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SECTION 25 11 10 – BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS - (RETROFIT)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 25 11 00 BAS Basic Materials, Interface Devices, and Sensors

C. Section 26 05 53 Identification for Electrical Systems

D. Although Specifications throughout the Mechanical, Electrical, Communications, Electronic Safety and Security divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them; additional Divisions also may be reciprocally applicable to this Section. Building automation system requirements may be specified, but not limited to, the following Sections when applicable:

1. Packaged engine generator system.
2. Fuel oil piping system.
3. Hot water boilers.
4. Computer room air conditioning units.
5. Automatic transfer switch.

1.02 SUMMARY

A. Section Includes:

1. This Section applies to situations where controls are being replaced on existing equipment but not where core equipment is being replaced.
2. Pneumatic Tubing
3. Wiring.
4. Control Valves and Actuators.
5. Control Dampers and Actuators.
6. Control Panels.
7. Sensors.
8. Pneumatic Control Components (Gauges, Switches, Relays, etc.)
9. Electric Control Components (Switches, EP Valves, Thermostats, Relays, etc.).
10. Transducers.
11. Current Switches.

12. Nameplates.

13. Testing Equipment.

B. Refer to Section 25 00 10 for general requirements.

C. Refer to other Division 23 Sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not Work of this Section.

D. Provide the following electrical Work as Work of this Section, complying with requirements of Division 26 sections:

1. Control wiring between field-installed controls, indicating devices, and unit control panels.

2. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated for all mechanical and controls.

3. Wiring associated with annunciator and alarm panels (remote alarm panels) and connections to their associated field devices.

4. All other necessary wiring for fully complete and functional control system as specified.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within all references.

1.04 WORK BY OTHERS

A. Control Valves furnished under this Section shall be installed under the applicable piping Section in accordance with the valve manufacturer's published installation instructions under the direction of the BAS Provider who will be fully responsible for the proper operation of the valve.

B. Control Dampers furnished under this Section shall be installed under the applicable air distribution or air handling equipment Section under the direction of the BAS Provider who will be fully responsible for the proper operation of the damper.

C. Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, etc. that will have wet surfaces, shall be installed under the applicable piping Section under the direction of the BAS Provider who will be fully responsible for the proper installation and application.

D. Variable Frequency Drives furnished under section 23 05 13 shall be provided with serial communication protocol information specific to the selected BAS Provider. BAS Provider shall be fully responsible to interface and make available VFD information in the building automation system as monitor only information. Control of the VFD shall meet controller standalone requirements of Section 25.

E. Controlled Equipment Power Wiring shall be furnished and installed under Division 26. Where control involves 120 volt (V) control devices controlling 120V equipment, Division 26 Contractor shall extend power wiring to the equipment. BAS Provider shall extend it from the equipment to the control device.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MATERIALS AND EQUIPMENT

A. Control Air Supply: Contractor may reuse existing control air in buildings where pneumatic controls will be reused

1. Branch Air Piping (to include main air between field control panels and field devices:

a. Seamless copper tubing, Type K or L, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder.

b. Virgin polyethylene non-metallic tubing type FR, ASTM D 2737 encased in EMT. Tubing outside diameter size shall be not less than the larger of ¼ inch or the instrument connection size

2. Branch Air Piping Termination, Concealed Air Piping, And Tubing Within Control Panels:

a. Virgin polyethylene non-metallic tubing type FR, ASTM D 2737. Use compression or push-on brass fittings. Branch air piping terminations length shall not exceed 24 inches.

B. General: Provide electronic and electric control products in sizes and capacities indicated, consisting of valves, dampers, controllers, sensors, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.

C. Communication Wiring and BAS low voltage wiring/cables: All wiring shall be in accordance with the latest edition of the National Electrical Code and Division 26. Wiring/cables shall be provided in a customized color jacketing material. Material color shall be as specified in section 27 05 53 (Identification for Low-Voltage Cables).

1. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals outside the UNIVERSITY OF HOUSTON IT infrastructure. (e.g., operator workstations, printers, and modems).

2. Local Supervisory LAN: For any portions of this network required under this Section of the Specification, Contractor shall comply with Division 27 Communication specifications. Network shall be run with no splices and separate from any wiring over thirty (30) volts.

3. Secondary Controller LANs: Communication wiring shall be individually 100 percent shielded pairs per manufacturer's recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over thirty (30) volts. Shield shall be terminated and wiring shall be grounded as recommended by building controller manufacturer.

    a. Wet / Damp Locations – Wiring in underground raceways or raceways which are subject to moderate degrees of moisture shall be listed for installation in wet locations. Direct burial wiring without a raceway is prohibited.

D. Signal Wiring: Contractor shall run all signal wiring in accordance with the latest edition of the National Electrical Code and Division 26.

1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100 percent shielded pair, minimum 18-gage wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.

    a. Wet / Damp Locations – Wiring in underground raceways or raceways which are subject to moderate degrees of moisture shall be listed for installation in wet locations. Direct burial wiring without a raceway is prohibited.

2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

E. Low Voltage Analog Output Wiring: Contractor shall run all low voltage control wiring in accordance with the latest edition of the National Electrical Code and Division 26.

1. Low voltage control wiring shall be 18-gage. Wiring size for RJ-11 and RJ-45 connectors shall be 22-gage, twisted pair, 100 percent shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.

    a. Wet / Damp Locations – Wiring in underground raceways or raceways which are subject to moderate degrees of moisture shall be listed for installation in wet locations. Direct burial wiring without a raceway is prohibited.

F. Control Panels: Provide control panels with suitable brackets for wall mounting, unless noted otherwise, for each control system. Locate panel adjacent to systems served. Mount center of control panels [60 inches – confirm with Owner] above finished floor or roof. [Refer to Figures A and B at end of Section]

G.

1. Interior: Fabricate panels of 16-gage furniture-grade steel, totally enclosed on four sides, with removable perforated backplane, hinged door and keyed lock, with manufacturer's standard shop-painted finish and color. Panel / enclosure shall be sized to provide adequate mounting space for all components plus a minimum of 25% spare backplane capacity. All components shall have a minimum of 2 inch clearance from the four sides of the panel unless factory wired and designed otherwise.

2. Exterior: 16-gage 304 or 316 stainless steel NEMA 4X enclosure. Panel shall have hinged door, keyed lock, and integral, thermostatically controlled heater. Provide hinged deadfront inside panel when flush-mounted control and/or indicating devices are included in panel. Fiberglass or aluminum, as applicable, to be used when gases that are being used in the panel area are corrosive to stainless steel.

3. Provide UL-listed cabinets for use with line voltage devices.

4. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip. Wire nuts are not acceptable in exposed area of panel. High and low voltage cables shall be isolated from each other.

5. All gauges and control components shall be identified by means of nameplates or Owner approved equivalent.

6. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover. (Electrical wireway shall be located underneath panel to run wire, allowing wiring to enter from below.)

