SECTION 23 0913
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL
1.01 RELATED REQUIREMENTS
   A. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.02 ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.
   B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.03 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
   C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
   D. Samples: Submit two of each type of room thermostat and cover.
   E. Design Data: Provide design data for sizing and selection of compressor.
   F. Manufacturer's Instructions: Provide for all manufactured components.
   G. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
      1. Revise shop drawings to reflect actual installation and operating sequences.
   H. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
   I. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
   J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. See Section 01 6000 - Product Requirements, for additional provisions.

1.04 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS
2.01 EQUIPMENT - GENERAL
   A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 CONTROL PANELS
   A. All direct digital controllers shall be installed in the control panel that has a lock and key. Panels shall be constructed of fire resistant material.

2.03 CONTROL VALVES
   A. Control valves shall be 2-way or 3-way mixing as shown in drawings. Terminal heating valves shall fail in last position. AHU chilled water valves shall fail closed and AHU hot water valves shall fail open. Steam control valves shall open. Valves shall be rated for a minimum of 150 percent of system operating pressure at the valve location but not less than 125 psig. Valves 2-inch and smaller shall be bronze body with screwed or flare connections. Valves 2-1/2 inch and larger shall be iron body with flanged connections. Valves shall have an equal percentage
relation of flow versus valve position. Pressure drop through water valves shall be the greater of 10 feet of water or the pressure drop through the controlled equipment. Pressure drop through medium pressure steam valves with atmospheric returns shall be 80% of inlet steam pressure.

1. Electronic Actuators:
   a. Electronic Operators: Select operator for full shutoff at maximum pump differential pressure or for maximum torque required for proper damper close off.
   c. Terminal Unit Operators (Modulating): Self-contained, linear motor, actuator with 60-second full travel, with transformer and single-throw, double-pole contacts. Actuators shall fail to last position.
   d. Actuators serving AHU heating valves shall fail open. Actuators serving AHU cooling valves shall fail closed.
   e. Actuators serving steam valves shall fail open.
   f. For electronic actuators that are installed, they must fail to protect the building and maintain safety.

2.04 DAMPERS
   A. All automatic motor operated louver dampers (except those provided as integral to AHU’s) and associated electronic motors shall be furnished under AUTOMATIC TEMPERATURE CONTROL and set in place by division 230800. It shall be the responsibility of this contractor to verify all damper sizes and furnish this information to the sheet metal contractor.
   B. Damper frame shall be insulated with Styrofoam on four sides and be thermally broken by means of polyurethane resin pockets complete with thermal cuts. Blades shall be extruded aluminum, internally insulated with expanded polyurethane foam and shall be thermally broken. Damper blades shall be permanently secured to blade shaft. Blade shaft mount to frame with double bearing allowing rod to rotate while outer bearing remains fixed. Blade and frame seals shall be of extruded silicone and be secured in an integral slot within the aluminum extrusion. Dampers shall be not more than 48 inches in length between bearings. Modulating dampers shall be of the opposed blade type. Dampers when closed shall be guaranteed by the manufacturer not to leak in excess of 5 cfm per square foot at 4 inches water gauge static pressure and -40°F. Dampers shall be installed with operators having sufficient power to limit leakage to the rate specified. Dampers shall have channel frames, and all parts of dampers shall be a minimum of 0.075” thickness extruded aluminum.
   C. Damper shall be Tamco Series 9000 BF, Arrow Type AFDTI-25LT, or Ruskin Model CDTI-50.
   D. Dampers shall be provided in types and sizes scheduled on the drawings.

2.05 INPUT/OUTPUT SENSORS
   A. Temperature Sensors:
      1. Duct-mounted, air-handling-unit-mounted or pipe-mounted temperature sensors shall be 1k ohm nickel, 1k ohm platinum, or 20k ohm thermistor type.
      2. Duct-mounted air temperature sensors shall include sensing elements and shall be suitable for duct mounting. Sensors shall be encased in an epoxy-filled tube to prevent condensation and the accumulation of moisture. Accuracy shall be +/- .75 degrees F in the 40 to 130 degree range.
      3. Air-handling-unit-mounted air temperature sensors shall include sensing element and shall be suitable for mounting in air handling unit casings. Sensing element shall consist of a averaging type sensor long enough to get an appropriate sample across the duct. Accuracy shall be +/- .75 degrees F. Range shall be -50 to 220 degree F for mixed air and cooling coil locations, and -50 to 220 degree F for heating coil leaving air temperature locations.
4. Outside air temperature sensors shall have a minimum range of -40 to 130 degrees F and mounted in a location that it won’t be adversely be affected by the sun or building conditions.

5. Water temperature sensors shall be the immersion type and shall be suitable for pipe or tank mounting. Each sensor shall be provided with a brass or stainless steel immersion well allowing the sensor to be removed without drain-down of the system. Accuracy shall be +/- 1 degree F in the -30 to 230 degree range.

