SECTION 251104

METERING DEVICES

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***NOTE TO SPECIFIER***

*Use this Specification Section for Mail Processing Facilities.*

***This is a Type 3 Specification with primarily required text; therefore, most of the text cannot be edited, but there is editable text which is noted within the Section with a “Note to Specifier.” Do not revise the required paragraphs without an approved Deviation from USPS Headquarters, Facilities Program Management, through the USPS Project Manager.***

*For Design/Build projects, do not delete the Notes to Specifier in this Section so that they may be available to Design/Build entity when preparing the Construction Documents.*

*For the Design/Build entity, this specification is intended as a guide for the Architect/Engineer preparing the Construction Documents.*

*The MPF specifications may also be used for Design/Bid/Build projects. In either case, it is the responsibility of the design professional to edit the Specifications Sections as appropriate for the project.*

*Text shown in brackets must be modified as needed for project specific requirements.* *See the “Using the USPS Guide Specifications” document in Folder C for more information.*

*The last date that USPS revised this standard specification section occurs in two places, at the end of this section and in the Table of Contents. If the date in this section matches the date in the Table of Contents, then you are using the latest version. Do not delete or revise the “last revised” date at the end of the section during the development of the Project Manual.*

*The footer in this section should be edited to replace the text, “USPS MPF SPECIFICATION” with the project name, and the blank date in the center should be replaced with the submission date, for interim design reviews, or the issue date of the completed Project Manual.*

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1. GENERAL
	1. SECTION INCLUDES
		1. Electric Meters.
		2. Flow Meters.
		3. Wiring.
		4. Testing Equipment.
	2. RELATED DOCUMENTS

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**NOTE TO SPECIFIER**

Edit the below to coordinate with Project Manual.

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* + 1. Section 230500 - Common Work Results for HVAC
		2. Section 260500 – Common Work Results for Communications
		3. Section 260533 – Raceway and Boxes for Electrical Systems
		4. Section 260623 – Lighting Control Devices
		5. Section 250504 - Building Automation System (BAS) General
		6. Section 253004 – (BAS) Basic Materials, Interface Devices, and Sensors
		7. Section 251404 - BAS Equipment, Software and Programming
		8. Section 255104 – EEMS Integration
		9. Section 259004 – Sequence of Operation
		10. Section 250804 – Building Automation System (BAS) Commissioning
	1. DESCRIPTION OF WORK
		1. Refer to Division 23 sections for installation of instrument wells, piping in mechanical systems; not work of this section.
		2. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:
			1. Control wiring between field-installed meter, indicating devices, and unit control panels.
			2. Wiring associated with indicating and alarm panels (remote alarm panels) and connections to their associated field devices.
			3. All other necessary wiring for fully complete and functional control system as specified.
1. PRODUCTS
	1. MATERIALS AND EQUIPMENT

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**NOTE TO SPECIFIER**

Edit the following to suit the project. Only delete products not needed for project. Delete all pneumatic references for new facilities or where existing pneumatic control systems will not be utilized.

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* + 1. General: Provide electronic [pneumatic][and][electric] control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, controllers, sensors, and other components as required for a 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.
		2. Instrument Pipe and Tube
			1. Hydronic and Instruments
				1. Connection to Main Piping: Provide 1/2-inch minimum size threadolet, 1/2 x 2 inch brass nipple, and 1/2-inch ball valve for connection to welded steel piping. Provide tee fitting for other types of piping.
				2. Remote Instruments: Adapt from ball valve to specified tubing and extend to remote instruments. Provide a union or otherwise removable fitting at ball valve so that connection to main can be cleaned with straight rod. Where manifolds with test ports are not provided for instrument, provide tees with 1/4-inch FPT branch with plug for use as test port. Adapt from tubing size to instrument connection.
				3. Line Mounted Instruments: Extend rigid piping from ball valve to instrument. Do not use close or running thread nipples. Adapt from ball valve outlet to instrument connection size. Provide a plugged tee if pipe makes 90 degree bend at outlet of valve to allow cleaning of connection to main with straight rod without removing instrument.
				4. Instrument Tubing: 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; or brass compression-type fittings. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder. Tubing OD size shall be not less than the larger of 1/4-inch or the instrument connection size.
				5. Rigid Piping for Line Mounted Instruments: Schedule 40 threaded brass, with threaded brass fittings.
			2. Low Pressure Air Instrument Sensing Lines
				1. Connections: Use suitable bulkhead type fitting and static sensing tip for static pressure connections. Adapt tubing to instrument connection.
				2. Tubing: Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, and with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.
		3. Communication Wiring: All wiring shall be in accordance with National Electrical Codes and Division 26 of this specification. Conduit systems shall be MC, EMT, PVC or as otherwise allowed by code. Non plenum rated wiring shall be in conduit meeting Division 26 requirements when run through plenum spaces.
			1. Contractor shall supply all communication wiring between Metering devices and Building Controllers, AAC’s, ASC’s and local or remote peripherals
			2. Communication wiring shall be individually 100% shielded pairs per manufacturers 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 equipment manufacturer.
		4. Signal Wiring: Contractor shall run all signal wiring in accordance with National Electric Codes and the Division 26 Specification. Conduit systems shall be MC, EMT, PVC or as otherwise allowed by code. Non plenum rated wiring shall be in conduit meeting Division 26 requirements when run through plenum spaces.
			1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.
			2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.
	1. GENERAL Meter devices

