DRESSER

IOM:B3
10.03

ROOTS Meters & Instruments

INSTALLATION, OPERATION & MAINTENANCE

Series B3 ROOTS® Meters Models:

Series B3: 8C175 - 56M175

Series B3-HP: 1M300 - 3M300

Series B3-HPC: 1M740 - 3M740

Series B3-HPC: 1M1480 - 7M1480

WARRANTY

Seller warrants that (i) its products will, at the F.O.B. point, be free from defects in materials and workmanship and (ii) its services will, when performed, be of good quality.

Any claim for failure to conform to the above and foregoing warranty must be made immediately upon discovery, but in any event, within eighteen (18) months following delivery of the specified product at the F.O.B. point or twelve (12) months after installation whichever is earlier, or twelve (12) months after performance of the specified services. Warranties may be extended in time pursuant to Seller's written warranties, provided payment has been received for the extension. Defective and nonconforming items must be held for Seller's inspection and returned at Seller's request, freight prepaid, to the original F.O.B. point.

Upon Buyer's submission of a claim as provided above and substantiation, Seller shall, at its option (i) either repair or replace its nonconforming product or correct or reperform its nonconforming services, as applicable, or (ii) refund an equitable portion of the purchase price attributable to such nonconforming products or services. Seller shall not be liable for the cost of removal or installation of materials or any unauthorized warranty work, nor shall Seller be responsible for any transportation cost, unless expressly authorized in writing by Seller. Any products or materials replaced by Seller will become the property of Seller. Repair or replacement of products, or correction or reperformance of services, or refund of an equitable portion of the purchase price shall be Seller's only obligation and the sole and exclusive remedy of Buyer in the event of a failure to conform to the foregoing warranty.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES (EXCEPT THAT OF TITLE) EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

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TABLE OF CONTENTS

ROOTS® Rotary Positive Displacement Gas Meters are precision measurement instruments. Although of very rugged construction, reasonable care should be given during handling and storage.

At Time of Delivery

1. Check the packing list to account for all items received.
2. Inspect each item for damage.
3. Record any visible damage or shortages on the delivery record.
    - File a claim with the carrier.
    - Notify your ROOTS® meter supplier immediately.

Do not accept any shipment with evidence of mishandling in transit without making an immediate inspection for damage and checking each meter for free rotation of the impellers. (Refer to "INSTALLATION INSTRUCTIONS" IS:B3 or contact the factory.)

All new meters should be checked for free rotation soon after arrival as damage to internal working parts can exist without obvious external evidence.

Should any serious problems be encountered during installation or initial operation of the meter, notify your ROOTS® meter supplier immediately.

Do not attempt repairs or adjustments, as doing so is a basis for voiding all claims for warranty.

If the meter is not tested or installed soon after receipt, store in a dry location in the original shipping container for added protection. Make sure the box remains horizontal with the arrow pointing up. Leave the protective caps installed in the meter flanges. The caps will provide reasonable protection against atmospheric moisture for a limited time.

Do not add oil to the meter end cover oil reservoirs until after the meter has been installed in a permanent installation and is ready for service. (Refer to INSTALLATION INSTRUCTIONS" IS:B3.)

Before initiating a test on a rotary meter that has been idle or in storage for an extended time, it is highly recommended that a few drops of oil be added to the four main shaft bearings.

"Check for free rotation" does not necessarily mean the meter will pass a test after sitting on the shelf for a year or two. The lube around the bearings has a tendency to coagulate over time. This condition can negatively affect meter test performance until the bearings loosen up. This is similar to the need to run a diaphragm meter to "loosen it up."

A small amount of oil is applied to the bearings when the meter is new or remanufactured. This is sufficient for a two point test. Meters removed from service will have remaining oil residue. New and remanufactured meters often sit in inventory for up to a year or longer. Before running an accuracy or differential test on a meter that has been sitting idle for an extended time, it is highly recommended that after applying a few drops of oil to the bearings that the meter be run at a flow rate between 80% & 100% of meter capacity for two minutes or until the meter is running smoothly.

After a meter is installed in line and oil had been added to the meter reservoirs, gas flow will rotate the meter impellers. The bottom impellers have oil slingers attached, splashing lubricant into the bearings. This will quickly reduce any operational friction created by dry bearings.

When reporting a suspected problem, please provide the following information:

- Your Purchase Order Number and/or Dresser's Sales Order Number
- Meter Model, Serial Number and Bill of Material Number
- Accessory Unit Bill of Material Number and Serial Number, if applicable
- Description of the problem
- Application information, such as gas type, pressure, temperature, and flow characteristics

Our Product Services Department offers professional services for all ROOTS® products. Authorization for return is required for all products shipped to the Factory for repair, calibration, warranty, exchange or credit. To obtain authorization for return of ROOTS® products purchased from a Dresser Distributor or Representative, please contact the Distributor or Representative from whom the product was purchased. All returns should be packaged in an original-type shipping container.

INTRODUCTION

Use and Limitations

The ROOTS® Meter is a positive displacement, rotary type gas meter designed for continuously measuring and indicating the accurate measurement of gas flow in a pipeline.

ROOTS® Meters are suitable for handling most types of clean, dry, common gases at either constant or varying flow rates. The meter is not suitable for handling liquids. Measurement accuracy and life expectancy can be impeded by excessive deposits of dirt or other types of foreign material in the gas stream.

Meters of standard construction are not directly suitable for handling acetylene, biogas or sewage gas. Specially constructed meters made of materials directly compatible with these and other gases are available. Please contact your ROOTS® meter supplier for details and to request publication S:SSM.

Operating Principle

As shown in Figure 1, two contra-rotating impellers of two-lobe or "figure 8" contour are encased within a rigid measuring chamber, with inlet and outlet connections on opposite sides. Precision machined timing gears keep the impellers in correct relative position. Optimal operating clearances between the impellers, cylinder, and headplates provide a continuous, non-contacting seal.

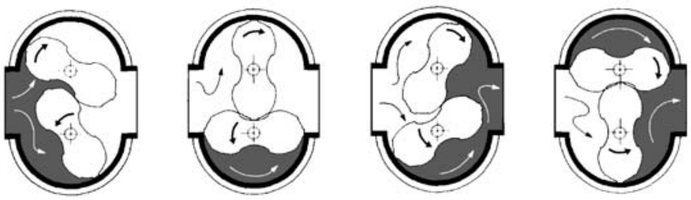


Figure 1 - Impellers rotating inside meter cylinder.

Because of this unique design, the gas at the meter inlet is always effectively isolated from the gas at the outlet. Consequently, a very small pressure drop across the meter will cause the impellers to rotate. During impeller rotation, the precisely machined measuring chamber traps a known volume between the impeller and the adjacent cylinder wall. With one complete revolution of both impellers, the meter will measure and pass four equal gas volumes.

The sum total of these volumes is the Displacement of the meter per revolution. The displaced volume of gas is indicated in Engineering units represented in cubic feet (or cubic meters).

Volumetric accuracy of the ROOTS® meter is permanent and non-adjustable. Measuring characteristics are established by the dimensions and precision machined contours of non-wearing fixed and rotating parts.

Meter rated capacity is the maximum flow rate at which the meter may be operated and is determined by the dynamic loads acting on the rotating parts of the meter. These loads are primarily related to meter RPM, and secondarily to the metering pressure. With few exceptions, the standard volume capacity of a rotary meter increases directly with changes in absolute line pressure and inversely with changes in absolute line temperature.

GENERAL DESCRIPTION

ROOTS® Meters are manufactured in accordance with the American National Standard specification ANSI/ASC-B109.3 for Rotary Type Gas Displacement Meters. ROOTS® Meters Series B3, Series B3-HP and Series B3-HPC have flanged inlet and outlet connections conforming dimensionally to ANSI/ASME standards. The operating temperature range is from -40°F to +140° F (-40° C to +60° C).

Every meter is static pressure tested at the factory at twice its Maximum Allowable Operating Pressure (MAOP) and leak tested at 125 percent of MAOP in accordance with ASME Boiler Pressure Vessel Codes. All aluminum parts internal to the measurement chamber (i.e., impellers, measurement chambers, and headplates) are hard-coat anodized for added corrosion and abrasion resistance. The external surface of the body and the two end covers are clear coat anodized.

Cleansing and lubrication for the main bearings and timing gears is provided by a "splash" lubrication system. The meter end covers on Series B meters serve as oil reservoirs. Oil slingers located within the meter end covers distribute oil for lubrication.

Accuracy is not affected by low or varying line pressures. Series B meters may be used satisfactorily for pressures ranging from a few ounces to full MAOP. The meter base rating is expressed in hundreds (C) or thousands (M) of Actual Cubic Feet per Hour (ACFH), or in Cubic Meters per Hour (m3H). Displaced volume measurement is completely independent of the gas specific gravity, temperature, and pressure and can be easily converted to volume at Standard conditions for elevated pressure and varying temperature by application of the Basic or Ideal Gas Laws. Refer to a meter sizing chart for capacity ratings at elevated line pressures.

IMPORTANT: The maximum working pressure of a rotary meter is limited by casing design. Meters should not be installed where line pressure can exceed the Maximum Allowable Operating Pressure. Refer to the basic meter body nameplate for the MAOP.

METER VERSIONS

Series B3 Meters

Sizes 8C-56M are typically machined with ANSI Class 150# FF flanges and the meters are rated to a 175 PSIG (1200 kPa) MAOP. Meter sizes 8C-2M are available with 1-1/2" NPT connections upon special request. Sizes 8C-5M are available with a MAOP rating of 200 PSIG. Major components of the meter are machined or cast from aluminum for a combination of strength and weight reduction. The 23M232 is rated for 232 PSIG (33,6 kPa) MAOP and has 4" 150#FF flanges.

Series B3-HP Meters

For low flows at higher pressures, the 1M300 and 3M300 meters utilize a slightly modified Series B meter body to provide a meter rated with a 300 PSIG MAOP. The flanges are machined to mate with ANSI Class 300# flanges.

Series B3-HPC Meters

High Pressure Cartridge (HPC) meters utilize a common cast-steel housing for two sizes of aluminum cartridges. A measurement cartridge assembly slides into the housing. The 1M and 3M cartridges share a common housing as do the 5M and 7M cartridges. Measurement cartridges are field replaceable and can be interchanged between the common housings.

1M and 3M cartridges will fit into both the 740 PSIG (862 kPa) MAOP housing with ANSI Class 300# flanges and the 1480 PSIG (10,204 kPa) MAOP housing with ANSI Class 600# flanges. The 5M and 7M cartridges share a housing with an MAOP of 1480 PSIG (10,204 kPa) and ANSI Class 600# flanges.

An optional, full flow internal bypass and/or optional indicator are available on meters and/or measurement cartridges. The bypass is set to trip at a meter differential pressure of 6.5 PSIG (44.8 kPa) for the 1M and 3M meters and at 7.2 PSIG (49.6 kPa) for the 5M and 7M sizes.

ACCESSORY UNIT

Totalization of the displaced gas volume is performed by a magnetically coupled, spur gear reduction unit referred to as the Series 3 Accessory Unit. These units are permanently lubricated for a long life and virtually maintenance-free operation. The Series 3 Accessory Unit is isolated from the meter body and is not pressurized. The modular design allows for complete inter-changeability of Accessory Units on Series B basic meter bodies of the same size. Every Series 3 Accessory Unit has the meter size and gear ratio imprinted on the Accessory Unit nameplate.

IMPORTANT: Verify that the model size written on the bottom right of the Accessory face plate matches the model size stamped on the meter body nameplate.

The Series 3 Accessory Unit shown in Figure 2 utilizes a unique method of masking (shielding) specific odometer digits. Translucent masks shade, but do not completely hide the digits on the odometer. However, opaque (black) masks completely cover the digits and will not allow the covered digit to be read unless the Accessory Unit is disassembled. Both types of masks (translucent and opaque) simply snap into place over the desired digits. Special configurations are available upon request.

A molded, optical quality Lexan® cover is used on the Series 3 Accessory Unit. The cover's smooth cylindrical design easily sheds rain and resists accumulations of snow, ice and dirt.

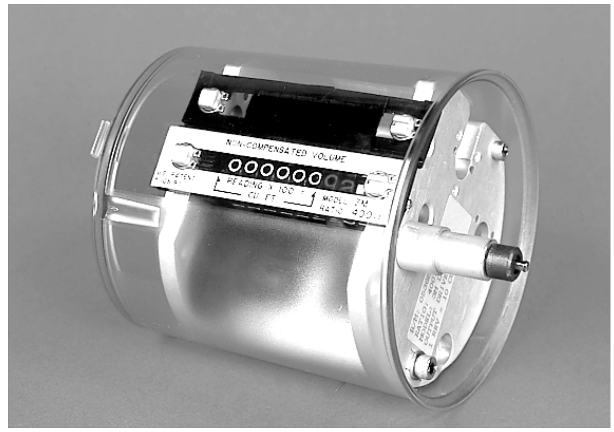


Figure 2 - Series 3 Accessories do not require oil. (CTR Version shown)

Counter (CTR) Version

The Series 3 Counter (CTR) unit is a gear reduction assembly housed in a cylindrical Lexan cover as previously described.

An 8-digit non-compensated index (odometer) registers displaced volume in actual cubic feet (ACF) or actual cubic meters (m^3). All numbered index wheels on the odometer have 10 divisions marked with the characters 0 through 9.

The 8C through 11M odometers with Imperial units of measure (i.e., actual cubic feet) have five exposed digits. As an industry standard, the first digit on the left of the odometer is typically concealed with an opaque mask. Translucent masks are normally specified to cover the two right-most digits. For the 16M through 56M odometers with Imperial units, six digits are exposed. Again, the first digit on the left of the odometer is typically concealed with an opaque mask while only the right-most digit is covered with a translucent mask. The odometers for 8C and 16M meters are shown in Figure 3.

