1.5" to 4" Guardsman Series (G) Models Turbine Meters

SS02002 Issue/Rev. 1.5 (11/25)

Smith Meter® Turbine Meters

The Smith Meter Guardsman (G) Series Turbine Meters are a bladed, rotor-type meter containing an upstream, cantilevered stator to support the horizontal, tungsten carbide, journal-bearing mounted rotor. These meters are intended for the measurement of a wide range of petroleum, petrochemical, and chemical custody-transfer measurement applications, including small product pipelines ranging from natural gas liquids (NGL) to light fuel oils.

The model specifications provided in this document are for the G Series 1.5" to 4" horizontal journal-bearing meter.

NOTE: Different features and requirements are available based on where the meter 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

- Stainless-steel measuring chamber and internals
- Locking stator that prevents wear and improves performance
- Tungsten carbide bearings system that provides long life on low-lubricating fluids
- Hydrodynamic thrust balance, which minimizes friction and wear on thrust bearings and facilitates long service life and high accuracy
- 125 to 250 arithmetic average roughness height (AARH) flange-face finish

Options

- Bidirectional flow, which enables the meter to accurately register flow in either direction
- Multiple pickup coils, used when direction sensing or pulse security is required
- National Association of Corrosion Engineers (NACE) compliance, which may be necessary when dealing with liquids containing hydrogen sulfide; the meter has housing materials certified to be in compliance with the material requirements set forth in NACE standard MR-01-75
- Premium ±0.15% (not available for 1.5" meter) and super premium linearity ±0.10% (3" and 4" meters only)
- Turbine meter diagnostics (available when used with AccuLERT)
- PA-6 preamplifiers

Operating Specifications

Materials of Construction	
Body	300 series stainless steel
Flanges	Carbon steel Optional: 300 series stainless steel
Internals	300 series stainless steel, except 430 stainless steel blades and cones
Bearings and Thrust Washers	Tungsten carbide journal and bearings

Flow Range (based on 0.8 specific gravity, 1.5 millipascal second (1.5 centipoise) liquid)					
Meter Sizes	Units	Normal Flow Range		Extended Maximum	Nominal K-Factor (Pulses/Unit) ±5%
		Minimum Linear	Maximum Linear		
1.5"	US gallons per minute (USGPM)	13	140	190	240
	US barrels per hour (USBPH)	18	200	270	10,080
	Liters per minute (l/min)	50	530	710	63.4
	Cubic meters per hour (m^3/h)	3	32	43	63,400
2"	USGPM	25	280	375	125
	USBPH	36	400	535	5,250
	L/min	95	1,060	1,415	33
	m^3/h	6	64	85	33,000
3" LF	USGPM	40	420	560	75
	USBPH	55	600	800	3,158
	L/min	150	1,590	2,120	19.8
	m^3/h	9	96	128	19,800
3"	USGPM	60	650	870	52.7
	USBPH	85	930	1,240	2,215
	L/min	230	2,460	3,280	13.9
	m^3/h	14	148	198	13,900
4"	USGPM	110	1,200	1,600	25
	USBPH	160	1,700	2,270	1,050
	L/min	415	4,500	6,000	6.6
	m^3/h	25	270	360	6,600

NOTES:

- Metric units are nominal and may not convert precisely.
- For bidirectional flow, the linearity in the reverse direction is ±0.25% and the minimum linear flow rate is 20% of the normal maximum linear.
- From normal minimum to extended maximum, the linearity is normally not degenerated.
- Extended minimum is the flow rate at which the meter can provide a reliable signal, but accuracy (linearity and repeatability) may be diminished.
- Extended maximum flow rate is for intermittent operation only.

Linearity	
Normal Flow Range	
Standard	±0.25%
Premium (not available for 1.5" meter)	±0.15%
Super Premium (3" and 4" meters only)	±0.10%

Repeatability

The meter's repeatability is ±0.02% over the normal range.