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**NOTE TO SPECIFIER**

Edit the following to suit the project. Only delete products not needed for project.

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* + 1. It shall be the Contractor's responsibility to assure that all metering devices are compatible with controller hardware and software.
		2. Meters specified herein are generally ‘two-wire’ type transmitters, with power for the device to be supplied from the respective controller. If the receiving device is not equipped to provide this power, or is not designed to work with ‘two-wire’ type transmitters, or if metering 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.
		3. 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 equal to, or better than, the accuracy listed for respective field devices.
		4. For devices specified to have a communication Interface, interface shall use one of the following protocols:
			1. BACnet MS/TCP communications compliant to ASHRAE Standard 135.
			2. Modbus RTU communications
			3. Modbus TCP/IP communications
		5. Accuracy: To include combined effects of nonlinearity, non-repeatability and hysteresis.
	1. PRESSURE TRANSMITTERS

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***NOTE TO SPECIFIER***

*Edit the following to suit the project. The application of meters and submeters needs to be balanced against the added benefit the collected information will provide in energy use reductions and monitoring for M&V purposes.*

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* + 1. Liquid, Steam and Gas:
			1. General: Two-wire smart cell type transmitter, 4-20 mA or 1-5 Vdc user-selectable linear or square root output, adjustable span and zero, stainless steel wetted parts.
			2. Environmental limits: –40 to 250 °F (-40 to 121°C), 0 to 100% RH.
			3. Accuracy: better than 0.2 percent of span.
			4. Output Damping: Time constant user selectable from 0 to 36 seconds.
			5. Vibration Effect: Less than ±0.1% of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.
			6. Electrical Enclosure: NEMA-4, -4X, -7, -9.
			7. Approvals: FM, CSA.
			8. Acceptable Manufacturers: Rosemount Inc. 3051 Series, Foxboro, Johnson-Yokagawa, Siemens Sitran
		2. Accessories
			1. Valve Manifold
				1. Provide a three valve manifold for all liquid or steam pressure sensors.
				2. Manifold shall include high and low pressure isolation valves, pressure vent valve
				3. Manifold may mount integral with transmitter or remotely.
			2. Provide siphon loop on all stream pressure transmitters
	1. DIFFERENTIAL PRESSURE TRANSMITTERS (DP)
		1. Liquid, Steam and Gas:
			1. General: Two-wire smart DP cell type transmitter, 4-20 mA or 1-5 Vdc user-selectable linear or square root output, adjustable span and zero, stainless steel wetted parts.
			2. Environmental limits: –40 to 250 °F (-40 to 121°C), 0 to 100% RH.
			3. Accuracy: better than 0.2 percent of span.
			4. Output Damping: Time constant user selectable from 0 to 36 seconds.
			5. Vibration Effect: Less than ±0.1% of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.
			6. Electrical Enclosure: NEMA-4, -4X, -7, -9.
			7. Approvals: FM, CSA.
			8. Acceptable Manufacturers: Rosemount Inc. 3051 Series, Foxboro, Johnson-Yokagawa, Siemens Sitran
		2. Accessories
			1. Valve Bypass Manifold
				1. Provide a five valve bypass manifold for all liquid or steam sensors.
				2. Manifold shall include high and low pressure isolation valves, high and low pressure vent valves, and a bypass valve
				3. Manifold may mount integral with transmitter or remotely.
	2. CURRENT TRANsducers
		1. Clamp-On Design Current Transducer
			1. Transducer  Measure true (rms.) current.
			2. Range: 208/270/480 Volt, up to 2000 amp
			3. Output: 0-5 VDC.
			4. Accuracy: +/- 1% from 10 % to 100 % of the rated current over a temperature range of 0-60° C.
			5. Transducer shall be internally isolated to 2000 VAC. Transducer case isolation shall be 600 VAC.
			6. Acceptable Manufacturers: Veris Industries H922, KELE SC100, NK Technologies ATR.
	3. kW transducers
		1. Clamp-On Design kW Transducer (for Power Sensing)
			1. Transducer shall consist of three split-core CTs hinged at both axes with embedded electronics or external CT as required.
			2. Range: 1-10 amps minimum, 20-200 amps maximum
			3. Output: 0-5 VDC.
			4. Accuracy: ±1% from 20 to 100 Hz.
			5. Transducer shall be internally isolated to 2000 VAC. Transducer case isolation shall be 600 VAC.
			6. Acceptable Manufacturers: Veris H8044 NK Technologies AP series.

