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

Bulletin SS02003 Issue/Rev. 2.3 (4/21)

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.

Note: Different features and requirements are available based on where a unit is manufactured. Throughout this document, manufacturing locations are denoted in parentheses after a feature. You must place your order with the noted location to receive a unit with the specific feature.

3" LSJ Model with Integral Strate Plate and Dual Pickup Coils

Models

- 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

Features

- Stainless-steel measuring chamber and internals
- Locking stator prevents wear and improves performance
- Stainless steel ball bearings (LB models) and tungsten carbide journal bearings (LJ and LSJ models) provide 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 application bulletin AB06061)

Options

- Dual pickup coils, used when pulse security is required
- Turbine Meter Diagnostics when used with AccuLERT (see specification SS02015)
- PA-6 preamplifiers

Operating Specifications

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

Repeatability is ±0.02% over the normal flow range.

1 Linearities and pressure drop based on 0.8 specific gravity, 1.5 millipascal second (mPa•s) (1.5 centipoise (cP)) liquid.

Flow Range

Meter Size	Model	Units[2]	Normal Flow Range		K-Factor (Pulses/ Units Volume) Nominal
			Minimum	Maximum	
1"	LB[3]	USGPM	8	80	500
		l/min	30	300	132
1.5"	LB[3] 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"[6]	LSJ-H	USGPM	70	700	52.7
		l/min	265	2,650	13.9
3"[6]	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

End Connections

Class 150 and 300 American Society of Mechanical Engineers (ASME) B16.5, 125-250 Arithmetic Average Roughness Height (AARH) finish raised-face (RF) flanges

Maximum Working Pressure

ASME	Carbon Steel
150	285 psi (1,965 kPa)[5]
300[4]	740 psi (5,102 kPa)[5]

Meter Operating Temperature Range[7]

Meter with	Range
Pickup coil	-20 °F to 225 °F -29 °C to 107 °C
Pickup coil and preamplifier or AccuLERT smart preamplifier	-20 °F to 158 °F -29 °C to 70 °C

Consult factory for temperatures outside noted ranges.

Approvals

Electrical safety approvals for hazardous locations are as follows:

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

- Underwriters Laboratories (UL/CUL) File E23545—Erie[8]
- Class I, Division 1, Groups C & D
- Class I, Zone 1, temperature ambient (Tamb) = -50 °C to 70 °C, IP66
- UNL-UL ENCL 4, CNL ENCL 4

International

- IECEx PTB 08.0040X (meter) (Erie[8] or Ellerbek[9])
  Ex d IIC (T3-T6) Tamb = -40 °C to +70 °C, IP66
- IECEx PTB 10.0052X (GP Junction Box) (Erie[8] or Ellerbek[9])
  Exd IIC (T4-T6) Gb Tamb = -40 °C to +70 °C, IP66

Brazil

- UL BR-19.00056X (meter) (Erie[8])
  Ex d IIC (T3-T6) Gb Tamb = -40 °C to +70 °C, IP66
- UL BR-19.00089X (GP Junction Box) (Erie[8])
  Ex d IIC (T4-T6) Gb Tamb = -40 °C to +70 °C, IP66

Russia

Eurasian Conformity (EAC) (Ellerbek[9])

Consult factory for others (Erie[8])

European Union

- Explosive Atmospheres (ATEX) Directive, ATEX 2014/34/EU
- PTB 08 ATEX 1034X (meter) (Erie[8])
  PTB 11 ATEX 1001X (meter) (Ellerbek[9])
  Exd IIC T3-T6 Tamb = -40 °C to +70 °C, IP66
- PTB 10 ATEX 1039X (GP junction box) (Erie[8])
  PTB 10 ATEX 1031X (GP junction box) (Ellerbek[9])
  Exd IIC T4-T6 Gb Tamb = -40 °C to +70 °C, IP66

Weights and Measures

- USA National Type Evaluation Program (NTEP) Certificate of Conformance (CC) 93-053 (Erie[8])
- Canadian NOA AV-2279 (Erie[8])
- PTB Issued International Organization of Legal Metrology (OIML) R117-1 Test Report (Erie[8] or Ellerbek[9])
- European Union: Measuring Instrument Directive (MID), MID 2014/32/EU (Ellerbek[9])
- Australia National Metering Identifier (NMI) 5/6B/87B (Erie[8])
- Brazil: INMETRO/DIMEL 333/2020 (Erie[8])
- Russia: EAC (Ellerbek[9])

