

# 3" to 16" MV Series Turbine Meters

Bulletin SS02016 Issue/Rev. 2.2 (1/23)



## Smith Meter® Turbine Meters

The Smith Meter Multiviscosity (MV) Series turbine meter is intended for the measurement of crude oils and other products having a relatively wide range of viscosities. It provides highly accurate measurements for custody transfer and volume balance pipeline applications. The meter's design with the helical rotor and horizontal journal bearing makes the MV Series a valuable asset for any pipeline application.

**Note:** Different features and requirements are available based on where a unit is manufactured. Throughout this document, manufacturing locations are denoted with either Erie, Pennsylvania, USA, or Ellerbek, Germany. Orders must be placed with the noted location to receive a unit with the specific feature.

### Features

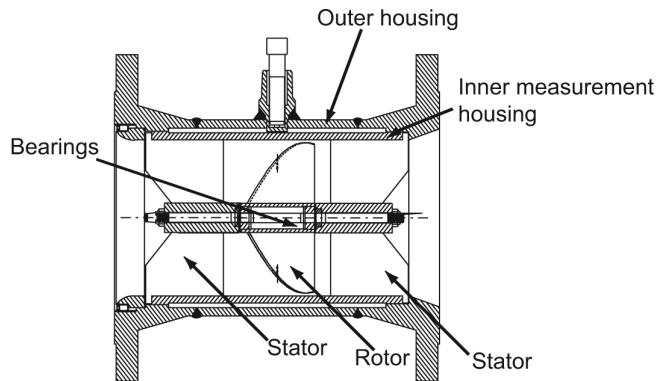
- Titanium, swept-front helical rotor design enables increased meter factor stability while minimizing the effects of contaminants or debris
- Stainless-steel, interchangeable measuring element provides ease of serviceability for corrosion-free service
- Tungsten-carbide bearings facilitate long service life and dependability on a wide variety of products
- National Association of Corrosion Engineers (NACE) compliance to MR0175/ISO 15126-1

### Options

- Viscosity correction and pulse resolution enhancement, available when used with a UPCC (refer to the UPCC specifications ([SS02017](#)))
- Turbine meter diagnostics, available when used with an AccuLERT (refer to the AccuLERT Smart Pre-Amp ID 2000 specifications ([SS02015](#)))
- PA-6 preamplifiers

## Operating Specifications

Materials of Construction	
<b>Housing and Flanges</b>	Low-temperature carbon steel
<b>Internals</b>	Measurement housing: 316 stainless steel Stators: 316 stainless steel Rotor: Titanium Bearings: Tungsten carbide



Flow Range				
Meter Sizes	Units	Normal Flow Range		Nominal K-Factor
		Minimum Rate	Maximum Rate	
3"	Barrel per hour (bph)	90	900	600
	Cubic meters per hour (m <sup>3</sup> /h)	14	140	3,775
4"	bph	190	1,900	250
	m <sup>3</sup> /h	30	300	1,570
6"	bph	400	4,000	100
	m <sup>3</sup> /h	64	640	630
8"	bph	750	7,500	40
	m <sup>3</sup> /h	119	1,190	250
10"	bph	1,250	12,500	18.5
	m <sup>3</sup> /h	199	1,990	116
12"	bph	1,900	19,000	11.1
	m <sup>3</sup> /h	302	3,020	70
16"	bph	2,700	27,000	6
	m <sup>3</sup> /h	429	4,290	38

The MV Series turbine meter is a Reynolds number (Re) dependent measurement device that accurately measures over a wide measurement turndown range (MTR).

The MTR of all turbine meters is dependent on both the flow range and the viscosity range of a given application. The ratio of flow range to viscosity range is expressed as a Re. The MTR is then determined by using the ratio of the maximum Reynolds number (Re<sub>max</sub>) over the minimum Reynolds number (Re<sub>min</sub>).

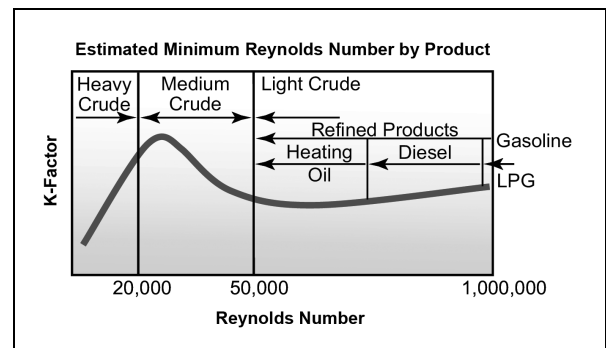
## Reynolds Number

The Re is calculated using the following equations:

$$Re_{\max} = \frac{2214 \times \text{Flow Rate}_{\max}}{\text{Meter Size} \times \text{Visc}_{\min}}$$