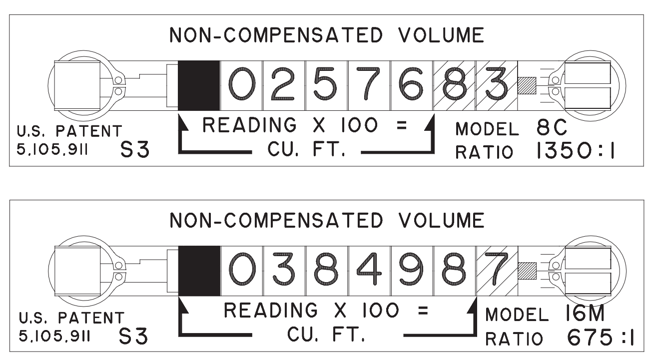


Figure 3 - Non-Compensated Series 3 Imperial unit odometer for 8C (Top) and 16M (Bottom).

Lexan® is a registered trademark of the General Electric Company.

When reading an 8C through 11M odometer, the five exposed digits (numbers) between the arrows are typically multiplied by 100 to read the volume in hundreds of cubic feet. For example, a reading of 2576 would be read as 257600 cubic feet. If the last two digits to the right of the arrows were included in the reading, and those numbers were 83, the reading would then be 257683 cubic feet.

For the 16M through the 56M sizes, the digits between the arrows are again typically multiplied by 100 to read the volume in hundreds of cubic feet. However, if the single digit to the right of the arrows were included, the reading would be in tens of cubic feet. For example, a reading of 38498 between the arrows would be read as 3849800 cubic feet. If the single digit to the right of the arrows was included in the reading, and the number was 7, the reading would then be 3849870 cubic feet.

Note: Some customers special order Accessory Units with a multiplication factor of 1000. Refer to the marking between the arrows on the Accessory Unit nameplate for verification of the multiplier used, i.e. "Reading X 100 Cu. Ft." (as explained previously), or "Reading X 1000 Cu. Ft."

A test wheel is located on the right side of the odometer. The graduated increments on the test wheel represent 0.2 cubic feet for the 8C through 11M meters and 2 cubic feet for the 16M through 56M meters. This allows for accurately estimated readings of 0.1 cubic feet and 1 cubic foot, respectively. White reflective marks are located to the left of the graduated increments for prover testing with an optical photo-sensor (scanner).

All 8 digits are exposed on the Metric odometer. On the 8C through 3M metric meters, the portion of the faceplate surrounding the last two digits to the right is printed black and a decimal point (comma) is shown just before the printing. The area between the arrows is read as cubic meters. For example, a reading of 202597 between the arrows would be read as 202597 cubic meters. If reading all 8 of the digits, a reading of 202597,39 would then translate to 202597 cubic meters plus a fractional reading of 0,39 cubic meters.

On the 5M through 38M metric meters, the portion of the faceplate surrounding the last digit to the right is printed black and a decimal point (comma) is shown just before the printing. Again, the reading between the arrows is read as cubic meters. Therefore, a reading of 1592432,7 would translate to 1592432 cubic meters plus a fractional reading of 0,7 cubic meters.

On the 56M metric meter, all of the odometer digits are between the arrows and are read as cubic meters. The decimal point (comma) is shown just before the graduated increments on the test wheel. A reading of 18074618 is literally 18074618 cubic meters.

Examples of metric odometers are shown in Figure 4.

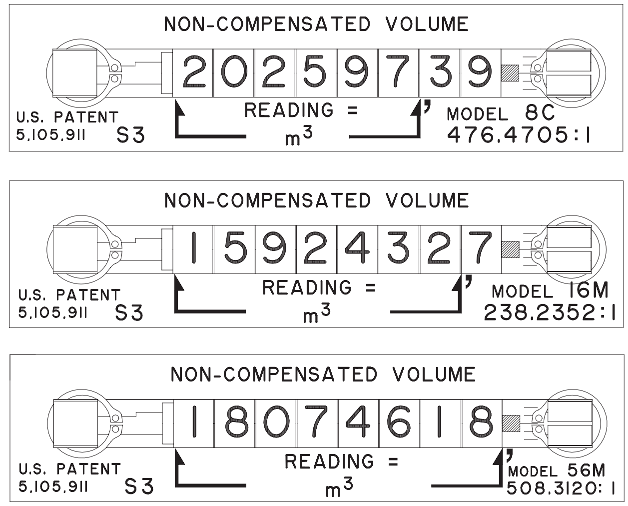


Figure 4 - Non-Compensated Series 3 Metric Unit odometers for 8C (Top), 16M (Middle), and 56M (Bottom).

A test wheel is located on the right side of the odometer. For metric versions, the graduated increments on the test wheel represent 0,002 cubic meters for the 8C through 3M meters, 0,02 cubic meters for the 5M through 38M meters, and 0,2 cubic meters for the 56M. This allows for accurately estimated readings of 0,001 cubic meters, 0,01 cubic meters, and 0,1 cubic meters respectively. White reflective marks are located to the left of the graduated increments for prover testing with an optical photo-sensor.

Note: On both Imperial and Metric versions, the high speed, black-and-white proving wheel attached to the end of the RPM drive shaft is visible either from the front or the end of the accessory and can be used for verification of unit operation and meter testing. Refer to "Proving Operations." The wheel is also shown in Figure 13 in the "Meter Start-Up" section.

Counter with Instrument Drive (CD) Version

The Counter with Instrument Drive (CD) unit utilizes the CTR gear reduction assembly, a specially designed Lexan cover, and an Instrument Drive support assembly. The Instrument Drive (ID) support is mechanically linked to the gear reduction of the CTR unit and drives the instrument 'drive dog' at the ID output. One revolution of the instrument drive dog represents a specific displaced volume measured by the meter, depending upon meter size. The drive rates are shown in Table 1.

Table 1 - Instrument Drive Rates for Series 3 Counter with Instrument Drive (CD) accessories.

	Meter Size	Volume/Revolution
Imperial	8C thru 11M	10 cu. ft./rev.
	16M thru 56M	100 cu. ft./rev.
Metric	8C thru 3m	0,1 m^3/rev.
	5M thru 38M	1,0 m^3/rev.
	56M	10,0 m^3/rev.

The instrument mounting section of the Instrument Drive (ID) housing can be easily relocated 90° to an upward position when changing the meter from Top to Side inlet or vice versa. (Refer to "ACCESSORY UNIT REMOVAL & CONVERSION PROCEDURES, Side Inlet to Top Inlet Conversion".) A cover plate on the Instrument Drive support housing allows access to bevel gears for directional change of rotation of the drive dog - from clockwise to counterclockwise rotation or vice versa. (Refer to "ACCESSORY UNIT REMOVAL & CONVERSION PROCEDURES, Changing the Rotational Direction of the Instrument Drive".) A decal located on the ID housing indicates output drive volume. There is also a universal instrument mounting plate installed on the ID support.

Note: Lubrication is not required for the ID support housing.

Temperature Compensated (TC) Version

Temperature compensation is accomplished by using a mechanical computational device to reference a spiral bi-metallic thermocouple (probe) located in a sealed temperature well at the meter inlet. This system allows Series 3 Temperature Compensated (TC) units to provide corrected gas volume readings in Standard Cubic Feet (SCF) between line gas temperatures of -20° F and + 120° F (-29° C and +49° C).

Note: Mechanical Temperature Compensation is not available on B3-HP and B3-HPC meters.

All standard design 8C175 through 16M175 and 8C200 through 5M200 Series B basic meter bodies are shipped with a temperature probe well installed. This allows for an easy and low cost conversion from a non-compensated meter to temperature compensated meter.

As shown in Figure 5, the TC unit has two digital odometers. The top odometer (highlighted in red) represents the Temperature Compensated volume, or the displaced gas volume corrected to Standard conditions (SCF) with respect to a contract Base temperature of 60° F (15° C).

Note: Reference the "Counter (CTR) Version" section for instructions on reading the digital odometers.

The bottom odometer is Non-Compensated and is typically covered with a translucent mask to reduce readability and/or prevent misreading. An optional black (opaque) mask can be specified to completely prevent viewing of the non-compensated odometer. Other masking configurations are available upon request.

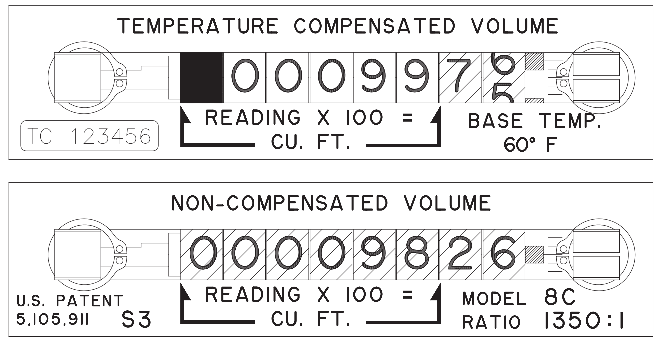


Figure 5 - Temperature compensated Accessory Units have two odometers for a temperature compensated reading on top and a non-compensated reading on the bottom.

Temperature Compensated with Instrument Drive (TD) Version

As the name implies, the Temperature Compensated with Instrument Drive (TD) Accessory Unit uses a standard TC unit along with an Instrument Drive (ID) support as described in the CD section. However, one revolution of the ID drive dog now represents gas volume corrected to Standard conditions with respect to a contract Base temperature of 60° F (15° C). The drive rates are provided in Table 2.

Note: Rotation of the "Drive Dog" is tied directly to the update of the compensated odometer and is therefore intermittent in nature.

All other features and functions described under the heading "TC Version" are applicable to the TD Version.

Table 2 - Instrument Drive rates for Series 3 Temperature Compensated with Instrument Drive (TD) Accessory Units.

Meter Size	Volume/Revolution
8C thru 11M	100 cu. ft./rev.
16M	1000 cu. ft./rev.

Pulser Version

ROOTS® Pulsers generate low frequency pulses representing volumetric information for remote data collection. Pulsers are available with Single or Dual MS style circular connectors, conduit ports, or cable gland connections.

The CTR unit's pulse output represents Non-Compensated volume only. The TC unit provides two pulse outputs; one representing Non-Compensated volume, the second representing Temperature Compensated volume. The pulse rates can be found on the decal and/or tag provided with the pulser, or in the "Pulse Rates" shown in Table 3.

Figure 6 provides a wiring diagram for pulsers. For additional information, request specification sheet TS: SSP.

Table 3 - Pulse Outputs for Series 3 Pulsers

Series B Meter Size	Series 3 Accessory	Imperial (Cubic Feet) Non-Compensated	Imperial (Cubic Feet) Compensated	Metric (Cubic Meter) Non-Compensated
8C-3M	CTR	10 cf	—	0,1 m^3
5M-11M	CTR	10 cf	—	1,0 m^3
16M-38M	CTR	100 cf	—	1,0 m^3
56M	CTR	100 cf	—	10,0 m^3
8C-11M	TC	10 cf	10 cf*	—
16M	TC	100 cf	100 cf*	—

* Prior to December 1, 1999, the compensated pulse outputs were 50 cf and 500 cf for the 8C-11M and the 16M, respectively.

Table 4 - Wiring Guide for Series 3 Pulsers

Pulser Type*	Pulser Connection Type	Non-Compensated Signal			Temperature Compensated Signal		
		Normally Open (Signal)	Common	Normally Closed	Normally Open (Signal)	Common	Normally Closed
CPWS MSC	MS Style Circular Connection	A	B	C	—	—	—
CPWD MSC	Two MS Style Circular Connections	A	B	C	—	—	—
CPWS CBG	Cable Gland with Leads (Pig Tail)	Brown	Green	Red	—	—	—
CPWD CBG	Two Cable Glands with Leads (Pig Tail)	Brown	Green	Red	—	—	—
CPWX CND	Conduit Compression Coupling with Lead (Pig Tail)	Brown	Green	Red	—	—	—
TPWS MSC	MS Style Circular Connection	A	B	C	D	E	F
TPWD MSC	Two MS Style Circular Connections	A	B	C	D	E	F
TPWS CBG	Cable Gland with Leads (Pig Tail)	Brown	Green	Red	White	Black	Blue
TPWD CBG	Two Cable Glands with Leads (Pig Tail)	Brown	Green	Red	White	Black	Blue
TPWX CND	Conduit Compression Coupling with Lead (Pig Tail)	Brown	Green	Red	White	Black	Blue

* Refer to Roots Meter Accessory Acronym Chart on page 29 for further explanation of "Pulser Type".

Counter with Electronic Transmitter (CEX) Version

Like the ROOTS® Solid State Pulsers, Counters with Electronic Transmitters have a magnetically driven pulser attached externally to the Counter (CTR) cover. The system generates a single channel high frequency pulse directly from the impeller revolution (from the non-compensated counter). This in turn allows for remote collection of volumetric increases while also providing a pulse rate suitable for an accurate determination of flow rate. Pulse rates for various meter sizes are shown in Table 5.

The two wire output and solid state construction eliminates mechanical switches and ensures maximum reliability. No battery or maintenance is required. The standard CEX is supplied with a single MS style circular connector. Conduit port and cable gland connections are available upon request. Table 6 provides wiring information for the CEX.

Table 5 - Pulse outputs for CEX Accessory Units in relation to meter sizes.

Meter Type	Freq. (Hz)	Volume per Pulse (CF)	Volume per Pulse (m^3)	Pulses per Volume* (CF)	Pulses per Volume* (m^3)	Flow Rate (ACFH)
8C175	120	0.00185175	0,00005243572	540	19071	800
11C175	146.67	0.0020825	0,000058969832	480	16958	1,100
15C175	166.67	0.0025	0,000070792116	400	14126	1,500
2M175	111.13	0.005	0,000141584	200	7063	2,000
3M175	133.33	0.00625	0,00017698	160	5650	3,000
5M175	150	0.00926	0,000262214	108	3814	5,000
7M175	124.46	0.015625	0,000442451	64	2260	7,000
11M175	122.2	0.025	0,000707921	40	1413	11,000
16M175	120	0.0370375	0,001048785	27	953	16,000
23M175	69	0.0925925	0,002621927	11	381	23,000
38M175	76	0.13889	0,003932927	7	254	38,000
56M175	89.6	0.17361	0,004916088	6	203	56,000
1M300	55.55	0.005	0,00014158	200	7063	1,000
3M300	133.33	0.00625	0,00017698	160	5650	3,000
1M740	75	0.0037037	0,000104888	270	9534	1,000
3M740	166.67	0.005	0,00014158	200	7063	3,000
1M1480	75	0.0037037	0,000104888	270	9534	1,000
3M1480	166.67	0.005	0,00014158	200	7063	3,000
5M1480	100	0.013889	0,000393293	72	2542	5,000
7M1480	124.46	0.015625	0,000442451	64	2260	7,000

* Pulse per volume rounded to nearest whole number. For calculation purposes, use volume per pulse.