End Connections

- Class 150, 300, 600, and 900 American Society of Mechanical Engineers (ASME) B16.5, 125-250 arithmetic average roughness height (AARH) raised-face (RF) finish flanges
- Nominal pressure (PN) 16, 25, and 40 Deutsches Institut für Normung (DIN) 2526 Form C flanges
- PN 63 and 100 DIN 2526 Form E flanges

Maximum Working Pressure (pounds per square inch (psi) (kilopascal (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)
900	2,220 (15,307)	2,160 (14,893)
DIN	Carbon Steel Flanges	Stainless Steel Flanges
PN16	232 (1,600)	176 (1,210)
PN25	362 (2,500)	274 (1,890)
PN40	580 (4,000)	439 (3,030)
PN63	928 (6,400)	692 (4,770)
PN100	1,450 (10,000)	1,098 (7,570)

NOTE: Maximum working pressures are for temperatures of -20 to 100 °F (-28 to 38 °C). Consult the factory for maximum working pressures at other temperatures.

Operating Temperature Range		
Pickup Coil Option	Carbon Steel Flanges	Stainless Steel Flange
Pickup coil	-20 to 225 °F (-29 to 107 °C)	-40 to 225 °F (-40 to 107 °C)
Pickup coil and preamplifier	-20 to 158 °F (-29 to 70 °C)	-40 to 158 °F (-40 to 70 °C)
Pickup coil and preamplifier with 24-inch standoff	-20 to 225 °F (-29 to 107 °C)	-40 to 225 °F (-40 to 107 °C)

NOTE: Consult factory for higher temperatures.

Approvals

Electrical safety 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 & D
- Class I, Zone 1, Tamb = -50 to 70 °C, IP66
- UNL-UL ENCL 4, CNL ENCL 4

International

- IECEx PTB 08.0040X (meter); may manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, plant

  Exd IIC T3-T6 Tamb = -40 to +70 °C, IP66
- IECEx PTB 10.0052X (GP junction box); may be manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, plant.

  Exd IIC T4-T6 Gb Tamb = -40 to +70 °C, IP66

Brazil

- UL BR 25.1036X (meter); must be manufactured in the Erie, Pennsylvania, USA, plant

  Ex d IIC (T3-T6) Gb Tamb = -40 to +70 °C, IP66
- UL BR 25.1042X (GP junction box); must be manufactured in the Erie, Pennsylvania, USA, plant

  Ex d IIC (T4-T6) Gb Tamb = -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

- Explosive Atmospheres (ATEX) Directive, ATEX 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

  Exd IIC T3-T6 Gb Tamb = -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

  Exd IIC T4-T6 Gb Tamb = -40 to +70 °C, IP66

Weights and Measures

- USA National Type Evaluation Program (NTEP) Certificate of Conformance (CC) 93-053; must be manufactured in the Erie, Pennsylvania, USA, plant
- Canadian NOA AV-2279; must be manufactured in the Erie, Pennsylvania, USA, plant
- PTB Issued International Organization of Legal Metrology (OIML) R117-1 Test Report; may manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, plant
- European Union: Measuring Instrument Directive (MID), MID 2014/32/EU; must be manufactured in the Ellerbek, Germany, plant
- Australia National Metering Identifier (NMI) 5/6B/87B; must be manufactured in the Erie, Pennsylvania, USA, plant
- Brazil: INMETRO/DIMEL 333/2020; must be manufactured in the Erie, Pennsylvania, USA, 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 (EU): Pressure Equipment Directive (PED), 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 Compliance by Council Directive EMC Directive 2014/30/EU; may manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, plant
- EN 61326-1: Electrical equipment for measurement, control and laboratory use; may manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, plant

Installation

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

Refer to the installation manual (MN02002) for detailed 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 equation can be used to approximate the increase (reduction in range) that will maintain the stated linearity:

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

NOTE: Use caution when dealing with liquids that result in a viscous minimum rate greater than two times the normal because variations in operating temperature can result in substantial meter factor shifts.

Low Density

When metering light hydrocarbons, such as liquefied petroleum gas (LPG) or other liquids with specific gravity less than 0.8, the minimum flow rate should be increased. The amount of shift can be approximated by multiplying the normal minimum flow rate by the following factor:

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

where S = the specific gravity of the liquid being metered.

