

Part 1 General

1.1 SECTION INCLUDES

- .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, switches, transducers, dampers, damper operators, valves, valve actuators, low voltage current transformers, variable frequency drives.

1.2 RELATED SECTIONS

- .1 Division 01 – General Requirements.
- .2 Section 25 05 01 - EMCS: General Requirements.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI):
 - .1 ANSI C12.7-2014 (R1999), Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-2008, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM):
 - .1 ASTM B148-14, Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA):
 - .1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA):
 - .1 AMCA Standard 500-D-12, Laboratory Method of Testing Dampers for Rating.
- .5 Canadian Standards Association (CSA):
 - .1 CSA-C22.1-15, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.4 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.5 SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with:
 - .1 Division 01 – General Requirements.
 - .2 Section 21 05 01 – Common Work Results for Mechanical.
- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.6 EXISTING CONDITIONS

- .1 Cutting and Patching: in accordance with Division 01 – General Requirements supplemented as specified herein.

- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to Owner's Representative existing materials removed from Work not identified for re-use.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant, assembly.
- .3 Operating conditions: 0 – 32°C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 TEMPERATURE SENSORS

- .1 General: to be resistance or thermocouple type to following requirements:

The following sensors shall apply to thermistor and resistance temperature sensors as applicable:

 - .1 Sensing element to be hermetically sealed.
 - .2 Stem and tip construction to be copper.
 - .3 Sensors to have a time constant response of less than 3 seconds to a temperature change of 10°C.
 - .4 Sensors shall operate over the following ranges with the accuracies over the noted range of the sensor.
-50°C to +50°C, plus or minus 0.5°C.
0°C to +50°C, plus or minus 0.25°C.
0°C to 25°C, plus or minus 0.1°C.
0°C to 100°C, plus or minus 1°C.
 - .5 Immersion wells shall be of (stainless steel) materials. Heat transfer compound to be compatible with sensor. Unless noted otherwise, where an existing sensor or well is not available, a strap-on sensor will be acceptable.

- .6 Immersion sensors shall be provided with a separable brass well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
- .7 Provide matched temperature sensors for differential temperature measurement.
- .2 Temperature sensors shall be of the following types:
 - .1 General Purpose Duct Type: Suitable for insertion into air ducts at any angle, insertion length of 457 mm and 760 mm as noted on schedule or drawings.
 - .2 Spring-Loaded Thermowell Type: Spring-loaded construction with compression fitting for 20 mm NPT well-mounting. Lengths of 100 mm or 150 mm as noted.
 - .3 Space Temperature Sensors:
 - (Type 1) – Surface Space Temperature Sensor: to be acceptable product – Greystone TSRC, Delta, or approved equal.
 - (Type 2) – Surface-Mounted Space Temperature Sensor complete with setpoint adjustment: Acceptable Products – Greystone, TSRC-S, Delta, or approved equal.
 - (Type 3) – Network Type Surface Space Temperature Sensor adjustment and programmable pushbutton, Pushbutton, Temperature Display, Setpoint adjust, built-in occupancy sensor: Acceptable Products – Delta, Greystone or approved equivalent. To be c/w protective open wire guard where indicated.
 - .4 Outdoor Air Type: Complete with non-corroding shield designed to minimize solar and wind effects, threaded fittings for mating to 13 mm conduit, probe length of 100-150 mm

2.3 PRESSURE TRANSDUCERS

- .1 Requirements:
 - .1 Transducer shall have linear output signal. Zero and span shall be field-adjustable.
 - .2 Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
 - .3 Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi. minimum. Transducer shall be complete with 1 – 5 vdc or 4 to 20 mA output, required mounting brackets and block and bleed valves.
 - .4 Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 1 – 5 VDC or 4 to 20 mA output, required mounting brackets, and five-valve manifold.
Acceptable Products: Greystone, ACI, BAPI.

2.4 DIFFERENTIAL PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Air System Differential Pressure Transducer:
 - .1 Provide proportional electrical output for unidirectional pressure range.
 - .2 Pressure Media: Typically air or similar non-conducting gases.
 - .3 Maximum Line Pressure: 62 Pa H₂O Gage.

