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Introduction

The Smith Meter® Sentry™ Series Turbine Meter, Figure 1, is a volumetric flow-measuring transducer with a frequency output that is directly proportional to flow rate.

The turbine meter consists of a rotor which senses the linear velocity of a flow stream. The moving liquid imparts a rotation velocity to the rotor, which is detected electrically by a variable reluctance-type pickup coil. As the equally spaced, ferromagnetic rotor buttons pass through the magnetic field created by the pickup coil, a sinusoidal voltage is generated. The peak-to-peak voltage of this signal is directly proportional to the rotor speed and each positive peak-to-peak voltage pulse represents an increment of volume throughput.

The output per unit volume is termed K-Factor (pulses/unit volume). For a specific meter the K-Factor, as determined through a factory performance test using 0.82 specific gravity and 2 cP viscosity product, is listed on a "Turbine Meter Test Data Card" which is supplied with the meter. For maximum accuracy, the actual K-Factor must be established for a given product from on-site proving at the actual operating conditions.

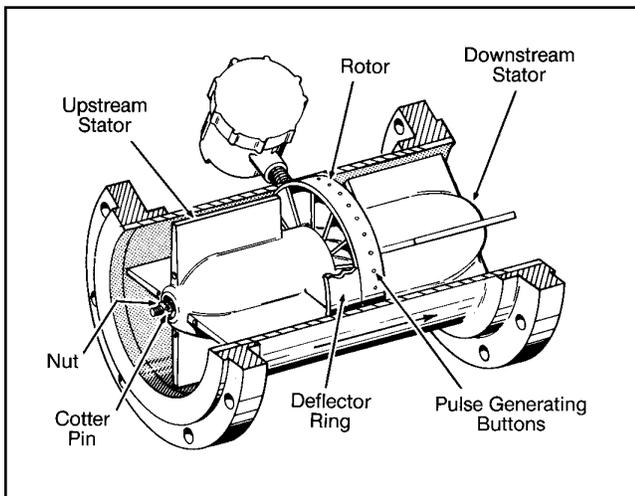


Figure 1

Receipt of Equipment

When the equipment is received, the outside packing case should be checked immediately for any shipping damage. If the packing case has been damaged, the local carrier should be notified at once regarding his liability. Carefully remove the unit from its packing case and inspect for damaged or missing parts.

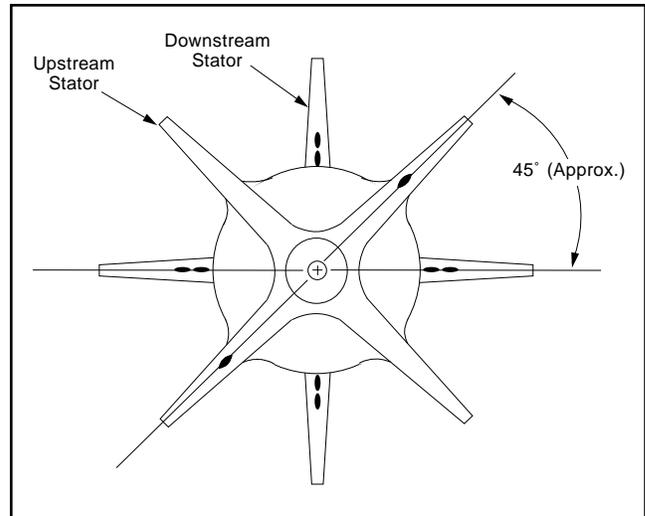


Figure 2

If damage has occurred during shipment or parts are missing, a written report should be submitted to the Customer Service Department, FMC Technologies Measurement Solutions, Inc., P.O. Box 10428, Erie Pennsylvania 16514-0428.

Prior to installation, the unit should be stored in its original packing case and protected from adverse weather conditions and abuse.