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**NOTE TO SPECIFIER**

**REQUIRED**: New Construction and Major R&A projects shall be equipped with advanced metering for whole building (utility level) metering of electricity. Include Paragraph 2.7 for all applicable R&A projects. Delete Paragraph 2.7 for all new construction and R&A projects that involve switchgear replacement, because advanced electric metering is to be provided as an integral part of the electrical switchgear (in Section 262413 – Switchboards) for these type projects.

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* 1. advanced metering EQUIPMENT (electrical UTILITY mains).
		1. The meter device shall be UL listed. All meters shall have the following ratings, features, and functions.
			1. Designed for multifunction electrical measurements on 3 phase power systems. The Meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
			2. Provide surge withstand ratings confirming to ANSI C62.41 (6KV)
			3. Be user programmable for voltage range to any PT ratio.
			4. Accept a direct voltage input range of up to 576 Volts Line to Neutral, and a range of up to 721 Volts Line to Line.
			5. Accept a current input of up to 11 amps continuous. Startup current for a 5 Amp input shall be no greater than .005 Amps.
			6. Have the following additional ratings and features:
				1. Fault Current Withstand shall be 100 Amps for 10 seconds, 300 Amps for 3 seconds, and 500 Amps for 1 second.
				2. Meter shall be programmable for current to any CT ratio.
				3. All inputs and outputs shall be galvanically isolated to 2500 Volts AC.
			7. Accept current inputs of class 10: (0 to 11A), 5 Amp Nominal and class 2 (0 to 2A), 1A Nominal Secondary.
			8. Provide an accuracy of +/- 0.5% or better for volts and amps, and 0.5% for power and energy functions and meet or exceed the accuracy requirements of ANSI C12.20 (Class 0.5%).
			9. Provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral.
			10. Provide sampling at 400+ samples per cycle on all channels measured readings simultaneously.
			11. The meter shall utilize 24 bit Analog to Digital conversion.
			12. Provide at a minimum Voltage and current per phase, kW, kVAR, PF, kVA, Frequency, kWh, %THD (% of total Harmonic Distortion).
			13. Shall be a traceable revenue meter, which shall contain a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy.
			14. The meter shall include 1 independent communications port on the back, with advanced features. The port shall provide Ethernet communication speaking Modbus/IP, Modbus MS/TCP or BACnet MS//TCP protocols
			15. Provide user configured fixed window or sliding window demand. This shall allow the user to set up the particular utility demand profile.
				1. Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features.
				2. All other parameters shall offer max and min capability over the user selectable averaging period.
				3. Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.
			16. Capable of operating on a power supply of 90 to 265 Volts AC and 100 to 370 Volts DC. Universal Power AC/DC Supply shall be available. An option shall also be available to operate on a power supply from 18-60 VDC.
			17. Meter shall provide update rate of 100 msec for Watts, Var and VA. All other parameters shall be 1 second.
			18. The meter shall be provided with I/O expandability through option card slots.
		2. Meter Software features
			1. Meter shall provide internally calculated values based in voltage and current inputs. The following parameters shall be provided for each measured phase and total of all 3 phases: volts, amps, kW, kVAR, PF, kVA, frequency., kWh, %THD. predicted kW based on selected demand period.
			2. All meter setup parameters shall be adjustable though a software configuration tools, though the front panel keypad or through a web based browser. All meter configurations shall be password protected from alteration.
			3. All meter parameters shall be accessible through the Modbus TCP/IP, Modbus RTU communication protocol or BACNet.
		3. Acceptable Manufactures Models
			1. Schnieder Electric/Square D – PM750
			2. Electro Industries - Shark S100
			3. Siemens – PAC3200
			4. General Electric – EPM 6000
			5. E-MON/D-MON
		4. Accessories:
			1. Current transformers: All CT’s should conform to the ANSI standard accuracy class for metering service of 0.3 or better and shall be provided with certificates of test stipulating the ratio and phase angle corrections at 10% and 100% of rating with the standard ANSI burden nearest to the actual "in-service" burden Whenever practical, the CT’s should be designed to withstand continuous operation and maintain class 0.3 or better metering accuracy at twice or more of rated current (ex. Transformer thermal rating factor greater than or equal to 2)
			2. Voltage Transformers: All VTs should conform to the ANSI standard accuracy class for metering service of 0.3 or better and be provided with certificates of test stipulating the ratio and phase angle corrections at 100% rating with zero burden and with the rated maximum standard burden.
			3. Test Block/Switches: These test blocks should be designed to provide a means to measure the input quantities from the current and/or voltage transformers and to allow the application of test quantities.