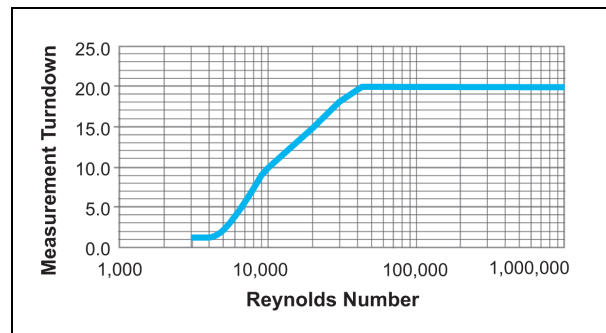
$$Re_{\min} = \frac{2214 \times \text{Flow Rate}_{\min}}{\text{Meter Size} \times \text{Visc}_{\max}}$$

The Re<sub>min</sub> determines the measurement turndown over which the meter can accurately measure.



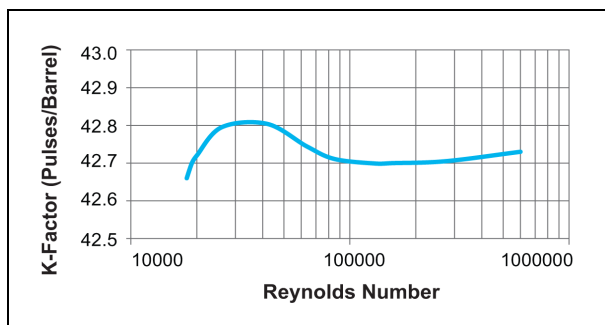
## Standard MVTM

Maximum linear measurement turndown range for a standard 8" MVTM:

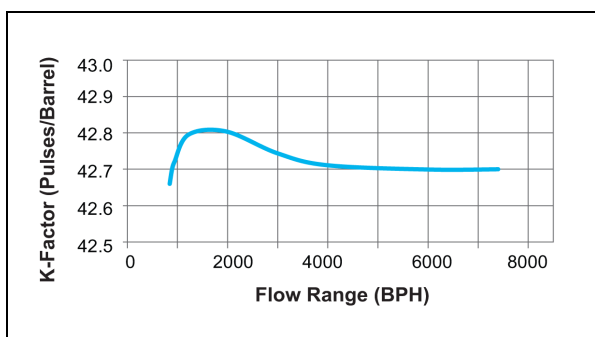


## Typical Accuracy Curve for 8" MVTM

Accuracy over the complete Re range tested on 13 centistoke (cSt) product:



Accuracy over the entire flow range tested on 13 cSt product:



## Linearity

±0.15% linearity over the approved MTR

Contact TechnipFMC for review of all applications to determine the MTR for a specific application.

## Repeatability

See repeatability information in the American Petroleum Institute (API) Manual of Petroleum Measurement Standards (MPMS) or International Organization of Legal Metrology (OIML) R-117-1.

## Material Specifications

### End Connections

The end connections are Class 150, 300, and 600 American Society of Mechanical Engineers (ASME) B16.5 with 125-250 arithmetic average roughness heights (AARH) finish raised-face (RF) flanges.

Consult the factory for higher working pressure or other types of flanges.

### Maximum Working Pressure

ASME	Carbon Steel Flanges
150	285 pounds per square inch (psi) (1,965 kilopascal (kPa))
300	740 psi (5,102 kPa)
600	1,480 psi (10,205 kPa)

### Operating Temperature Range (with low-temperature, carbon-steel flanges)

Meter with:	UL/CUL	ATEX
Pickup coil and preamp	-50 to 158 degrees Fahrenheit (°F) (-46 to 70 degrees Celsius (°C))	-40 to 158 °F (-40 to 70 °C)
Pickup coil and preamp with 24-inch standoff	-50 to 225 °F (-46 to 107 °C)	-40 to 225 °F (-40 to 107 °C)

## Pulse Output

See the PA-6 specifications ([SS02012](#)), UPCC specifications ([SS02017](#)), and AccuLERT Smart Pre-Amp ID 2000 specifications ([SS02015](#)) for information.