6. Tamper proof space temperature sensors shall consist of temperature sensing element and cover plate only. Element shall be installed in a fully recessed junction box with a flat stainless steel cover plate secured to the junction box with tamper resistant screws. Engineering Note: UND Facilities Management shall approve where these sensors get used.

B. Humidity Sensors:
1. Duct relative humidity sensors shall be installed where required to provide accurate readings of airstream relative humidity and be suitable for duct mounting. Housing material type shall be suitable for plenum installations.
2. Humidity sensors shall be supplied as 4-20 mA or 0-10 volt signal versions.
3. Humidity sensors shall have an accuracy of 2%, certified. All certified sensors shall include a certificate of calibration. Humidity calibration and certification shall be based on a 3-point process of 20, 50, and 85% RH @ 73°F.
4. The humidity element shall have an operating range of 0 to 100% RH and a measurement range of 0 to 95% RH from temperature of -30°F through 120°F.
5. Room Relative Humidity Sensors:
   a. Room relative humidity sensors shall be installed where indicated in plans.
   b. All relative humidity sensors shall be installed with a fully recessed junction box. Relative humidity sensor covers will not be allowed to be installed on a wall without a junction box housing the wiring connections.
   c. Humidity sensors shall be supplied as 4-20 mA or 0-10 volt signal versions.
   d. Humidity sensors shall have an accuracy of 2%, certified. All certified sensors shall include a certificate of calibration. Humidity calibration and certification shall be based on a 3-point process at 20, 50, and 85% RH @ 73°F.
   e. The humidity element shall have a measurement range of 0 to 100% RH from temperatures of 32°F through 120°F.

C. Static Pressure Sensors:
1. High duct static pressure shall be monitored by a diaphragm type differential pressure switches with SPDT contacts. Pressure switches shall operate in the 0.1 to 10" w.c. range and withstand an over pressure of at least ½ psi differential. A digital signal shall be provided for alarm.

D. Equipment Operation Sensors:
1. Fan and pump status shall be monitored by current sensing switches. Provide switches on the load side of the power circuit for each monitoring point. Adjust current setpoint to detect when operating current is above or below normal operating level for all constant speed motors. Adjust current setpoint to detect when operating current is below the minimum speed operating level for all variable speed motors.
2. Digital to Pneumatic Transducers:
   a. Digital-to-Pneumatic Transducers: Converts continuous proportional current or voltage to 0 to 15 psi. Furnish units with HAND-OFF-AUTO switches, adjustment dials which are active in HAND position, and pressure gauges on pneumatic output lines.

E. Water Flow Switches:
1. Water-Flow Switches: Pressure-flow switches of the snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vapor proof type.

F. Air Temperature Switches:
   1. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint. Bulb Length shall be a minimum 20 feet. Provide one thermostat for every 20 sq. ft. of coil surface.

G. Condensate Pump Failure Monitoring:
   1. The steam condensate receiver shall have a temperature sensor installed on the vent line approximately 6 feet from the tank that can sense the temperature in the vent line. The alarm temperature shall be set at 160 degrees F with a 2 minute alarm delay. The sensor shall be of immersion type.

H. Filter status shall be monitored by a diaphragm type differential pressure switches. Pressure switches shall operate in the 0.1 to 10” w.c. range and withstand an over pressure of at least ½ psi differential. A digital signal shall be provided for alarm.
   1. Carbon Dioxide Sensors:
      a. Carbon dioxide sensors shall be solid-state non-dispersive infrared optical diffusion sensing type suitable for duct mounting with remote analog output signal transmitter. Each transmitter shall be housed in a plastic enclosure. The sensor shall have a maximum range of 0-2000 ppm. Sensor accuracy shall be +/- 3% of full scale. The output signal shall be 0-10 VDC or 4-20 mA and linear with carbon dioxide level and shall be factory calibrated. Input power shall be 24 VAC.

2.06 THERMOSTATS
   A. Electric Room Thermostats:
      1. Space temperature thermostats shall be housed in an impact resistance plastic casing and shall include a space temperature sensing element, setpoint adjustment and LCD room temperature indication must display degrees Fahrenheit, unoccupied override button/switch with indication, and a plug in jack for network access. All thermostats must be wired for network access unless approved by UND Facilities Management in writing. All thermostats with network access must have their location noted on the asbuilts.
      2. Space temperature sensing elements shall be thermistor type with negative sloping temperature coefficient. Accuracy shall be +/- .75 degrees F with a minimum 40 to 95 degree range. Any space temperature sensors located in vestibules or near outside entries shall have a sensor range similar to an outside air temp sensor to account for the high and low temps that will be sensed due to outside conditions.
      3. All space temperature thermostats shall be installed with a fully recessed junction box. Thermostat covers will not be allowed to be installed on a wall without a junction box housing the wiring connections. Thermostats that have a built-in location for batteries shall not have the battery installed to ensure the thermostat is receiving power from the system and not battery power.
      4. Setpoint adjustment shall be accomplished by a dial, lever, or buttons, which is adjustable from 68-75 degrees F.

