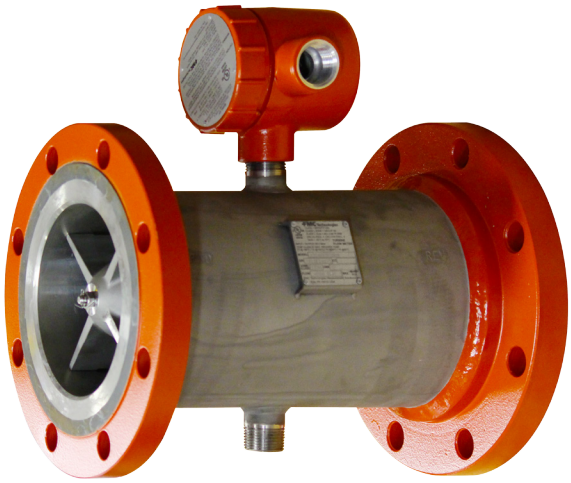
4" to 20" Sentry™ Series

Bulletin SS02001 Issue/Rev. 1.5 (2/18)



Model Code K2DG

Smith Meter® Turbine Meters

The Smith Meter® Sentry™ Series Turbine Meter is a rimmed, rotor-type meter with helical blades. Sentry Series Turbine Meters utilize both an upstream and downstream stator and have tungsten carbide bearings with a hydro-dynamic 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.

Repeatability

Per API MPMS or OIML R-117-1.

Flow Range

Meter Sizes	Units[1]	Normal Flow Range[3]		Nominal K-Factor[1] (Pulses/Unit) ±5%
		Min. Rate[3]	Max. Rate	
4"[2]	BPH	150	1,500	2,100
	m^3/h	24	240	13,210
6" LF[2]	BPH	250	2,500	1,050
	m^3/h	40	400	6,615
6"[2]	BPH	400	4,000	1,050
	m^3/h	64	635	6,615
8"[2]	BPH	750	7,500	525
	m^3/h	120	1,195	3,300
10"	BPH	1,200	12,000	525
	m^3/h	191	1,910	3,300
12"	BPH	1,800	18,000	265
	m^3/h	286	2,860	1,670
16"	BPH	2,700	27,000	105
	m^3/h	430	4,295	662
18"	BPH	3,500	35,000	105
	m^3/h	557	5,565	662
20"	BPH	4,200	42,000	105
	m^3/h	668	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, ASME 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)		
ASME	**Carbon Steel Flanges**	**Stainless Steel Flanges**
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 Flange**
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 and 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.

Approvals

Electrical Safety for Hazardous Locations

North American (United States and Canada) and countries following the US NEC Code

UL/CUL File E23545
Class I, Division I, Groups C & D
Class 1, Zone 1, Tamb = -50° to 70°C, IP66
UNL-UL ENCL 4, CNL ENCL 4

International

IECEx PTB 08.0040X (meter)
Exd IIC T3 - T6 Tamb = -40°C to +70°C, IP66

IECEx PTB 10.0052X (GP Junction Box)
Exd IIC T4 - T6 Gb Tamb = -40°C to +70°C, IP66

European Union: ATEX – Explosive Atmospheres Directive, ATEX 2014/34/EU
PTB 08 ATEX 1034X (meter)
Exd IIC T3 - T6 Tamb = -40°C to +70°C, IP66

PTB 10 ATEX 1039X (GP Junction Box)
Exd IIC T4 - T6 Gb Tamb = -40°C to +70°C, IP66

Weights and Measures

PTB Issued OIML R117-1 Test Report

European Union: MID – Measuring Instrument Directive, MID 2014/32/EU

Consult Factory for others

Pressure Safety Requirements

European Union: PED – Pressure Equipment Directive, PED 2014/68/EU

CRN – Canadian Registration Number – Consult Factory

Electromagnetic Compatibility

European Union: EMC Compliance by Council Directive EMC Directive 2014/30/EU
EN 61326-1: Electrical equipment for measurement, control and laboratory use.

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

Installation

The meter must be mounted in a horizontal attitude (±5°) within a suitable flow conditioning assembly and 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 **MN02003** 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.