## Approvals

Electrical safety regulations for hazardous locations are as follows:

### North American and countries following the United States (US) National Electrical Code (NEC)

- Underwriters Laboratories (UL/CUL) File E23545; must be manufactured in the Erie, Pennsylvania, USA, plant
- Class I, Division 1, Groups C and D
- Class I, Zone 1, Tamb equal to -50 to 70 °C, IP66
- UNL-UL ENCL 4, CNL ENCL 4

### International

- International Electrotechnical Commission (IEC) Explosive Atmospheres (Ex) PTB 08.0040X (meter); may be manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, plant

Ex d IIC T3 through T6 Tamb equal to -40 to +70 °C, IP66

- IECEx PTB 10.0052X (GP junction box); may be manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany plant

Ex d IIC T4 through T6 Gb Tamb equal to -40 to +70 °C, IP66

#### **Brazil**

- UL BR-19.00079X (meter); must be manufactured in the Erie, Pennsylvania, USA, plant

Ex d IIC (T3-T6) Gb Tamb equal to -40 to +70 °C, IP66

- UL BR-19.00089X (GP junction box); must be manufactured in the Erie, Pennsylvania, USA, plant

Ex d IIC (T4-T6) Gb Tamb equal to -40 to +70 °C, IP66

#### **Russia**

- Eurasian Conformity (EAC); must be manufactured in the Ellerbek, Germany, plant
- Consult factory for others; must be manufactured in the Erie, Pennsylvania, USA, plant

#### **European Union (EU)**

- Explosive Atmospheres ATEX Directive 2014/34/EU
- PTB 08 ATEX 1034X (meter); must be manufactured in the Erie, Pennsylvania, USA, plant  
PTB 11 ATEX 1001X (meter); must be manufactured in the Ellerbek, Germany, plant  
Ex d IIC T3 through T6 Gb Tamb equal to -40 to +70 °C, IP66
- PTB 10 ATEX 1039X (GP junction box); must be manufactured in the Erie, Pennsylvania, USA, plant  
PTB 10 ATEX 1031X (GP junction box); must be manufactured in the Ellerbek, Germany, plant  
Ex d IIC T4 through T6 Gb Tamb equal to -40 to +70 °C, IP66

### **Weights and Measures**

- European Union: Measuring Instrument Directive (MID) 2014/32/EU; must be manufactured in the Ellerbek, Germany, plant

- Russia: EAC; must be manufactured in the Ellerbek, Germany, plant
- Consult factory for others; must be manufactured in the Erie, Pennsylvania, USA, plant

### **Pressure Safety Requirements**

- European Union: Pressure Equipment Directive (PED) 2014/68/EU; must be manufactured in the Ellerbek, Germany, plant
- Canadian Registration Number (CRN), consult factory; must be manufactured in the Erie, Pennsylvania, USA plant
- Consult factory for others; must be manufactured in the Erie, Pennsylvania, USA, plant

### **Electromagnetic Compatibility (EMC)**

- European Union: EMC Directive 2014/30/EU; may be manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, plant
- EN 61326-1, regarding electrical equipment for measurement, control, and laboratory use; may be manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, plant

### **Installation**

The meter must be mounted in a horizontal attitude ( $\pm 5^\circ$ ) downstream of a strainer with suitable flow conditioning according to API MPMS Chapter 5.3, followed by the system control valve.

Refer to the Models 3" Through 16" MV Series Installation/Operation Manual ([MN02009](#)) for more information.

### **Applications**

#### **Meter Selection**

Consult the factory for information.

#### **Minimum Back Pressure**

To prevent cavitation, API MPMS Chapter 5 recommends a minimum back pressure according to the following formula:

$$BP = (2 \times \Delta P) + 1.25 VP$$

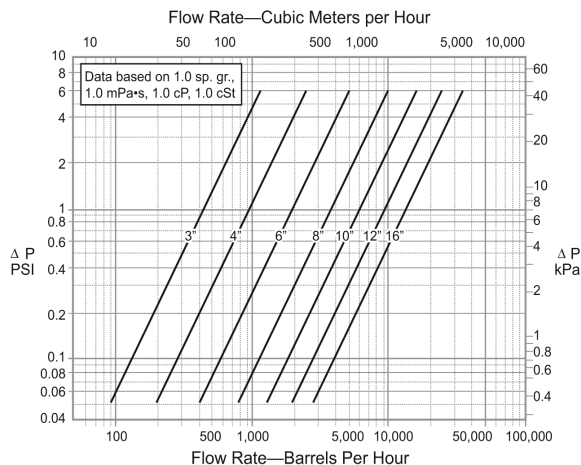
where

- BP = minimum back pressure
- $\Delta P$  = pressure drop at maximum flow rate
- VP = absolute vapor pressure at operating temperature

For example, 6" MV at 4,000 BPH -  $\Delta P$  = 4 psi, where the absolute vapor pressure of butane at operating temperature - VP = 5 psia (pound-force per square inch absolute).

$$\begin{aligned}\text{Minimum BP} &= (2 \times 4) + 1.25 (5) \\ &= 14.25 \text{ psi}\end{aligned}$$

## Pressure Drop



## Pressure Drop Correction

For liquids with other than 1.0 centipoise (cP) viscosity and 1.0 specific gravity (SG), the meter pressure drop can be estimated using the following equation:

$$\Delta P = PD \times \mu^{1/4} \times SG^{3/4}$$

where

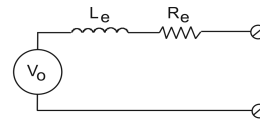
- PD = pressure drop from chart at desired flow rate
- $\mu$  = absolute viscosity (cP or millipascal-second (mPa·s))
- SG = specific gravity

For example, 6" meter at 4,000 BPH, 50 cP, 0.9 SG, where

- $\Delta P$  = 4 psi (from chart)  $(50)^{1/4} \times (0.9)^{3/4}$
- $\Delta P$  = 9.8 psi

## Pickup Coil Specifications

### Inductive Type



### Electrical Characteristics

- Effective series resistance ( $R_e$ ): 4,700 ohms ( $\pm 10\%$ )
- Effective series inductance ( $L_e$ ): 6 hertz (Hz) at 100 Hz
- Minimum open circuit voltage ( $V_o$ ): 75 millivolts peak-to-peak (mVpp) at minimum flow rate
- Maximum transmission distance: 2,000 feet (ft) (610 meters (m)) using #20 American Wire Gauge (AWG) two-conductor, shielded cable

Note: A preamplifier is recommended for remote instrumentation that does not have common-mode noise rejection. See the PA-6 specifications ([SS02012](#)) for details.

## Preamplifiers

### PA-6

Preamplifiers, optional with all MV Series turbine meters, are recommended for remote instrumentation that does not have common-mode noise rejection. See the PA-6 specifications ([SS02012](#)) for more information.

### AccuLERT

The AccuLERT smart preamplifier is available in lieu of the standard PA-6 preamplifier. See the AccuLERT Smart Pre-Amp ID 2000 specifications ([SS02015](#)) for more information.

### UPCC

The UPCC is available in lieu of the standard PA-6 preamplifier. See the UPCC specifications ([SS02017](#)) for more information.

### PA-IS-1

The PA-IS-1 intrinsically safe preamplifier is available in lieu of a standard preamplifier. This model is only Ex certified for areas accepting ATEX certifications.

## MMRT-II

The MMRT-II rate totalizer is available in lieu of a standard preamplifier. See the MMRT-II Rate Totalizer specifications ([SS09045](#)) for hazardous location certification details.

**Note:** The MMRT-II is intended as a reference-only local indication device. It does not have weights and measures approvals to be used for indications in legal-for-trade transactions.

## Catalog Code

The following guide defines the correct turbine meter for a given application and its respective catalog code. This code is part of the ordering information and should be included on the purchase order.

1	2	3	4	5	6	7	8	9	10	11
K	2	V	F	A	L	U	3	A	0	0

### Position 1: Code

K—Catalog code

### Position 2: Product Line

2—Turbine meter

### Positions 3 and 4: Model and Size

**Note:** Two pickup bosses are standard for all sizes. Additional pickup coils and preamplifiers can be added, if required.

VE—3"

VF—4"

VG—6"

VH—8"

VJ—10"

VK—12"

VM—16"

### Position 5: Pressure Class

ASME End Connections (ASME B16.5)

A—Class 150

B—Class 300

D—Class 600

## Position 6: Material and End Connections

L—Low-temperature carbon-steel RF flanges

## Position 7: Internal Configuration

U—Swept-front titanium rotor, unidirectional flow

## Position 8: Pickup Coils and Preamplifiers

**Note:** The AccuLERT also provides dual channel preamplification and online diagnostics. See specifications bulletin ([SS02015](#)) for details.

### Meter-Mounted Junction Boxes with Pickup Coils

3--Two pickup coils and two preamplifiers

E—Two PA-IS-1 with pickup coils and two PA-IS-1 preamplifiers; must be manufactured in the Ellerbek, Germany, plant

### Pickup Coils with Explosion Proof Totalizer/Flow Rate Indicator

9--MMRT-II totalizer and two pickup coils

### Pickup Coils with Online Diagnostics

T—Two pickup coils and AccuLERT XU

U—UPC compensator with one pickup coil

W—Two UPC compensators with two pickup coils

### Extended Temperature Range with Preamplifier

J—Two pickup coils and two preamplifiers on 24-inch standoffs (-40 to 225 °F)

### Extended Temperature Range with Online Diagnostics

K—Two pickup coils and AccuLERT XU on 24-inch standoff (-40 to 225 °F)

## Position 9: Testing/Linearity

### Standard Meters

0—Linearity  $\pm 0.15\%$ , tested with high-performance flow conditioner

1—Linearity  $\pm 0.15\%$ , tested with conventional flow conditioner

**Note:** All meters are tuned to a specific application. Consult factory for more information.

### **Meters Tuned for Special Conditions**

A—Linearity, specify; tested with high-performance flow conditioner

B—Linearity, specify; tested with conventional flow conditioner

### **Meters Configured for Viscosity Compensation with UPCC**

C—Linearity, specify; tested with high-performance flow conditioner

D—Linearity, specify; tested with conventional flow conditioner

### **Position 10: Compliance with Standards**

0—UL/CUL listed; must be manufactured in the Erie, Pennsylvania, USA, plant

3—ATEX/IECEX certified; must be manufactured in the Erie, Pennsylvania, USA, plant

4—ATEX/IECEX/PED certified; must be manufactured in the Ellerbek, Germany, plant

5—UL/CUL/CRN; must be manufactured in the Erie, Pennsylvania, USA, plant

6—UL Brazil; must be manufactured in the Erie, Pennsylvania, USA, plant

### **Position 11: Specials**

0—None

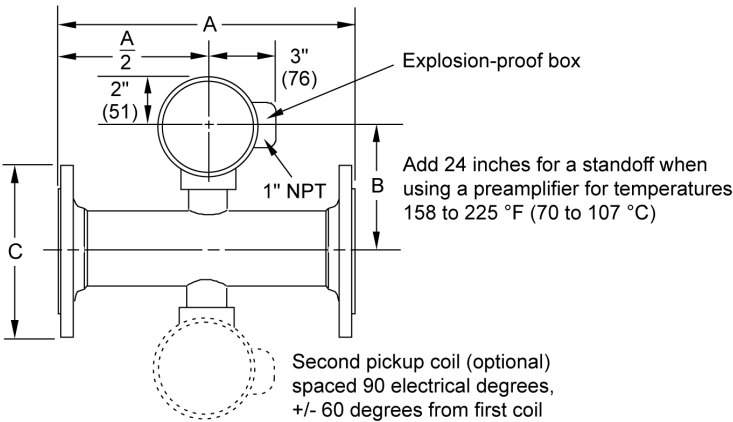
X—Special, specify



## Dimensions and Weight

The dimensions in the below drawing are shown in inches to the nearest tenth (millimeters (mm) to the nearest whole mm), each independently dimensioned from respective engineering drawings.

Consult the factory for dimensions of meters with AccuLERT and UPCC options.



Size	A	B	Class 150 ASME		Class 300 ASME		Class 600 ASME	
			C	Weight	C	Weight	C	Weight
3"	10.0 (254)	6.38 (162)	7.5 (191)	60 (27)	8.3 (211)	76 (34)	8.3 (211)	100 (45)
4"	12.0 (305)	6.8 (173)	9.0 (229)	65 (30)	10.0 (254)	85 (39)	10.8 (274)	110 (50)
6"	14.0 (356)	7.9 (201)	11.0 (279)	100 (45)	12.5 (318)	145 (66)	14.0 (356)	245 (111)
8"	16.0 (406)	8.9 (226)	13.5 (343)	155 (70)	15.0 (381)	230 (104)	16.5 (419)	320 (145)
10"	20.0 (508)	9.9 (252)	16.0 (406)	265 (120)	17.5 (445)	350 (159)	20.0 (508)	560 (254)
12"	24.0 (610)	10.0 (279)	19.0 (483)	385 (175)	20.5 (521)	575 (261)	22.0 (559)	750 (340)
16"	32.0 (813)	12.6 (320)	23.5 (597)	835 (379)	25.5 (648)	1,080 (490)	Consult factory	Consult factory

**Note:** Meter weights are by flange class with one pickup coil and explosion-proof box. Add 5 pounds (2.3 kilograms) for each additional pickup coil and explosion-proof box.





The specifications contained herein are subject to change without notice and any user of said specifications should verify from the manufacture that the specifications are currently in effect. Otherwise, the manufacturer assumes no responsibility for the use of specifications which may have been changed and are no longer in effect.

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