**SECTION 40 71 13.13**

**ELECTROMAGNETIC FLOW MEASURING SYSTEM**

**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.
2. Related Sections:
   1. Control and Information System Scope and General Requirements
   2. Powered Instruments, General

**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. Process Connection.
   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 instruments in facilities 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 CALIBRATION AND WARRANTY**

1. The meter shall have standard one year warranty from date of shipment. 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 or materials 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 accessible via a web enabled system with a license. The instrument specific information shall be accessed via serial number. When services are provided by an authorized service provider, the service information (ex. subsequent field calibrations) shall be archived and accessible via this web enabled system.

**PART 2 - PRODUCTS**

**2.01 MANUFACTURER**

1. One of the following:
2. Endress+Hauser - Promag W 500

**2.02 MANUFACTURED UNITS**

1. The flow meter shall be a flanged sensor (by application and instrument schedule) and transmitter mounted separately (remote) from the sensor.
2. The flow meter shall be microprocessor based and possess a method in which to store the sensor calibration and transmitter setup information in non-volatile memory. The electronics shall be interchangeable for meters sizes 1” – 120”
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 carry Class 150 or 300 for 24” and smaller, and AWWA Class D for 28” and larger as specified.
   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.
5. The system shall simultaneously produce multiple process variables (ex. volume flow and conductivity) while in operation.
6. The sensor liner and electrode material shall be chosen to be compatible with the process fluid. All fluids require a minimum conductivity of 5 µS/cm.
7. The sensor tube shall be lined with polyurethane, PTFE, or hard rubber in accordance with NSF-61 based upon the size of the flow meter and the process media conditions.
8. The sensor shall house two measuring electrodes, a grounding electrode, and one for physical empty pipe detection. The electrodes shall be made of 316L SS, Alloy C22, or Tantalum as specified.

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 system shall include an electrical circuit for cleaning electrodes from magnetite buildup as specified.
4. The sensor shall be rated for NEMA 4X as standard.
   1. An optional sensor rating for NEMA 6P/IP68 service shall allow for permanent immersion in water depths up to 10 feet.

12. If NEMA 6P is specified in the instrument schedule, the system shall include custom length cables which are attached to the sensor at the factory.

13. 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 shall not be accepted without type test documentation to support the exposure conditions, depth, and duration of resistance.

14. The system shall be a remote design insensitive to external vibrations and immune from external piping forces due to robust design.

1. The transmitter shall be a three-stage microprocessor controller mounted remotely as specified in the instrument schedule. The transmitter shall operate on AC (100 to 240V) or DC (24 V) via a dedicated or universal power supply as specified. 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 measurement signals from the sensor shall be conducted up to 1,000 feet to the transmitter.

2. The transmitter shall allow local or remote programming that can be operated via an optical display or WLAN connection without opening the compartment.

3. The transmitter display shall indicate simultaneous flow rate and total flow with three Totalizers (eg. forward, reverse and net total) and user-selectable engineering units, readout of diagnostic remedy messages, and support at least 19 standard languages.

4. The transmitter shall safeguard against entering of invalid data for the particular meter size and all programming parameters shall be access-code protected and retained in the embedded HistoROM.

5. The transmitter primary output shall be specified, as:

4-20mA HART, or

Modbus RS485, or

PROFIBUS PA, or

FOUNDATION Fieldbus, or

EtherNet/IP, or

PROFINET

And up to (3) secondary configurable analog I/O slots (freely programmable to 4-20mA in/output, 0-10 kHz pulse/frequency, or status input)

6. The transmitter output(s) shall be integral to the electromagnetic flowmeter transmitter electronics; using an external third party signal converter is unacceptable.

7. The transmitter output selected must be supported by Add-on Instructions (AOI), faceplates, device drivers, instructions and pre-engineered code.

8. The transmitter shall internally retain all setup parameters, calibration parameters and accumulated measurements in non-volatile memory in the event of power failure.

9. The transmitter shall be protected against voltage spikes from the power source with internal transient protection.

10. The transmitter and sensor must support an onboard, ISO traceable means of attested in-situ verification utilizing redundant references to validate measurement quality over the lifespan.

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

12. The transmitter shall support commissioning and maintenance options via a service interface for operation via an internal web server, accessible via a standard RJ-45 cable.

13. The transmitter shall include a wireless local area network (WLAN) option built into the device display with a five meter operating range. The WLAN shall permit unique SSID programming, four encryption levels and activation/deactivation of the function at the owner preference.

1. Remote configuration shall be capable of being performed thorough the programmable automation controller with common off the shelf tools, software, interfaces or gateways. Generic profiles or special tools and hardware will not be acceptable.

**2.03 ACCESSORIES**

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

**2.04 SOURCE QUALITY CONTROL & CALIBRATION**

1. Electromagnetic flow meters shall be factory calibrated on an ISO 17025 accredited test stand with certified accuracy traceable to NIST per “General Requirements for the Competence of Testing and Calibration Laboratories”
2. Evidence of accreditation must 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% or 0.2% of rate as specified.
   1. An optional calibration for 0.5% or 0.2% flat specification across the measuring range as identified in the manufacturer’s technical documentation.
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 addition.

B. All devices shall be certified for use in hazardous areas, independent of the output protocol selected.

C. At a minimum, the device shall allow installation in a Class I, Division 2, Group A to D as a non-incendive design.

D. All devices shall be suitable for use as non-incendive devices when used with appropriate non-incendive associated equipment.

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

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

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

**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’s recommendations.
     2. Reduced inlet installations must be 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