7. Provide a 6 inch x 6 inch minimum wireway (metal wiring/tubing) trough across the entire width of the panel mounted to the bottom of the panel with close nipples of sufficient size for additional 50 percent wiring and tubing capacity. Wireways shall not be less than 24 inches in length. Control panel wiring shall be installed and distributed in the wireway to minimize routing of wiring and tubing within the control panel. Wireway construction to be the same as the associated control panel.

8. Complete wiring and tubing termination Drawings shall be mounted in, and a second set mounted adjacent to, each panel in a frame with lexan cover of sufficient size to be easily readable.

2.03 CONTROL VALVES

A. General:

1. Provide factory fabricated control valves of type, body material and pressure class indicated on the 'Control Valve Specification Sheet' located at the end of this Section. Control valves for chilled water and heating water coils shall be pressure independent type, Contractor shall utilize the sheet to submit the control valves for the Project.

2. Valves shall be as manufactured by Belimo, Siemens, Fisher Controls International, Valtek Control Products, DeZurik/Copes-Vulcan, Keystone, Leslie Controls Inc., or equal.

3. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system.

4. Provide pressure independent valve size in accordance valve manufacturer's recommendations. Provide pressure dependent valve size in accordance with scheduled or specified maximum pressure drop across control valve.

5. Control valves shall be equipped with heavy-duty actuators and pilot positioners with proper close-off rating and capability for each individual application. Pressure independent control valves shall be provided with actuators manufactured, and warranted by the valve manufacturer. Entire valve/actuator assembly shall be warranted for 5 years; first two years shall be unconditional.

6. Minimum close-off rating shall be as scheduled and adequate for each application, and shall generally be considered at dead head rating of the pump.

7. Pressure independent control valves shall be provided with one (1) service tool or one (1) copy of service software for use in commissioning these valves. Service tool or software shall be provided to TAB contractor, and subsequently transferred to Owner's Representative with job Record Documents. Pressure independent control valve manufacturer shall provide one (1) hour of training in the use of the service tool/service software to TAB personnel and BAS personnel prior to the start of the commissioning process. Pressure independent control valve manufacturer shall provide one (1) hour of training in the use of the service tool/service software to Owner's personnel as part of the required BAS training.

2.04 CONTROL DAMPERS

A. General: Provide factory fabricated automatic control dampers of sizes, velocity and pressure classes as required for smooth, stable, and controllable airflow. Provide parallel or opposed blade dampers as recommended by manufacturer's sizing techniques. For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service. Control dampers used for smoke dampers shall comply with UL 555S. Control Dampers used for fire dampers shall comply with UL 555.

B. For general isolation and modulating control service in rectangular ducts at velocities not greater than 1500 feet per minute (fpm) (7.62 m/s), differential pressure not greater than 2.5 inches w.c. (622 Pa):

1. Performance: Test in accordance with AMCA 500.

2. Frames: Galvanized steel, 16-gage minimum thickness, welded or riveted with corner reinforcement.

3. Blades: Stainless steel in lab exhausts and galvanized steel elsewhere, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts with set screws, 16 gage minimum thickness.

4. Blade Seals: Synthetic elastomer, mechanically attached, field replaceable.

5. Jamb Seals: Stainless steel.

6. Shaft Bearings: Oil impregnated sintered bronze, graphite impregnated nylon sleeve or other molded synthetic sleeve, with thrust washers at bearings.

7. Linkage: Concealed in frame.

8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.

9. Leakage: Less than one percent based on approach velocity of 1500 fpm. (7.62 m/s) and 1 inches wg. (249Pa).

10. Maximum Pressure Differential: 2.5 inches wg. (622 Pa).

11. Temperature Limits: -40 to 200 degrees F (-40 to 93 degrees C).

12. Where opening size is larger than 48 inches (1219 mm) wide or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for installation.

C. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6 inches w.c. (1493 Pa):

1. Performance: Test in accordance with AMCA 500.

2. Frames: Galvanized steel, 16-gage minimum thickness, welded or riveted with corner reinforcement.

3. Blades: Extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 1/2 inch (12.7 mm) shafts, 14 gage minimum extrusion thickness.

4. Blade Seals: Synthetic elastomeric, mechanically attached, field replaceable.

5. Jamb Seals: Stainless steel.

6. Shaft Bearings: Oil impregnated sintered bronze sleeve, graphite impregnated nylon sleeve, molded synthetic sleeve, or stainless steel sleeve, with thrust washers at bearings.

7. Linkage: Concealed in frame.

8. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.

9. Leakage: Less than 0.1 percent based on approach velocity of 4000 fpm. (20.3 m/s) and 1 inches wg. (249Pa).

10. Maximum Pressure Differential: 6 inches wg. (622 Pa).

11. Temperature Limits: -40 to 200 degrees F (-40 to 93 degrees C).

12. Where opening size is larger than 48 inches (1219 mm) wide or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for the installation.

D. For general isolation and modulating control service in rectangular ducts at velocities not greater than 4000 fpm, differential pressure not greater than 12 inches w.c.:

1. Performance: Test in accordance with AMCA 500.

2. Frames: Galvanized steel, 12-gage minimum thickness, welded or riveted with corner reinforcement.

3. Blades: Extruded aluminum hollow airfoil shape, maximum blade size 8 inches (200 mm) wide by 48 inches (1219 mm) long, attached to minimum 3/4 inch (19 mm) shafts with set screws.

4. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.

5. Linkage: 10-gage minimum thickness galvanized steel clevis type crank arms, 3/16 inch x 3/4 inch (4.76 mm x 19 mm) minimum thickness tie rods.

6. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.

7. Leakage: Less than 0.2 percent based on approach velocity of 4000 fpm (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.

8. Maximum Pressure Differential: 12 inches wg. (2984 Pa).

9. Temperature Limits: -40 to 300 degrees F (-40 to 149 degrees C).

10. Where opening size is larger than 48 inches (1219 mm) wide or 72 inches (1829 mm) high, provide dampers in multiple sections, with intermediate frames and jackshafts appropriate for the installation.

E. For general isolation and modulating control service in round ducts up to 40 inches in size at velocities not greater than 2500 fpm (12.7 m/s), differential pressure not greater than 4 inches w.c. (994 Pa):

1. Performance: Test in accordance with AMCA 500.

2. Frames: Rolled 12 gage steel strip for sizes 6 inch and smaller, rolled 14 gage steel channel for larger sizes, galvanized or aluminum finish.

3. Blades: Steel construction, 12 gage minimum thickness for dampers less than 18 inches (457 mm) in size, 10 gage minimum thickness for larger dampers.

4. Blade Seals: Full circumference neoprene.

5. Shaft: ½ inch (12.7 mm) diameter zinc or cadmium plated steel.

6. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.

7. Leakage: Less than 0.2 percent based on approach velocity of 4000 fpm. (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.

8. Maximum Pressure Differential: 4 inches wg. (994 Pa).

9. Temperature Limits: -40 to 300 degrees F (-40 to 149 degrees C).

F. For general isolation and modulating control service in round ducts up to 60 inches in size at velocities not greater than 4000 fpm (20.3 m/s), differential pressure not greater than 6 inches w.c. (1492 Pa):

1. Performance: Test in accordance with AMCA 500.

2. Frames: Rolled 10-gage steel channel for sizes 48 inch and smaller, rolled 3/16 inch (4.76 mm) thick steel channel for larger sizes, galvanized or aluminum finish.

