

## **APPENDIX X**

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### **The Ohio State University Water and Gas Utility Systems BTU Meter**

#### **BTU Meter:**

#### 1. General

##### 1.1 Scope

- A. The main objective of this design standard is to outline the specifications of a BTU meter for chilled water (CHW) or hot water (HW) to measure the consumption of energy in total British Thermal Units (BTU) in the buildings own by the Ohio State University.
- B. The BTU meter, elements and devices, shall be custody transfer. A custody transfer measurement furnishes quantity and quality information which can be used as the basis for a change in ownership and/or a change in responsibility for materials, e.g., billing for rate of energy demand plus totalized energy transfer.
- C. Section 3 describes the general requirements for a totalizing BTU meter, primary element, transmitters, secondary elements, RTDs temperature sensor/transmitters, and a flow computer.

##### 1.2 Submittals

- A. Data sheets and catalog literature for the BTU meter, the transmitters, the RTDs temperature sensor/transmitters and the flow computer must be sent to the Ohio State University for evaluation.
- B. Interconnections and drawings for installation of the primary, secondary, and tertiary elements with the flow computer must be surrendered prior their installation.
- C. Certificates for the calculation and conformance of the BTU meter according to engineering procedures and practices, and standards, shall be supplied. Density correction with temperature and pressure for water or glycol solutions, coefficients, linear regressions, constants, equations, methodologies and basis of calculations to establish the BTU rates.
- D. Certificates of calibration for the BTU meter with water other liquid available in the calibration facility, as well as a certificate of calibration conformance for the transmitters in accordance to NIST, U.S. National Institute of Science and Technology.

## 2. Premises for the Selection of the BTU Meter

The selection of the BTU meter shall be based on the following parameters and recommendations to guarantee that the accuracy of the BTU meter relies within the  $\pm 2\%$ , and the repeatability within  $\pm 1\%$ .

- A. The supply pressure could vary between 60 and 120 psig, whereas the supply temperature change between 110 and 180°F with a return temperature 5 to 25°F lower than the supply temperature.
- B. The pipe diameter shall be known and never be reduced to install the flow sensor.
- C. The location of the components of the BTU meter shall comply with the straight-run pipes upstream and downstream recommended by the manufacturer(s). Only those meters that require a straight-run pipe distance of 15 times the diameter (15D) of the pipe or less, 10D upstream and 5D downstream, will be allowed.
- D. The volume flow rate shall be computed in gallons per minute, gpm. The flow sensor turndown shall be no less than 8 to 1.
- E. The pressure drop through the primary element, sensor, shall not be greater than 10 inches w.g.c. for the maximum volume flow rate.
- F. The flow computer shall provide a 4-20 mA signal for the energy rate in BTU/hr and/or a pulse signal for the total energy in BTU. The flow computer shall totalize the BTU rate and shall be equipped with a Modbus TCP/IP communications port or other approved remote communications capability. The flow computer must be submitted and tested by owner to prove interoperability with Utilities DCS prior to meter approval.
- G. A remote readout five feet above floor level shall be provided for those cases where the display of the BTU meter is more than six feet or less than four feet above the ground level.

## 3. Products

### 3.1 Primary Element, Flow Sensor

- A. Dual turbine insertion flow meters, embedded ultrasonic probes, or magnetic flow sensors, along with RTDs, which measure supply and return temperatures, shall be used as the primary elements of the BTU meter. The material of the components of the flow sensor and the RTDs must be 316-stainless-steel or better. The nominal size of the sensor shall match the size of the pipe where the flow sensor will be installed. The primary element shall comply with standard codes, ISO, ASME, and so on.
- B. For those cases that apply, the flow sensor shall be installed in lug type arrangement, constructed of 316 stainless steel, or better, rated for 150 psig and 250°F.
- C. Calculations, equations and/or methodology used to determine the size of the flow sensor shall be supplied to the Ohio State University for acceptance. Where applies, Reynolds number dependent equations shall be checked for maximum and minimum volume flow rates.
- D. Upstream and downstream distances shall be in conformance with the recommendations of the manufacturer, and shall be verified to fulfill the ASME Standards, if applicable.