   B. Electric Low Limit Duct Thermostat:
      1. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint. Bulb Length shall be a minimum 20 feet. Provide one thermostat for every 20 sq. ft. of coil surface.

2.07 CONTROL CABLE:
   A. Control cable used shall be per controller specifications.
2.08 AUTOMATIC TEMPERATURE CONTROL SYSTEM COMPONENTS:
   A. Miscellaneous automatic temperature control system components shall be as specified in the
      following paragraphs. Engineering Note: If there are no special or miscellaneous components,
      this section can be removed.

2.09 AIR FLOW MEASURING STATION:
   A. Provide and install airflow measuring station(s) capable of continuously monitoring the fan or
      duct capacities (air volumes) they serve. Airflow measuring stations will be provided on outside
      air, return/exhaust air and supply air for ALL Air-Handling units and elsewhere where indicated
      in sequences. Outdoor air measurement stations shall be duct mounted. Return/Exhaust air
      and supply air measurement stations shall be either duct mounted or fan inlet type.
   B. The airflow/temperature measurement station (AFMS) shall be capable of monitoring airflow
      and temperature rates at each measurement location. Sensors shall use thermal dispersion
      technology with two “bead in glass”, hermetically sealed thermistor probes at each
      measurement point. The system shall be factory tested prior to shipment and not require
      calibration or adjustment over the life of the equipment when installed in accordance to
      manufacturer’s guidelines.
   C. Each sensor probe shall be provided with a UL plenum-rated connecting cable. All sensor
      calibration data shall be stored in the sensor probe. No additional devices or transducers shall
      be required to interface with the host controls.
   D. Sensors shall be factory-calibrated to NIST-traceable standards for both airflow and
      temperature. Each sensing point shall independently measure airflow and temperature prior to
      averaging. Installed accuracy shall be percent of reading and demonstrated at both maximum
      and minimum airflow rates for each measurement location.
   E. The airflow measuring station(s) shall be fabricated of a minimum of 14 gauge. Galvanized
      steel, welded casing in 8" depth with 90° connecting flanges in a configuration and size equal to
      that of the duct it is mounted into. Each station shall be complete with an open parallel cell air
      straightener-equalizer honeycomb mechanically fastened to the casing, and external signal
      connection fittings. An identification label shall be placed on each station casing listing model
      number, size, area, and specified airflow capacity.
   F. The transmitter shall be microprocessor-based. The transmitter shall operate on 24 VAC and
      be internally fused and protected. Analog output signals shall be field selectable (0-10 VDC or
      4-20 mA). All inputs and outputs shall be fused, protected, and internally isolated from the 24
      VAC power supply. The transmitter shall have a digital adjustment for output signal offset/gain
      and an adjustable digital filter for airflow output. The transmitter shall be capable of being field
      configured to display either I.P. or S.I. units. The transmitter shall accept a user-defined area for
      CFM or LPS display. The transmitter shall be capable of continuously performing sensor and
      transmitter diagnostics and perform a full system check on power-up. A sensor detection
      system shall ignore any malfunctioning sensors and send an alarm to BAS.
   G. The enclosure shall be aluminum alloy for indoor use and capable of operating over a
      temperature range of +30°F to +120°F. The electronics shall be installed inside and protected
      from the weather. (NEMA4 for outdoor use).
   H. Sensor probes shall be constructed of anodized aluminum alloy tube with stainless steel
      mounting brackets. Probes shall be constructed as insertion, internal, or standoff mounting,
      depending on the installation requirements.
   I. The sensor accuracy for airflow shall be at least ±-2% of Reading over the sensor probe
      operating ranges. The installed total accuracy for airflow shall be better than ±-3% of Reading
      over the sensor probe operating ranges when installed in accordance with manufacturers’
      guidelines. The sensor accuracy for temperature shall be better than ±-0.15°F (±-0.1°C) over
      the entire operating range.
   J. Acceptable manufacturers shall include Ebron or approved equal.
   K. Use of air flow measuring stations shall be approved by UND Facilities Management.
2.10

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that systems are ready to receive work.
C. Beginning of installation means installer accepts existing conditions.
D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
F. Ensure installation of components is complementary to installation of similar components.
G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Mount compressor and tank unit on vibration isolation consisting of springs, with minimum 1 inch static deflection and 1 inch clearance to floor. Isolate air supply with wire-braid reinforced rubber hose or polyethylene tubing. Pipe manual and automatic drains to nearest floor drain.
C. Supply instrument air from compressor units through filter, pressure reducing valve, pressure relief valve, with pressure gages, and shutoff and bypass valves.
D. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches above floor. Align with lighting switches and humidistats. Refer to Section 26 2726.
E. Provide conduit and electrical wiring in accordance with Section 26 2717. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

END OF SECTION