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***NOTE TO SPECIFIER***

***REQUIRED****: Specifier must confer with the gas utility provider to see if existing meters can be retrofitted with a pulse initiator. This is the preferred method for metering incoming utility services. If meters cannot be retrofitted or other submetering is required, Specifier must indicate which flow meters below are acceptable natural gas applications.*

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* 1. Utility provided main Gas meter Pulse INITIATOR
		1. Existing main gas meters shall be retrofitted by the utility provider to provide usage information. Contractor is to coordinate retrofit with the utility provider.

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***NOTE TO SPECIFIER***

***REQUIRED****: Specifier must confer with the utility provider to see if existing meters can be retrofitted with a pulse initiator. This is the preferred method for metering incoming utility services. If meters cannot be retrofit, replace or other submetering is required, i.e., tower water make-up, Specifier must clearly indicate which flow meters are acceptable for the application.*

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* 1. Utility provided main water meter Pulse INITIATOR
		1. Existing main meters shall be retrofitted by the utility provider to provide usage information. Contractor is to coordinate retrofit with the utility provider.
	2. Domestic, Potable and Reclaimed water service meters
		1. The type or combination of types of meters to be used for recording water consumption from a service must accurately record consumption over the expected range of flow. The size selected shall ensure pressure losses are within acceptable limits and provide long meter life. There are three types of cold-water meters accepted for use. These are displacement, turbine and compound types. The actual meter or combination of meters accepted for use must accurately account for the total water use of the property serviced
		2. Displacementmeters are to be either nutating disk or oscillating piston type are to conform to AWWA C-700. Meters are to have a bronze case with cast iron or plastic frost protection cover. Meters 38 mm and 50 mm in size are to have oval two bolt flanged ends.
			1. Acceptable Manufacturers: Sensus (Invensys, Rockwell) SRII or SR’ Neptune (Schlumberger) T-10.
		3. Turbine meters are to conform to the AWWA C-701 class II. Meters are to have a cast bronze case with flanged connections. Meters 38 mm and 50 mm in size are to have oval two bolt flanged ends.
			1. Acceptable Manufacturers: Sensus (Invensys, Rockwell) Series 'W', Neptune (Schlumberger) HP
		4. Compoundmeters are to conform to AWWA C-702. Meters are to have a cast bronze case with flanged connections. 50 mm in size are to have oval two bolt flanged ends.
			1. Acceptable Manufacturers: Sensus (Invensys, Rockwell) SRH, Neptune (Schlumberger) TRU/FLO
		5. Accessories
			1. Registers: All meter shall be provided with a direct reading odometer style register. Unit of measure shall be hundreds of cubic feet. Register shall have a sweep hand or flow indicator for low flow indication. Compound meters shall provide registers appropriately scaled for each meter section.
			2. Contact output: Integral to the register or as a separate device, meter shall provide a dry contact closure for monitoring by other systems. Contract shall not require an external power source for activation. Pulse shall be scaled to provide 1 pulse per 10 gallons for meters with a maximum flow rate less than 100 GPM and 1 pulse per 100 gallons for all other flow ranges.
			3. Strainers: All meters are to be installed with a meter of the style recommended by the meter manufacturer.

