**SECTION 40 71 13.13**

**Inline Magnetic Flow Meters**

***PART 1- GENERAL***

**1.01 SUMMARY**

1. Electromagnetic flow meters for permanent installations both above and below ground. The meters shall utilize bipolar pulse DC coil excitation to measure voltage induced by the flow of conductive liquid through a magnetic flux. The voltage shall be linearly proportional to flow velocity from 0.033 to 33 feet per second.

**1.02 SUBMITTALS**

1. Furnish complete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer’s certifications, Manufacturer’s Field Reports
2. Product Data:
   1. Dimensional Drawings.
   2. Materials of Construction:
      1. Sensor.
      2. Liner.
      3. Electrodes.
      4. Flanges.
   3. Measurement accuracy.
   4. Range and range ability.
   5. Enclosure Rating.
   6. Classification Rating.
   7. Power:
      1. Voltage.
      2. Wattage.
   8. Output options.

**1.03 QUALITY ASSURANCE**

1. Manufacture facilities shall be certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

**1.04 DELIVERY, STORAGE, AND HANDLING**

1. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
2. Any instruments that are not stored in strict conformance with the manufacturer’s recommendation shall be replaced.

**1.05 PROJECT OR SITE CONDITIONS**

1. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

**1.06 WARRANTY**

1. The meter shall have standard one year warranty from date of shipment and if the meter is commissioned by a factory certified technician, the warranty is extended to three years from the date of shipment.

**1.07 MAINTENANCE**

A. Provide all parts, necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

**1.08 LIFECYCLE MANAGEMENT**

A. Instrument documentation, like original calibration certificates, manuals and product status information shall be accessed via a web enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web enabled system.

***PART 2 - PRODUCTS***

**2.01 MANUFACTURER**

1. Endress+Hauser Promag 400 W Series

**2.02 MANUFACTURED UNITS**

1. The flow meter shall be a flanged sensor (by application and instrument schedule) which complies with AWWA C751 and transmitter which may be mounted integral (compact) to the sensor or remote with interconnecting cables up to 650 feet in length.
2. The flow metering system shall be microprocessor-based and possess a non-volatile memory to store the sensor calibration and transmitter setup information. The electronics shall be interchangeable for meters sizes 1”- 90”.
3. The sensor shall be the proper size to measure the design flow rate of the piping and measure bi-directional flow as a standard.
4. The sensor shall consist of a stainless steel flow tube with ANSI B16.5 or AWWA C207 carbon steel or stainless steel flanges. The flanges shall be Class 150 for 24” and smaller, and AWWA Class D for 28” and larger (listed by the application and instrument schedule).

* 1. Sensors from 1”-12” shall have fixed (welded) or rotating lap joint flanges.
  2. Sensors from 14”-120” shall have the flanges welded to the sensor body.

1. The sensor liner and electrode material shall be chosen to be compatible with the process fluid. All fluids require a minimum conductivity of 5µS/cm (20µS/cm for deionized water).
2. The sensor tube shall be lined with polyurethane, hard rubber or PTFE in accordance with NSF-61 based upon the size of the flow meter and the process media conditions.
3. The sensor shall house two measuring electrodes, a grounding electrode, and one for physical empty pipe detection. The electrodes shall be bullet-nosed shaped and made of 316L SS or Alloy C22 (listed by the application and instrument schedule).

a. Optional unrestricted mounting magnetic flowmeter sensor for applications without the typical inlet/outlet straight pipe run requirements. The full bore magnetic flowmeter in sizes 1”-120” shall maintain zero pressure loss while achieving 0.5% of rate accuracy even when mounted directly before or after a piping elbow, T-fitting or insertion device. This flow tube shall have four measuring electrodes (sizes 1-2.5”) and six measuring electrodes (sizes 3”-120”) plus a grounding electrode and an empty pipe electrode. Optional 0.2% of rate calibration is available with this sensor design however the flowmeter must be installed with the proper upstream (5 diameters) and downstream (2 diameters) pipe run requirements.