3. Blades: Steel construction, 10-gage minimum thickness for dampers not greater than 48 inches in size, ¼ inch (6.35 mm) minimum thickness for larger dampers.

4. Blade stops: ½ inch x ¼ inch (12.7 mm x 6.35 mm) full circumference steel bar.

5. Blade Seals: Full circumference neoprene.

6. Shaft: Zinc or cadmium plated steel, angle reinforcing as necessary.

7. Shaft Bearings: Oil impregnated sintered bronze or stainless steel, pressed into frame, with thrust washers at bearings.

8. Leakage: Less than 0.4 percent based on approach velocity of 4000 fpm (20.3 m/s) and 1 inches wg. (249Pa) differential pressure.

9. Maximum Pressure Differential: 6 inches wg. (1492 Pa).

10. Temperature Limits: -40 to 250 degrees F (-40 to 121 degrees C).

2.05 ACTUATORS

A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.

B. Actuators:

1. Ambient Operating Temperature Limits: -10 to 150 degrees F (-12.2 to 66 degrees C).

2. Two Position Electric Actuators: Line voltage (120 volt, 24 volt) with spring return. Provide end switches as required.

3. Modulating Electronic Actuators: Provide actuators with spring return for 0-5 Vdc, 0-10 Vdc, 2-10Vdc, and 4-20 mA on valves greater than 1 inch. 3-point floating actuators for terminal units are to fail in place unless specified otherwise. Actuators shall travel full stroke in less than 150 seconds. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL listed. Provide stroke indicator. Actuators shall have positive positioning circuit where indicated. [Parallel actuators on a single valve are allowed only if written approval is given by Owner]. Actuators shall have current limiting motor protection. Actuators shall have manual override. Modulating actuators for valves shall have minimum rangeability of 40 to 1.

a. Close-Off Pressure: Provide the minimum torque required, and spring return for fail positioning (unless otherwise specifically indicated) sized for required close-off pressure. Required close-off pressure for two-way water valve applications shall be the shutoff head of associated pump. Required close-off rating of steam valve applications shall be design inlet steam pressure plus 50 percent for low pressure steam, and 10 percent for high pressure steam. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.

b. Subject to compliance with requirements, approved manufacturers are as follows:

1) Siemens.

2) Automated Logic.

3) Belimo.

4) Johnson Controls.

5) Delta.

6) Substitutions: By written approval from Owner.

2.06 GENERAL FIELD DEVICES

A. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.

B. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

C. Field devices specified herein are generally ‘two-wire’ type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, is not designed to work with ‘two-wire’ type transmitters, if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide ‘four-wire’ type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.

D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy and repeatability equal to, or better than, the accuracy and repeatability listed for respective field devices.

E. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis.

2.07 VFD SERIAL COMMUNICATION

A. VFD Serial communications shall include, but not be limited to monitor the following feedback signals:

1. Process variable.

2. Output speed/frequency.

3. Current

4. Torque

5. Power (kW)

6. Operating hours

7. Kilowatt hours (kWh)

8. Relay outputs

9. Diagnostic warning and fault information

2.08 TEMPERATURE SENSORS (TS)

A. Sensor Type Selection

1. Certified Control and Monitoring sensors shall require a matching class A RTD and transmitter pair which is factory calibrated and installed for the following application:

a. Dedicated building side immersion CHW supply temperature sensor for each heat exchanger.

b. TECO CHW immersion supply and return temperature sensors.

c. Dedicated averaging final supply air temperature sensor for all AHU greater than 20,000 CFM.

d. CHW and HW temperature sensors used for BTU calculation.

e. Other certified temperature sensors identified in the construction documents.

2. Standard Control and Monitoring sensors shall be utilized for all other sensors not identified as Certified Control and Monitoring sensors.

B. Sensor resolution: When matched with A/D converter of BC, AAC/ASC, or SD, sensor range shall provide a resolution of no worse than 0.2 degrees F (unless noted otherwise). Where thermistors are used, the stability shall be better than 0.25 degrees F over five (5) years.

C. Room Temperature Sensor: Shall be an element contained within a ventilated cover, suitable for wall mounting, unless noted otherwise. Provide insulated base. Sensor color and type shall match surrounding existing sensor when applicable. Following sensing elements are acceptable:

1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, ±0.6 degrees F accuracy at calibration point.

2. Provide setpoint adjustment where indicated. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable via the BAS.

3. Provide an occupancy override button on the room sensor enclosure where indicated. This shall be a momentary contact closure.

4. Provide current temperature indication via an LCD or LED readout, where indicated.

D. Single-Point Duct Temperature Sensor: Application allowed on supply air volumes of 2000 CFM or less and non-critical return air readings. Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated.

1. Sensing element shall be 100 Ohm platinum RTD which transmits a 4 to 20 mA output signal. The accuracy of this sensor shall be ± 0.7 degrees F. This type of sensor does not require field calibration and shall be replaced if tolerance of ± 1.4 degrees F is exceeded.

2. 10,000 ohms sensing element shall be allowed for the auxiliary temperature sensor for air terminal application specific controllers. Temperature range 55-95 Deg F. Mid Range Accuracy + (-) 0.5 Deg F. Sensor shall be secured in place with a minimum of a 2x4 metal enclosure.

E. Averaging Duct Temperature Sensor: Shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each three square feet of cooling coil/duct face area. Provide a minimum of two sensors when coil/duct face area exceeds 149 square feet. Temperature range as required for resolution indicated.

1. Sensing element shall be class A 100 Ohm platinum RTD which transmits a 4 to 20 mA output signal.

a. Standard Control and Monitoring: The accuracy of this sensor shall be ± 0.7 degrees F. This type of sensor does not require field calibration and shall be replaced if tolerance of ± 1.4 degrees F is exceeded

b. Certified Control and Monitoring" The accuracy of this matched paired sensor shall be ± 0.2 degrees F. This sensor shall be factory calibrated and shall be replaced if field tolerance of ± 0.3 degrees F is exceeded. Provide to owner the manufacturer's matched pair certificate of temperature uncertainty at 25%, 50% and 75% of temperature span of the unit

F. Liquid immersion temperature sensor shall include brass thermowell (with thermally-conductive paste), sensor and connection head for wiring connections. Temperature range shall be as required to fit the application

1. Sensing element shall be class A100 Ohm platinum RTD which transmits a 4 to 20 mA output signal..

a. Standard Control and Monitoring: The accuracy of this sensor shall be ± 0.6 degrees F. This type of sensor shall be factory calibrated and shall be replaced if tolerance of ± 0.9 degrees F is exceeded.

b. Certified Control and Monitoring: The accuracy of this matched paired sensor shall be ± 0.2 degrees F. This type of sensor shall be factory calibrated and shall be replaced if field tolerance of ± 0.3 degrees F is exceeded. Provide to owner the manufacturer's matched pair certificate of temperature uncertainty at 25%, 50% and 75% of temperature span of the unit.