Table 6 - Wiring guide for Series 3 CEX.

CEX Connection Type	Normally Open (Signal)	Common
MS Style Circular Connection	A	B
Conduit with Leads	White	Black
Cable Gland with Leads	White	Black

METER INSTALLATION

Piping Configurations

Series B3, B3-HP, and B3-HPC meters can be installed in either a Top Inlet (vertical) or a Side Inlet (horizontal) configuration as shown in Figures 8 and 9 respectively. The preferred or recommended installation is top inlet in a vertical pipeline with gas flowing downward. Although the design of the impellers tends to make the meter inherently self-cleaning, the top inlet mounting enhances the possibility for gravity to pass dirt, pipe scale, or other debris through the meter.

Piping should be rigid and properly aligned. The meter does not require any direct means of support, but the piping on either side should be supported to eliminate any unnecessary piping strains on the meter body.

An additional recommendation is to install the meter in a side loop with a bypass adjacent to the main line. Also, the installation of tees upstream and downstream of the meter will help facilitate transfer proving with the meter still mounted in the line.

Do not install the meter lower than the discharge pipe run to avoid accumulation of condensate and foreign materials in the metering chamber. Use a Dresser ROOTS® Gasket Strainer, Dresser ROOTS® Pipeline Strainer, or other Y-type strainer upstream of the meter to help remove liquids and foreign matter (pipe sealant, tape, weld slag, etc.) from the gas stream. A 100 Mesh screen is recommended for the Dresser ROOTS® Pipeline Strainer or other Y-type strainer.

The installation of a lubricated gas valve directly before a meter is not recommended, as excess valve lubricant or other foreign material can stop impeller rotation. Dresser ROOTS® Style 350 ULTRASEAL permanently-lubricated gas valves are designed and recommended for use in ROOTS® Meter installations at pressures up to 175 PSIG.

If over-speed conditions occur, a restricting flow orifice plate should be installed 2 to 4 pipe diameters downstream of the meter outlet. (Orifice plates are included with all B3-HP and B3-HPC high pressure meter shipments.) Contact the factory or your Dresser representative for sizing, pricing and availability.

Note: Warranty does not cover meter failure due to over-speed conditions.

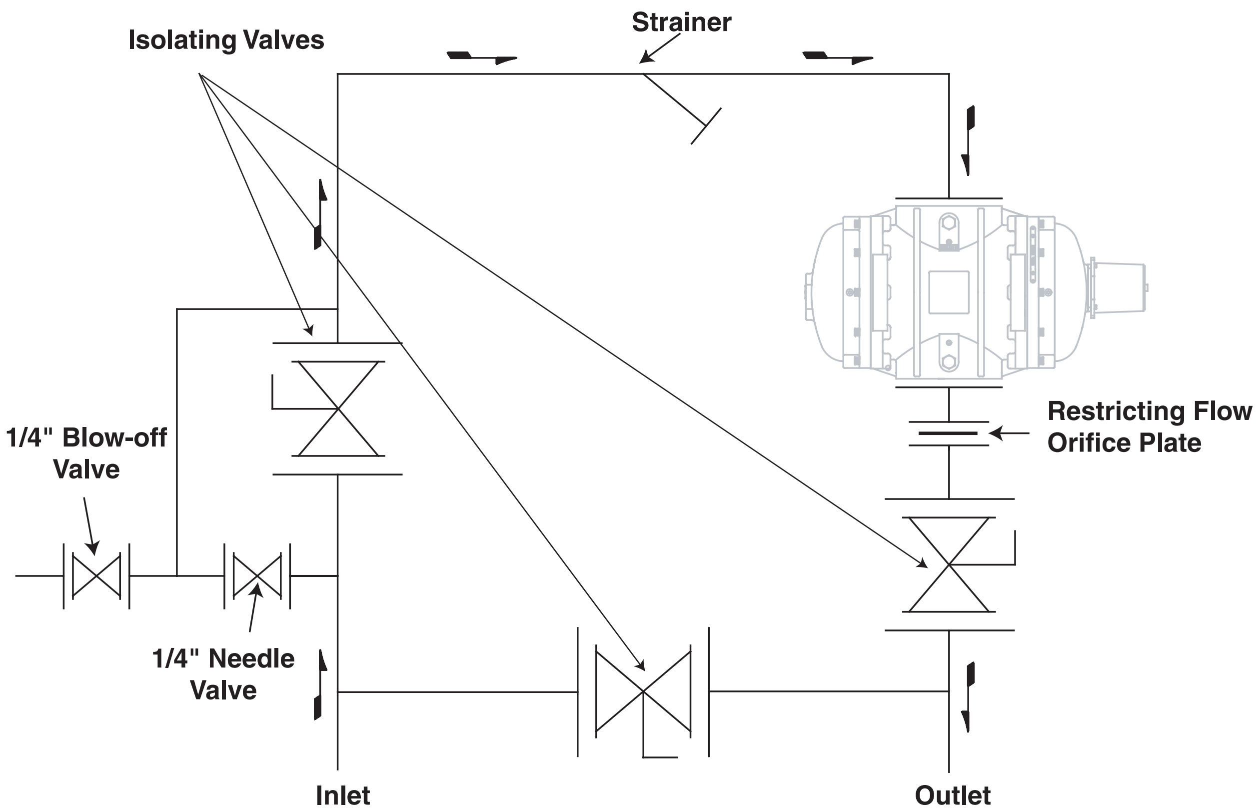


Figure 8 - Top Inlet Configuration for Series B3 Meter.

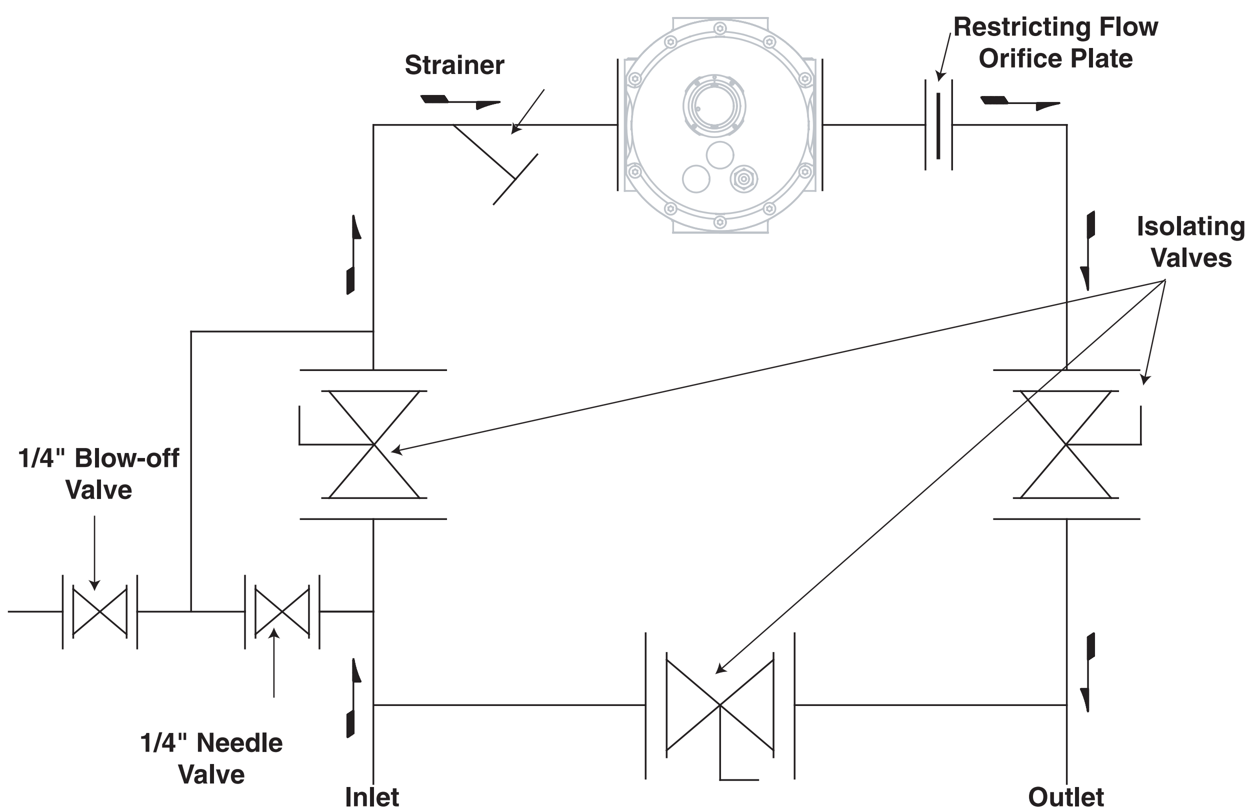


Figure 9 - Side Inlet Configuration for Series B3 Meter.

Placing Meter In Line

1. Before installing a meter:
   - Make sure the upstream piping is clean by venting the line to the atmosphere. During this procedure, use extreme caution and follow recommended company procedures.
   - Remove the plastic protective caps from both meter flanges prior to meter installation.
   - Insure the impellers turn freely and no objects or contaminants are in the measuring chamber. Depending upon meter condition, it may be necessary to flush the meter with an approved solvent. After flushing, drain all solvent from both end covers. Make sure the measuring chamber is clean and dry and that the impellers turn freely. Refer to "INSPECTION AND MAINTENANCE, Cleaning and Flushing."
2. Meter Orientation:
   - Connect meter inlet to the gas supply side of the line, insuring the gas flow will be in the same direction as the arrow on the meter body name plate (i.e., arrow pointing downward for Top Inlet).
   - In a correct installation, both meter oil level gauges are parallel to the ground.
3. Install the meter without piping strain to prevent a binding of the impellers. Use pipe supports as required. Level all meters to within 1/16" per running foot (5 mm/m), side-to-side and front-to-back.
4. Tighten flange bolts evenly in a cross-pattern. The maximum recommended torques are provided in Table 7.

Table 7 - Recommended Flange Bolt Torques

Meter Size	Bolt Diameter	Torque (ft-lbs)	
		Lubricated	Non-Lubricated
8C175-16M175	5/8"	55	Not Recommended
23M232	5/8"	55	
23M175-56M175	3/4"	100	
1M300	3/4"	80	
3M300	5/8"	80	
1M740-3M740	3/4"	150	
1M1480-7M1480	3/4"	150	

5. **CAUTION: The meter must NOT be under pressure for this procedure.** After the meter is installed, remove the socket head plug in the timing gear end cover (as shown in Figure 10) using an Allen (hex) wrench. Insert an Allen wrench into the gear clamp and slowly turn the impellers clockwise, checking for free rotation. If binding is present, do not attempt to disengage the impellers.

Remove the meter from the set and clear all obstructions or piping strain prior to reinstallation. Replace the plug after verifying free impeller rotation and torque to 7 ft-lbs.

CAUTION: Perform a Leak Test immediately after placing meter back in service. Refer to meter Start-Up procedures, below. All leak points must be eliminated quickly and before leaving the meter site. Otherwise, remove the meter from service by placing on bypass or other method. See steps 1a-h below.

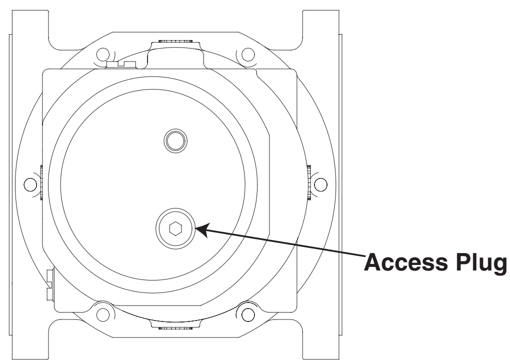


Figure 10 - Remove the access plug to check impeller rotation.

6. Oil is shipped with each new meter in a quantity sufficient to fill the meter body reservoir(s) in either a Top Inlet or a Side Inlet configuration. Slowly add oil to the meter body end cover reservoir(s) until the oil level is to the center of the oil gauge (sight glass) as shown in Figure 11. Refer to Figure 12 for oil fill/drain plugs and sight glass locations. DO NOT OVERFILL.

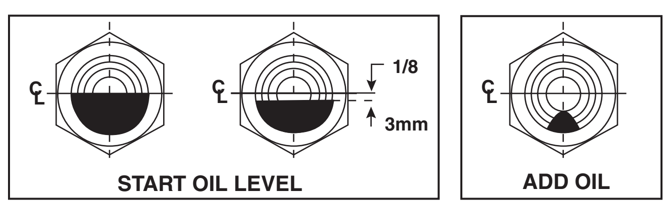
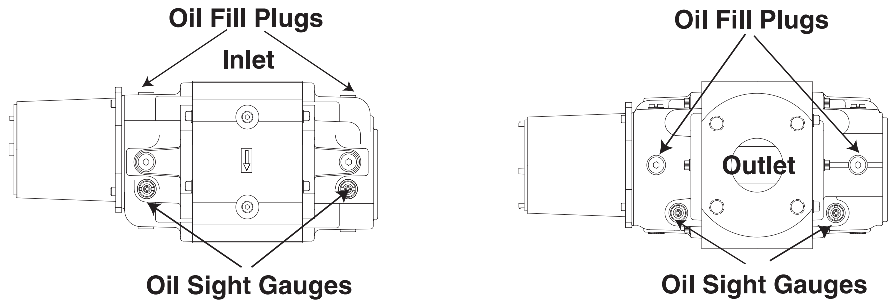
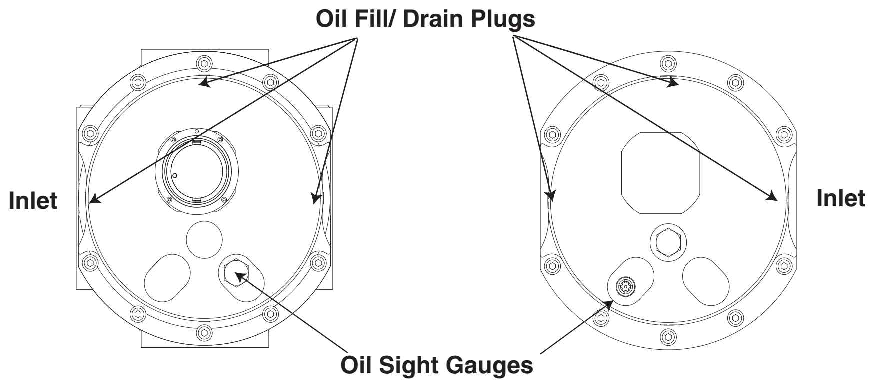


Figure 11 - Fill oil reservoirs to mid level of sight glass.