1. The external sensor housing shall enclose the coil assemblies and internal wiring. The materials shall be designed and constructed to prevent moisture ingress and promote corrosion resistance.
2. The electrode circuit shall have a minimum impedance of 1012 ohms to overcome moderate coating buildup.
3. The sensor shall be rated for NEMA 4X service as standard.
   1. An optional sensor rating for NEMA 6/IP67 service shall allow for temporary immersion in water depths of 10 feet for 168 hours OR 30 feet for 48 hours.
   2. An optional sensor rating for NEMA 6P/IP68 service shall allow for permanent immersion in water depths up to 10 feet.
4. If NEMA 6 or 6P is specified in the instrument schedule, the transmitter shall be remotely mounted and custom length cables shall be attached at the factory.
5. In the event of industrial treatment or corrosive/brackish environments, the flow sensor shall be painted and certified according to ISO-12944 corrosion class. Third party modification or sensor preparations will not be accepted without type test documentation to support the exposure conditions, depth and duration of resistance.
6. The transmitter shall be a three-stage microprocessor controller mounted integrally or remotely as specified in the instrument schedule. The transmitter shall incorporate a universal 100-240 VAC/18-30 VDC power supply. The transmitter housing will carry a NEMA 4X rating and shall be constructed to prevent moisture ingress, promote corrosion resistance, and be impervious to saline environments.

1. The transmitter shall allow local programming that can be operated through the enclosure window without opening the electrical enclosure.

2. The transmitter display shall indicate simultaneous flow rate and total flow with 3 totalizers (forward, reverse and net total) and user-selectable engineering units, readout of diagnostic error messages, and support 12 standard languages.

3 The transmitter shall safeguard against entering of invalid data for the particular meter size and all programming parameters shall be access-code protected with a minimum requirement of dual passwords according to data sensitivity.

4. The transmitter output shall be specified, as either:

a. 4-20mA HART®, 0-20mA, pulse/frequency/switch.

b. Modbus RS-485

c. Profibus® DP

d. Or a standard, unmodified form of Ethernet (ex. EtherNet/IP™)

5. The transmitter output(s) shall be integral to the magnetic flowmeter transmitter electronics and using an external third party signal converter is unacceptable.

6. There shall be no limitation of transmitter operational capability or diagnostic dependency between integral and compact mounting orientation.

7. The transmitter output selected must be supported by add-on instructions (AOI), Level 3 add-on profiles (AOP), device drivers (DD), general station description (GSD) files, instructions and pre-engineered code.

8. The transmitter shall support commissioning options via a service interface or device driver less operation via an internal web server accessible through a transmitter accessible RJ-45 Ethernet port or a WLAN (Wireless Local Area Network) connection as specified.

9. The transmitter shall retain all setup parameters and accumulated measurements internally in non-volatile memory in the event of power failure. The memory unit shall be transferrable from a damaged unit or used for a duplicate device with no loss of device parameters or data stored.

10. The transmitter shall be protected against voltage spikes from the power source with internal transient protection. Power consumption shall be no more than 16 VA, independent of meter size.

11. Device failure modes, self-monitoring characteristics and remedy diagnosis shall follow NAMUR standards NE 43 and NE 107.

12. The transmitter shall provide access to service and monitoring parameters designed to identify transient or permanent process influences.

13. The transmitter and sensor shall include a method to verify flow meter performance to the original manufacturer specifications.

a. The system shall be traceable to factory calibration using a third party, attested onboard system pursuant to ISO standards.

b. The verification technique shall not require external handhelds, interfaces, special tooling or electrical access for a verification to be performed.

c. The transmitter shall store up to eight verifications in the microprocessor.

d. A verification of the system shall be possible at any time, locally or remotely, on demand and under process conditions.

e. f. The verification report shall be compliant to common quality systems such as ISO 9000 7.6.a to prove reliability of the meter specified accuracy.