Pre-Installation Inspection

Visually inspect the meter and meter nameplate to ensure the proper size, model number, flange rating, and flow range. Note the direction of flow (described by an arrow) in which the unit was calibrated and should be installed. In the case of a bidirectional turbine meter, the "FWD" direction is the normal direction of flow; the "REV" direction is normally the backflow direction.

Check to make certain certain stators are positioned at 45° to each other (Figure 2). Tests have proven that when stators are positioned in this manner, meter accuracy is improved.

The Smith Meter Sentry Turbine Meter is a precise measuring instrument and should be treated as such. Install carefully.

When transporting the meter, make certain it is not subjected to any severe shock as bearings may be damaged. Cover flange openings to protect internals.

Section 2 – Installation

Mechanical Installation

Warning: Care must be taken in the installation of turbine meters. The installer must comply with all national, regional, and local codes.

It is recommended that turbine meters be installed in the section of piping where the pressure is highest, downstream from pumps and upstream from valves (see figure 3). When it is expected that flow will be intermittent, the turbine meter should not be mounted at or near a low point in the piping. Solids or water which settle in a low point can freeze or damage the metering element.

The piping arrangements herein described are intended to be general recommendations and, therefore, may require modification to fit your specific applications.

Back Pressure

Positive back pressure is required to prevent cavitation and inaccurate output. The required back pressure at any flow rate should be a value greater than the following approximation. Recommended Back Pressure = 2 x Pressure Drop + 1.25 x Absolute Vapor Pressure.

Example: 4-inch Turbine Meter, Flow Rate 600 gpm, Vapor Pressure 10 psia, Pressure Drop 1 psi.

Back Pressure = 2 x 1 + 1.25 x 10 = 14.5 psig.

WARNING! Thermal Pressure

Thermal expansion of liquid in this equipment can cause high pressure damage. A Thermal Pressure Relief Valve may be necessary in the system.

Strainer

A strainer should be installed to protect the flow meter and extend service life. For most installations, a 20 or 40 mesh screen is suitable.

Flow Conditioning

API Manual of Petroleum Measurements Standards, Chapter 5, Section 3–Turbine Meters, recommends that 20 diameters of straight pipe or 10 diameters with a tube bundle be installed upstream of the meter. Five diameters of straight pipe should be used downstream. However, if severe flow disturbances, such as proving connections, must be placed upstream of the meter run, it is advisable to increase the length of the upstream section as much as possible. For sequential blending manifold arrangements, separate meter factor may be required. Installation for bidirectional flow should use 20 diameters of straight pipe or 10 diameters with a tube bundle on each side of the meter. It is suggested that after the final installation, the straightening sections be dowel-pinned to the meter to provide proper alignment.

Meter Bypass

Where possible, such as in a new system, it is advisable to include a valved bypass around the metering section. This allows inspection of the meter without stopping the system flow. The bypass connections, however, should not be placed within the “meter run” (see Figure 3).