### 3.2 Secondary Element, Transmitter(s), Multivariable Transmitter

- A. The output shall be 4-20mA with digital signal with HART protocol. The accuracy shall be at least  $\pm 0.1\%$  of span, 4 to 20mA, and  $\pm 0.07\%$  of span, digital. Drift less than  $\pm 0.1\%$  of URL over at least 8,000 hours.
- B. Range limits for the differential pressure measurement shall be 0 to 200 inches of H<sub>2</sub>O with a minimum transmitter pressure rating of 150 psi.. The transmitter shall be fed with a 120-Volt source.
- C. Programming shall be accomplished via a Windows-based software package without the need to open the enclosure. Thus maintaining the NEMA 4X integrity of the enclosure.
- D. Standard LCD indicator shall be included.
- E. The multivariable transmitter or flow computer shall provide precise and reliable measurement of absolute and differential pressure, sensor and electronics temperatures, and process temperature from an external RTD. It shall calculate water densities, or glycol solutions according to a reliable source
- F. The process connectors, NPT ½-inch, shall be 316 stainless steel. A 316 stainless steel 3-valve manifold to mount the transmitter shall be supplied. Drain/vent material and isolation valves shall be also 316 stainless steel and furnished.
- G. The multivariable transmitter or flow computer shall be supplied with shall be supplied with at least 12 feet of AWG-18 shielded twisted pair cable for the RTD input connection.

### 3.3 RTD Temperature Sensor/Transmitter

- A. A spring loaded RTD assembly with transmitter shall be furnished preferably.
- B. The temperature process input range shall be 20 to 300°F.
- C. The thermo-well shall be 316-stainless steel, long enough for the size of the process pipe, and provided with a ¾-inch NPT connection.

## 4. Certifications

### 4.1 Calibration and Calculations

- A. A conformance certificate for the calibration of the BTU meter shall be provided.
- B. A certified calculation, for the maximum and minimum volume flow rates at working conditions of temperature, pressure, additive concentration, if present, and pressure shall be supplied.
- C. Calibration of the transmitter(s), or multivariable transmitter, or flow computer shall be accomplished following NIST standards. A certification of conformance shall be submitted.

## 5. Warranty and Manuals

### 5.1 Terms

- A. The supplier/manufacturer shall train OSU personnel to program, calibrate, operate and maintain the above-mentioned devices for at least 3 hours. Training shall be scheduled within two weeks of completion of the installation.
- B. The supplier/manufacturer of the above specified equipment shall guarantee for twenty four (24) months from equipment startup or thirty (30) months from date of shipment, whichever occurs first, that the

equipment shall be free from defects in design, workmanship or materials.

- C. In the event a component fails to perform as specified or is proven defective in service during the warranty period, the manufacturer shall promptly repair or replace the defective part at no cost (freight, labor at manufacturer facility and parts) to the owner.
- D. The manufacturer or contractor shall furnish the Ohio State University with an installation, operation and maintenance manual of the BTU meter and all its components. Including the flow computer and a program manual.
- E. If necessary, Cat 5E shielded cable and conduit between the flow computer and the nearest building network switch shall be installed.

6. Inspection

A representative of Utilities Division must inspect the installation and performance of the BTU meter for acceptance and approval before commissioning.

7. Pre-approved BTU Meter Manufacturers and Models

Onicon Inc. Onicon BTU Meters. Insertion Turbine flow meters, temperature sensors and transmitters, as well as the flow computer are supplied.

Emco Ultrasonic flow meters, temperature sensors and transmitters, as well as the flow computer are supplied.

Other models and manufacturers require submittal and pre-approval by The Ohio State University Utilities Division.

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