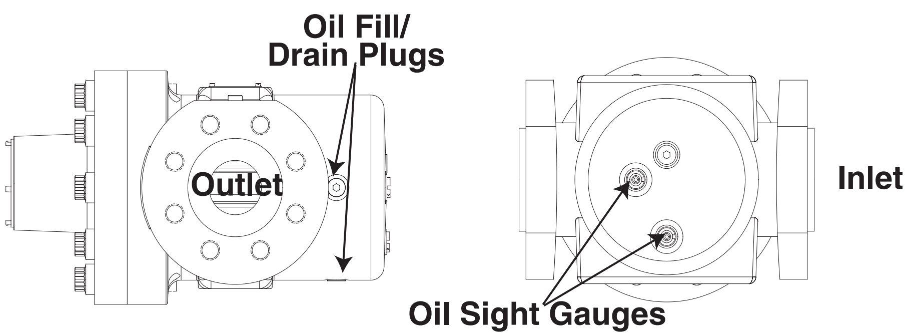
IMPORTANT: DO NOT add oil to the permanently lubricated Series 3 Accessory Unit. **DO NOT** drill and tap the Lexan cover.



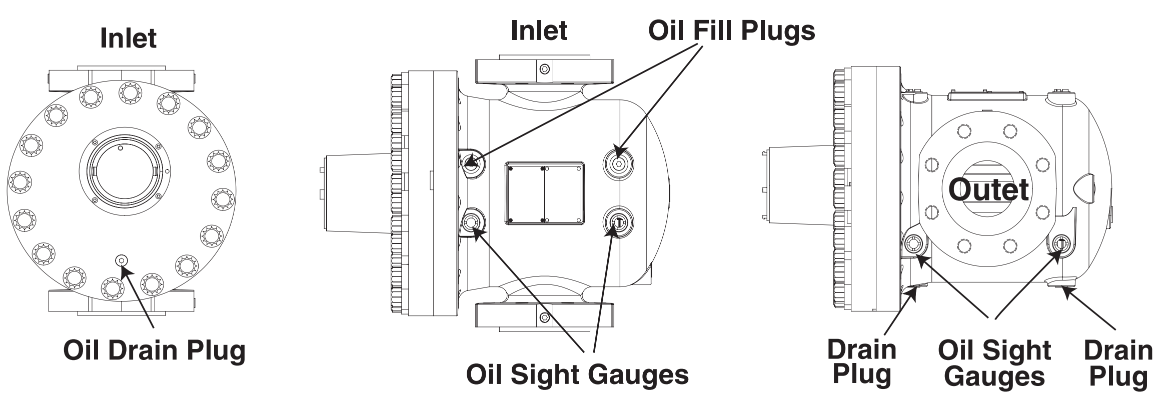
Series B3 and Series B3-HP 8C-16M, 23M232



Series B3 23M-56M (Side Inlet Shown)



Series B3-HPC 1M & 3M



Series B3-HPC 5M & 7M

Figure 12 - Oil fill/drain plugs and oil level sight gauge locations.

Meter Start-Up

1. Slowly pressurize the meter in accordance with the following recommendations:

IMPORTANT: Do not exceed 5 psig/second (35 kPa/second) maximum when pressurizing. Rapid pressurization can cause an over-speed condition which may damage the meter. Resulting damage is not covered by warranty.

a) Open the bypass and outlet (downstream of meter) gas valves.

b) Partially open the meter inlet gas valve until the meter starts operating at low speed. Throttling the bypass valve may be necessary to initiate gas flow through the meter. Verify gas is flowing through the meter by watching for movement of the black-and-white RPM wheel on the Accessory Unit. The wheel, shown in Figure 13, is visible from either the front or the side of the Lexan cover. If movement is present, go to step c). If the RPM dial is not turning, verify gas is being delivered to the meter. If gas is flowing to the meter inlet and the RPM wheel is not moving, go to step e).

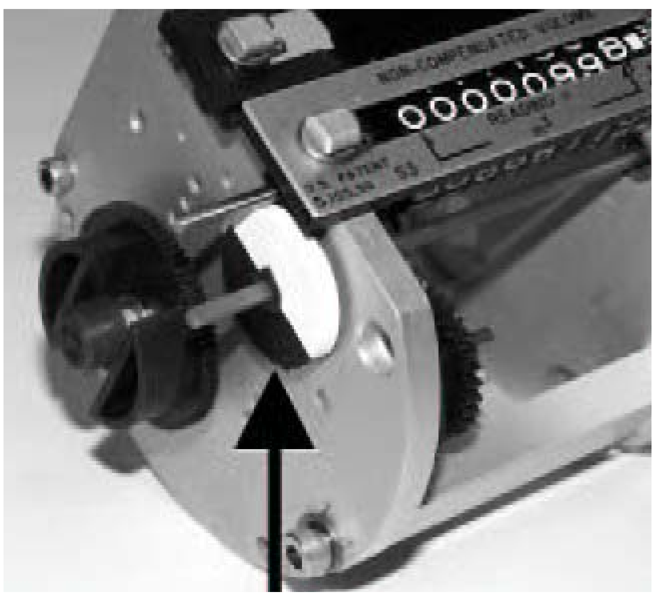


Figure 13 - Movement of the RPM wheel indicates impeller rotation.

c) Let the meter operate at low speed for several minutes. Listen closely for unusual scraping or knocking sounds.

d) If operation is satisfactory, go directly to step f).

e) If unusual sounds are present or the accessory unit's RPM wheel is not turning, place the meter in bypass. Slowly depressurize and vent all pressure from the meter set before checking for piping mis alignment, piping strain, torsion, or other related problems. (Release pressure at a rate less than 5 psig/second.) Once the problem is resolved, repeat the start-up procedure beginning with step a).

DANGER: Slowly depressurize and vent all pressure from the meter set before working on meter.

f) Gradually open the inlet valve until full line flow is passing through the meter and the inlet valve is fully open.

g) Slowly close the bypass valve.

h) Follow your company's authorized procedures or common industry practices to leak test the meter and all connections. Soapy water, Snoop®, and gas analyzers are commonly used for this procedure.

INSPECTION AND MAINTENANCE

Maintenance for the Series 3 Accessory

The CTR, CD, CEX, TC, TD and Solid State Pulser do not require scheduled maintenance.

To clean the Lexan cover, use hot water and soap, mineral spirits, Isopropyl alcohol, or cleaning products approved for use on Lexan. Important: Aromatics, Ketones, and Chlorinated hydrocarbons will damage the plastic cover. Do not use acetone, carbon tetrachloride, etc..

Lubrication

Use only ROOTS® Meter Oil or other instrument grade oils approved for service by the manufacturer.

Meters installed and maintained in accordance with factory recommendations can be expected to operate dependably for many years. Proper oil level and cleanliness have the greatest effect on meter life expectancy. Visually inspect the two oil reservoirs in the meter end covers for proper mid-gauge oil levels once a month until a practical interval is determined. Add oil as necessary.

Snoop is a registered trademark of the Swagelok Company.

Oil change frequency will depend upon the cleanliness of the gas being measured. Change oil when the color darkens or when the level increases, indicating an accumulation of moisture. Under favorable conditions, these periods may be from 3 to 5 years, or longer.

CAUTION: THE METER END COVER IS PRESSURIZED.
Bleed off the line pressure before removing the oil fill or drain plug from the meter.

DO NOT add oil to the Series 3 Accessory Unit.
No scheduled lubrication maintenance is required.

Meter Level

Since the meter is supported entirely by the gas pipe line, movement of the piping due to accidents, settling of the ground or other causes may impede meter operation and accuracy. Refer to "INSTALLATION" procedures. Make sure the meter remains level within 1/16" per foot (5 mm/m) in any direction, side-to-side and front-to-back.

Meter Testing

The Differential Rate Test is an accurate and convenient method of comparing a rotary meter's performance at any time with its original performance. This and other commonly used test methods are covered later in this manual under "TESTING."

Cleaning and Flushing

After removing the meter from the line, if there is any evidence of dirt or dust in the meter, a suggested method for cleaning is to windmill the impellers (at a speed less than maximum capacity) by injecting low pressure, dry compressed air from a nozzle into the meter inlet. Flush approximately 5 ounces (150 ml) of an approved non-toxic, non-flammable solvent through the meter. Drain any residual cleaning fluid from the meter body and end covers. Use the compressed air to completely dry the meter.

Note: Before performing this procedure, drain all oil from the meter end covers. Add oil after the meter has been replaced in the meter set.

ACCESSORY UNIT REMOVAL & CONVERSION PROCEDURES

The following sections cover general procedures for changing complete Accessory Units as well as configuring the Series 3 Instrument Drive. For detailed instructions of these procedures, refer to the documentation cited at the end of each section. These general procedures require the following tools and equipment:

- 5/32" Allen wrench
- 9/64" Allen wrench
- A light grade of machine oil, grease, or petroleum jelly for lubricating O-rings.
- Torque wrench adjustable down to 20 in-lbs.
- Flat blade screwdriver

Removing the Accessory Unit from the Meter
(Refer to Figure 14.)

1. Using the 5/32" Allen wrench, remove the four #10-24 screws holding the slip flange on the meter end cover. Loosen the screws in a cross or star-like pattern to avoid stressing the cover.
2. Remove the Accessory Unit by carefully pulling the complete assembly directly away from the meter body, taking care not to damage the male driving magnet on the accessory gear train. IMPORTANT: If the Accessory Unit is temperature compensating, slide the assembly directly away from the meter end cover until the temperature probe has cleared the end of the meter. Make sure the thermocouple (bi-metallic probe) does not bind in the probe well during the removal process. Shock and/or damage will result in a loss of compensating accuracy.
3. Remove the O-ring from the meter end cover.

For detailed information on Removing the Accessory Unit from the Meter, request document #056549-000.

Removing the Gear Reduction Assembly from the Lexan Cover (Refer to Figure 15.)

1. Using a 9/64" Allen wrench, remove the mounting screw holding the accessory in the Lexan cover. The screw can be accessed through the Tool Access Port.
2. Slide the gear reduction unit out of the Lexan cover.

For detailed information on Removing the Gear Reduction Assembly from the Lexan Cover, request document #056549-000.

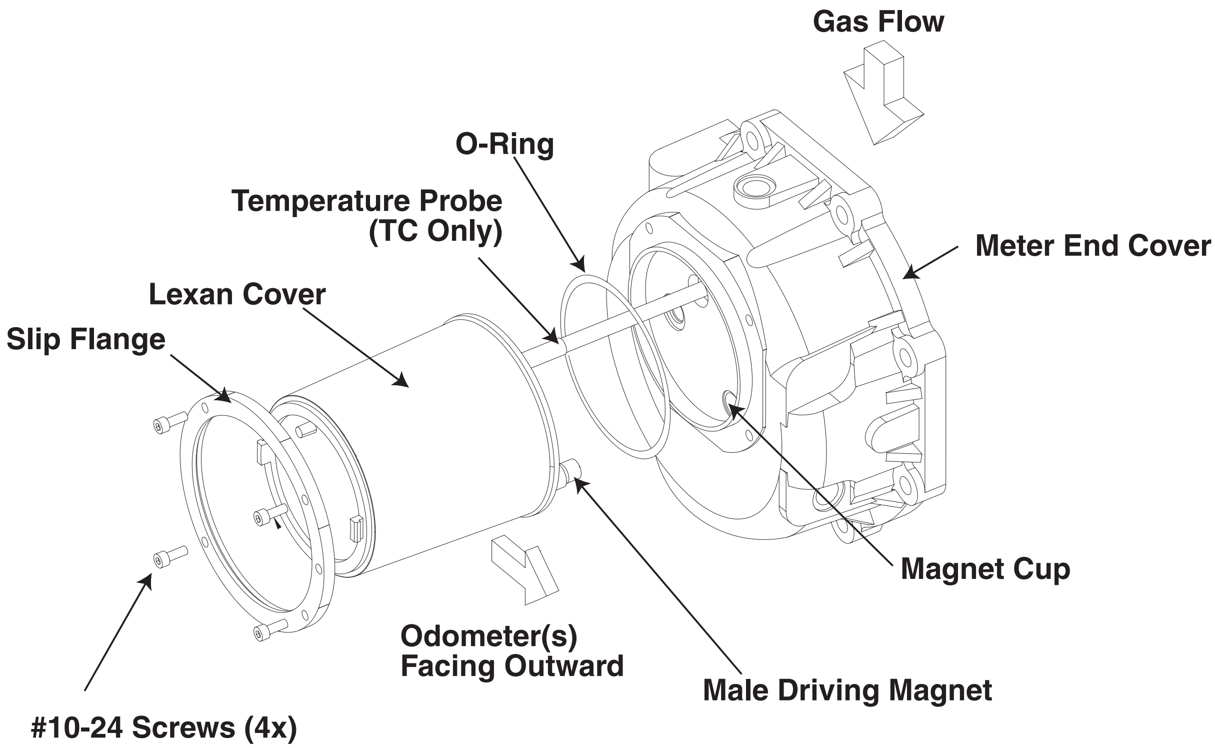


Figure 14 - Assembling Series 3 Accessory to meter end cover.

