**SECTION 40 75 53**

**Process and Immersion Turbidity and Total Suspended Solids Sensor**

1. **General**
   1. **SUMMARY**
      1. Requirements for a digital sensor for process turbidity or Total Suspended Solids (TSS) measurement. For measurement a light beam will be sent through the medium and diverted from its original direction by optically denser particles (solid matter), resulting in light scatter. The sensor shall accommodate both 90° scatter that is less influenced by particle size and 135° scatter to provide sufficient signal with high numbers of particles. A dual sensor technology will allow for operation with a large range of suspended solids. The sensor will be equipped with two LED light sources, pulsed to eliminate interference from extraneous light sources, and two independent sensor units that are arranged in parallel, with application-specific analysis of both signals resulting in a stable measurement value. The sensor will incorporate Memosens® digital technology for maximum process and data integrity with simple operation. The sensor shall be calibrated prior to leaving the producing factory with calibration data including the date and time of the calibration stored within the sensor, for immediate installation.
      2. Related Sections.
         1. Control and Information Systems Scope and General Requirements.
         2. Power Instruments, General.
   2. SUBMITTALS
      1. Furnish co­mplete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer’s certifications, Manufacturer’s Field Reports.
      2. Product Data:
   3. Dimensional Drawings.
   4. Materials of Construction.
   5. Measurement accuracy.
   6. Measurement range.
   7. Enclosure Rating.
   8. Classification Rating.
   9. Power.
   10. Output options.
   11. **QUALITY ASSURANCE**
       1. Manufacturing facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.
   12. **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.
   13. **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.
   14. **CALIBRATION AND WARRANTY**
       1. Sensors shall arrive pre-calibrated and ready for installation. Calibrate in FNU, FTU or solids concentration with a standard 3 point calibration. Calibration information is to be stored in the sensor for automatic download to the transmitter, once connected.
       2. The manufacturer’s warranty does not cover normal wear and tear, damage to the sensor due to improper storage or handling, or any other mode of failure or reduced sensor life that is not a direct consequence of a manufacturing defect.
       3. The sensor and transmitter system 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.
   15. **MAINTENANCE**
       1. Provide all parts necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.
   16. **LIFE CYCLE MANAGEMENT** 
       1. 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.
2. **Products**
   1. **SYSTEMS/ASSEMBLIES**
      1. Manufacturer
         1. Endress+Hauser Turbimax CUS51D with Liquiline CM44x or CM44xR transmitter.
      2. Performance Criteria (Sensor)
         1. Range:
            1. 0 to 4000 FNU (Formazin Nephelometric Units), with a display range of 9999 FNU and solids content of 0 to 4 g/L, or
            2. 0 to 4000 FNU, with a display range of 9999 and solids content of 0 to 300 g/L (0-15% solids).
         2. Measurement error:
            1. Turbidity: less than 2% of measured value or within 0.1 FNU (whichever is greater).
            2. Solids: less than 5% of the measured value or 1% of full scale (whichever is greater); valid for sensors in the calibrated measuring range.
         3. Limit of detection (LOD):
            1. Formazine Range: 0-50 FNU; LOD: 0.006 FNU.
            2. Formazine Range: 0-9999 FNU; LOD: 0.4 FNU.
            3. Kaolin range: 0 to 4000 mg/l; LOD: 0.85 mg/l.
      3. Certifications
         1. Interference emission and interference immunity complies with EN 61326:2005, Namur CE21:2007.
      4. Environment
         1. Ambient temperature: -20 °C to 60 °C (4 °F to 140 °F).
         2. Storage temperature: -20 °C to 70 °C (4 °F to 158 °F).
         3. Process temperature: -5 °C to 50 °C (23 °F to 120 °F).
         4. Process pressure: 0.5 to 10 bar (7 to 145 psi) absolute.
         5. Minimum flow: None required
         6. Ingress protection: IP68 (test conditions 1 m (3.3 ft) water column during 60 days, 1 mol/L KCL).
   2. **MANUFACTURED UNITS**
      1. Transmitter
         1. Shall be a multi-parameter controller with up to eight measuring channels based on digital Memosens technology.
         2. Programmed computations and features resident in nonvolatile memory.
         3. Transmitter firmware shall be upgradable in the field by the user or a factory technician, without removing the transmitter from service.
         4. Transmitter shall be available in a Nema 4X field housing with integral display or a DIN rail-mount version for cabinet mounting with remote display.
         5. Digital communications provides for plug and play for all sensor configurations.
         6. Shall be capable of modification for new or extended functions by use of modular components that are easily retrofitted in the field without the aid of tools, and without the need to power down the transmitter or re-boot the system.
         7. Simple wiring for all types of digital Memosens sensors plus an option for a M12 sensor connector.
         8. Digital communications protocols available shall include the following without using an external converter. Digital communication shall be available as a native output from the sampler. Use of an external third-party signal converter is not acceptable.
            1. 4-20mA, HART.
            2. Profibus RS485 with webserver.
            3. Modbus RS485 with webserver.
            4. Modbus TCP with webserver.
            5. EtherNet/IP with webserver.