Minimum Back Pressure

In order to prevent cavitation, the American Petroleum Institute (API) Manual of Petroleum Measurement Standards (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

ΔP = pressure drop at maximum flow rate

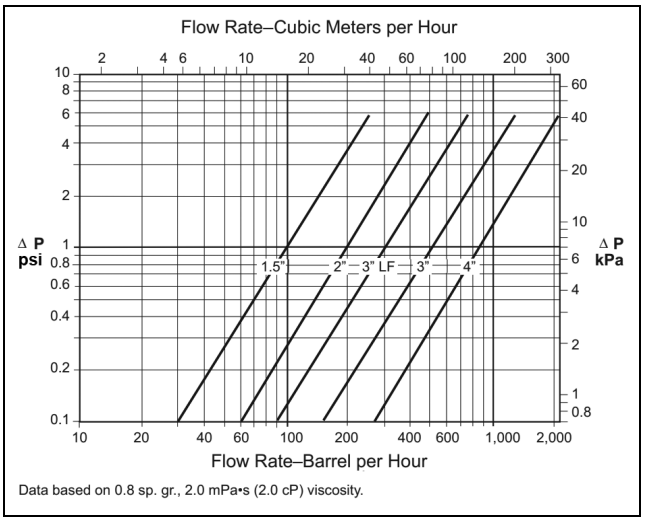
VP = absolute vapor pressure at operating temperature

For example, 3" Guardsman at 1,000 BPH - ΔP = 4 psi.

Absolute vapor pressure of butane at operating temperature - VP = 50 psia.

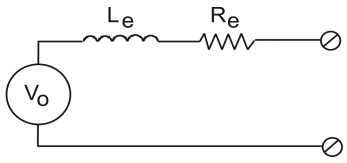
BP = (2 x 4) + 1.25 (50)
= 70.5 psig

Pressure Drop



Pickup Coil Specifications

Type: Variable reluctance



Electrical Characteristics

- Effective series resistance (R_e): 1,200 ohms (±10%)
- Effective series inductance (L_e): 400 megahertz (mH) at 1,000 hertz (Hz)
- Minimum open-circuit voltage (V_o): 300 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 preamplifier specifications (SS02012) for details.

Preampliers

PA-6

Preamplifiers, optional with all G-series models of turbine meters, are recommended for remote instrumentation that does not have common-mode noise rejection. See the PA-6 preamplifier specifications (SS02012) for more information.

AccuLERT™

The AccuLERT smart preamplifier is available in lieu of the standard PA-6 preamplifier. See the AccuLERT specifications (SS02015) 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 local rate/totalizator is available in lieu of a standard preamplifier. See the MMRT-II specifications (SS09045) for hazardous locations 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 the respective catalog code. This code is part of the meter's ordering information and should be included in purchase orders.

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

Position 1: Code

K—Catalog Code

Position 2: Product Line

2—Turbine Meter

Positions 3 and 4: Model and Size

Guardsman G Series—Journal Bearings

BA—1.5"

BB—2"

BC—3" Low Flow

BD—3"

BE—4"

Positions 5 and 6: Pressure Class and End Connections

ASME End Connections

Carbon-Steel RF Flanges

A0—Class 150

B0—Class 300

D0—Class 600

E0—Class 900

300 Series SS RF Flanges

AF—Class 150

BF—Class 300

DF—Class 600

EF—Class 900

DIN End Connections

Carbon-Steel RF Flanges

H0— PN16

J0—PN25

K0—PN40

M0—PN100

300 Series SS RF Flanges

HF—PN16

JF—PN25

KF—PN40

LF—PN63

MF—PN100

Position 7: Internal Configuration

A—Unidirectional flow, 430 stainless-steel blades

B—Bidirectional flow, 430 stainless-steel blades

Position 8: Pickup Coils and Preamplifiers

> NOTE: Note: See the AccuLERT (SS02015) and MMRT (SS09040) specifications 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 at the Ellerbek, Germany, plant

Pickup Coils with Explosion-Proof Totalizer/Flow Rate Indicator

8—MMRT-II with one pickup coil and a separate pickup coil; hazardous locations certificate not available, enclosure meets the requirements for Class I, Division 1, Groups C and D

9—MMRT-II with one PA-6 preamplifier packaged in the GP junction box; hazardous locations certificate

not available, enclosure meets the requirements for Class I, Division 1, Groups C and D