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**NOTE TO SPECIFIER**

**REQUIRED**: Specifier must confer with the utility provider to see if existing meters can be retrofitted with a pulse initiator or replaced with a new meter with this feature, as this is the preferred method for metering incoming utility services. The meter below should be considered if the utility meters are not available and therefore shall be thoroughly evaluated economically. Coordinate and obtain approval through the USPS Project Manager. If meters cannot be retrofit or replaced, Specifier must clearly indicate which flow meters are acceptable for the application and delete references to non-applicable meters.

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* 1. Insertion type turbine meter for water service
		1. Turbine Insertion Flow Meter sensing method shall be impedance sensing (iron magnetic and non-photoelectric), with volumetric accuracy of +/- 2% of reading over middle 80% of operating range, and +/- 4% of reading over the entire operating range. Turbine Insertion Flow Meter shall have maximum operating pressure of 400 psi and maximum operating temperature of 200F continuous (220F peak). All wetted metal parts shall be constructed of 316 stainless steel. Flow meter shall meet or exceed all of the accuracy, head loss, flow limits, pressure and material requirements of the AWWA standard C704-70 for the respective pipe or tube size. Analog outputs shall consist of non-interactive zero and span adjustments, a DC linearly of 0.1% of span, voltage output of 0-10 V, and current output of 4-20 mA.
			1. Install in water systems with a minimum of 10 pipe diameters unobstructed flow.

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***NOTE TO SPECIFIER***

***REQUIRED****: Double turbine insertion required at between 10 and 4 diameters unobstructed flow.*

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* + - 1. Acceptable Manufacturers: Onicon Corp., Emco, Nice.

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**NOTE TO SPECIFIER**

**REQUIRED**: Specifier must confer with the utility provider to see if existing meters can be retrofit with a pulse initiator or replaced with a new meter with this feature, as this is the preferred method for metering incoming utility services. The meters below should be considered if the utility meters are not available and therefore shall be thoroughly evaluated economically. Coordinate and obtain approval through the USPS Project Manager. If meters cannot be retrofit or replaced, Specifier must clearly indicate which flow meters are acceptable for the application and delete references to non-applicable meters.