G. Pipe Surface-Mount Temperature Sensor: Shall be used only where indicated or by written approval by Owner. Sensor shall include metal junction box and clamps and shall be suitable for sensing pipe surface temperature and installation under insulation. Provide thermally conductive paste at pipe contact point.

1. Sensing element shall be 100 Ohm platinum RTD which transmits a 4 to 20 mA output signal. The accuracy of this sensor shall be ± 1.1 degrees F on a range of 30 - 250 degrees F scale. This sensor shall be factory calibrated and shall be replaced if tolerance of ± 0.9 degrees F is exceeded.

H. Outside air sensors shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage.

1. Sensing element shall be 100 Ohm platinum RTD which transmits a 4 to 20 mA output signal. The accuracy of this sensor shall be ± 0.6 degrees F. This type of sensor does not require field calibration and shall be replaced if tolerance of ± 1.2 degrees F is exceeded.

2.09 HUMIDITY TRANSMITTERS

A. Units shall be suitable for their application. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (% RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:

1. Input Range: 0 to 100% RH.

2. Accuracy (% RH): ±2 percent between 20-90% RH at 77 degrees F, including hysteresis, linearity, and repeatability.

3. Sensor Operating Range: As required by application.

4. Long Term Stability: Less than 1 percent drift per year.

B. Acceptable Manufacturers: Units shall be Siemens, Vaisala HM Series, General Eastern, Microline, or Hy-Cal HT Series.

2.10 DIFFERENTIAL PRESSURE TRANSMITTERS (DP)

A. Liquid, Steam and Gas:

1. General: Two-wire smart DP cell type transmitter, 4-20 mA linear output, adjustable span and zero, stainless steel wetted parts.

2. Ambient Limits: 0 to 175 degrees F.

3. Process Limits: 0 to 175 degrees F.

4. Accuracy: Less than 0.3 percent.

5. Output Damping: Time constant user selectable from 0 to 36 seconds.

6. Vibration Effect: Less than $\pm$0.1 percent of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.

7. Electrical Enclosure: NEMA 4, 4X, 7, 9.

8. Approvals: FM, CSA.

9. Acceptable Manufacturers: Setra, Rosemount Inc. 3051 Series, Foxboro, Johnson-Yokagawa.

B. General Purpose Low Pressure Air: Generally for each measurement of duct pressure, filter differential pressure or constant volume air velocity pressure measurement where the range is applicable. Sensor shall be in range at all times.

1. General: Loop powered two-wire differential capacitance cell-type transmitter.

2. Output: Two wire 4-20 mA output with zero adjustment.

3. Overall Accuracy: Plus or minus 1 percent.

4. Minimum Range: 0.1 inches w.c.

5. Maximum Range: 10 inches w.c.

6. Housing: Polymer housing suitable for surface mounting.

7. Acceptable Manufacturers: Units shall be Setra,

8. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.

9. Magnehelic Gauges: Provide Dwyer Series 200 Magnehelic Differential Pressure Gauge (or equal) for each DP transmitter for filter differential pressure. Provide gauge, mounting bracket, ¼ inch aluminum tubing, static pressure tips, and molded plastic vent valves for each gauge connection. Select range for specified recommended filter loading pressure drop to be 75 percent full-scale. For other DP transmitters select range for specified setpoint to be between 25 percent and 75 percent full-scale.

2.11 VALVE BYPASS FOR DIFFERENTIAL PRESSURE SENSORS

A. Provide a five valve bypass kit for protection of DP sensors where the static on the pipe can cause on over pressure when connected to one port with the other at atmospheric pressure. Kit shall include high and low pressure isolation valves, high and low pressure vent valves, calibration taps, and a bypass valve contained in a NEMA 1 enclosure.

2.12 DIFFERENTIAL PRESSURE SWITCHES (DPS)

A. General Service Auto Reset - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing. Acceptable Manufacturer - Dwyer Series 1900 or approved equal.

B. General Service Manual Reset - Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Manual reset shall be readily accessible in reach of personnel installed at height not to exceed 5 feet above finished floor. Provide manufacturer's recommended static pressure sensing tips and connecting tubing. Acceptable Manufacturer - Dwyer Series 1900 or approved equal. The High Static Pressure Safety Switch shall alarm to the Building Automation System upon activation.

C. General Service - Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range and 0 degrees F to 160 degrees F operating temperature range.

2.13 PRESSURE SWITCHES (PS)

A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150 percent of rated pressure.

B. Acceptable Manufacturers: Siemens, Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Johnson Controls.

2.14 TRANSDUCERS

A. Consult Owner for direction in the application of Transducers.

B. Standard Capacity Electronic-to-Pneumatic (E-P) Transducers: E-P transducers shall be Voltage-to-Pneumatic (V-P) type, Current-to-Pneumatic (I-P) type **[PNEUMATICS ALLOWED IN RETROFIT APPLICATIONS ONLY]**:

1. Electrical Power Supply: 24 Vac or 24 Vdc.

2. Pneumatic Air Supply: 30 psig (2.07 bar) maximum

3. Air Capacity: 1100 scim @ 20 psig (300 cm3/sec @ 1.4 bar).

4. Air Consumption: Zero at steady state.

5. Output Span: 0-20 psig (0-1.4 bar).

6. Input: 4-20 mA, 0-5 Vdc, 1-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-15 Vdc, or 3-15 Vdc input.

7. Gauges: Provide with main and branch air gauges

8. Enclosure: Polymer designed for surface or panel mount. Provide with main air and branch air gauges.

9. Air Connections: ¼ inch (6.35 mm) barbed.

10. Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.

11. Acceptable Manufacturers: RE Technologies Model UCP-522.

C. Consult Owner for direction in the application of Transducers.

D. Electronic-to-Pneumatic (E-P) Transducers: E-P transducers shall be Voltage-to-Pneumatic (V-P) type, Current-to-Pneumatic (I-P) type, Phase cut Type **[PNEUMATICS ALLOWED IN RETROFIT APPLICATIONS ONLY]**:

1. Electrical Power Supply: 24 Vac or 24 Vdc, 100 mA.

2. Accuracy: +/- 1 percent.

3. Feedback: Branch pressure feedback from an on board pressure sensor - VDC Feedback.

4. Override: Manual Potentiometer.

5. Pneumatic Air Supply: 25-30 psig (2.07 bar) maximum.

6. Air Capacity: .5 scim @ 20 psig (300 cm3/sec @ 1.4 bar).

7. Air Consumption: None.

8. Output Span: 3-15 psig factory set field adjustable.

9. Input: 4-20 mA, 0-5 Vdc, 0-10 Vdc, 2-10 Vdc, 0-18 Vdc, 0-20V Phase Cut input.

10. Gauges: Provide with main and branch air gauges.

11. Enclosure: NEMA 1. Provide with main air and branch air gauges.

12. Air Connections: ¼ inch (6.35 mm) barbed brass.

13. Failure Mode on Power Loss: Non-failsafe transducers shall have no output air loss. Failsafe transducers shall exhaust output upon power loss.

