1" to 4" Guardsman Series Loading Rack (L) Models Turbine Meters

SS02003 Issue/Rev. 2.6 (11/25)

Smith Meter® Turbine Meters

Smith Meter Guardsman Series L models are rimless-type rotor turbine meters that use an upstream stator to support the rotor. They are intended for use at loading racks to provide the highly accurate measurement required for custody transfer of petroleum liquids.

The Guardsman Series L models are as follows:

- **LB:** 1" to 1.5" horizontal or vertical locking-stator, ball-bearing meter
- **LJ:** 1.5" to 2" horizontal or vertical locking-stator, journal-bearing meter
- **LSJ:** 3" to 4" horizontal or vertical locking-stator, strate-plate, journal-bearing meter

NOTE: Different features are available based on where the meter is manufactured and are noted throughout this document.

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
- Stainless steel ball bearings (LB models) and tungsten carbide journal bearings (LJ and LSJ models) provides long life on low-lubricating fluids
- Integral-strate-plate flow conditioner (LSJ models)
- Horizontal or vertical installation
- Turbine Meter Diagnostics when used with AccuLoad III (see the AccuLoad III Turbine Meter Diagnostics applicaton bulletin (AB06061))

Options

- Dual pickup coils, used when pulse security is required
- Turbine meter diagnostics available when used with AccuLERT (see the AccuLERT Smart Pre-Amp ID 2000 specifications (SS02015))
- PA-6 preamplifiers

Operating Specifications

Materials of Construction

	LB Model	LJ and LSJ Models
Body	300 series stainless steel	
Flanges	Carbon steel	
Bearings	440C stainless steel ball type	Tungsten carbide journal and thrust

NOTE: Flanges are non-wetted on 1" through 2" and wetted on 3" and 4".

Flow Range					
Meter Sizes	Model	Units	Normal Flow Range		K-Factor (Pulses/ Units Volume) Nominal
			Minimum	Maximum	
1"	LB	US gallons per minute (USGPM)	8	80	500
		Liters per minute (l/min)	30	300	132
1.5"	LB or LJ-H	USGPM	13	130	240
		l/min	50	500	63.4
2"	LJ-H or LJ-V	USGPM	25	250	125
		l/min	95	950	33
3"	LSJ-H	USGPM	70	700	52.7
		l/min	265	2,650	13.9
3"	LSJ-V	USGPM	70	700	60
		l/min	265	2,650	15.8
4"	LSJ-H or LSJ-V	USGPM	120	1,200	25
		l/min	450	4,500	6.6

NOTES:

- Metric units are nominal and may not convert precisely.
- LB models should not be used for liquefied petroleum gas (LPG) service or on products with a viscosity of less than 0.5 centipoise (cP).
- 3" LSJ-H and LSJ-V models have physically different rotors.

Linearity		
Normal Flow Range		
1"	1.5" and 2"	3" and 4"
±0.25%	±0.25%	±0.15%

NOTE: Linearities and pressure drop are based on 0.8 specific gravity and 1.5 millipascal second (mPa•s) (1.5 cP) liquid.

Repeatability

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

End Connections

Class 150 and 300 American Society of Mechanical Engineers (ASME) B16.5, 125-250 arithmetic average roughness height (AARH) raised-face (RF) finish flanges.

Maximum Working Pressure (pounds per square inch (psi) (kilopascal (kPa))	
ASME	Carbon Steel Flanges
150	285 (1,965)
300	740 (5,102)

NOTES:

- ASME 300 is not available with the 1" LB model.
- 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	
Meter with	Range
Pickup coil	-20 to 225 °F (-29 to 107 °C)
Pickup coil and preamplifier or AccuLERT smart preamplifier	-20 to 158 °F (-29 to 70 °C)

NOTES:

- Stand off may be required on products that exceed the temperature range to maintain the rated Ex operating temperature of the Ex d enclosures.
- Consult the factory for temperatures outside the noted ranges.