EtherNet/IP communication shall be supported with the Electronic Data Sheet (EDS) file available for download directly from the sampler. The Add-On Profile (AOP) for integration shall be a Level 3 profile to simplify control system integration.

The EtherNet/IP communications shall also be supported with Add-on Instructions (AOI) files and pre-configured faceplates for ease of control system integration.

* + - 1. Transmitter shall have an option for relay outputs, analog inputs, and discrete input/outputs.
      2. Option for integral web-server for remote operation, diagnostics and configuration.
    1. Sensor
       1. The sensor system shall be a microprocessor-based, continuous-reading, instrument. Each system shall consist of a sensor and associated transmitter.
       2. The measurement shall be based on two LED light sources and four light receivers. The LED will be used as a monochromatic light source and pulsed to eliminate interference from extraneous light sources.
       3. The sensor will employ multi-channel technology, where the two measuring signals will be detected at the four light receivers, applying the 90° or 135° scattered light method. The eight measuring signals will be processed and converted into turbidity units or solids concentration.
       4. The sensor shall have scratch-proof sapphire windows and a compact shock-proof design for installations in pipes or basins.
       5. The sensor shall only require simple commissioning with up to a 5-point calibration and 1-point adjustment.
       6. Up to seven calibration data records, according to customer specification, shall be capable of being stored.
       7. The sensor shall have as an option a pressurized air cleaning system using a primary air supply of between 22 to 30 psi.
       8. The sensor shall utilize Memosens technology for plug and play operation and having all characteristics and calibration values stored in the sensor.
  1. **ACCESSORIES**
     1. Assembly holder
        1. A modular system for sensor mounting shall be available with components for installing the sensor in open basins, channels and tanks.
        2. The mounting systems shall be capable for securing: to the ground, to the top of the wall, on the wall or directly on a rail.
        3. The mounting system shall be stainless steel construction.
     2. Compressed air cleaning
        1. Optional cleaning assemblies shall be available for in-process sensor cleaning using air or liquid
  2. SOURCE QUALITY CONTROL & CALIBRATION
     1. Any standards and cleaning solutions will be supplied with MSDS data sheets.
  3. SAFETY
     1. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest addition.
     2. All devices shall be suitable for operation in a non-hazardous area.
     3. Device failure modes, self-monitoring characteristics and diagnosis shall follow NAMUR standard NE 43.

1. EXECUTION
   1. 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.
   2. **INSTALLATION**
      1. Contractor will install the transmitter and sensor in strict accordance with the manufacturer’s instructions and recommendation.
      2. The sensor must be mounted using a suitable mounting assembly so that the sensor is always submersed in the solution to be measured.
      3. The standard one-year warranty against manufacturing defects shall be extendable to three-years on covered equipment if paid start-up service is accomplished on that covered equipment by an authorized service provider.
      4. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances for proper installation of instruments.
         1. General contractor
         2. Electrical or Instrumentation contractor
         3. Factory trained authorized service provider or representative
         4. Site (owner/operator) personnel
         5. Engineer
   3. **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 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 manufacturer authorized service provider – the warranty against manufacturing defects is three years.
         1. Manufacturer field service representative shall verify installation of all installed sensors, cables and transmitters.
         2. Manufacturer representative shall notify the ENGINEER in writing of any problems or discrepancies and proposed solutions.
         3. Manufacturer representative shall generate a configuration report for each senor installation following commissioning.
   4. **ADJUSTING**
      1. Verify factory calibration of all instruments in accordance with the Manufacturer’s instructions.
   5. **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.