14. Acceptable Manufacturers: TRIATEK CP-3000.

2.15 CURRENT SWITCHES (CS)

A. Clamp-On Design Current Operated Switch (for Motor Status Indication):

1. Range: 3.5 to 135 amps.
2. Trip Point: Adjustable.
3. Switch: Solid state, normally open, 0.1A @ 30VAC/DC.
4. Trip Indication: LED.
5. Approvals: UL, CSA.
6. Maximum Cable Size: 350 MCM.
7. Manufacturers: Veris Industries H-608, H-904, H-908.
    a. Veris Model Number H-608 restricted to constant speed motors rated 40 horsepower or less.
    b. Veris Model Number H-904 required on VFD motors.

B. Variable Speed Status: Contractor shall utilize programmable status contacts from the VSD where applicable.

2.16 CURRENT TRANSFORMERS (CT)

A. Clamp-On Design Current Transformer (for Motor Current Sensing)
1. Range: 1-10 amps minimum, 20-200 amps maximum.
2. Trip Point: Adjustable.
3. Output: 0-5 VDC.
4. Accuracy: ±0.2 percent from 20 to 100 Hz.
5. Acceptable Manufacturers: KELE SA100.

[ENGINEER MUST REFER TO THE BAS MASTER SPECIFICATION SECTION 25 11 10 FOR THE FOLLOWING APPLICATIONS IF NEEDED:

AIRFLOW MEASURING STATIONS (AFMS)

ULTRASONIC FLOW METER FOR WATER SERVICE

ULTRASONIC FLOW METER FOR STEAM SERVICE

INSERTION TYPE TURBINE METER FOR WATER SERVICE

VORTEX SHEDDING FLOW METER FOR LIQUID, STEAM AND GAS SERVICE

MAGNETIC FLOW METER FOR WATER SERVICE

VENTURI FLOW METER FOR WATER SERVICE

REFRIGERANT MONITOR]

2.17 CO_2 SENSORS/TRANSMITTERS (CO2)

A. General: CO_2 sensors shall use silicon based, diffusion aspirated, infrared single beam, dual-wavelength sensor.

B. Accuracy: ±100 ppm.

C. Stability: 5 percent over 5 years.

D. Output: 4-20 mA, 0-10 Vdc or relay.

E. Mounting: Duct or Wall as indicated.

F. Acceptable Manufacturer: Vaisala, Inc. GMD20 (duct) or GMW20 (wall).

2.18 PNEUMATIC CONTROL COMPONENTS (RETROFIT ONLY)

A. Analog Pressure Gauges: Gauges shall be pneumatic type, minimum 1-1/2 inches (38 mm) in diameter, with white face and black numerals. Surface-mounted gauges shall have chrome plated trim and be a minimum of 2-1/2 inches (64 mm) in diameter.

B. Pneumatic Actuated Pressure Switches (PE) (for 30 psig max pressure control systems): Pressure ranges and sensitivity of PEs shall match control system sequence of operation. Switch operation shall be externally adjustable over the operating pressure range (nominal 0-20 psig, 0 to 138 KPa). PE switches shall be SPDT type, rated for the particular application, and shall be UL listed. PE shall be as manufactured by Penn.

C. Pilot Positioners: Operating span adjustment range is from 3 to 15 psi (21 to 104 kPa), or as required for the actuator being served. Positioner shall be furnished with zero and span adjustments and a mounting bracket for attachment directly to the actuator.

2.19 ELECTRIC CONTROL COMPONENTS

A. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley.

B. Low Temperature Detector (‘Freezestat’) (FZ): Low temperature detector shall consist of a ‘cold spot’ element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8 inch x 20 feet (3.2mm x 6.1m), junction box for wiring connections and gasket to prevent air leakage or vibration noise, DPDT (4 wire, 2 circuit) with manual reset. Manual reset shall be readily accessible in reach of personnel installed at height not to exceed 5 feet above finished floor. Temperature range 15 to 55 degrees F (-9.4 to 12.8 degrees C), factory set at 38 degrees F. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each five square feet of cooling coil/duct face area. The Low Temperature Detector shall alarm to the Building Automation System upon activation

C. High Temperature Detectors (‘Firestat’) (FS): High temperature detector shall consist of 3-pole contacts, a single point sensor, junction box for wiring connections and gasket to prevent air leakage of vibration noise, triple-pole, with manual reset. Temperature range 25 to 215 degrees F (-4 to 102 degrees C).

D. Surface-Mounted Thermostat: Surface-mounted thermostat shall consist of SPDT contacts, operating temperature range of 50 to 150 degrees F (10 to 65 degrees C), and a minimum 10 degrees F fixed setpoint differential.

E. Low Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT sealed contacts, operating temperature range of 50 to 90 degrees F (10 to 32 degrees C), switch rating of 24 Vac (30 Vac maximum), and both manual and automatic fan operation in both the heat and cool modes.

F. Control Relays: All control relays shall be UL listed, with contacts rated for the application.

1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:

a. Pilot light indication of power-to-coil. Pilot light shall be visible from a standing position of 5 feet AFF.

b. Coil rated for 50 and 60 Hz service.

c. Relays shall be labeled in a professional manner to identify the function or purpose per 26 05 53 Identification for Electrical Systems.. Coordinate with owner for approved verbiage of labels

d. Acceptable Manufacturers: Relays shall be Functional Devices (RIB), Potter Brumfield, Model KRPA or approved equal.

2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 horsepower, and 1/3 horsepower, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC or approved equal.

3. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.

4. All safety circuits shall be installed to operate individual interposing relays located in the associated equipment control panel. Each safety device (i.e. freezestat, DP safety, smoke detector, firestat, etc.) wiring circuit shall be installed with individual homeruns back to the associated control panel. See control Drawings for details.

G. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA 1 enclosure. Manufacturer shall be Square 'D', Cutler-Hammer or Westinghouse.

H. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. 120/24 VAC transformers shall be fused in accordance with the NEC. Transformer shall be properly sized for application, and mounted in minimum NEMA 1 air vented enclosure. Multiple transformers in a single enclosure shall have fan aided ventilation whenever ambient temperature exceeds 140 deg F

1. Transformers shall be manufactured by Westinghouse, Square ‘D’, Jefferson or approved equal.

I. Time Delay Relays (TDR): TDRs shall be capable of on or off delayed functions, with adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a NEMA 1 enclosure.

1. TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.

2. TDRs shall be UL and CSA listed, Crouzet type.

J. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley or approved equal.

K. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley or approved equal.

L. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory or approved equal.

M. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley or approved equal.

2.20 NAMEPLATES

A. Provide engraved phenolic or micarta nameplates for all equipment, components, and field devices furnished. Nameplates shall be 1/8 inch thick, black, with white center core, and shall be minimum 1 inch x 3 inch, with minimum ¼ inch high block lettering. Nameplates for devices smaller than 1 inch x 3 inch shall be attached to adjacent surface.

B. Each nameplate shall identify the function for each device.

2.21 TESTING EQUIPMENT

A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is ±0.5 percent accurate, test equipment shall be ±0.25 percent accurate over same range).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in Drawings and details shown on Drawings. Install electrical components and use electrical products complying with requirements of the latest edition of the National Electrical Code and all local codes.

D. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connection of electric control devices.

1. Wiring System: Install complete wiring system for electric control systems. Conceal wiring exposed in mechanical rooms and areas where other conduit and piping are exposed. Installation of wiring shall generally follow building lines. Install in accordance with the latest edition of the National Electrical Code and Division 26. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

2. Control Wiring Conductors: Install control wiring conductors, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with the latest edition of the National Electrical Code and Division 26.

3. Communication wiring, signal wiring and low voltage control wiring shall be installed separate from any wiring over thirty (30) volts. Signal wiring shield shall be grounded at controller end only, unless otherwise recommended by the controller manufacturer.

4. All WAN and LAN patch cords shall be approved and installed as directed by owner.

5. BAS low voltage wiring/cables: All cables shall have legible printed sleeve identification labels at each device and the panel termination.

    a. Labels shall be high temperature permasleeve (TM) Brady PermaSleeve ™, part number - "BPSPT-187-175-WT" or owner approved equivalent.

    b. Each label shall be identified with the entire BAS point name utilized in the BAS database and the point address.

6. Terminate all control wiring internal to panels to screw terminals connections or owner approved wire connection equivalent. Wire nuts and/or splices are not allowed in panels. When terminating a wire cable, the cable jacket, cable shielding wire, and cable shielding material shall be finished in a neat consistent workmanlike manner.

7. Install all control wiring external to panels in electric metallic tubing or raceway. Installation of wiring shall generally follow building lines. Provide steel type connectors. Install wiring in galvanized rigid steel conduit at all exterior locations and where subjected to moisture. Install in PVC Schedule 40 conduit if encased in concrete. All conduits penetrating partitions, walls or floors shall be sealed with a submitted and approved fire/smoke sealant to prevent migration of air through the conduit system.

8. Communication wiring, signal wiring and low voltage control wiring may be run without conduit in concealed, accessible locations if noise immunity is ensured.

    a. Contractor shall be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.

    b. Accessible locations are defined as areas inside mechanical equipment enclosures, such as heating and cooling units, instrument panels etc.; in accessible pipe chases with easy access, or suspended ceilings with easy access. Installation of wiring shall generally follow building lines.

c. Run in a neat and orderly fashion, bundled where applicable, and completely suspended (strapped to rigid elements or routed through wiring rings) away from areas of normal access. Tie and support conductors neatly with suitable nylon ties and not to exceed five (5) foot intervals. Communication wiring may not be bundled with electrical nor with fire alarm wiring. All in-wall communication wiring must be run in a ¾"minimum conduit. Wiring passing thru a fire-rated partition must be fire-caulked.

d. Conductors shall not be supported by the ceiling system or ceiling support system. Conductors shall be pulled tight and be installed as high as practically possible in ceiling cavities. Wiring shall not be laid on the ceiling or duct.

e. Conductors shall not be installed between the top cord of a joist or beam and the bottom of roof decking.

9. Secondary LAN Communication cabling shall be provided in an Owner approved color dedicated to the BAS. All wiring shall be in accordance with the latest edition of the National Electrical Code and Division 26. Wiring/cables shall be provided in a customized color jacketing material. Color coding shall be green or orange. Material and labeling hall be as specified in section 27 05 53 (IDENTIFICATION FOR COMMUNICATIONS SYSTEMS). http://www.uh.edu/facilities-planning-construction/vendor-resources/owners-design-criteria/master-specs/jan-2017/division27Jan2017updated.pdf#page=35.Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation Drawings..

E. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. [Refer to Figure C at end of Section] Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down.

F. Averaging Temperature Sensors: Cover no more than two square feet per linear foot of sensor length except where indicated. Manufacturer recommended mounting clips shall be used to support and prevent any movement of the sensing probe in the air flow. Generally, where flow is sufficiently homogeneous/adequately mixed at sensing location, consult Engineer of Record for requirements.

G. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe.

H. Relative Humidity Sensors: Provide element guard as recommended by manufacturer for high velocity installations. For high limit sensors, position remote enough to allow full moisture absorption into the air stream before reaching the sensor.

I. Water Differential Pressure Transmitters: Provide 5 valve bypass arrangement to protect against over pressure damaging the transmitter.

J. Steam Differential Pressure Transmitters: Install per manufacturer's instructions at location as shown on the Drawings.

K. Pipe Surface Mount Temperature Sensors: Install with thermally conductive paste at pipe contact point. Where sensor is to be installed on an insulated pipe Contractor shall neatly cut insulation install sensor, repair or replace insulation and vapor barrier and adequately seal vapor barrier.

L. Flow Switches: Where possible, install in a straight run of pipe at least 15 diameters in length to minimize false indications.

M. Current Switches for Motor Status Monitoring: Adjust so that set point is below minimum operating current and above motor no load current.

N. Supply Duct Pressure Transmitters:

1. General: Install pressure tips with at least four (4) 'round equivalent' duct diameters of straight duct with no takeoffs upstream. Install static pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions. Locate the transmitter at an accessible location to facilitate calibration.

2. VAV System 'Down-Duct' Transmitters: Locate pressure tips approximately 2/3 of the hydraulic distance to the most remote terminal in the straightest run in the air system.

O. Cutting and Patching Insulation: Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

[FOR CRITICAL SERVICE CONTROL VALVE APPLICATIONS, ENGINEER SHALL COMPLETE THE APPLICABLE FOLLOWING FORMS FOR EACH INDIVIDUAL APPLICATION AND/OR VALVE. CONTROL VALVE SIZING AND SELECTION IS THE INITIAL RESPONSIBILITY OF THE ENGINEER AND NOT LEFT TO THE BAS PROVIDER. THE ITEMS NOTED WITH A * AND *, SHALL BE COMPLETED BY THE ENGINEER TO LIST THE REQUIREMENTS OF THE VALVES FOR CV, CLOSE OFF, TEMPERATURE RATINGS, CAGE MATERIAL, SEAT MATERIAL, TRIM MATERIAL ETC. FOR EACH INDIVIDUAL APPLICATION. THIS SHOULD BE A RESULT OF ANALYZING THE VALVES PERFORMANCE AND APPLICATION ACROSS THE RANGE OF CONTROL. ENGINEER SHALL CONSULT WITH OWNER PRIOR TO SPECIFYING THESE VALVES.]**

END OF SECTION 25 11 10

University of Houston									
Steam Control Valve Specification Sheet (Globe Body)									
Project Name		REVISIONS				SHEET		xx of xx	
		NO.	BY	DATE	DESCRIPTION	SPEC. NO.		REVISION	
		1				15951		*	
		2				CONTRACT		DATE	
		3				X		mm/dd/yy	
		4				PROJECT NUMBER			
		5				XXXX.XX			
		6				BY	CHECKED	APPROVED	
		7				XYZ	XYZ	XYZ	
GENERAL	Tag Number	*							
	Service Description	*							
	P&ID Sheet Number	*							
	Line No. or Vessel No.	*							
	Line Size / Mat'l / Sch.	*							
	Electrical Class / Power Supply	*			*				
PROCESS DATA	Fluid / Fluid State	SATURATED STEAM <125 PSIG			VAPOR				
	Operating Condition	Units	Minimum	Normal	Maximum	Other			
	Flow Rate	LB/HR	*	*	*	*			
	Inlet Pressure	PSIG	*	*	*	*			
	Outlet Pressure	PSIG	*	*	*	*			
	Temperature	DEG F	*	*	*	*			
	Mol. Wt.								
	Sp. Wt / Sp. Grav								
	Viscosity / Sp Heat								