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* 1. Vortex shedding flow meter for liquid, steam and gas service:
		1. Output: 4-20 mA, 0-10 VDC, or 0-5 VDC
		2. Maximum Fluid Temperature: 800 °F (427 °C)
		3. Wetted Parts: Stainless Steel
		4. Housing: NEMA 4X
		5. Turndown: 10:1 minimum.
		6. Accuracy: 0.5% of calibrated span for liquids, 1% of calibrated span for steam and gases.
		7. Body: Wafer style or ANSI flanged to match piping specification
		8. Insertion: Hot tap insertable with guide and extraction device
		9. Acceptable Manufacturers: Foxboro 83 series, Sierra, Rosemount, Siemens, and Onicon .
	2. Venturi FLOW METER FOR WATER SERVICE
		1. Flow Sensing Element: Differential-pressure Venturi-type designed for installation in piping.
		2. Construction: Bronze or cadmium plated steel with brass quick connect fittings and attached tag with flow conversion data and rated flow. Ends shall be threaded for 2 inches and smaller and flanged or welded for larger than 2 inches.
		3. Differential transmitter shall be dual range industrial grade as specified above.
		4. Apply Venturi-type flow meters where minimum flow range is no less than 40% of maximum flow.
	3. Ultrasonic Flow meter for Water service:
		1. General: Single-channel non-wetted ultrasonic meter to measure volumetric fluid using transit-time flow measurement:
		2. Measurement: [Single channel] [Two Channel] measurement.
		3. Enclosure: Epoxy-coated aluminum NEMA 4X, IP66 weatherproof.
		4. Accuracy: ± 2% of velocity reading at 1 to 40 ft/s.
		5. Rangeability: 100 to 1.
		6. Repeatability: ± 0.2 to 0.5% at full scale.
		7. Input Power: 120 VAC or 24VDC.
		8. Operating Temperature: 14° to 140°F.
		9. Control Panel: Stainless Steel case. Digital display: 2-line x 16-character LCD display, LED backlight, configurable to display up to 4 measurement parameters in sequence.
		10. Keypad: 6-button internal keypad.
		11. Output: [Single Channel – one 4-20 mA] [Two Channel – two 4-20 mA].
		12. Output Units: Velocity in ft/s or m/s.
		13. Volumetric Flow: Cubic feet (ft3), cubic meters (m3), gallons (gal), and liters (L).
		14. Totalizer Cubic feet (ft3), cubic meters (m3), gallons (gal), and liters (L).
		15. Transducer Temperature Range: –40° to 140°F.
		16. Provide all slide track brackets, stainless steel chain or strap, for a complete installation. Provide connecter cables and connectors as required for a complete system.
		17. Acceptable Manufacturers: EMCO. Siemens, Controlotron, Sierra.

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**NOTE TO SPECIFIER**

**REQUIRED:** Specifier must only utilize BTU meter below if facility is fed from and charged by a District Utility system providing hot or chilled water system. Use and specification shall be provided only in close coordination with the USPS Project Manager. This metering type is atypical for nearly all facilities and would only be used as a check against utility charges if an auxiliary contact is not provided by the utility company or if secondary confirmation of charges is requested by the USPS Project Manager. Omit this metering section if district hot water or chilled water are not provided.