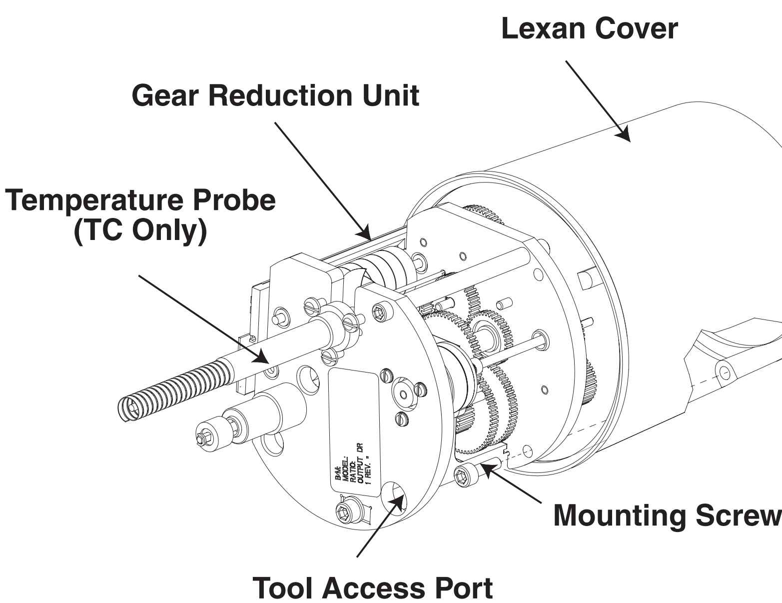


Figure 15 - Exploded view of Gear Reduction assembly and Lexan Cover.

Replacing the Gear Reduction Unit in Lexan Cover
(Refer to Figure 15.)

1. Slide the gear reduction unit into the Lexan cover. Align the odometer(s) with the large, clear window on the cover. When the gear reduction unit is properly installed, the pin that is molded into the bottom of the Lexan cover will engage a hole in the bottom of the plate.
2. Using a 9/64" Allen wrench, insert the screw into the threaded boss on the Lexan cover and torque to 20-25 in.-lb. Do not over tighten to avoid damage to the threaded boss.

For detailed information on Replacing the Gear Reduction Unit in Lexan Cover, request document #056549-000.

Installing a Complete Accessory Unit on the Meter
(Refer to Figure 14.)

1. Before installing a new O-ring onto the meter end cover, apply a thin film of grease to the O-ring. Position the O-ring onto the end cover.
2. Properly align the male driving magnet with the magnet cup in the meter body. If the Accessory Unit is temperature compensated, align the temperature probe with the probe well. Carefully slide the probe into the meter end cover probe well until the Lexan cover meets the O-ring.
3. While holding the Accessory Unit in place, slide the slip flange over the Lexan cover. The counter bored side of the slip ring will be towards the meter. Rotate the slip flange until all four holes in the slip flange are aligned with the four screw holes in the meter end cover. A dimple in the non-instrument drive version slip flanges should be aligned with the odometer(s).
4. While holding the slip flange to the meter end cover, insert the four #10-24 screws into position and tighten in a cross or star-like pattern to 47-53 in.-lb. When properly installed, the slip flange will be in continuous contact with the meter end cover.
5. If applicable, follow company procedures for installing tamper-evident security devices.

For detailed information on Installing a Complete Accessory Unit on the Meter, request document #056549-000.

Instrument Drive Side Inlet to Top Inlet Conversion

The following procedures are required to change the position of the instrument drive assembly. Refer to Figures 16 and 17 for component locations.

Note: Regardless of the meter being mounted in either a Side Inlet or Top Inlet position, the Instrument Drive Accessory must always remain in a vertical position during operation. Refer to the "METER INSTALLATION - Piping Configurations" section of this manual for proper meter mounting practices.

1. Use a flat blade screwdriver to remove the two #1/4-20 screws holding the Universal Instrument Adapter Plate to the ID support assembly.
2. Using the 5/32" Allen wrench, remove the four #10-24 screws holding the neck of the ID Support Assembly to the aluminum ID Housing.
3. Using a 5/32" Allen wrench, remove the two #10-24 screws holding the Side Cover Plate onto the aluminum ID housing. Remove the cover plate.
4. Install the ID support assembly in the vertical mounting position (where the cover plate was removed). Torque the screws to 40 in.-lb.
5. Re-install the Side Cover Plate to the position from where the ID Support was removed. Torque the screws to 5 in.-lb.
6. Using a 5/32" Allen wrench, remove the two #10-24 screws holding the Front Cover Plate onto the aluminum ID housing. Remove the cover plate.
7. Using a 5/32" Allen wrench, remove the two #10-24 screws holding the Modular Bevel Gear Train Assembly in place. Make sure the O-ring behind the modular assembly remains affixed to the back of the modular assembly. Do not allow sand, dirt, or other debris to contaminate the O-ring.
8. Making sure the O-ring behind the modular assembly remains in place, re-install the modular gear assembly in the vertical position. Torque the screws to 5 in.-lb.
9. Ensure the rotation is set as desired and the modular gear assembly meshes properly with the ID drive shaft. Windmill the meter or rotate the modular assembly a minimum of one revolution to ensure proper rotation of the Drive Dog.
10. Re-install the Front Cover and torque the screws to 5 in.-lb.
11. If applicable, follow company procedures for installing tamper-evident security devices.
12. Re-install the Instrument Adapter Plate onto the ID Support Housing.

For detailed information on Instrument Drive Side Inlet to Top Inlet Conversion, request document #056550-000.

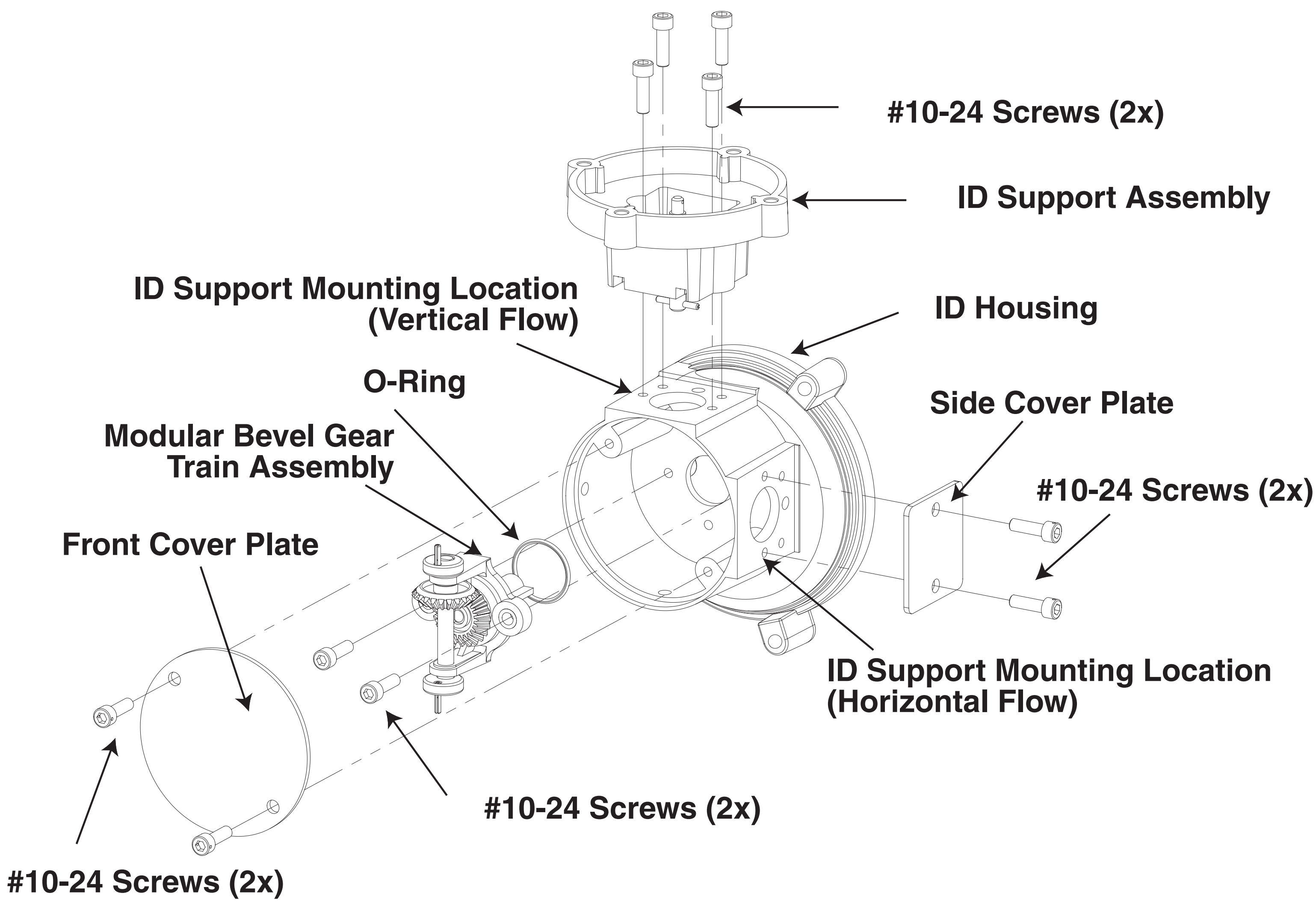


Figure 16 - Exploded View of Instrument Drive (ID) Assembly.

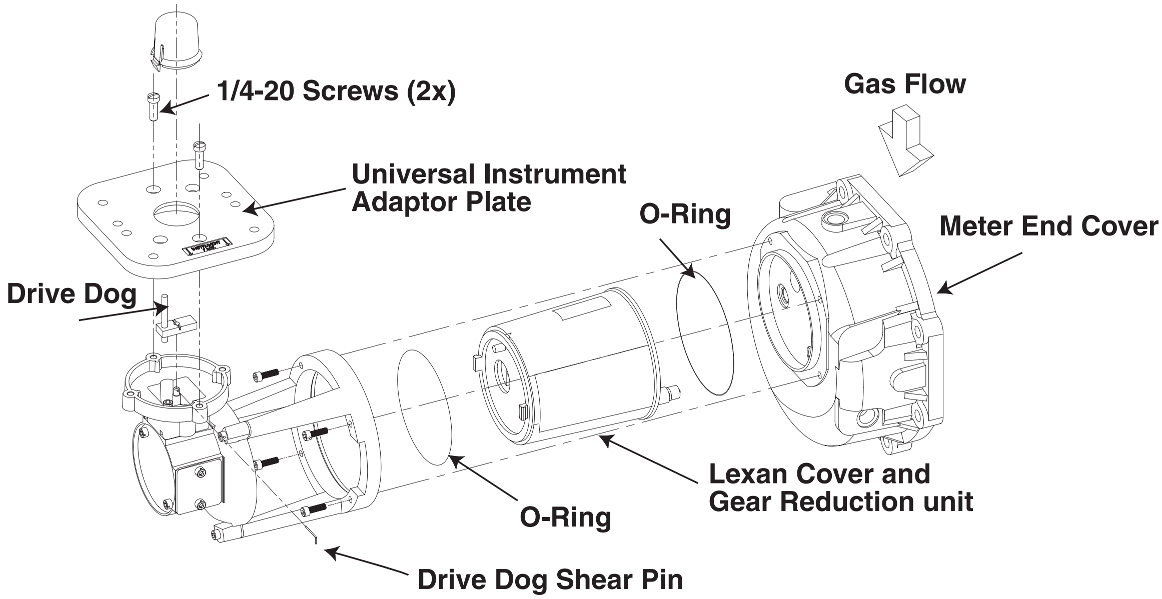
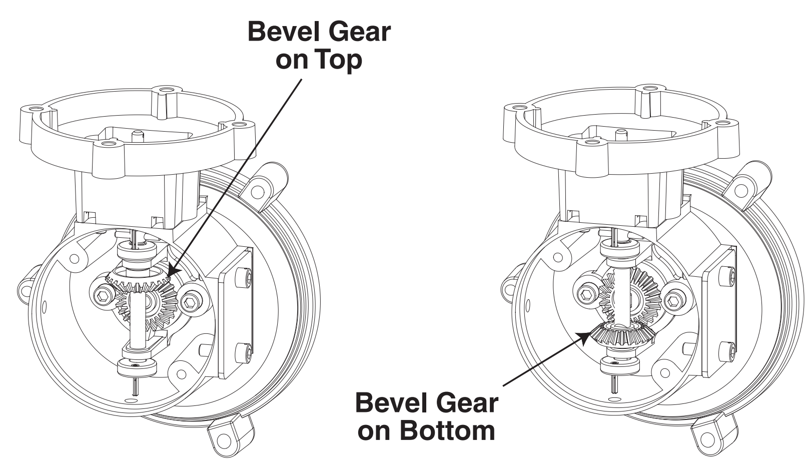


Figure 17 - Assembly Instrument Drive to meter end cover.



CD Meters
Counter-clockwise (A) Rotation

TD Meters
Clockwise (B) Rotation

CD Meters
Clockwise (B) Rotation

TD Meters
Counter-clockwise (A) Rotation

Figure 18 - Placement of bevel gears determines rotational direction.

Changing the Rotational Direction of the Instrument Drive

Unless otherwise specified, all meters with an instrument drive are shipped from the Factory where the “drive dog” will turn in a Clockwise direction (CW-B). To change to Counter-clockwise (CCW-A), use the following procedure:

1. Using a 5/32” Allen wrench, remove the two #10-24 screws holding the Front Cover Plate onto the aluminum ID housing. Remove the cover plate. (Refer to Figure 16 for component identification.)
2. Remove the two #10-24 screws holding the Modular Bevel Gear Train Assembly in place. Make sure the O-ring behind the modular assembly remains affixed to the back of the modular assembly. Do not allow sand, dirt, or other debris to contaminate the O-ring.
3. Rotate the modular drive assembly 180° to obtain the proper Drive Dog rotation (refer to Figure 18). Making sure the O-ring behind modular assembly remains in place, re-install the modular gear assembly in the vertical position. Torque the screws to 5 in.-lb.
4. Ensure the rotation is set as desired and the modular gear assembly meshes properly with the ID drive shaft. Windmill the meter or rotate the modular assembly a minimum of one revolution to ensure proper rotation of the Drive Dog.
5. Re-install the Front Cover and torque the screws to 5 in.-lb.
6. If applicable, follow company procedures for installing tamper-evident security devices.