BODY	Style	Size	GLOBE	xx"
	End Connection	Rating	xx" RF FLANGED	ANSI CLASS 150
	Port Size	Travel	*	*
	Valve Cv	Valve C1/Km	*	**
	Body Matl.	Bonnet	ASTM A216 WCB	ASTM A216 WCB
	Characteristic	Trim Number	EQUAL PERCENTAGE	*,**
	Cage Matl.	Retainer Matl.	*	*
	Seat Matl.	Seat Ring Matl.	*,**	*,**
	Plug Matl.	Stem Matl.	*,**	*,**
	Flow Action		DOWN	
	Gaskets		SPIRAL METALLIC	
	Stem Guide		**	
	Packing		GLASS FILLED PTFE**	
	Required Seat Tightness		ANSI CLASS IV	
	Max. Allowable Sound Level (dBA)		<75 dBA	
ACTUATOR	Type		PNEUMATIC	
	Size	Bench Set	*	*
	Push-Down To	Fail Position	CLOSE*	CLOSE*
	Close At	Open At	6 PSIG*	30 PSIG*
	Handwheel		NONE*	
POSITIONER	Type		Electronic	
	Communications Protocol		*	
	Input Signal	Output Signal	4-20 mA	
	Air Supply		80 PSIG NOMINAL*	
TRANSDUCER	Type		*	
	Input Signal		*	
	Output Signal		*	

OPTIONS	Air Set w/ Gauges	YES*
	Solenoids	*
	Position Switches	*
SELECTION BASED ON	Manufacturer	Fisher, Valtek, Dezurik-Copes, Leslie, Belimo
	Valve Model Number	*
	Actuator Model No.	*
	Positioner Model No.	*
	Filter Regulator	YES
NOTES	**, ** Engineer to consult with and use manufacturer's recommended steam trim for the service, usually a hardened 400 series stainless steel.* ** Engineer shall fill in to suit application.* *** Vendor to confirm based on process data provided.*	

University of Houston										
Water Control Valve Specification Sheet (Globe Body)										
Project Name		Revisions					SHEET		xx of xx	
		NO.	BY	DATE	DESCRIPTION		SPEC. NO.		REVISION	
		1					15951		*	
		2					CONTRACT		DATE	
		3					X		mm/dd/yy	
		4					PROJECT NUMBER			
		5					XXXX.XX			
		6					BY	CHECKED	APPROVED	
		7					XYZ	XYZ	XYZ	
GENERAL	Tag Number		*							
	Service Description		*							
	P&ID Sheet Number		*							
	Line No. or Vessel No.		*							
	Line Size / Mat'l / Sch.		*							
	Electrical Class	Power Supply	*			*				
PROCESS DATA	Fluid	Fluid State	WATER			LIQUID				
	Operating Condition		Units	Minimum	Normal	Maximum	Other			
	Flow Rate		GPM	*	*	*	*			
	Inlet Pressure		PSIG	*	*	*	*			
	Outlet Pressure		PSIG	*	*	*	*			
	Temperature		DEG F	*	*	*	*			
	Level		FEET	*	*	*	*			
	Mol. Wt.									
	Sp. Wt	Sp. Grav								
	Viscosity	Sp Heat								

BODY	Style	Size	GLOBE	xx"
	End Connection	Rating	xx" RF FLANGED	ANSI CLASS 150
	Port Size	Travel	*	*
	Valve Cv	Valve C1/Km	*	**
	Body Matl.	Bonnet	ASTM A216 WCC	ASTM A216 WCC
	Characteristic	Trim Number	EQUAL PERCENTAGE	**
	Cage Matl.	Retainer Matl.	*	*
	Seat Matl.	Seat Ring Matl.	316 STAINLESS STEEL	316 STAINLESS STEEL
	Plug Matl.	Stem Matl.	316 STAINLESS STEEL	316 STAINLESS STEEL
	Flow Action		DOWN	
	Gaskets		PTFE	
	Stem Guide		**	
	Packing		PTFE	
	Required Seat Tightness		ANSI CLASS IV	
	Max. Allowable Sound Level (dBA)		<75 dBA	
ACTUATOR	Type		PNEUMATIC	
	Size	Bench Set	*	*
	Push-Down To	Fail Position	CLOSE*	CLOSE*
	Close At	Open At	6 PSIG*	30 PSIG*
	Handwheel		NONE*	
POSITIONER	Type		Electronic	
	Communications Protocol		*	
	Input Signal	Output Signal	4-20 mA	
	Air Supply		80 PSIG NOMINAL*	
TRANSDUCER	Type		*	
	Input Signal		*	
	Output Signal		*	
OPTIONS	Air Set w/ Gauges		YES*	
	Solenoids		*	
	Position Switches		*	
SELECTION BASED ON	Manufacturer		Fisher, Valtek, Dezurik-Copes, Leslie, Belimo	
	Valve Model Number		*	
	Actuator Model No.		*	
	Positioner Model No.		*	

	Filter Regulator	YES
NOTES	** Engineer shall fill in to suit application.* *** Vendor to confirm based on process data provided.*	

University of Houston										
Water Control Valve Specification Sheet (Globe Body)										
Project Name		Revisions					SHEET		xx of xx	
		NO.	BY	DATE	DESCRIPTION		SPEC. NO.		REVISION	
		1					15951		*	
		2					CONTRACT		DATE	
		3					X		mm/dd/yy	
		4					PROJECT NUMBER			
		5					XXXX.XX			
		6					BY	CHECKED	APPROVED	
		7					XYZ	XYZ	XYZ	
GENERAL	Tag Number		*							
	Service Description		*							
	P&ID Sheet Number		*							
	Line No. or Vessel No.		*							
	Line Size / Mat'l / Sch.		*							
	Electrical Class	Power Supply	*			*				
PROCESS DATA	Fluid	Fluid State	WATER			LIQUID				
	Operating Condition		Units	Minimum	Normal	Maximum	Other			
	Flow Rate		GPM	*	*	*	*			
	Inlet Pressure		PSIG	*	*	*	*			
	Outlet Pressure		PSIG	*	*	*	*			
	Temperature		DEG F	*	*	*	*			
	Level		FEET	*	*	*	*			
	Mol. Wt.									
	Sp. Wt	Sp. Grav								
	Viscosity	Sp Heat								