Pickup Coils with Online Diagnostics

S—One pickup coil and AccuLERT XU; the AccuLERT also provides dual channel preamplification and online diagnostics

T—Two pickup coils and AccuLERT XU; the AccuLERT also provides dual-channel preamplification and online diagnostics

Extended Temperature Range with Preamplifier

D—One pickup coil and one preamplifier on 24-inch standoff

J—Two pickup coils and two preamplifiers on 24-inch standoff

Extended Temperature with Online Diagnostics

E—One pickup coil and AccuLERT XU on 24-inch standoff; the AccuLERT also provides dual-channel preamplification and online diagnostics

K—Two pickup coils and AccuLERT XU on 24-inch standoff; the AccuLERT also provides dual-channel preamplification and online diagnostics

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

F—MMRT-II with one pickup coil and a separate pickup coil; hazardous locations certificate not available, enclosure meets the requirements for Class I, Division 1, Groups C and D

L—MMRT-II with one PA-6 preamplifier packaged in the GP junction box; hazardous locations certificate not available, enclosure meets the requirements for Class I, Division 1, Groups C and D

Position 9: Testing/Linearity

0—Standard ±0.25% linearity

1—Premium ±0.15% linearity (not available for 1.5" size)

2—Super premium ±0.10% linearity; super premium ±0.10% linearity is not available for sizes 1.5", 2", and 3" low flow

Position 10: Compliance with Electrical and Other 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/INMETRO; must be manufactured in the Erie, Pennsylvania, USA, plant

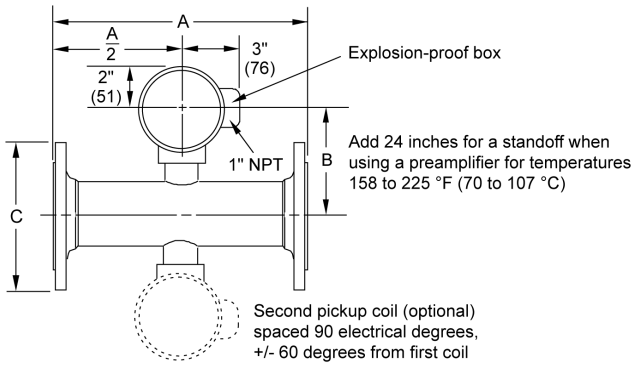
Position 11: Specials

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 MMRT-II options.



Size	A	B	Class 150 ASME		Class 300 ASME		Class 600 ASME		Class 900 ASME		
				Weight	C	Weight	C	Weight	A	C	Weight
1.5"	6.0" (152)	6.4" (162)	5.0" (127)	14 lb (6 kg)	6.1" (155)	19 lb (9 kg)	6.1" (155)	24 lb (11 kg)	9.0" (229)	7.0" (178)	40 lb (18 kg)
2"	6.5" (165)	6.6" (168)	6.0" (152)	20 lb (9 kg)	6.5" (165)	24 lb (11 kg)	6.5" (165)	33 lb (15 kg)	9.0" (229)	8.5" (216)	65 lb (30 kg)
3" and 3" low flow	10.0" (254)	5.1" (130)	7.5" (191)	65 lb (30 kg)	8.3" (211)	76 lb (34 kg)	8.3" (211)	45 lb (20 kg)	10.0" (254)	9.5" (241)	152 lb (69 kg)
4"	12.0" (30)	5.6" (142)	9.0" (229)	65 lb (30 kg)	10.0" (254)	80 lb (36 kg)	10.8" (274)	110 lb (50 kg)	12.0" (305)	11.5" (292)	160 lb (72 kg)

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

Size	PN16		PN26/PN40	
	C	Weight	C	Weight
1.5"	5.9" (150)	13 lb (6 kg)	5.9" (150)	18 lb (8 kg)
2"	6.5" (165)	20 lb (9 kg)	6.5" (165)	20 lb (9 kg)
3" and 3" low flow	7.9" (200)	55 lb (25 kg)	7.9" (200)	60 lb (27 kg)
4"	8.6" (220)	60 lb (27 kg)	9.2" (235)	66 lb (30 kg)

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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