Approvals

Electrical safety approvals 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, factory
- Class I, Division 1, Groups C and D
- Class I, Zone 1, temperature tambient (Tamb) = -50 to 70 °C, IP66
- UNL-UL ENCL 4, CNL ENCL 4

International

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

  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, factory

  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, factory

  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, factory

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

Russia

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

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, factory

  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, factory

PTB 10 ATEX 1031X (GP junction box); must be manufactured in the Ellerbek, Germany, factory

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, factory
- Canadian NOA AV-2279; must be manufactured in the Erie, Pennsylvania, USA, factory
- PTB Issued International Organization of Legal Metrology (OIML) R117-1 Test Report; may manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, factory
- European Union: Measuring Instrument Directive (MID), MID 2014/32/EU; must be manufactured in the Ellerbek, Germany, factory
- Australia National Metering Identifier (NMI) 5/6B/87B; must be manufactured in the Erie, Pennsylvania, USA, factory
- Brazil: INMETRO/DIMEL 333/2020; must be manufactured in the Erie, Pennsylvania, USA, factory
- Russia: EAC; must be manufactured in the Ellerbek, Germany, factory

Consult the factory for others; must be manufactured in the Erie, Pennsylvania, USA, factory.

Pressure Safety Requirements

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

Consult the factory for others; must be manufactured in the Erie, Pennsylvania, USA, factory.

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, factory
- EN 61326-1: Electrical equipment for measurement, control and laboratory use; may be manufactured in the Erie, Pennsylvania, USA, or Ellerbek, Germany, factory

Installation

The meter must be mounted in a horizontal or vertical attitude (±5°) within a suitable flow conditioning assembly or immediately downstream of a strate plate. 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 Guardsman G and L Series Installation, Operation, and Service manual (MN02002) for detailed instructions.

NOTES:

- LB models can be installed vertically (upward flow) or horizontally.
- LJ-H and LSJ-H models must be installed horizontally.
- LJ-V and LSJ-V models must be installed vertically (upward flow).

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:

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

WARNING: Use caution when dealing with liquids that result in a viscous minimum rate greater than two times the normal rate 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 SG = 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

Δ P = pressure drop at maximum flow rate

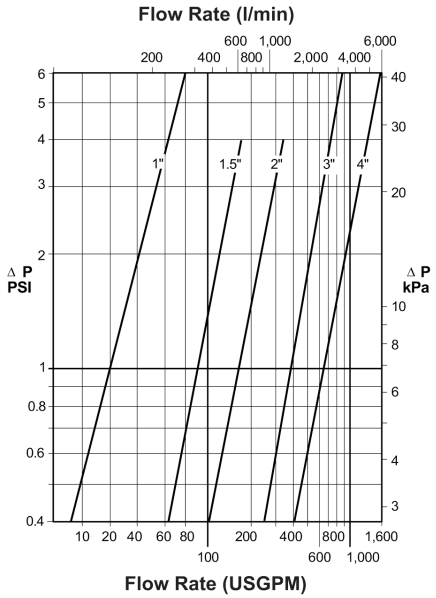
VP = absolute vapor pressure at operating temperature

For example, 3" Guardsman LSJ at 600 BPH - Δ P = 2.5 psi.

Absolute vapor pressure of gasoline at operating temperature - VP = 9.5 psia, where

$$BP = (2 \times 2.5) + 1.25\ (9.5)$$
$$= 16.9\ \text{psi}$$

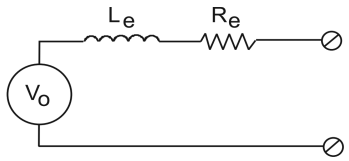
Pressure Drop



Pressure drop based on 0.8 specific gravity 1.5 mPas (1.5 cP) liquid.

Pickup Coil Specifications

Type: Variable Reluctance



Electrical Characteristics

- Effective series resistance (R_e): 1,200 ohms (±20%)
- Effective series inductance (L_e): 450 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

Preampliers

> NOTE: An optional preamplifier is recommended for remote instrumentation that does not have common-mode noise rejection.

PA-6

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.

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.

Model Code

The following guide defines the correct turbine meter for a given application and the respective model 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	C	A	A	0	0	1	1	0	0

Position 1: Code

- K—Model Code

Position 2: Product Line

- 2—Turbine Meter

Positions 3 and 4: Model and Size

Guardsman Series LB Model Horizontal and Vertical Ball Bearing ASME End Connections

- C1—1"
- CA—1.5"

Guardsman Series LJ-H Model Horizontal Journal Bearing ASME End Connections

- EA—1.5"
- EB—2"

Guardsman Series LJ-V Model Vertical Journal Bearing ASME End Connections

- PB—2"

Guardsman Series LSJ-H Model Horizontal Journal Bearing ASME End Connections

- GD—3"
- GE—4"

Guardsman Series LSJ-V Model Vertical Journal Bearing ASME End Connections

- SD—3"
- SE—4"

Positions 5: Pressure Class

ASME End Connections (ASME B16.5)

- A—Class 150
- B—Class 300

Position 6: End Connections

- 0—Carbon steel RF flanges

> NOTE: Consult the factory if stainless steel end connections are required.