Consult Factory for others (Erie[8])

Pressure Safety Requirements

- European Union (EU): Pressure Equipment Directive (PED), PED 2014/68/EU (Ellerbek[9])
- Canadian Registration Number (CRN) Consult Factory (Erie[8])
- Consult factory for others (Erie[8])

Electromagnetic Compatibility (EMC)

- European Union: EMC Compliance by Council Directive EMC Directive 2014/30/EU (Erie[8] or Ellerbek[9])
- EN 61326-1: Electrical equipment for measurement, control and laboratory use (Erie[8] or Ellerbek[9])

2 Metric units are nominal and may not convert precisely. USGPM (US gallons per minute); L/min (Liters per minute).
3 LB models should not be used for liquefied petroleum gas (LPG) service or on products with a viscosity of less than 0.5 cP.
4 Not available with 1" LB model.
5 Maximum working pressure is for temperatures of -20 °F to 100 °F (-28 °C to 38 °C). Consult factory for maximum working pressures at other temperatures. psi (pound-force per square inch); kPa (kilopascal).
6 3" LSJ-H and LSJ-V models have physically different rotors.
7 Stand off may be required on products that exceed the temperature range to maintain the rated Ex operating temperature of the Ex d enclosures.
8 Must be manufactured in the Erie, Pennsylvania, USA plant only.
9 Must be manufactured in the Ellerbek, Germany plant only.

Materials of Construction		
	LB Model	**LJ and LSJ Models**
Body	300 Series Stainless Steel	300 Series Stainless Steel
Flanges[10]	Carbon Steel	Carbon Steel
Bearings	440C Stainless Steel Ball Type	Tungsten Carbide Journal and Thrust

Installation

- 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).

The meter should be mounted in a horizontal or vertical attitude (±5 degrees) 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 system control valve. Refer to the Guardsman G and L Series Installation/Operation/Service manual (MN02002) for full instructions.

Applications

High Viscosity

The flow range of turbine meters is considerably reduced 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:

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

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 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.

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

Minimum Back Pressure (BP)

In order to prevent cavitation, American Petroleum Institute (API) Manual of Petroleum Measurement Standards (MPMS) Chapter 5 recommends a minimum back pressure according to the following equation:

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

where BP = back pressure
ΔP = pressure change at maximum flow rate
Vp = absolute vapor pressure at operating temperature
GPM = gallons per minute
psi = pounds-force per square inch
psia = pounds-force per square inch absolute.

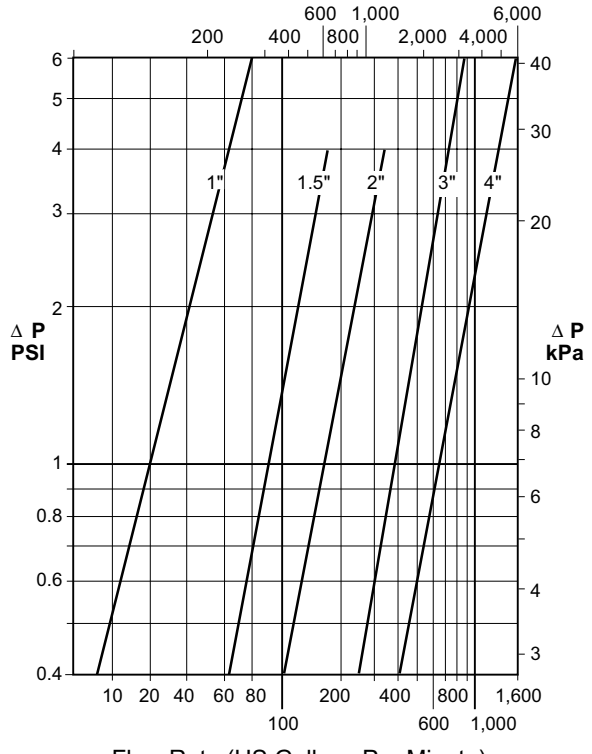
For example, 3" Guardsman LSJ at:

$$600\ GPM - \Delta P = 2.5\ psi$$

The absolute vapor pressure of gasoline at operating temperature Vp = 9.5 psia, where

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

Pressure Drop

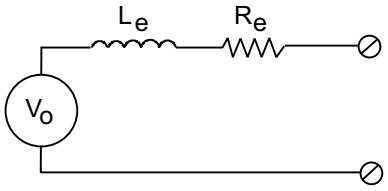


Pressure drop based on 0.8 specific gravity, 1.5 mPa·s (1.5 cP) liquid.