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* 1. BTU metering Devices (Hot and chilled water Systems)
		1. The entire BTU metering device shall be built and calibrated by a single manufacturer and shall consist of a flow meter, two temperature sensors, a BTU meter, temperature thermowells, and all required mechanical installation. A certificate of NIST traceable calibration shall be provided with each system. All equipment shall be covered by the manufacturer’s two year warranty.
			1. Insertion Temperature sensors: Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST\* traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within +0.15°F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).
			2. Flow Meter: Provide a turbine or ultrasonic flowmeter as specified in other paragraphs.
			3. BTU Meter: The BTU meter shall provide the following points both at the integral LCD and as data available through a communications interface: Energy Total, Energy Rate, Flow Rate, Supply Temperature Return Temperature. Output signals shall be either serial network (protocol conforming to BACnet MS/TP, MODBUS RTU, or MODBUS TCP) and via individual analog and pulse outputs. Communication interface shall allow the reset of total energy and total flow. Each BTU meter shall be factory programmed for its specific application, and shall be re-programmable using the integral front panel keypad.
		2. Acceptable Manufacturer: Onicon, Sierra, Nice, Siemens.
	2. Compressed Air flow Transmitters
		1. Insertion Mass Flow Type
			1. Provide a loop powered, thermal mass flow type level with adjustable span and zero.
			2. Output: 4-20 mA.
			3. Integral display
			4. Electrical Enclosure: NEMA 4, 4X, 7, 9.
			5. Approvals: UL or CSA.
			6. Accuracy: ±1% of reading.
			7. Sierra 640S, Nice, Siemens, Foxboro
		2. Insertion Vortex shedding Type
			1. Output: 4-20 mA, 0-10 VDC, or 0-5 VDC
			2. Maximum Fluid Temperature: 800 °F (427 °C)
			3. Wetted Parts: Stainless Steel
			4. Housing: NEMA 4X
			5. Turndown: 10:1 minimum.
			6. Accuracy: 1% of calibrated spa.
			7. Body: Wafer style or ANSI flanged to match piping specification.
			8. Insertion: Hot tap insertable with guide and extraction device.
			9. Acceptable Manufacturers: Foxboro 83 series, Johnson-Yokagawa, and Rosemount Siemens, Onicon F2000.
	3. Continuous Level Transmitters
		1. Capacitance Type
			1. Provide a loop powered, continuous capacitance type level transmitter with adjustable span and zero.
			2. Output: 4-20 mA.
			3. Probe: Fluoropolymer coated stainless steel rod or cable. Provide cable probe with end attachment hardware or weight.
			4. Electrical Enclosure: NEMA 4, 4X, 7, 9.
			5. Approvals: UL or CSA.
			6. Accuracy: ±1% of calibrated span.
			7. Process Connection: MPT or ANSI Flange as required.
			8. Acceptable Manufacturers: Drexelbrook, Endress & Hauser. Substitutions shall be allowed per Division 1.
		2. Hydrostatic Pressure
			1. Two wire smart d/p cell type transmitter
			2. 4-20 mA or 1 to 5 volt user selectable linear or square root output
			3. Adjustable span and zero
			4. Stainless steel wetted parts
			5. Environmental limits: –40 to 250 °F (-40 to 121°C), 0 to 100% RH
			6. Accuracy: less than 0.1 percent of span
			7. Output Damping: time constant user selectable from 0 to 36 seconds
			8. Vibration Effect: Less than ±0.1% of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.
			9. Electrical Enclosure: NEMA 4, 4X, 7, 9
			10. Approvals: FM, CSA
			11. Acceptable Manufacturers: Rosemount Inc. 3051 Series, Foxboro, and Johnson-Yokagawa Siemens.
	4. Fuel Oil meters
		1. Type:
			1. High precision oscillating piston oil flow
			2. Body: Cast bronze
			3. Internal components: Brass Chamber; aluminum piston
			4. Seals: compatible with oil type
		2. Ratings:
			1. Maximum operation pressure: 225 PSI
			2. Maximum operating temperature: 260 degree F.
		3. Accuracy: ±1% from 10% to 90% operating range.
		4. Process Connection: MPT or ANSI Flange as required.
		5. Accessories
			1. Registers: All meters shall be provided with a direct reading odometer style register. Unit of measure shall be gallons. Register shall have a sweep hand or flow indicator for low flow indication.
			2. Contact output: Integral to the register, meter shall provide a dry reed contact closure for monitoring by other systems. Contact shall not require an external power source for activation. Pulse shall be scaled to provide 10 pulse per 1 gallon for 3/4-inch meters and smaller. All other meters shall provide 1 pulse per 1 gallon
			3. Strainers: All meters are to be installed with a stainless steel strainer of the style recommended by the meter manufacturer.
		6. Acceptable Manufacturers: AMCO, Elster.
	5. NAMEPLATES
		1. 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 x 3 inches, with minimum 1/4-inch high block lettering. Nameplates for devices smaller than 1 x 3 inches shall be attached to adjacent surface.
		2. Each nameplate shall identify the device tag number as identified on the control drawings.
	6. TESTING EQUIPMENT
		1. 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% accurate, test equipment shall be +/-0.25% accurate over same range).
1. EXECUTION
	1. INSPECTION
		1. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
	2. INSTALLATION OF Meters
		1. 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 National Electric Code and all local codes.
		2. 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 except in mechanical rooms and areas where other conduit and piping are exposed. Installation of wiring shall generally follow building lines. Install in accordance with National Electrical Code and Division 26 of this Specification. 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 National Electrical Code and Division 26 of this Specification.
			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. Install all control wiring external to panels in electric metallic tubing or raceway. However, communication wiring, signal wiring and low voltage control wiring may be run without conduit in concealed, accessible locations if noise immunity is ensured. Contractor will be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance. 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. 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. 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. Conductors shall not be installed between the top cord of a joist or beam and the bottom of roof decking. Contractor shall be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.
			5. Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.
		3. Electric meters: Install shorting switches and test blocks for all PT and CTs according to manufacturer’s instructions.
		4. Fluid Flow Sensors: Install per manufacturer’s recommendations in an unobstructed straight length of pipe.
		5. Pressure Transmitters: Install valve manifolds at transmitters per manufactures requirements. Provide isolation/ shutoff valve at pressure tap connection to piping.
		6. 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.

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END OF SECTION

USPS MPF Specification Last Revised: 10/1/2022