For detailed information on Changing the Rotational Direction of the Instrument Drive, request document #056550-000.

Installing a Solid State Pulser on a CTR or TC Meter

Converting a CTR or TC Meter to a Counter Pulser or TC Pulser Meter requires the following three steps. First, the CTR or TC Accessory must be removed from the meter. To do this, remove the four screws holding the slip flange on, and remove the slip flange. Gently pull the accessory housing assembly off the meter. Remove the screws, slip ring and mounting surface O-ring, and discard the O-ring. Then, remove the CTR or TC accessory from its housing by loosening the screw inside the housing. Lastly, line up and slide the counter assembly into the new Pulser Accessory housing. Install a new O-ring and slide the slip flange onto the meter’s accessory housing mounting surface, then tighten the screws to complete the installation.

Note: For detailed information on the FIELD INSTALLATION of Solid State Pulsers, request document #057162-000.

Installing a Counter with Electronic Transmitter (CEX) to a CTR Accessory

Installing the CEX consists of two basic steps. The first step is to install the pulser magnet kit (except on meters/accessories purchased from the factory as “CEX ready”) on the gear reduction unit inside Lexan cover. As the magnet rotates on the high speed shaft, a sensor within the CEX housing senses a change in the magnetic field. The next step is to snap the CEX into position on the Lexan cover. This aligns the magnet inside the cover with the sensing unit within the CEX housing. Wiring and pulse output information is stated in the “ACCESSORY UNIT - Counter with Electronic Transmitter (CEX) Version” section of this manual.

For detailed information on the Installation of the CEX, request document #056098-000.

SERIES B3-HPC CARTRIDGE REPLACEMENT AND CHANGEOUT

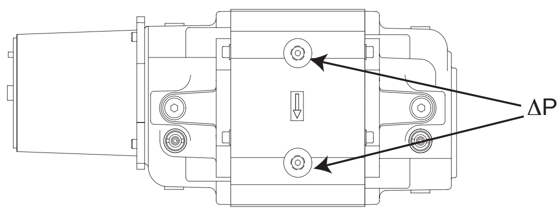
Cartridge Replacement

Meter cartridges are field replaceable for ease of maintenance and repair. The 1M and 3M cartridges will fit in either the 740 PSIG or 1480 PSIG meter housing while the 5M and 7M cartridges share a common 1480 PSIG meter housing.

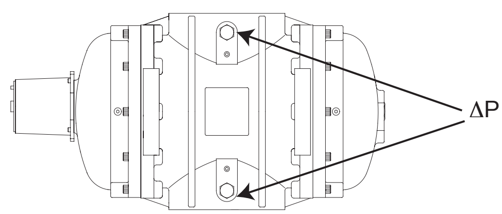
Special Tooling is used during the removal and installation of cartridges. For 1M and 3M meters, use the Cartridge Removal Studs (P/N 054668-000). Two (2) Cartridge Removal Studs are necessary for the procedure. For the 5M and 7M meters, use the Cartridge Installation/Removal Kit (P/N 056213-000). The Cartridge Removal Studs and the Cartridge Installation/Removal Kit are reusable tooling.

For detailed information on replacing the 1M and 3M cartridges, request document #056552-000.

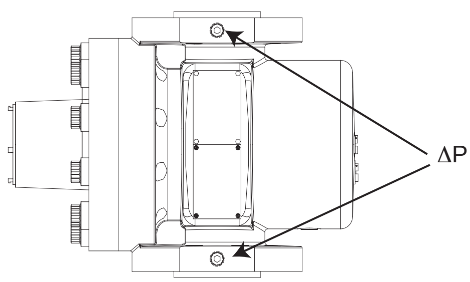
For detailed information on replacing the 5M and 7M cartridges, request document #056352-000.



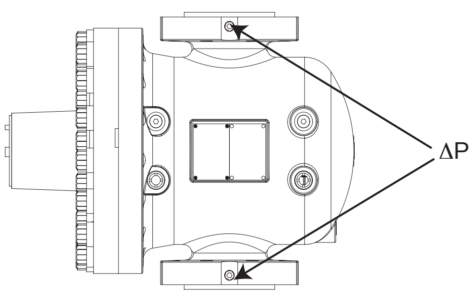
8C - 16M B3
1M/3M B3-HP



23M - 56M B3



1M/3M B3-HPC



5M/7M B3-HPC

Figure 19 - Differential pressure taps are located above and below the meter nameplate.

Cartridge Change-out

Within a family size, a cartridge can be exchanged for a different size cartridge if the meter capacity requirements change. The 1M and 3M cartridges are interchangeable as a family while the 5M and 7M cartridges belong to a separate family. When changing measurement cartridges, make sure the Series 3 Accessory Unit matches the cartridge size. For example, a 3M cartridge must be used in conjunction with a 3M Series 3 Accessory Unit. The Accessory Unit model (size) is identified on the lower right-hand corner of the accessory nameplate, while the cartridge is identified on the cartridge headplate.

Special Tooling is used during the removal and installation of cartridges. For 1M and 3M meters, use the Cartridge Removal Studs (P/N 054668-000). Two (2) Cartridge Removal Studs are necessary for the procedure. For the 5M and 7M meters, use the Cartridge Installation/Removal Kit (P/N 056213-000). The Cartridge Removal Studs and the Cartridge Installation/Removal Kit are reusable tooling.

For detailed information on changing the 1M and 3M cartridges, request document #054523-000. For detailed information on converting from a 1M to a 3M cartridge (or vice versa), request document #054526-000.

For detailed information on changing or converting the 5M and 7M cartridges, request document # 056352-000.

TESTING

General

Rotary meters can be tested for accuracy by several industry accepted methods. These test methods include, but are not limited to, bell or piston provers, transfer provers, sonic nozzle provers, and critical flow proving. The Differential Rate Test is unique to rotary meters and is an accurate and convenient method of comparing a meter's performance to previous or original performance records. Differential testing is accepted by many State Utility Commissions as a means of periodically substantiating that the original accuracy of a meter has remained unchanged.

Differential Rate Test

A change in the meter's internal resistance can affect rotary meter accuracy. Any significant increase on the meter's internal resistance to flow will increase the pressure drop between the inlet and outlet of the meter, thus increasing the differential. Therefore, the meter differential pressure appears as a prime indicator of meter condition.

A test under actual operating conditions will provide the most reliable data for future checks of a meter's operating condition. Although accuracy cannot be directly determined by a differential test, results have shown that an increase of up to 50 percent in differential pressure, at the higher flow rates, can be tolerated without affecting meter accuracy (25% and above) by more than 1 percent. Supportive technical data is available upon request.

Typically, a simple meter flushing will eliminate a high pressure differential due to increased internal friction. Refer to “INSPECTION AND MAINTENANCE, Cleaning and Flushing” for cleaning instructions.

A differential rate test consists of a series of differential pressure readings taken across the meter at several gas flow rates within the meter’s capacity range. Typical locations of meter differential taps are shown in Figure 19. Ideally, testing should be performed when the meter is first installed and under the actual conditions of gas line pressure and specific gravity that will exist in service. This is particularly important when the line pressure is higher than 15 PSIG (200 kPa Absolute). Since the meter differential pressure increases with line pressure, multiple curves may be necessary for meters under varying pressure conditions.

When less than 15 PSIG (200 kPa Absolute), the meter differential can, for all practical purposes, be compared directly with Factory curves or specific meter test results. The factory Test Data Sheet lists actual meter test results of accuracy and differential obtained from a bell or piston prover test on air at atmospheric pressure. Comparisons can also be made against Factory published Characteristic Accuracy Curves which are typically based on an average of 25 to 30 meters. Published data is representative of typical product production.

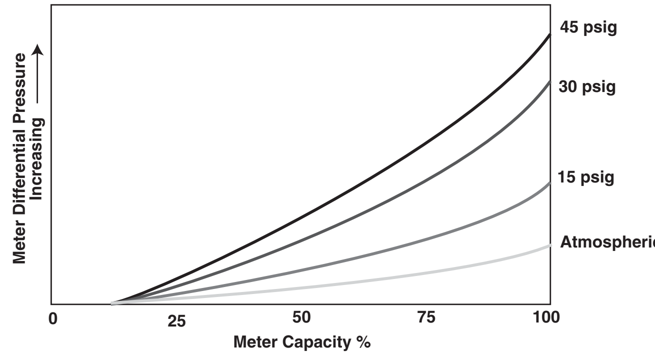


Figure 20 - Differential Curves change as pressure increases.

Establishing Baseline Curves - Developing an original differential or baseline curve is recommended at the time of meter initial installation. Since an increase in flow rate, line pressure or specific gravity will cause an increase in the differential, at least three (3) test points are required at gas flow rates from 25% to 100% of meter capacity. (As shown in Figure 20, the resulting data points will be non-linear, so a minimum of three points is necessary to establish a curve.) Plot the points on a graph and then connect the points to form a curve. This provides an accurate baseline for comparison to later tests. To help with record keeping, a chart like the one shown in Figure 21 will allow the technician to compare new test data to older data.

Note: The gas line pressure, specific gravity of the gas, and line temperature should also be recorded. If the application is under varying pressure conditions, plot multiple curves for various pressure ranges (e.g., 15, 30, 45 and 60 psig).

Differential - Rate Test Data - SAMPLE SHEET

Meter Model:	**Mfg. Serial No:**	**Utility Serial No.:**
Location:	**Date Installed:**	**Register Reading:**

Line Pressure	Gas Temp	Specific Gravity	Volume Measured	Run Time	Rate (ft^3)	Differential Pressure In. W.C.	% Change	Date	Tester
Initial Tests - New Meter									
Periodic Check Tests									

Figure 21 - Having a single chart for each meter provides a detailed history of differential rate tests.

After developing a baseline curve, meter condition and performance can be checked periodically by running a similar differential rate test at a single selected point. This does not give the overall characteristics for the meter, but does provide a quick reference check. Differentials taken at varying flow rates are needed to give an overall picture. If the differential pressure increases by more than 50 percent of the original value, inspect the meter for causes of increased resistance. Principal causes are binding of impellers, worn bearings, contaminates such as dirt or valve grease in the metering chamber, and too heavy or excess oil. Refer to “INSPECTION AND MAINTENANCE, Cleaning and Flushing” for cleaning instructions.

Test Procedure - The test is performed using a ROOTS® Versi-Test Calibrator, manometer, or other differential pressure test equipment with an indicating scale range of about 6 inches of water column. The testing device should have inlet, outlet, and bypass valving and must be pressure rated for the maximum metering pressure for the test. Pressure lines should be connected to the 1/4" meter inlet and outlet pressure taps located on the meter body (just above and below the meter nameplate). For meters with pressure ratings of 300 psig (2068 kPa) or less, test plugs can be permanently installed in the pressure taps to facilitate testing.

A pressure gauge is used to verify pressure readings. A stop watch is used to “clock” the meter RPM for calculating gas flow rate.

CAUTION: When the meter is pressurized, follow applicable safety rules and wear appropriate protective apparatus.

1. Install the pressure differential indicating device into the meter inlet and outlet differential taps. Follow the manufacturer’s instructions for proper installation and operating procedures. On the upstream side of the meter, install a pressure gauge or other pressure standard if not a component of the test equipment.
2. Adjust the meter bypass and the meter inlet valves until the meter is operating at a predetermined or selected flow rate in the lower capacity range, no less than 25 percent of the meter’s rated capacity. Let the flow rate stabilize.
3. Time or “clock” the passage of a predetermined volume of gas as registered on the odometer or instrument to determine the Index or Flow Rate in Actual Cubic Feet per Hour (or m^3/h):

$$\text{Index Rate} = \frac{\text{(Cubic Feet of Gas) x (3600)}}{\text{(Test Time in Seconds)}}$$

Convert the calculated flow rate to a percentage of meter rated capacity:

$$\text{\% Meter Capacity} = \frac{\text{Index Rate}}{\text{Meter Base Rating}}$$

Note: The base rating for a meter can be found on the nameplate located on the body of the meter. The rating is designated as both “CFH Max” and “m^3/h Max”.

4. Record the pressure differential, line pressure, and gas specific gravity. Repeat the test to obtain an accurate average reading.

Note: At the time of meter start-up in a new installation, repeat Steps 2 - 3 at a minimum of three different flow rates, each between 25% and 100% of meter capacity. The original baseline curve should be drawn using data at a constant pressure for all three tests.

5. Remove the differential test equipment and pressure standard.
6. If the pressure differential is within acceptable limits, return the meter to full service. If the pressure differential is higher than recommended, remove the meter for inspection and service.

For Factory repairs and/or inspection, please call the Product Services Department, your Customer Service Representative or your local Sales Representative or Distributor and request a Return Material Authorization (RMA).

Proving Operations

The accuracy of a ROOTS® meter is easily verified using standard transfer proving techniques. A Model 5 ROOTS® prover allows for virtually hands free testing and offers four different methods for collecting field meter volume data. The first two methods, which utilize original equipment included with the Model 5 Provers, are performed using the Manual Start/Stop Switch and the field meter Instrument Drive Pulser. With the manual Start/Stop switch, the operator will input the desired volume into the Model 5 controller program. After the flow and temperature have stabilized, the operator will use the switch to start the test. After the field meter odometer has reached the desired volume, the operator again pushes the switch to stop the test.

For non-compensated meters with an Instrument Drive, the field meter Instrument Drive Pulser mounts directly to the instrument drive and provides a more accurate automated test. The desired volume is selected and the prover will automatically start the test after conditions have stabilized and will then stop the test at the desired test volume.

Optional equipment for the Model 5 provers include the RS-Scanner and a Field CTR Pulser Module. Like the Instrument Drive Pulser, these options also automate the control of the test. The RS-Scanner can be used to test both Temperature Compensated (TC) and Non-Compensated meters. This system uses a light beam to focus on the white squares on the right side of the odometer or the high speed RPM dial at the end of the Series 3 Accessory Unit. The shift from white to black (and vice versa) triggers a pulse relating to a specific volume. A special rubber collar and bracket is included with the RS-Scanner Assembly to ease the task of securing and focusing the RS-Scanner on the Series 3 Accessory Unit. These items may also be purchased separately.