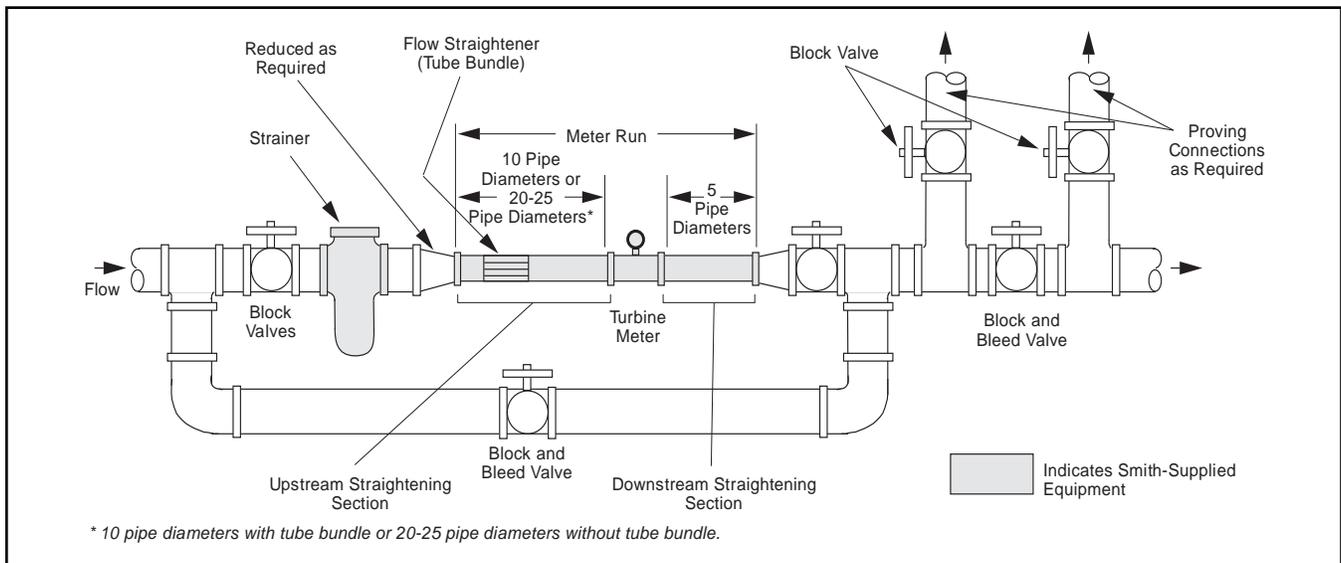


Figure 3 – Typical Sentry Series Turbine Meter Installation (Horizontal Only)

Section 2 – Installation (continued)

Electrical Installation

The Sentry Series Turbine Meters are supplied with a signal pickup coil mounted in an explosion-proof housing attached to the meter. Where the transmission distance from the meter to an electronic readout is less than 2,000 feet (609.6 m), no special amplification is required if Smith Meter electronic instruments having “Common Mode Rejection” are employed. The signal input, direct from the pickup coil, enters the readout device through a common mode noise rejection circuit. The circuit is sensitive to low level meter signals, but highly insensitive to unwanted noise interference.

In cases where the signal transmission distance is greater than 2,000 feet (609.6 m) and Smith Meter instruments are being used, or if the receiving instruments accept only pulse inputs, then a preamplifier is recommended.

The Smith Meter PA-6 Preamplifier is designed to fit in the standard explosion-proof coil housing shown in figures 4 through 7.

Recommended Signal Transmission Cable

Distance	Wire Size	Type Cable (or Equal)
Up to 2,000 ft (610 metres)	#20 AWG	2 Conductor - Belden 8762 3 Conductor - Belden 8772 4 Conductor - Alpha 2414
Up to 3,000 ft (915 metres)	#18 AWG	2 Conductor - Belden 8760 3 Conductor - Belden 8770 4 Conductor - Alpha 2424
Up to 5,000 ft (1,525 metres)	#16 AWG	2 Conductor - Belden 8719 3 Conductor - Belden 8618 4 Conductor - Alpha 3248

Note: For distances greater than 5,000 ft, a trial run should be made employing the best available engineering techniques.

Important: All cable shields must be terminated **only** at the instruments.

Electrical Installations (General)

The maximum ambient temperature for the GP Junction box w/PA-x amplifier and or UPCC/ID-2000 instrument is 70°C; if the process temperature of the Turbine meter is expected to exceed this value then the enclosure(s) shall be remotely mounted to guarantee the 70°C ambient is not exceeded.

Note: Electrical installations should only be performed by qualified technicians / electricians that are trained in the techniques that apply to hazardous locations electrical equipment.

Caution: To prevent ignition of hazardous atmospheres, disconnect from supply circuit before opening, keep enclosure tightly closed when circuits are in operation.

Warning: Enclosure may contain batteries and or capacitors, to prevent ignition of hazardous atmospheres, do not open unless area is known to be non-hazardous.