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

Formula valid for:

Viscosity (cP) > 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 minimum flow rate should be shifted upward. The amount of shift can be approximated by multiplying the normal minimum flow rate 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:

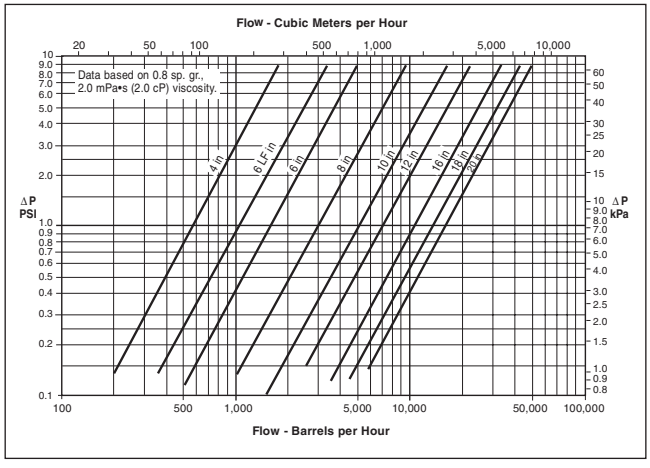
$$BP = (2 \times \Delta P) + 1.25\ Vp$$

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.

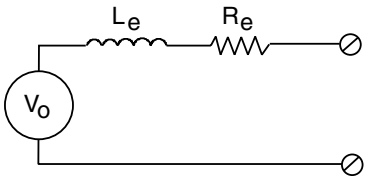
Min. BP = (2 x 6) + 1.25 (50)
= 74.5 psi

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

Notes: *A preamplifier is recommended for remote instrumentation that does not have Common Mode Noise Rejection. See Bulletin* ***SS02012*** *for PA-6 Preamplifier Specifications.*

4 Linearities and pressure drops based on 0.82 sp. gr., 1 mPa•s (1.5 cP) liquid.

Catalog Code

The following guide defines the correct Sentry 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	D	F	A	0	A	1	0	0	0

Position 1: Code

K - Catalog Code

Position 2: Product Line

2 - Turbine Meter

Position 3: Model

D - Sentry Series – ASME 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

ASME 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[8] with PA-11 and 1 Pickup Coil
9 - MMRT[8] 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[8] with PA-11 and 1 Pickup Coil
L - MMRT[8] with PA-11 and 2 Pickup Coils

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

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[7] Certified
5 - UL / CUL / CRN

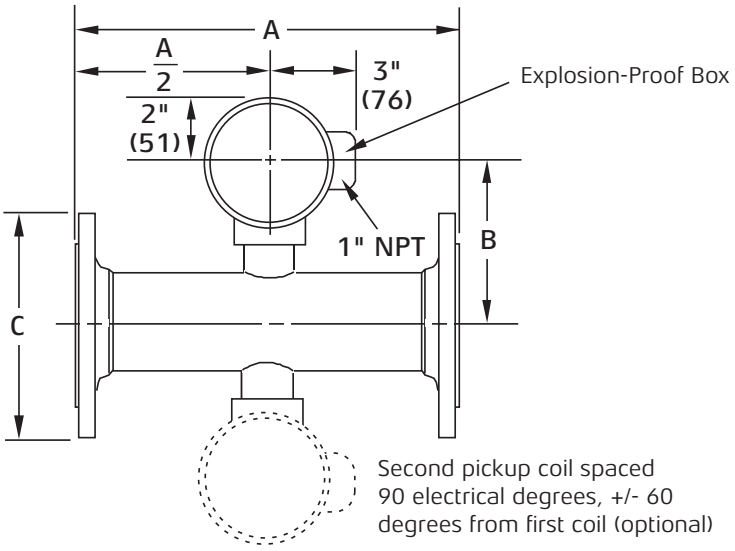
Position 11: Specials

0 - None
X - Special - Specify

5 Low temperature (below -20°F) requires stainless steel end connections.
6 The AccuLERT also provides dual channel preamplification and online diagnostics. - for details see **SS02015**.
7 PED required for all European countries; equipment must be manufactured by Ellerbek, Germany facility.
8 Hazardous locations certificate not available, enclosure meets the requirements for CLI, Div 1, Groups C&D, for details see **SS09040**.

Dimensions and Weight

Inches (mm) and Pounds (kg)



Dimensions – inches to the nearest tenth (millimeters to the nearest whole mm), each independently dimensioned from respective engineering drawings.

			Class 150 ASME		Class 300 ASME		Class 600 ASME	
Size	**A**	**B[9]**	**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: 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.

9 Add 24" for a standoff when using a preamplifier for temperatures 158°F to 225°F (70°C to 107°C).

Revisions included in SS02001 Issue/Rev. 1.5 (2/18):
Page 2: Approvals section updated. Footnotes 8 - 10 have been added/adjusted.

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