For "pulser ready" Non-Compensated meters (CTR), the field CTR Pulser Module is installed by "snapping" the pulser onto the end of the Series 3 Accessory Unit.

Test results derived from the field meter instrument drive, non-compensated odometer, RPM dial, or the Field CTR Pulser Module will all provide the "Uncorrected Accuracy" of the meter. For a "Combined Accuracy" test (the combined accuracy of the meter and the temperature compensated accessory) the RS-Scanner is required.

Note: The Combined Accuracy can also be calculated by determining the Uncorrected Accuracy of the meter and combining this with the results of the TC Unit Operational Check. This procedure is outlined in the next section.

Specific testing information can be found in the Model 5 Prover "Help Files." Press the "F1" key on the controlling computer while the Model 5 program is running to access the Help Files.

TC Unit Operational Check

This procedure may be used to verify the overall accuracy of the TC Unit, independent of the basic meter body measurement accuracy. The designed accuracy for the TC Unit is within ± 0.5% of the theoretical correction for gas temperatures between -20°F to +120°F (-29°C and +49°C).

Note: All Series B3 ROOTS TC meters are compensated to a 60° F (15° C) Base Temperature.

The TC Unit Operational Check is based upon Calculated Measurement Counts (actual measurement) versus Theoretical Counts, using a 25 cycle count of the compensation cycle. This is the best method for determining the accuracy of the TC unit with the meter in service. By using the 25 cycle method, all of the gears in the TC unit make a complete revolution, and thus provides a greater amount of confidence in the resulting accuracy calculation. The method for determining the theoretical counts for a 25 cycle is outlined in the "Calculating Theoretical Counts" section.

A ROOTS® Transfer Prover is a commonly used device for conducting a TC Unit Operation Check in the shop or when the meter is not in service. The prover is used for flow rate control and indication of temperature during the test procedure. The prover may also be used during this time to test the accuracy of the basic meter body using the non-compensated odometer or the RPM test wheel (See: "Proving Operations," in the previous section.) The information derived from the TC Unit Operation Check is then combined with the meter's non-compensated accuracy to determine the meter's overall accuracy, including temperature compensation (basic meter body non-compensated accuracy X accuracy of TC unit = overall or combined accuracy).

Note: Calibration is not covered in this manual other than to state that during the calibration procedure the TC probe should be immersed into a tightly controlled isothermal temperature bath set within the unit's temperature compensating range. Calibration of the TC Unit should not be performed while the accessory is installed on the meter or with the temperature probe exposed to the atmosphere (air).

Procedure for the TC Unit Operational Check

1. Measure and record stabilized gas (or air) temperature directly at the meter inlet using a certified temperature standard.

Note: Inaccurate results may occur if the gas temperature is not stabilized before starting the test.

2. Record the temperature displayed by the Accessory Unit's temperature probe. The indicated temperature is visible through the accessory housing window located above the odometers. Compare to the readings taken in step 1. Both values should agree within ± 4 °F.

Note: The temperature indicated by the unit's temperature probe will not be used since this is an estimated reading. Use the temperature recorded in Step 1 as the reference temperature for the TC unit operational check.

3. Observe the Temperature Compensated volume odometer. When the odometer stops turning after an intermittent compensating cycle, record the last 3-digit reading (**Ci**) indicated on the odometer, PLUS the value indicated by the graduated marks on the test wheel. Read as a whole number. (See the Sample Counter Reading in Figure 22.)

Note: Some of these digits may be partially or completely obscured by masking. The masking must be removed if the readings are not visible.

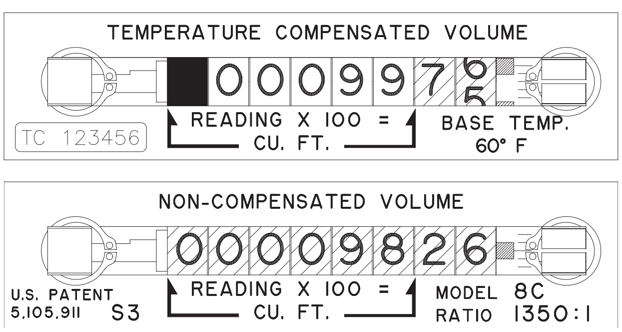


Figure 22 - A reading of 9756 would be the number recorded for TC unit operational check.

4. After the Compensated Volume odometer has cycled 25 times and stopped, record the last 3 digits of the Temperature Compensated odometer **(Cf)**, PLUS the graduated wheel estimation as described in Step 3 above.

5. Use Table 8 (page 27) or the calculation described in the next section (Calculating Theoretical Counts) to determine the Theoretical Number of Counts **(TNC)** for the indicated temperature recorded in Step 1.

6. Calculate the percent accuracy of the TC Unit with the following equation:

$$\text{Percent Accuracy} = \frac{\mathbf{Cf - Ci}}{\mathbf{TNC}} \times 100$$

Example: Assume the gas temperature is 53.0°F, and from Figure 22, the initial odometer reading (**Ci**) = 9756. We then allow the odometer to cycle 25 times and record the final reading. We will further assume the final odometer reading (**Cf**) = 2295.

Note: When **Cf** is less than **Ci**, place a "1" in front of the reading for **Cf**. In this example, the adjusted reading for **Cf** would read as "12295".

From Table 8, the Theoretical Number of Counts **(TNC)** = 2534.1.

Using these numbers in the "Percent Accuracy" formula, the accuracy is calculated as:

$$\frac{12295 - 9756}{2534.1} \times 100 = 100.19\%$$

Calculating Theoretical Counts

The number of theoretical counts **(TNC)** can be calculated as shown:

Where **TB** = Base Temperature (Typically 60° F)

TA = Actual Gas Temperature

Therefore:

Theoretical Number of Counts (**TNC**) =

For Fahrenheit $$\frac{(460 + \mathbf{TB}) \times (\text{Number of Cycles} \times 100)}{460 + \mathbf{TA}}$$

Example: For a 25 cycle test, the Theoretical Number of Counts (**TNC**) for gas temperature of 70.0°F and a 60° F base temperature is calculated as follows:

$$= \frac{(460 + 60) \times (25 \times 100)}{460 + 70.0}$$

$$= \frac{1{,}300{,}000}{530.0} = 2452.8$$

Table 8 - Temperature Cycle Testing -Theoretical Number of Counts (TNC) for specified temperature in degrees Fahrenheit (°F) and degrees Celsius (°C). Based on 10 Temperature Compensation Cycles.

°F	TNC	°F	TNC	°F	TNC	°F	TNC	°F	TNC	°F	TNC
50.0	2549.0	55.0	2524.3	60.0	2500.0	65.0	2476.2	70.0	2452.8	75.0	2429.9
50.1	2548.5	55.1	2523.8	60.1	2499.5	65.1	2475.7	70.1	2452.4	75.1	2429.5
50.2	2548.0	55.2	2523.3	60.2	2499.0	65.2	2475.2	70.2	2451.9	75.2	2429.0
50.3	2747.5	55.3	2722.8	60.3	2498.6	65.3	2474.8	70.3	2451.4	75.3	2428.5
50.4	2547.0	55.4	2522.3	60.4	2498.1	65.4	2474.3	70.4	2451.0	75.4	2428.1
50.5	2546.5	55.5	2521.8	60.5	2497.6	65.5	2473.8	70.5	2450.5	75.5	2427.6
50.6	2546.0	55.6	2521.3	60.6	2497.1	65.6	2473.4	70.6	2450.1	75.6	2427.2
50.7	2545.5	55.7	2520.8	60.7	2496.6	65.7	2472.9	70.7	2449.6	75.7	2426.7
50.8	2545.0	55.8	2520.4	60.8	2496.2	65.8	2472.4	70.8	2449.1	75.8	2426.3
50.9	2544.5	55.9	2519.9	60.9	2495.7	65.9	2472.0	70.9	2448.7	75.9	2425.8
51.0	2544.0	56.0	2519.4	61.0	2495.2	66.0	2471.5	71.0	2448.2	76.0	2425.4
51.1	2543.5	56.1	2518.9	61.1	2494.7	66.1	2471.0	71.1	2447.7	76.1	2424.9
51.2	2543.0	56.2	2518.4	61.2	2494.2	66.2	2470.5	71.2	2447.3	76.2	2424.5
51.3	2542.5	56.3	2517.9	61.3	2493.8	66.3	2470.1	71.3	2446.8	76.3	2424.0
51.4	2542.0	56.4	2517.4	61.4	2493.3	66.4	2469.6	71.4	2446.4	76.4	2423.6
51.5	2541.5	56.5	2516.9	61.5	2492.8	66.5	2469.1	71.5	2445.9	76.5	2423.1
51.6	2541.0	56.6	2516.5	61.6	2492.3	66.6	2468.7	71.6	2445.4	76.6	2422.7
51.7	2540.6	56.7	2516.0	61.7	2491.9	66.7	2468.2	71.7	2445.0	76.7	2422.2
51.8	2540.1	56.8	2515.5	61.8	2491.4	66.8	2467.7	71.8	2444.5	76.8	2421.8
51.9	2539.6	56.9	2515.0	61.9	2490.9	66.9	2467.3	71.9	2444.1	76.9	2421.3
52.0	2539.1	57.0	2514.5	62.0	2490.4	67.0	2466.8	72.0	2443.6	77.0	2420.9
52.1	2538.6	57.1	2514.0	62.1	2489.9	67.1	2466.3	72.1	2443.1	77.1	2420.4
52.2	2538.1	57.2	2513.5	62.2	2489.5	67.2	2465.9	72.2	2442.7	77.2	2420.0
52.3	2537.6	57.3	2513.0	62.3	2489.0	67.3	2465.4	72.3	2442.2	77.3	2419.5
52.4	2537.1	57.4	2512.6	62.4	2488.5	67.4	2464.9	72.4	2441.8	77.4	2419.1
52.5	2536.6	57.5	2512.1	62.5	2488.0	67.5	2464.5	72.5	2441.3	77.5	2418.6
52.6	2536.1	57.6	2511.6	62.6	2487.6	67.6	2464.0	72.6	2440.9	77.6	2418.2
52.7	2535.6	57.7	2511.1	62.7	2487.1	67.7	2463.5	72.7	2440.4	77.7	2417.7
52.8	2535.1	57.8	2510.6	62.8	2486.6	67.8	2463.1	72.8	2439.9	77.8	2417.3
52.9	2534.6	57.9	2510.1	62.9	2486.1	67.9	2462.6	72.9	2439.5	77.9	2416.8
53.0	2534.1	58.0	2509.7	63.0	2485.7	68.0	2462.1	73.0	2439.0	78.0	2416.4
53.1	2533.6	58.1	2509.2	63.1	2485.2	68.1	2461.7	73.1	2438.6	78.1	2415.9
53.2	2533.1	58.2	2508.7	63.2	2484.7	68.2	2461.2	73.2	2438.1	78.2	2415.5
53.3	2532.6	58.3	2508.2	63.3	2484.2	68.3	2460.7	73.3	2437.7	78.3	2415.0
53.4	2532.1	58.4	2507.7	63.4	2483.8	68.4	2460.3	73.4	2437.2	78.4	2414.6
53.5	2531.6	58.5	2507.2	63.5	2483.3	68.5	2459.8	73.5	2436.7	78.5	2414.1
53.6	2531.2	58.6	2506.7	63.6	2482.8	68.6	2459.3	73.6	2436.3	78.6	2413.7
53.7	2530.7	58.7	2506.3	63.7	2482.3	68.7	2458.9	73.7	2435.8	78.7	2413.2
53.8	2530.2	58.8	2505.8	63.8	2481.9	68.8	2458.4	73.8	2435.4	78.8	2412.8
53.9	2529.7	58.9	2505.3	63.9	2481.4	68.9	2457.9	73.9	2434.9	78.9	2412.3
54.0	2529.2	59.0	2504.8	64.0	2480.9	69.0	2457.5	74.0	2434.5	79.0	2411.9
54.1	2528.7	59.1	2504.3	64.1	2480.4	69.1	2457.0	74.1	2434.0	79.1	2411.4
54.2	2528.2	59.2	2503.9	64.2	2480.0	69.2	2456.5	74.2	2433.5	79.2	2411.0
54.3	2527.7	59.3	2503.4	64.3	2479.5	69.3	2456.1	74.3	2433.1	79.3	2410.5
54.4	2527.2	59.4	2502.9	64.4	2479.0	69.4	2455.6	74.4	2432.6	79.4	2410.1
54.5	2526.7	59.5	2502.4	64.5	2478.6	69.5	2455.1	74.5	2432.2	79.5	2409.6
54.6	2526.2	59.6	2501.9	64.6	2478.1	69.6	2454.7	74.6	2431.7	79.6	2409.2
54.7	2525.7	59.7	2501.4	64.7	2477.6	69.7	2454.2	74.7	2431.3	79.7	2408.7
54.8	2525.3	59.8	2501.0	64.8	2477.1	69.8	2453.8	74.8	2430.8	79.8	2408.3
54.9	2524.8	59.9	2500.5	64.9	2476.7	69.9	2453.3	74.9	2430.4	79.9	2407.9

TROUBLE SHOOTING CHECKLIST

Trouble	Item	Possible Cause	Remedy
No Flow Registered	1	Obstruction in piping or meter.	Check piping and valves to assure an open flow path. Check for impeller rotation. Refer to Step #5 in the "Placing Meter in Line" section of this manual.
	2	Index or RPM wheel does not turn.	No gas flow. Open valve or remove obstruction per Item #1.
Low Volume Registration	3	Meter oversized for load.	Use proper meter size.
	4	Leak at meter bypass.	Check bypass and valves.
	5	Meter internal friction.	See High Differential, Item #6.
High Differential	6	Build-up of deposits in measuring chamber.	Flush meter.
	7	Worn bearings or gears.	Replace or Return to Dresser's Product Services Department.
	8	High oil level or heavy oil.	Check oil level and cleanliness.
	9	Impellers rubbing cylinder or headplates, or meter out of time.	Rotate impellers manually to check for binding or rubbing. Remove obstructions and/or time the meter. Verify that the meter is level.
Vibration/Noise	10	Piping misalignment or strain.	Remove piping strain. Level the meter.
	11	Impellers rubbing casing.	See items #7 & #9.
	12	Contaminants in measuring chamber.	See item #6.