Pickup Coil Specifications

Type

Variable reluctance



Electrical Characteristics

- Effective Series Resistance (Re): 1,200 Ω (±20%)
- Effective Series Inductance (Le): 450 mH @ 1,000 Hz
- Minimum Open Circuit Voltage (Vo): 300 millivolts p/p at minimum flow rate
- Maximum Transmission Distance: 2,000 ft (610 meters (m)) using #20 AWG two-conductor, shielded cable

Preampliers

PA-6

Preamplifiers—optional with all Guardsman LB, LJ, and LSJ turbine meters—are recommended for remote instrumentation that does not have common mode noise rejection. See PA-6 preamplifier specifications (SS02012) for more information.

AccuLERT™

The AccuLert Smart Preamplifier is available in lieu of the standard PA-6 preamplifier. See 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 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 ordering information and should be included on the purchase order.

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—Catalog 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"

Position 5: Pressure Class

ANSI end connections (ASME B16.5)
A—Class 150
B—Class 300

Position 6: End Connections[11]

0—Carbon steel RF flanges

Position 7: Internal Configuration

0—Unidirectional flow

Position 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 (Ellerbek[9])

Pickup coils with explosion-proof totalizer/flow rate indicator
8—MMRT-II[13] with one pickup coil and a separate pickup coil
9—MMRT-II[13] with one PA-6 preamplifier packaged in the GP junction box

Pickup coils with online diagnostics
S—One pickup coil and AccuLERT[12] XU
T—Two pickup coils and AccuLERT[12] 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 (Erie[8])
3—ATEX/IECEx certified (Erie[8])
4—ATEX/IECEx/PED certified (Ellerbek[9])
5—UL/CUL/CRN (Erie[8])
6—UL Brazil/INMETRO (Erie[8])

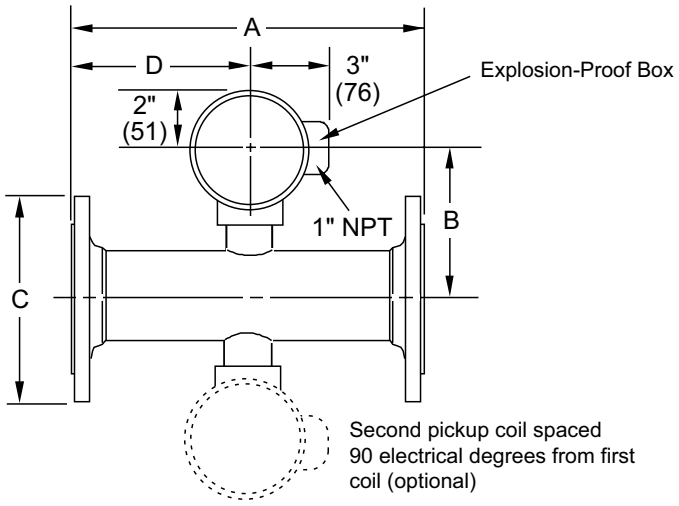
Position 11: Specials

0—None
X—Special (specify)

11 Consult factory if stainless steel end connections are required.
12 The AccuLERT also provides dual channel preamplification and online diagnostics. See specifications (SS02015) for details.
13 See MMRT-II specifications (SS09045) for details.

Dimensions and Weight

Inches (mm) and pounds (kg)



Consult factory for dimensions with AccuLert and MMRT-II options.

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

Size	A	B[14]	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)

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

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

Revisions made to SS02003 Issue/Rev. 2.3 (4/21):
Total revision.

The specifications contained herein are subject to change without notice and any user of said specifications should verify from the manufacturer 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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