide CO2 sensors to accomplish control sequence
   B. Coordinate final location

3.11 OCCUPANCY SENSORS
   A. Provide occupancy sensors to accomplish control sequences
   B. Ceiling mounted occupancy sensors shall be installed to ensure unobstructed coverage of the entire monitored space.
   C. Ceiling mounted occupancy sensors shall be wired in parallel to a common power supply.

3.12 ELECTRIC/PNEUMATIC TRANSDUCERS (EP’S – I/P’S)
   A. Provide transducers to operate pneumatic actuators.
   B. Mount in local control panel enclosure.
   C. Provide air pressure gauge for each output.

3.13 PRESSURE TO ELECTRIC TRANSMITTERS (P-E):

3.14 Transmitters, Indicators, and Transducers:
   A. Locate transmitters at sensing devices or within 100 ft of remote mounted transmitters. For hot systems (150°F and higher) mount electronics on side of pipe or remotely mount. For indicating type instruments, locate indicating element with 6 ft of floor with readout easily visible from floor level. Provide remote readouts if necessary.
   B. Provide pressure transducers integral to DDC panels or separate components to convert digital analog signals to variable pneumatic air pressure signals.
   C. Provide P-E transducers to convert analog pressure signals to analog electronic signals for input to DDC panels.
3.15 VIBRATION SENSOR/TRANSMITTER

A. Provide vibration sensor/transmitter for motors and equipment where shown on drawings.

B. Coordinate installation/mounting requirements with motor and equipment manufacture.

END OF SECTION