ROOTS® Meter Accessory Acronym Chart
for Series B3, B3_HP, & B3_HPC Meters

16M 175 CPWS CBG

Pulser Connection Types

- **MSC** - military spec circular connector
- **CBG** - cable gland
- **CND** - conduit

Accessory Types

Accessory Types

- **CTR** - Non-compensated Counter
- **TC** - Temperature Compensated Counter
- **CD** - Counter with Instrument Drive
- **TD** - Temperature Compensated Counter with Instrument Drive
- **ICPWS** - Counter and Pulser with a Single Connector
- **ICPWD** - Counter and Pulser with Dual Connectors
- **ITPWS** - Temperature Compensated Counter and Pulser with a Single Connector
- **ITPWD** - Temperature Compensated Counter and Pulser with Dual Connectors
- **ICPWX** - Counter and Pulser with a Conduit Connection
- **ITPWX** - Temperature Compensated Counter and Pulser with a Conduit Connection
- **CEX** - Non-Compensated Counter with Electronic Transmitter
- **IMC/C-PTZ+Log** - Integrally mounted Micro Corrector with Mechanical Non-compensated Counter
- **IMC/C-T+Log** - Integrally mounted Micro Corrector with Mechanical Non-compensated Counter Temperature Only
- **IMC/W-PTZ+Log** - Integrally mounted Micro Corrector (without Mechanical Counter)
- **IMC/W-T+Log** - Integrally mounted Micro Corrector (without Mechanical Counter) Temperature Only

Maximum Allowable Operating Pressure (MAOP)

- **175** psig
- **200** psig
- **232** psig
- **300** psig
- **740** psig*
- **1480** psig*

***OPTIONS:**

- **BPV** Internal Bypass Valve for 1M-7M HPC Series B Body Meters
- Indicator with Pulse Output for **BPV**

Meter Capacities and Multipliers
Multipliers: C = x 100 acfh M = x 1000 acfh
(example: 16M = 16000 acfh)

- **8C**
- **11C**
- **15C**
- **1M**
- **2M**
- **3M**
- **5M**
- **7M**
- **11M**
- **16M**
- **23M**
- **38M**
- **56M**

Imperial Sizing Charts

LINE MOUNTED														Foot Mount
MODEL	8C175*	11C175*	15C175*	2M175*	3M175*	5M175*	7M175	11M175	16M175	23M232	23M175	38M175	56M175	102M125
RATING	800	1100	1500	2000	3000	5000	7000	11000	16000	23000	23000	38000	56000	102000
PSIG	Corrected Capacity at Metering Pressure – in MSCFH													
1	0.84	1.15	1.57	2.09	3.1	5.2	7.3	11.5	16.7	24.0	24.0	39.7	58.5	106.6
3	0.94	1.30	1.77	2.60	3.5	5.9	8.3	13.0	18.9	27.2	27.2	44.9	66.1	120.5
5	1.05	1.45	1.98	2.63	4.0	6.6	9.2	14.5	21.1	30.3	30.3	50.0	73.8	134.3
10	1.32	1.82	2.48	3.31	5.0	8.3	11.6	18.2	26.5	38.1	38.1	62.9	92.7	168.9
15	1.60	2.20	2.99	3.89	6.0	10.0	14.0	22.0	31.9	45.9	45.9	75.8	111.8	203.6
20	1.87	2.57	3.50	4.67	7.0	11.7	16.3	25.7	37.4	53.7	53.7	88.7	130.8	238.2
25	2.14	2.94	4.01	5.35	8.0	13.4	18.7	29.4	42.8	61.5	61.5	101.7	149.8	272.9
30	2.41	3.32	4.52	6.03	9.0	15.1	21.1	33.2	48.2	69.3	69.3	114.5	168.8	307.4
40	2.95	4.06	5.54	7.35	11.1	18.5	25.9	40.6	59.1	84.9	84.9	140.3	206.8	376.7
50	3.50	4.81	6.56	8.74	13.1	21.9	30.6	48.1	70.0	100.6	100.6	166.1	244.8	445.9
60	4.04	5.56	7.58	10.10	15.2	25.3	35.4	55.6	80.8	116.2	116.2	191.9	282.9	515.2
70	4.58	6.30	8.60	11.50	17.2	28.7	40.1	63.0	91.7	131.8	131.8	217.7	320.9	584.5
80	5.13	7.05	9.61	12.80	19.2	32.0	44.9	70.5	102.5	147.4	147.4	243.5	358.9	653.7
90	5.67	7.80	10.63	14.20	21.3	35.4	49.6	78.0	113.4	163.0	163.0	269.3	396.9	723.0
100	6.21	8.54	11.65	15.50	23.3	38.8	54.4	85.4	124.3	178.6	178.6	295.1	434.9	792.1
110	6.76	9.29	12.67	16.93	25.3	42.2	59.1	92.9	135.1	194.2	194.2	320.9	472.9	861.4
120	7.30	10.04	13.69	18.25	27.4	45.6	63.9	100.4	146.0	209.9	209.9	346.7	510.9	930.6
125	7.57	10.41	14.20	18.90	28.4	47.3	66.2	104.1	151.4	217.7	217.7	359.6	530.0	965.3
135	8.11	11.16	15.21	20.33	30.4	50.7	71.0	111.6	162.3	233.3	233.3	385.4	568.0	
150	8.93	12.28	16.74	22.30	33.5	55.8	78.1	122.8	178.6	256.7	256.7	424.1	625.0	
175	10.29	14.15	19.29	25.70	38.6	64.3	90.0	141.5	205.8	295.8	295.8	488.7	720.2	
200	11.64	16.01	21.83											

*Also available in 200 PSIG Rating

HIGH PRESSURE METERS								
MODEL	1M300	1M740	1M1480	3M300	3M740	3M1480	5M1480	7M1480
RATING	1000	1000	1000	3000	3000	3000	5000	7000
PSIG	Corrected Capacity at Metering Pressure — in MSCFH							
125	9.5	9.5	9.5	28.4	28.4	28.4	47.3	66.2
150	11.2	11.2	11.2	33.5	33.5	33.5	55.8	78.1
175	12.9	12.9	12.9	38.6	38.6	38.6	64.3	90.0
200	14.6	14.6	14.6	43.7	43.7	43.7	72.8	102
250	18.0	18.0	18.0	53.9	53.9	53.9	89.8	126
300	21.3	21.3	21.3	64.0	64.0	64.0	107	149
350		24.7	24.7		74.2	74.2	124	173
500		34.9	34.9		105	105	175	244
600		41.7	41.7		125	125	209	292
740		51.2	51.2		154	154	256	359
800			55.3			166	276	387
900			62.1			186	310	435
1200			82.4			247	412	577
1480			102			305	508	711

NOTE: All capacities listed are Standard Cubic Feet per Hour (SCFH) and based upon Average Atmospheric Pressure (14.4 PSIA), Base Pressure (14.73 PSIA), and Base Temperature (60°F). Tables do not take into account Supercompressibility. Please refer to RM-135 for further information on the Application of Temperature and/or Pressure Correction Factors in Gas Measurement.

SIZING INSTRUCTIONS

To select the proper meter size, use the Minimum Operating Pressure and the Maximum Instantaneous Hourly Flow Rate. Do not exceed meter's Maximum Allowable Operating Pressure.

To prevent oversizing of a meter, sizing should be based upon the total connected load giving consideration to the load diversity. When using this method to size a meter, a selected diversity factor times the total connected load will be used as the Maximum Instantaneous Flow Rate for sizing purposes.

A diversity factor of 0.85 is commonly used for a single application where two or more major appliances are in use (i.e. boilers, furnaces, space heaters, etc.).

As the number of appliances considered when determining a connected load increases, the diversity factor will typically decrease. For applications such as multiple ranges and water heaters, some examples of commonly used diversity factors are:

Qty	Factor	Qty	Factor*
0-5	1	6	0.9
7	0.85	8	0.83

* The diversity factors listed above are estimates. For proper sizing, consult your company or industry standards for determining accepted values.

ENERGY VALUE	
Gas	BTU/Cu. Ft.
Acetylene	1498
Butane	3200
Ethane	1758
Ethylene	1606
Methane	997
Natural Gas	965/1055
Propane	2550

Metric Sizing Charts

LINE MOUNTED															Foot Mount
MODEL			8C175*	11C175*	15C175*	2M175*	3M175*	5M175*	7M175	11M175	16M175	23M175	38M175	56M175	102M125
			*Also Available with 200 PSIG Rating (13,8 Bar); (1379 kPa); (14,1 kg/cm²)												
RATING			22,6	31	42	57	85	142	200	310	450	650	1000	1600	2885
PSIG	Bar	kPa	Corrected Capacity at Metering Pressure – in Nm³/H												
1	0,07	7	23,7	32,6	44,4	59,2	88,8	148,0	207,2	325,5	473,5	680,7	1124,6	1657,3	3018,6
3	0,21	21	26,8	36,8	50,2	66,9	100,3	167,2	234,1	367,9	535,1	769,3	1270,9	1873,0	3411,5
5	0,34	34	29,8	41,0	55,9	74,6	111,9	186,5	261,1	410,3	596,8	857,8	1417,3	2088,7	3804,3
10	0,69	69	37,5	51,6	70,3	93,8	140,7	234,5	328,3	515,9	750,4	1078,7	1782,1	2626,3	4783,6
15	1,03	103	45,2	62,2	84,8	113,1	169,6	282,6	395,7	621,8	904,4	1300,1	2148,0	3165,5	5765,7
20	1,38	138	52,9	72,7	99,2	132,3	198,4	330,6	462,9	727,4	1058,0	1520,9	2512,8	3703,1	6745,0
25	1,72	172	60,6	83,3	113,6	151,5	227,3	378,8	530,3	833,3	1212,1	1742,4	2878,7	4242,3	7727,1
30	2,1	207	68,3	93,9	128,0	170,7	256,1	426,8	597,5	938,9	1365,7	1963,2	3243,5	4780,0	8706,4
40	2,8	276	83,7	115,0	156,9	209,2	313,8	522,9	732,1	1150,4	1673,4	2405,5	3974,3	5856,8	10667,7
50	3,4	345	99,1	136,2	185,7	247,6	371,4	619,1	866,7	1362,0	1981,0	2847,7	4705,0	6933,6	12629,1
60	4,1	414	114,4	157,3	214,6	286,1	429,1	715,2	1001,3	1573,5	2288,7	3290,0	5435,7	8010,5	14590,5
70	4,8	483	129,8	178,5	243,4	324,5	486,8	811,4	1135,9	1785,0	2596,4	3732,3	6166,4	9087,3	16551,9
80	5,5	552	145,2	199,7	272,3	363,0	544,5	907,5	1270,5	1996,5	2904,0	4174,6	6897,1	10164,2	18513,3
90	6,2	621	160,6	220,8	301,1	401,5	602,2	1003,7	1405,1	2208,1	3211,7	4616,8	7627,8	11241,0	20474,7
100	6,9	689	175,9	241,9	329,9	439,9	659,8	1099,7	1539,5	2419,3	3518,9	5058,5	8357,5	12316,3	22433,2
110	7,6	758	191,3	263,1	358,7	478,3	717,5	1195,8	1674.1	2630,8	3826,6	5500,7	9088,2	13393,1	24394,6
120	8,3	827	206,7	284,2	387,6	516,8	775,2	1292,0	1808,7	2842,3	4134,3	5943,0	9818,9	14469,9	26356,0
125	8,6	862	214,4	294,8	402,0	536,0	804,1	1340,1	1876,1	2948,2	4288,3	6164,5	10184,8	15009,1	27338,1
135	9,3	931	229,8	315,9	430,8	574,4	861,7	1436,1	2010,6	3159,4	4595,5	6606,1	10914,4	16084,4	
150	10	1034	252,9	347,7	474,1	632,2	948,2	1580,4	2212,6	3476,9	5057,3	7269,8	12011,0	17700,5	
175	12	1207	291,4	400,6	546,3	728,4	1092,6	1821,0	2549,4	4006,1	5827,1	8376,5	13839,4	20394,9	
200	14	1379	329,6	453,3	618,1										

HIGH PRESSURE METERS										
	MODEL		1M300	1M740	1M1480	3M300	3M740	3M1480	5M1480	7M1480
	RATING		28	28	28	85	85	85	142	200
PSIG	Bar	kPa	Corrected Capacity at Metering Pressure - in Nm³/H							
125	8,6	862	268,0	268,0	268,0	804,1	804,1	804,1	1340,1	1876,1
150	10	1034	316,1	316,1	316,1	948,2	948,2	948,2	1580,4	2212,6
175	12	1207	364,2	364,2	364,2	1092,6	1092,6	1092,6	1821,0	2549,4
200	14	1379	412,1	412,1	412,1	1236,2	1236,2	1236,2	2060,3	2884,4
250	17	1724	508,3	508,3	508,3	1525,0	1525,0	1525,0	2541,7	3558,4
300	21	2068	604,3	604,3	604,3	1813,0	1813,0	1813,0	3021,7	4230,4
350	24	2413		700,6	700,6		2101,9	2101,2	3503,2	4904,5
500	34	3447		988,9	988,9		2966,8	2966,8	4944,7	6922,5
600	41	4137		1181,2	1181,2		3543,7	3543,7	5906,1	8268,6
740	51	5102		1450,6	1450,6		4351,7	4351,7	7252,8	10153,9
800	55	5516			1565,8			4697,4	7829,1	10960,7
900	62	6205			1758,1			5274,3	8790,5	12306,7
1200	83	8274			2334,7			7004,1	11673,5	16342,9
1480	102	10204			2874,5			8623,4	14372,4	20121,4

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