**2.03 ACCESSORIES**

* + 1. Stainless steel tag - labeled to match the contract documents.
    2. Provide grounding rings, as per manufacture’s recommendations, if required
    3. Provide sun shield for outdoor installations as required per the instrument schedule.

**2.04 SOURCE QUALITY CONTROL & CALIBRATION**

1. Magnetic flow meters shall be factory calibrated on an ISO-17025 accredited test stand per “General Requirements for the Competence of Testing and Calibration Laboratories” with certified accuracy traceable to NIST.
2. Evidence of accreditation shall originate from a national verification agency such as A2LA.
3. Each meter shall ship with a certificate of a 2-point calibration report exceeding stated standard accuracy of 0.5% of rate.
   * + 1. Optional calibration to 0.2% of rate shall be performed.
       2. An optional performance calibration for a Flat Accuracy Specification shall be performed In the event of low initial design flow rate.
4. A real-time computer generated printout of the actual calibration data points shall indicate apparent and actual flows. The flow calibration data shall be confirmed by the manufacturer and shipped with the meters to the project site.
5. The manufacturer shall provide complete documentation covering the traceability of all calibration instruments.
6. The manufacturer shall provide ISA data sheet ISA-TR20.00.01 as latest revision of form 20F2321. The manufacturer shall complete the form with all known data and model codes and dash out the inapplicable fields. Incomplete data sheets submitted will result in a rejected submittal.

**2.05 SAFETY**

A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest edition.

B. All devices shall be certified for use in hazardous areas: Class 1, Div. 2, Groups B/C; temperature rating T3 (200 deg. C)

C. All devices shall be suitable for use as non-incendive devices when used with appropriate non-incendive associated equipment. Devices with intrinsically safe ratings will normally be acceptable with vendor’s approval.

D. Electrical equipment housing shall conform to NEMA 4X classification.

E. Non-intrinsically safe electrical equipment shall be approved by a Nationally Recognized Testing Laboratory (NRTL) such as FM, UL, CSA, etc. for the specified electrical area classification.

F. Electrical equipment specified as intrinsically safe shall qualify as “simple apparatus” or NTRL approved intrinsically safe equipment per ANSI/ISA-RP12.6 “Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations,” latest edition.

***PART 3-EXECUTION***

3.01 EXAMINATION

1. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.
2. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.02 INSTALLATION

1. As shown on installation details and mechanical Drawings.
2. As recommended by the manufacturer’s installation and operation manual.
3. Specific attention should be given to the following technical requirements:
   * 1. Verify ground rings (if required) have been installed according to the manufacturer recommendations.
     2. Reduced inlet installations must either be specified in the device ordering information or accompanied by manufacturer’s documented evidence of third party testing and data collection in comparison to a traceable standard.

3.03 FIELD QUALITY CONTROL

1. Each instrument shall be tested before commissioning and the ENGINEER shall witness the interface capability in the PLC control system and associated registers.
   * + 1. Each instrument shall provide direct programming capability through the PLC
       2. Each instrument shall provide direct control of totalizer reset functions through the PLC
       3. Each instrument shall be supported with a device profile permitting direct integration in the PLC
2. The ENGINEER shall witness all instrument verifications in the field.
3. Manufacturers Field Services are available for start-up and commissioning by a Factory field service representative or a manufacturer’s authorized service provider (ASP) – the warranty against manufacturing defects is three years.
4. Manufacturer representative shall verify installation of all installed flow tubes and transmitters.
5. Manufacturer representative shall notify the ENGINEER in writing of any problems or discrepancies and proposed solutions.
6. Manufacturer representative shall perform field verification at the time of installation for long-term analysis of device linearity, repeatability and electronics health. A comparative report shall be generated for each meter tested.
7. Manufacturer representative shall generate a configuration report for each meter.

3.04 ADJUSTING

1. Verify factory setup of all instruments in accordance with the Manufacturer’s instructions.

3.05 PROTECTION

1. All instruments shall be fully protected after installation and before commissioning. Replace any instruments damaged before commissioning:
   * + - 1. The ENGINEER shall be the sole party responsible for determining the corrective measures