- .4 Accuracy: $< \pm 1.0\%$ full scale.
Resolution: Infinite.
Repeatability: $< 0.3\%$ F.S.
- .5 Environmental & Mechanical Data:
 - .1 Temperature: 0 to 175°F.
 - .2 Case: Fire-retardant glass filled polyester.
 - .3 Pressure Connections: 4.76 mm barbed brass pressure fitting for 6.35 mm push-on tubing.
 - .6 Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as shown.
Acceptable Products – Greystone, ACI, BAPI.

2.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

- .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
 - .2 Adjustable setpoint and differential.
 - .3 Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as shown.
 - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
 - .5 Accuracy: within 1% repetitive switching.
 - .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
 - .7 Switches on steam and high temperature hot water service: provide pigtail syphon.
Acceptable Products – Greystone, ACI, BAPI.

2.6 ELECTROMECHANICAL RELAYS

- .1 Requirements: Double pole double throw (DPDT) relays control and status indication of alarms and/or electrical starters and equipment where shown on point schedule.
 - .1 Relay coils shall be rated for 120V or 24V. Where other voltages occur, provide transformer.
 - .2 Contacts rated at 5 amps at 130V AC.
 - .3 Relays to be plug-in type with termination base.
 - .4 Relay to have visual status indication.

2.7 SOLID STATE RELAYS

- .1 General:
 - .1 Input and output Barrier Strips to accept 14 to 28 AWG wire.
 - .2 Operating temperature range to be -20°C to 70°C.

- .3 Relays to be CSA Certified.
- .4 Input/output Isolation Voltage to be 4000 VAC at 25°C for 1 second maximum duration.
- .5 Operational frequency range, 45 to 65 HZ.
- .2 Input:
 - .1 Control voltage, 3 to 32 VDC.
 - .2 Drop out voltage, 1.2 VDC.
 - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output.
 - .1 AC or DC Output Model to suit application.

2.8 CURRENT TRANSDUCERS

- .1 Requirements: Supply and install where status points on equipment are required, unless otherwise noted.
 - .1 AC current transducers will be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 0-5vdc two-wire output. Unit ranges shall be 10A, 20A, 50A, 100A, 150A, and 200A full scale, internal zero and span adjustment, and $\pm 1\%$ full scale accuracy at 500 ohm maximum burden.
 - .2 Transducer shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
 - .3 Unit shall be split-core type for clamp-on installation.

2.9 ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
 - .1 Electronic direct-coupled actuation shall be provided.
 - .2 For damper actuators, the actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a “V” bolt design with associated “V” shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage.

All actuators to be spring-return.

Spring return actuators shall have a “V” clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 27 mm when the damper is constructed in this manner. Single bolt or screw type fasteners are not acceptable.
 - .3 The actuator shall have electronic overhead or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to de-activate the actuator at the end of rotation are not acceptable.
 - .4 For power failure/safety applications, an internal mechanical spring-return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.

- .5 All spring-return actuators shall be capable of both clockwise and counter-clockwise spring-return operation by simply changing the mounting orientation.
- .6 Proportional actuators shall accept a 0 – 10 VDC or 0 to 20 mA control input and provide a 2 to 10 VDC or 4 to 20 mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper or valve is acceptable. All actuators shall provide a 2 to 10 VDC position feedback signal.
- .7 All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 watts for DC applications. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall now require more than 11 VA.
- .8 All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
- .9 Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
- .10 Actuators shall be Underwriters Laboratories Standard UL60 7030-1 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standard.
- .11 All damper actuators shall provide no less than 12.2 N.M/M².
- .12 All valve actuators shall be shipped already mounted to their respective valves.
- .13 Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rate torque and shall have a 2-year manufacturer's warranty, starting from the date of installation. Manufacturer shall be ISO9001 certified.
- .14 Actuators shall provide direct positional feedback to the control system.
- .15 Acceptable Products: Belimo, Neptronic and Siemens.
- .16 This Contractor is responsible to provide necessary quality of actuators and linkages to properly operate all damper sections.

