

Changes shown by ↗

SCOPE

- I 1.1 This practice covers the design and selection of flow meters and associated equipment.
- I 1.2 **Restriction and mixing orifices** are not covered by this practice.
- I 1.3 **An asterisk (*)** indicates that a decision by the Owner's Engineer is required, that additional information is to be furnished by the Owner's Engineer, or that information for Owner's Engineer approval is to be supplied by the vendor or contractor.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I *2.1 **Table 1** lists the practices and standards which shall be used with this practice as specified by the Owner's Engineer.

TABLE 1

PRACTICES			
IP 3-6-1	Piping for Instruments	IP 3-18-1	Piping Fabrication Shop or Field
IP 3-10-1	Piping Selection and Design Criteria	IP 15-6-1	Electronic and Pneumatic Instruments
IP 3-16-1	Flanged Joints, Gaskets and Bolting	IP 15-7-2	Protective Systems
STANDARDS			
API Standards		ASME Standards	
RP 551 Process Measurement Instrumentation		B16.5 Pipe Flanges and Flanged Fittings	
Manual of Petroleum Measurement Standards		B16.34 Valves Flanged, Threaded and Welding Ends	
Chapter 4 Proving Systems		B16.36 Steel Orifice Flanges Class 300, 600, 900, 1500, and 2500	
Chapter 5.2 Measurement of Petroleum Liquid Hydrocarbons by Positive Displacement Meters		B31.3 Process Piping	
Chapter 5.3 Turbine Meters		BSI Standard	
Chapter 5.5 Fidelity and Security of Flow Measurement		1042 Specification for Square-Edged Orifice Plates and Nozzles (with drain holes, Section 1.2 in pipes below 50 mm diameter, as inlet and outlet devices) and Other Orifice Plates	
Chapter 14.3 Natural Gas Fluids Measurement - Concentric, Square-edged Orifice Meters		ISO Standard	
		5167 Measurement of Fluid Flow by Means of Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular Cross Section Conduits Running Full	

MEASURING ELEMENT SELECTION

- I ↗ *3.1 Wherever suitable, the **standard flow measurement instrument** shall be a concentric square-edged orifice plate with flange taps. Other meter selections will be subject to Owner's Engineer Approval.
 - a. Where a measurement is required for internal accounting (or for other reasons) then the **accuracy requirements** will be specified by the Owner's Engineer. Pressure, temperature, or density measurements may be necessary to achieve the desired measurement accuracy.
 - b. Where the measurement is required for **custody transfer** applications, **Positive Displacement or Turbine meters shall be used for liquid** services subject to the special requirements of Section 6 of this International Practice. For **gas and vapor services an orifice meter or a turbine meter** installation shall be used subject to the special requirements of Section 5 and 6 respectively of this practice.
 - c. **Variable area flow meters** may be used in certain applications subject to the special requirements of Section 7 of this practice.
 - d. Where the **Pipe Reynolds Number (RD) is less than 10,000** then the use of a quadrant edge orifice, a conical entrance orifice or wedge meter may be considered.
 - e. Flow nozzles or venturi tubes shall be used for steam flow measurement from boilers.
 - f. All measurement element selections included in a, b, c, and d above shall be **approved by the Owner's Engineer** as shall the use of any other technique such as Venturi, Nozzle, Vortex, Coriolis, Magnetic etc. which may be required to suit specific flow measurement requirements.

IP 15-4-1		Flow Instruments	
Page 2 of 4			
Rev. 1	June 1999		

(This practice is appropriate for attachment to Inquiry or Purchase Document)

(This practice is appropriate for attachment to Inquiry or Purchase Document)

STANDARD ORIFICE METER INSTALLATION

- R 4.1 The **minimum pipe size** for an orifice plate installation shall be NPS 2 (50 mm). Where the process line size is less than NPS 2 (50 mm), then the line size shall be increased for the length of the metering run. If this is not possible, then an integral orifice or a prefabricated meter run shall be used.
- O 4.2 **Flow rates and choice of differential pressure transmitters** shall be as follows:
- a. Normal flow rate shall be between 70% and 80% of the full scale flow provided that the anticipated minimum and maximum flow rates will be between 33% and 95% of the full scale flow and the accuracy of the transmitter is at least 0.25% of the calibrated span.
 - b. Where the **rangeability required is between 33% and 95%** then a single transmitter may be used.
 - * c. Where the **rangeability required is greater than 33% to 95%** then transmitter selection shall be approved by the Owner's Engineer. Smart transmitter re-ranging is preferred.
 - d. Where a differential pressure transmitter is used as a flow input to a **Protective Instrument System** (as defined by [IP 15-7-2](#)) then the transmitter range shall be such that the trip point is at least 33% of the full scale calibrated span.
- O 4.3 Orifice meter differential ranges shall be as follows:
- a. For **new piping** and existing piping up to and including NPS 4 (100 mm) if the meter d / D ratio exceeds 0.7 for a 200 in. of water (500 mbar) range then the process piping line size shall be increased for the meter run.
 - b. For **existing piping** over NPS 4 (100 mm) if the meter d / D ratio exceeds 0.75 for a 200 in. of water (500 mbar) range then the process piping line size shall be increased for the meter run.
 - c. Orifice meter differential range shall be 20, 25, 50, 100, or 200 in. of water (50, 62.5, 125, 250, or 500 mbar). A range of 100 in. (250 mbar) is preferred.
 - d. For **compressible fluids** the meter differential range in in. of water shall not exceed 1.5 times the normal upstream static pressure in psi absolute (kPa not to exceed 0.054 times the normal upstream static pressure in kPa absolute) except that for exhaust steam [approximately 30 psi (100 kPa) absolute] a 50 in. of water (125 mbar) range may be used.
- I 4.4 **Orifice plate flanges** shall be per **ANSI B16.36** and the following:
- a. Flanges shall be the **welding neck type**.
 - b. **Pressure taps** shall be equipped with round head bar stock plugs.
 - * c. **Flange rating**, facing and finish shall be specified [for raised face flanges the raised face shall not be less than 0.06 in. (1.6 mm)].
 - d. **Ring joint type orifice plates** NPS 6 (150 mm) and smaller shall be fabricated with the holder and the plate being in one piece. For sizes above NPS 6 (150 mm) the plate may be removable from the holder provided that the method of attachment securely holds the plate and minimizes any leakage between the plate and the holder.
 - * e. For other differential pressure elements, such as venturi meters, **flanged connections are preferred**. The connection technique shall be approved by the Owner's Engineer.
- I 4.5 **Orifice plate thickness** shall be the "Recommended" value given in the API Manual of Petroleum Measurement Standards Chapter 14.3 except that for NPS 6 and 8 (150 and 200 mm) services above 750°F (400°C) the plate thickness shall be 1/4 in. (6 mm).
- O 4.6 **No drain or weep hole** shall be made in any orifice plate.

CUSTODY TRANSFER ORIFICE METER INSTALLATIONS

- I 5.1 **Custody Transfer metering systems** shall be designed in accordance with the **Regional Guidelines for custody transfer**, the associated Implementation Guidelines and any specific legal requirements for the country of installation. In general, custody transfer orifice meter installations should be designed and installed in the same way as for a standard orifice meter except for the following:
- * a. The **accuracy requirements** and the need to calculate volume, mass or energy flow will be specified by the Owner's Engineer. Pressure, temperature or density measurements will be necessary to achieve the desired measurement accuracy.
 - b. The differential pressure transmitter shall have an accuracy of at least 0.1% of transmitter calibrated span. Smart transmitters are preferred.