Electrical Installations Utilizing ATEX and IEC Ex Certifications

All electrical installations shall be in accordance with EN/IEC 60079-14 “Explosive atmospheres – Part 14: Electrical installations design, selection and erection”

Cable entry must be in accordance to EN/IEC 60079-1 section 13. “Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures “d”

For systems utilizing cable glands, the gland and or thread adaptor must be Ex certified. The cable end must be securely installed and depending on the cable type be properly protected from mechanical damage.

For systems utilizing conduit, an Ex certified sealing device must be used immediately at the entrance of the enclosure. Any unused entry must be suitably blocked with an Ex certified plug.

Installations Following North American Electrical Codes

All electrical installations shall be in accordance with appropriate electrical codes or with the rules provided by the regulatory authority having jurisdiction.

USA – NEC code, NFPA 70 Articles 500 – 515 as appropriate
Canada – CEC Code, CSA 22.1 as appropriate

Electrical Connections

Due to the variety of electronic totalizers used with turbine meters, only general information is provided in this manual. The installation manual for a particular totalizer should be consulted.

The two pickup bosses are positioned on the housing such that the pulses coming from the boss stamped “2” will proceed those from “1” by 90 electrical degrees. Refer to Figures 4 through 7 for suggested wiring for pickup coil and PA-6 preamplifier.

Note: When installing a high resolution rotor (24 button) in an existing 4” Sentry Series Turbine Meter, it will be necessary to switch the pickup leads (if equipped with dual pickups) in order to maintain a 90 electrical degree relationship between pickup 1 and pickup 2.

When installing conduit, a union should be installed for ease of meter removal for servicing.

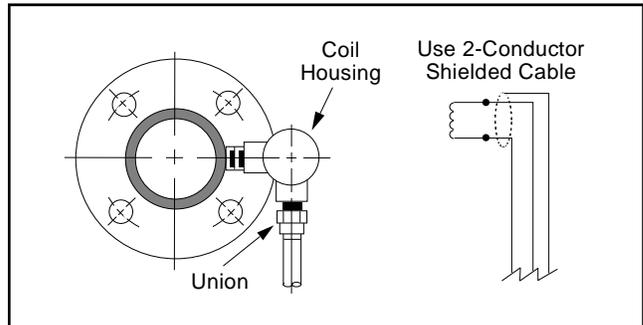


Figure 4 – 1 Coil - No Preamplifier

Section 2 – Installation (continued)

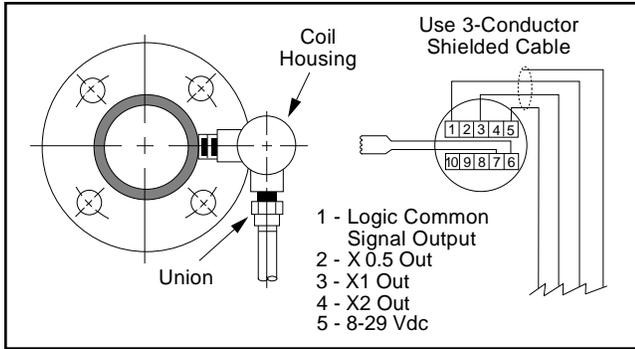


Figure 5 – 1 Coil and 1 PA-6 Preamplifier

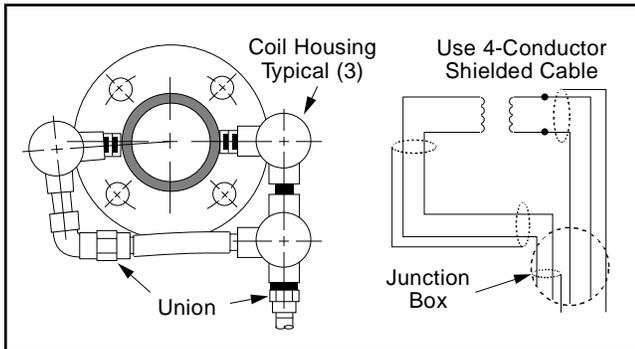


Figure 6 – 2 Coils - No Preamplifier

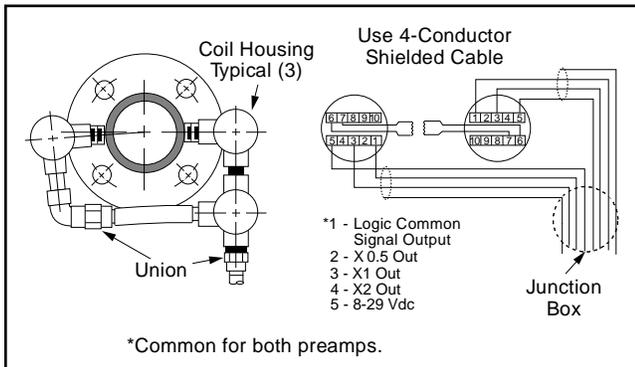


Figure 7 – 2 Coils and 2 PA-6 Preamplifiers

Typical Hook-Up

The signal leads are connected to the meter coil at one end and the appropriate readout device at the other, Figure 8. **The shielding is connected to the instrument ground only**, not at the meter and not to any earth ground. Because neither signal lead is grounded there is no polarity and, hence, either signal lead may be connected to either coil terminal.

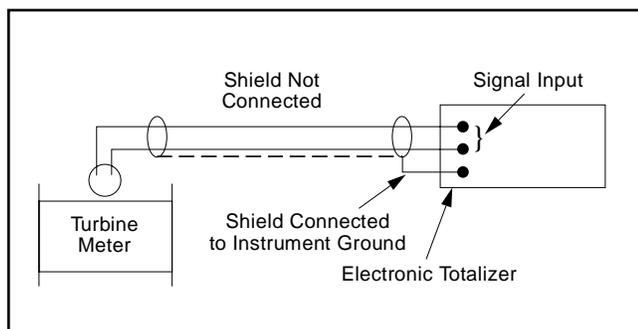


Figure 8

Proving

Once the meter has been installed into the line, it should be proved. This is normally accomplished using a displacement type prover of certified volume. Recommended procedures are covered in the API Manual of Petroleum Measurement Standards, Chapters 4 and 12. It is very important that the proving be done under conditions (flow rate, pressure, temperature, and liquid characteristics) that are as close to those of normal operation as possible.

Verify that there are no leaks (internal or external) and that all liquid going into the prover has passed through the meter.

If, during the proving, suitable repeatability of runs is not obtained and the prover is functioning properly, verify that the pickup coil is tightly in place and that there is no electrical “noise” on the pulse circuit. If proper repeatability continues, check for adequate back pressure as described in Section 2.

It may be necessary to remove the meter and inspect it for damage to the rotor, thrust bearings, or platform bearing.

Maintenance

Maintenance is normally required when proving shows a dramatic shift in the K-Factor or suitable repeatability cannot be obtained.

In some cases, the internals may have to be cleaned of buildup or deposits. Always check that the ports on the stator fins are free and clean of any debris. When draining the turbine meter installation for inspection, the line should be opened downstream of the meter so that fine debris that may be attached to the leading edges of the blades remains affixed. Draining from upstream creates a backflow that may remove this debris.

Notes:

1. When a meter is removed from the line, particularly if it has been disassembled and reassembled, it should be recalibrated for optimum accuracy.
2. These products have been designed for petroleum applications, where corrosion/erosion is normally minimum. The design has adequate material allowance for typical petroleum applications. Consult the factory for other applications or for the actual material allowances.

Section 4 – Related Publications

The following literature can be obtained from FMC Measurement Solutions Literature Fulfillment at measurement.fulfillment@fmcti.com or online at www.fmctechnologies.com/measurementsolutions.

When requesting literature from Literature Fulfillment, please reference the appropriate bulletin number and title.

Turbine Meters

Specifications

4" Through 20" Sentry Series Bulletin SS02001

Parts Lists (Form No.)¹

4" Through 20" Sentry Series P0586 through P0594

¹ The latest edition is indicated by a 2-digit postscript (e.g., 01, 02, etc.)

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