2.10 PANELS

- .1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Owner's Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.11 WIRING

- .1 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .2 Wiring must be continuous without joints.
- .3 Sizes:
 - .1 Field wiring to digital device: #18AWG stranded twisted pair.

- .2 Analog input and output: #18 minimum stranded twisted pair.

2.12 ETHERNET SWITCHES

- .1 16-Ports.
- .2 Managed.
- .3 Rack Mountable.
- .4 Approved Product: HP V1910-16G switch, manufacturing part: JE005A #ABA.

2.13 CONTROL VALVES

- .1 General: Contractor shall select valves according to manufacturer's instructions, submit schedule indicating CV and pressure drop. Maximum PD 138 kPa (20 psi).
- .2 Pressure Independent Characterized Control Valve (PICCV):
 - .1 13 mm to 50 mm size (1/2" to 2") 2-way.
 - .2 Body: Brass, Nickel plated.
 - .3 Ball: Stainless Steel ball and stem c/w brass characterizing disc.
 - .4 Seats: Teflon PTFE.
 - .5 Seat O-rings: Viton.
 - .6 Stem O-ring: EPDM (lubricated).
 - .7 Temp Rating: -18°C to 100°C (0°F to 212°F).
 - .8 Press Rating:
 - .1 ½", ¾", 1" valves: 4137 kPa (600 psi).
 - .2 1-1/4", 1-1/2", 2": 2758 kPa (400 psi).
 - .9 Close-off pressure: 1380 kPa (200 psi).
 - .10 Differential Pressure: 34.5 to 345 kPa (5 to 50 psi).
 - .11 Actuator: Normally open, fail open, control inputs: Multi-Function Technology (2-10Vdc) modulating, spring return and feedback signal.
 - .12 Refer to schedule on drawings for size/capacity and additional information.
 - .13 2-Way Butterfly Valve:
 - .1 Body: ductile iron ASTM A536 with epoxy powder coat finish.
 - .2 End fitting: for ASME/ANSI class 125/150 flange.
 - .3 Disc: 304 Stainless Steel.
 - .4 Shaft: 416 Stainless Steel.
 - .5 Seat: EPDM.
 - .6 Stem packing: EPDM (lubricated).
 - .7 Bushing: RPTFE.
 - .8 Trim: HD.
 - .9 Temp Rating: -30°C to 120°C (-22°F to 250°F).
 - .10 Pressure Rating: consistent with ASME/ANSI class 125.

- .11 Close-off pressure:
 - .1 1379 kPa (200 psi) (2" – 12").
- .12 Actuator: Normally open, fail open, control inputs: Multi-Function Technology (2-10Vdc) modulating, electronic fail safe and feedback signal.
- .13 Refer to schedule on drawings for size/capacity and additional information.

Part 3 Execution

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping. Maintain fire rating integrity.

3.2 INSTALLATION OF SENSORS

- .1 Install all sensors in accordance with the manufacturer's recommendations.
- .2 Mount sensors rigidly and adequately for the environment within which the sensor operates.
- .3 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- .4 All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
- .5 Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip.
- .6 Low limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m² of coil area.
- .7 All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

- .8 Install outdoor air temperature sensors on north wall complete with sun shield at designated location.
- .9 Strap-on sensor installation shall be as follows:
 - .1 Scrape and sand the top portion of the bare pipe, where the sensor is installed.
 - .2 Install heat conductive compound.
 - .3 Submerge sensor in compound.
 - .4 Completely cover the top of the sensor with additional compound.
 - .5 Cover compound with a reflective heat shield. Install tightly over complete installation.
 - .6 Install pipe bracket. (Gear clamp).
 - .7 Install insulation over complete installation.
- .10 Stainless steel plate sensors to utilize a foam gasket to isolate sensor perimeter from direct contact with wall surface. Foam fill cavity directly behind space sensor then installation is recessed into wall.

3.3 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.4 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.5 ACTUATORS

- .1 Mount and link control damper actuators per manufacturer's instructions.
 - .1 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5°C open position, manually close the damper, and then tighten the linkage.
 - .2 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - .3 Provide all mounting hardware and linkages for actuator installation.
- .2 Electric/Electronic:
 - .1 Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
 - .2 Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.6 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION