FMC Technologies

Smith Meter® Turbine Meters

4" to 20" Sentry™ Series

Specifications

Issue/Rev. 1.1 (3/12) Bulletin SS02001

*The **Smith Meter® Sentry™ Series Turbine Meter** is a rimmed, rotor-type meter with helical blades. They utilize both an upstream and downstream stator and have tungsten carbide bearings with a hydrodynamic thrust balance system. They provide highly accurate measurement required for custody transfer of petroleum liquids such as crude oil and refined products in larger pipelines.*

Features

- **Rimmed rotor** for durability and high resolution pulse output.
- **Helical blades** for a streamlined flow pattern less susceptible to cavitation.
- **All Stainless Steel** wetted parts for corrosion-free service.
- **Tungsten carbide bearings** provide long life on low lubricity liquids.
- **Hydrodynamic thrust balance system** to minimize friction and wear on thrust bearings which allows for long service life and high accuracy.
- **NACE Compliance** to MR0175/ISO 15156-1.

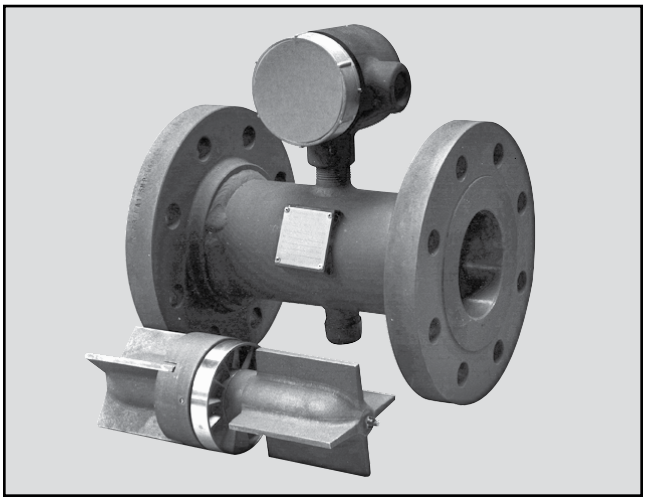
Options

- **Bidirectional flow** allows the meter to accurately register flow in either direction.
- **Multiple pickup coils** are used when direction sensing or pulse security is required. A third pickup coil is available to drive auxiliary equipment, such as a back-up counter or prover.
- **±0.10% and ±0.07% linearity available**.
- **High-resolution (HR) output** available on 4" through 8" meters to increase the pulse output per unit volume to allow proving with a smaller-size pipe prover[1].

Operating Specifications

Linearity[4]

±0.15% linearity over normal flow range.
±0.10% linearity over 5:1 flow range.
±0.07% linearity over 5:1 flow range.



4" Model Code K2DRA

Repeatability

Per API MPMS or OIML R-117-1.

Flow Range

Meter Size	Units[1]	Normal Flow Range[3]		Nominal K-Factor[1] (Pulses/Unit) ±5%
		Minimum Rate[3]	Maximum Rate	
4"[2]	BPH	200	1,500	2,100
	m^3/h	30	240	13,210
6" LF[2]	BPH	350	2,500	1,050
	m^3/h	55	400	6,615
6"[2]	BPH	500	4,000	1,050
	m^3/h	80	635	6,615
8"[2]	BPH	1,000	7,500	525
	m^3/h	160	1,195	3,300
10"	BPH	1,500	12,000	525
	m^3/h	250	1,910	3,300
12"	BPH	2,500	18,000	265
	m^3/h	400	2,860	1,670
16"	BPH	3,500	27,000	105
	m^3/h	560	4,295	662
18"	BPH	4,500	35,000	105
	m^3/h	715	5,565	662
20"	BPH	5,700	42,000	105
	m^3/h	900	6,680	662

1 Available with higher resolution (HR) pulse output than the nominal K-factor: size 4" - x1.5; sizes 6" LF, 6", and 8" - x2.
2 Metric units are nominal and may not convert precisely.
3 For bidirectional flow the minimum flow rate is 20% of the normal maximum rate.
4 Linearities and pressure drops based on 0.82 sp. gr., 1 mPa•s (1.5 cP) liquid.

Overspeed

130% of maximum flow rate for 5% duty cycle.

End Connections

Class 150, 300, 600, ANSI B16.5, 125-250 AARH finish raised face (RF) flanges.

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

Maximum Working Pressure – PSI (kPa)

ANSI	Carbon Steel	Stainless Steel
150	285 (1,965)	275 (1,896)
300	740 (5,102)	720 (4,964)
600	1,480 (10,205)	1,440 (9,929)

Meter Operating Temperature Range

Meter With	Carbon Steel Flanges	Stainless Steel Flanges
Pickup Coil	-20°F to 225°F -29°C to 107°C	-50°F to 225°F -46°C to 107°C
Pickup Coil and Preamp	-20°F to 158°F -29°C to 70°C	-50°F to 158°F -46°C to 70°C
Pickup Coil & Preamp with 24" Standoff	-20°F to 225°F -29°C to 107°C	-50°F to 225°F -46°C to 107°C

Consult factory for temperatures outside noted ranges.

Electrical Approvals

UL/CUL, Listed 557 N – Class I Groups C and D; Class I, Zone I, Group IIB; Class I, Zone I, AExd IIB T6 IP66; UNL-UL ENCL. 4, CNL-CSA ENCL. 4; Tamb -50°C to 70°C.

ATEX/IEC Ex

PTB 08 ATEX 1034X, IEC Ex PTB 08.0040X

EX d IIC T6 Tamb = -40°C to 70°C IP66.

Essential Health and Safety Requirements

EN/IEC 60079-0: Electrical apparatus for potentially explosive atmospheres – General requirements.

EN/IEC 60079-1: Electrical apparatus for potentially explosive atmospheres – Flameproof enclosures 'd'.

EN 60529: Degrees of protection provided by enclosures (IP code).

EMC Compliance: (by Council Directive 2004/108/EC)

Electromagnetic Emissions: EN 61000-6-3.

Electromagnetic Immunity: EN 55022.

IEC 61000-4-2: Electrostatic Discharge (ESD), Level 3+ (8.0 kV by contact, 12 kV by air).

IEC 61000-4-3: Radiated Electromagnetic Field, Level 3 (10 V/m)

IEC 61000-4-4: Electrical Fast Transient (Burst), Level 2 (1kV).

IEC 61000-4-5: Electrical High Energy Pulses (Surge), Installation Class 3, Criterion B.

Materials of Construction

Body Flanges (Not Wetted)	316 Series Stainless Steel Carbon Steel Optional: 304 Stainless Steel
Internals	300 Series Stainless Steel, Except 430 Stainless Steel Rotor Buttons
Bearings and Thrust Washers	Tungsten Carbide

Installation

The meter should be mounted in a horizontal attitude (±5°) within a suitable flow conditioning assembly. It is recommended that the meter be installed downstream of a strainer for protection and upstream of the system control valve.

Refer to the installation manual for full instructions.

Applications

High Viscosity

The flow range of turbine meters is reduced considerably when metering viscous liquids.

The minimum flow rate must be increased as the viscosity increases. The following relationships can be used to approximate the increase (reduction in range) that will maintain the stated linearity.

$$\text{Viscous Min. Rate} = \text{Normal Min. Rate} \times \frac{\text{Viscosity (cP)}}{\text{Meter Size (in)}}$$

Note: *Caution should be used when dealing with liquids that result in a viscous minimum rate greater than two times the normal, since variations in operating temperature can result in substantial meter factor shifts.*

Low Density

When metering light hydrocarbons such as LPG or other liquids with specific gravity less than 0.8, the flow range should be shifted upward. The amount of shift can be approximated by multiplying the normal minimum and maximum flow rates by the following factor:

$$\text{Rate Increasing Factor} = \frac{0.9}{\sqrt{S}}$$

Where: S = The specific gravity of the liquid being metered.

The increased flow rate should not exceed the meter's overspeed flow rate.

Minimum Back Pressure

In order to prevent cavitation, API M.P.M.S. Chapter 5 recommends a minimum back pressure according to the following:

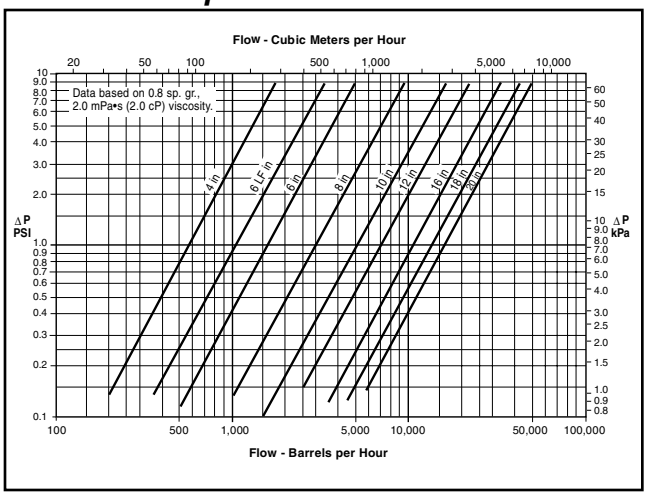
$$BP = (2 \times \Delta P) + 1.25\ Vp$$

Where: BP = Minimum back pressure
ΔP = Pressure drop at maximum flow rate
Vp = Absolute vapor pressure at operating temperature

Example:
6" Sentry at 4,000 BPH – ΔP = 6 psi.
Absolute vapor pressure of butane at operating temperature – Vp = 50 psia.

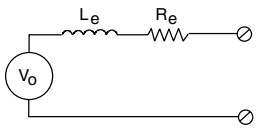
Min. BP = (2 x 6) + 1.25 (50)
= 74.5 psi

Pressure Drop[4]



Pickup Coil Specifications

Type: Variable reluctance.



Electrical Characteristics

Effective Series Resistance (R_e): 1,020 Ω (±20%).

Effective Series Inductance (L_e): 450 mH @ 1,000 Hz.

Minimum Open Circuit Voltage (V_o): 300 millivolts p/p at minimum flow rate.

Maximum Transmission Distance: 2,000 ft (610 m) using #20 AWG two-conductor, shielded cable.

Note: *A preamplifier is recommended for remote instrumentation that does not have Common Mode Noise Rejection. See Bulletin SS02012 for PA6 Preamplifier Specifications.*

Catalog Code

The following guide defines the correct Sentry Series Turbine Meter for a given application and the 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	0	A	1	0	0	0

Position 1: Code

K - Catalog Code

Position 2: Product Line

2 - Turbine Meters

Position 3: Model

D - Sentry Series – ANSI End Connections

Position 4: Size and Type

R - 4-Inch
V - 4-Inch High Resolution
F - 6-Inch Low Flow
W - 6-Inch Low Flow, High Resolution
G - 6-Inch
S - 6-Inch High Resolution
H - 8-Inch
T - 8-Inch High Resolution
J - 10-Inch
K - 12-Inch
L - 16-Inch
M - 18-Inch
N - 20-Inch

Position 5: Pressure Class

ANSI End Connections (ASME B16.5)

A - Class 150
B - Class 300
D - Class 600

Position 6: End Connections[5]

0 - Carbon Steel RF Flanges
F - 304 Stainless Steel RF Flanges

Position 7: Internal Configuration

A - Unidirectional Flow, 430 Stainless Steel Buttons
B - Bidirectional Flow, 430 Stainless Steel Buttons

Position 8: Pickup Coils and Preamplifiers

Meter Mounted Junction Box(es) with

0 - 1 Pickup Coil
1 - 1 Pickup Coil and Preamplifier
2 - 2 Pickup Coils
3 - 2 Pickup Coils and 2 Preamplifiers
4 - 2 Pickup Coils and 1 Preamplifier
7 - 3 Pickup Coils and 2 Preamplifiers
P - 3 Pickup Coils and 3 Preamplifiers

Pickup Coil(s) with Explosion Proof Totalizer/Flow Rate Indicator

8 - MMRT with PA-11 and 1 Pickup Coil
9 - MMRT with PA-11 and 2 Pickup Coils

Pickup Coil(s) with Online Diagnostics

S - 1 Pickup Coil and AccuLERT[6] XU
T - 2 Pickup Coils and AccuLERT[6] XU

Extended Temperature Range with Preamplifier on 24-Inch Standoff

D - 1 Pickup Coil and 1 Preamplifier
J - 2 Pickup Coils and 2 Preamplifiers

Extended Temperature Range with Online Diagnostics on 24-Inch Standoff

E - 1 Pickup Coil and AccuLERT[6] XU
K - 2 Pickup Coils and AccuLERT[6] XU

Extended Temperature Range with Explosion Proof Totalizer/Flow Rate Indicator on 24-Inch Standoff

F - MMRT with PA-11and 1 Pickup Coil
L - MMRT with PA-11and 2 Pickup Coils

Miscellaneous

M - INVALCO 202D Totalizer with Pickup Coil
N - INVALCO 202D Totalizer with Pickup Coil on 24 Inch Standoff
X - Special

[5] *Low temperature (below -20°F) requires stainless steel end connections.*
[6] *The AccuLERT also provides dual channel preamplification and online diagnostics.*

Catalog Code (Continued)

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

Position 9: Testing/Linearity

	Linearity
0	±0.15%
1	±0.10% (5:1 flow turndown)
2	±0.07% (5:1 flow turndown)
3	special testing

Position 10: Compliance with Standards

0 - UL/CUL Listed
3 - ATEX / IEC Ex Certified
4 - ATEX / IEC Ex / PED Certified[8]
5 - UL/CUL/CRN

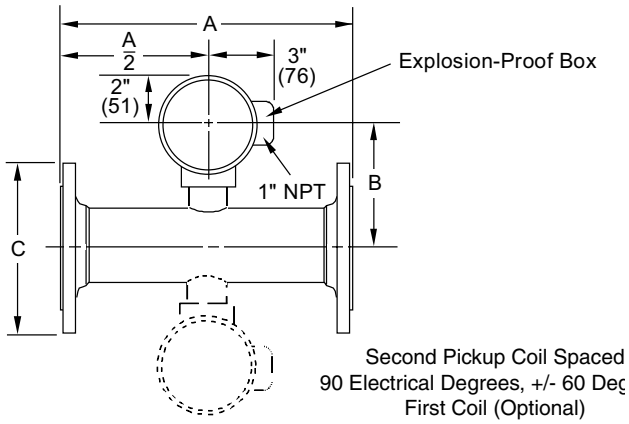
Position 11: Specials

0 - None
X - Special – Specify

Dimensions

Inches (mm) and Pounds (kg)

			Class 150 ANSI		Class 300 ANSI		Class 600 ANSI	
Size	**A**	**B[7]**	**C**	**Wt.**	**C**	**Wt.**	**C**	**Wt.**
4"	12.0 (305)	5.8 (149)	9.0 (228)	65 (30)	10.0 (254)	85 (38)	10.8 (273)	110 (50)
6"LF	14.0 (356)	6.9 (175)	11.0 (279)	135 (61)	12.5 (318)	185 (84)	14.0 (356)	295 (134)
6"	14.0 (356)	6.9 (175)	11.0 (279)	100 (45)	12.5 (318)	145 (66)	14.0 (356)	245 (111)
8"	16.0 (406)	7.9 (201)	13.5 (343)	155 (70)	15.0 (381)	230 (104)	16.5 (419)	320 (114)
10"	24.0 (610)	9.0 (228)	16.0 (406)	265 (120)	17.5 (445)	350 (159)	20.0 (508)	560 (294)
12"	30.0 (762)	10.0 (253)	19.0 (483)	385 (175)	20.5 (521)	575 (261)	22.0 (559)	750 (340)
16"	40.0 (1,016)	11.6 (294)	23.5 (597)	835 (379)	25.5 (648)	1,080 (490)		
18"	45.0 (1,143)	12.6 (320)	25.0 (635)	1,060 (481)	28.0 (711)	1,405 (638)	CF	–
20"	50.0 (1,270)	13.6 (345)	27.5 (699)	1,510 (686)	CF	–	CF	–



Note: *Dimensions – Inches to the nearest tenth (millimetres to the nearest whole mm), each independently dimensioned from respective engineering drawings.*

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

7 Add 24" for a standoff when using a preamplifier for temperatures 158°F to 225°F (70°C to 107°C).
8 PED required for all European Countries; equipment must be manufactured by Ellerbek, Germany facility.

Revisions included in SS02001 Issue/Rev. 1.1 (3/12):
Revised Repeatability on page 1.

Contact information is subject to change. For the most current contact information, visit our website at www.fmctechnologies.com/measurementsolutions and click on the "Contact Us" link in the left-hand column.

Headquarters:
500 North Sam Houston Parkway West, Suite 100, Houston, TX 77067 USA, Phone: +1 (281) 260 2190, Fax: +1 (281) 260 2191

Measurement Products and Equipment:
Erie, PA USA +1 (814) 898 5000
Ellerbek, Germany +49 (4101) 3040
Barcelona, Spain +34 (93) 201 0989
Beijing, China +86 (10) 6500 2251
Buenos Aires, Argentina +54 (11) 4312 4736
Burnham, England +44 (1628) 603205
Dubai, United Arab Emirates +971 (4) 883 0303
Los Angeles, CA USA +1 (310) 328 1236
Melbourne, Australia +61 (3) 9807 2818
Moscow, Russia +7 (495) 5648705
Singapore, +65 6861 3011

Integrated Measurement Systems:
Corpus Christi, TX USA +1 (361) 289 3400
Kongsberg, Norway +47 (32) 286700
Dubai, United Arab Emirates +971 (4) 883 0303

Visit our website at www.fmctechnologies.com/measurementsolutions