BODY.	Style	Size	GLOBE	xx"
	End Connection	Rating	xx" RF FLANGED	ANSI CLASS 150
	Port Size	Travel	*	*
	Valve Cv	Valve C1/Km	*	**
	Body Matl.	Bonnet	ASTM A216 WCC	ASTM A216 WCC
	Characteristic	Trim Number	EQUAL PERCENTAGE	**
	Cage Matl.	Retainer Matl.	*	*
	Seat Matl.	Seat Ring Matl.	316 STAINLESS STEEL	316 STAINLESS STEEL
	Plug Matl.	Stem Matl.	316 STAINLESS STEEL	316 STAINLESS STEEL
	Flow Action		DOWN	
	Gaskets		PTFE	
	Stem Guide		**	
	Packing		PTFE	
	Required Seat Tightness		ANSI CLASS IV	
	Max. Allowable Sound Level (dBA)		<75 dBA	
ACTUATOR	Type		PNEUMATIC	
	Size	Bench Set	*	*
	Push-Down To	Fail Position	CLOSE*	CLOSE*
	Close At	Open At	6 PSIG*	30 PSIG*
	Handwheel		NONE*	
POSITIONER	Type		Electronic	
	Communications Protocol		*	
	Input Signal	Output Signal	4-20 mA	
	Air Supply		80 PSIG NOMINAL*	
TRANSDUCER	Type		*	
	Input Signal		*	
	Output Signal		*	
OPTIONS	Air Set w/ Gauges		YES*	
	Solenoids		*	
	Position Switches		*	
SELECTION BASED ON	Manufacturer		Fisher, Valtek, Dezurik-Copes, Leslie, Belimo	
	Valve Model Number		*	
	Actuator Model No.		*	
	Positioner Model No.		*	

	Filter Regulator	YES
NOTES	** Engineer shall fill in to suit application.* *** Vendor to confirm based on process data provided.*	

University of Houston										
Water Control Valve Specification Sheet (Pressure Independent, ½"-2")										
Project Name			Revisions				SHEET		xx of xx	
			NO.	BY	DATE	DESCRIPTION	SPEC. NO.		REVISION	
			1				15951		*	
			2				CONTRACT		DATE	
			3				X		mm/dd/yy	
			4				PROJECT NUMBER			
			5				XXXX.XX			
			6				BY	CHECKED	APPROVED	
			7				XYZ	XYZ	XYZ	
GENERAL	Tag Number		*							
	Service Description		*							
	P&ID Sheet Number		*							
	Line No. or Vessel No.		*							
	Line Size / Mat'l / Sch.		*							
	Electrical Class	Power Supply	*			*				
PROCESS DATA	Fluid	Fluid State	WATER			LIQUID				
	Operating Condition		Units	Minimum	Normal	Maximum	Other			
	Flow Rate		GPM	*	*	*	*			
	Inlet Pressure		PSIG	*	*	*	*			
	Outlet Pressure		PSIG	*	*	*	*			
	Temperature		DEG F	*	*	*	*			
	Level		FEET	*	*	*	*			
	Mol. Wt.									
	Sp. Wt	Sp. Grav								
	Viscosity	Sp Heat								
BODY.	Style	Size	Pressure Independent				xx"			
	End Connection	Rating	xx" Female NPT				400 PSI			
	Body Matl.	Characteristic.	Forged Brass, Nickel Plated				Equal Percentage			
	Char. Disc ½" & ¾"	Char. Disc 1"-2"	Brass				TEFZEL®			
	Diaphragm ½" & ¾"	Diaphragm 1"-2"	Silicone and Nomex				Polyester Reinforced Silicone			
	Seat Matl.	Seat Ring Matl.	Fiberglass reinforced Teflon® PTFE				Viton®			

	Ball Matl.	Stem Matl.	Chrome Plated Brass	Chrome Plated Brass
	Valve Action		Rotary	
	Regulator Components		Stainless Steel, Brass, Delrin 500AF	
	Spring		Stainless Steel	
	Packing		2 EPDM O-Rings	
	Required Seat Tightness		ANSI CLASS IV	
	Max. Allowable Sound Level (dBA)		<75 dBA	
ACTUATOR	Type		Electronic	
	Size	Bench Set	*	*
	Normal Position	Fail Position	CLOSE*	CLOSE*
	Close At	Open At	2 VDC	10 VDC
	Manual Overide		*	
OPTIONS	Feedback		YES*	
	Position Switches		*	
	Service Tool/Software		YES*	
SELECTION BASED ON	Manufacturer		Fisher, Valtek, Dezurik-Copes, Leslie, Belimo	
	Valve Model Number		*	
	Actuator Model No.		*	
NOTES	** Engineer shall fill in to suit application.* *** Vendor to confirm based on process data provided.*			

University of Houston										
Water Control Valve Specification Sheet (Pressure Independent, 2½"-6")										
Project Name			Revisions				SHEET		xx of xx	
			NO.	BY	DATE	DESCRIPTION	SPEC. NO.		REVISION	
			1				15951		*	
			2				CONTRACT		DATE	
			3				X		mm/dd/yy	
			4				PROJECT NUMBER			
			5				XXXX.XX			
			6				BY	CHECKED	APPROVED	
			7				XYZ	XYZ	XYZ	
GENERAL	Tag Number		*							
	Service Description		*							
	P&ID Sheet Number		*							
	Line No. or Vessel No.		*							
	Line Size / Mat'l / Sch.		*							
	Electrical Class	Power Supply	*			*				
PROCESS DATA	Fluid	Fluid State	WATER			LIQUID				
	Operating Condition		Units	Minimum	Normal	Maximum	Other			
	Flow Rate		GPM	*	*	*	*			
	Inlet Pressure		PSIG	*	*	*	*			
	Outlet Pressure		PSIG	*	*	*	*			
	Temperature		DEG F	*	*	*	*			
	Level		FEET	*	*	*	*			
	Mol. Wt.									
	Sp. Wt	Sp. Grav								
	Viscosity	Sp Heat								
BODY.	Style	Size	Pressure Independent				xx"			
	End Connection	Rating	xx" ANSI 125 Flange				ANSI 125, Standard Class B			
	Body Matl.	Characteristic.	Cast Iron-GG25 and Ductile Iron-GGG50				Equal Percentage			
	Char. Disc 2"-3"	Char. Disc 4"-6"	Stainless Steel				Stainless Steel			
	Seat Matl.	Seat Ring Matl.	PTFE				PTFE			
	Ball Matl.	Stem Matl.	Stainless Steel				Stainless Steel			

	Valve Action		Rotary	
	Packing		2 EPDM O-Rings	
	Required Seat Tightness		ANSI CLASS IV	
	Max. Allowable Sound Level (dBA)		<75 dBA	
ACTUATOR	Type		Electronic	
	Size	Bench Set	*	*
	Normal Position	Fail Position	CLOSE*	CLOSE*
	Flow Sensor Type		Magnetic	
	Manual Overide		*	
OPTIONS	Feedback		YES*	
	Position Switches		*	
	Service Tool/Software		YES*	
SELECTION BASED ON	Manufacturer		Fisher, Valtek, Dezurik-Copes, Leslie, Belimo	
	Valve Model Number		*	
	Actuator Model No.		*	
NOTES	** Engineer shall fill in to suit application.* *** Vendor to confirm based on process data provided.*			