Position 7: Internal Configuration

- 0—Unidirectional flow

Positions 8: Pickup Coils and Preamplifiers

Meter-mounted Junction Boxes with

- 0—One pickup coil
- 1—One pickup coil and preamplifier, standard
- 2—Two pickup coils
- 3—Two pickup coils and two preamplifiers
- 4—Two pickup coils and one preamplifier
- 7—Three pickup coils and two preamplifiers
- P—Three pickup coils and three 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

> NOTE: See MMRT-II Rate Totalizer Specifications (SS09045) for more information.

- 8—MMRT-II with one pickup coil and a separate pickup coil
- 9—MMRT-II with one PA-6 preamplifier packaged in the GP junction box

Pickup Coils with Online Diagnostics

> NOTE: The AccuLERT also provides dual channel preamplification and online diagnostics. See AccuLERT Smart Pre-Amp ID 2000 specifications (SS02015) for more information.

- S—One pickup coil and AccuLERT XU
- T—Two pickup coils and AccuLERT XU

Position 9: Testing/Linearity

Size 1" through 2"

- 0—±0.25% linearity

Sizes 3" and 4"

- C—±0.15% linearity tested with strate plate

Position 10: Compliance with Electrical and Other Standards

- 0—UL/CUL listed; must be manufactured in the Erie, Pennsylvania, USA, factory
- 3—ATEX/IECEx certified; must be manufactured in the Erie, Pennsylvania, USA, factory
- 4—ATEX/IECEx/PED certified; must be manufactured in the Ellerbek, Germany, factory
- 5—UL/CUL/CRN; must be manufactured in the Erie, Pennsylvania, USA, factory
- 6—UL Brazil/INMETRO; must be manufactured in the Erie, Pennsylvania, USA, factory

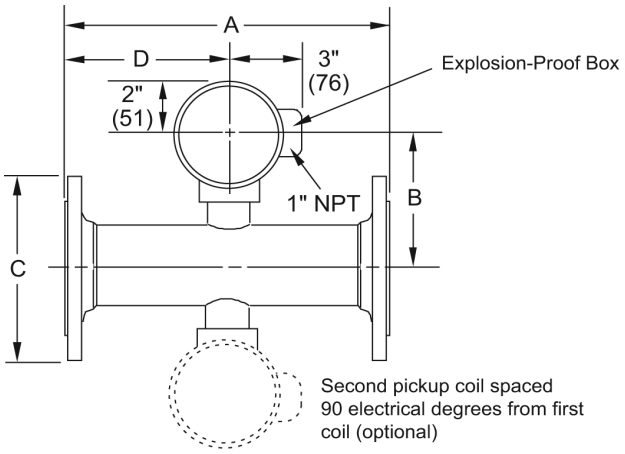
Position 11: Specials

- 0—None
- X—Special, specify

Dimensions and Weights

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		D
			C	Weight	C	Weight	
1"	5.5" (140)	5.1" (130)	4.25" (108)	12 lb (5 kg)	–	–	3.14" (80)
1.5"	6.0" (152)	5.5" (140)	5" (127)	14 lb (6 kg)	6.1" (155)	19 lb (9 kg)	3" (76)
2"	6.5" (165)	5.7" (145)	6" (152)	20 lb (9 kg)	6.5" (165)	24 lb (11 kg)	3.25" (83)
3"	10.0" (254)	6.5" (160)	7.5" (191)	60 lb (26 kg)	8.3" (211)	68 lb (31 kg)	5.28" (134)
4"	12.0" (305)	6.7 (170)	9" (229)	65 lb (29 kg)	10" (254)	80 lb (36 kg)	6.42" (163)

NOTES:

- Add 24" (609.6 mm) to dimension B, from table, for a standoff when using a preamplifier for temperatures 158 to 225 °F (70 to 107 °C).
- 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.

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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