

ROOTS Meters & Instruments

INSTALLATION, OPERATION & MAINTENANCE

ROOTS® Meters Series B3 Meter Models 5CI5 and 8CI5



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1 Year Warranty

Dresser Roots Meters & Instruments (herein referred to as the Company) agrees to supply equipment of good design and first class material and workmanship. In the event of any defect of material or workmanship, the Company will repair F.O.B. place of manufacture, or furnish without charge, place of manufacture, similar part or parts which, within one year after their shipment, are proven to have been so defective at the time of shipment, provided the Purchaser gives the Company immediate written notice of such alleged defects.

Notwithstanding the proceeding, warranty claims involving ROOTS® Rotary Positive Displacement Gas Meters used only to measure gas volumes in a permanent installation may be made within one (1) year from shipment. A complete list of products covered by this extended warranty is available by writing our general offices.

Except as herein provided, there are no other warranties either expressed or implied (including without limitation, the implied warranties of merchantability and fitness for particular purpose), and any such warranties are hereby expressly disclaimed. The Company, except in the case of gross or willful negligence, shall not be liable for any damages for cause or reason whatsoever, either direct, indirect, special or consequential, arising out of any contact or from the operation or failure properly to operate any apparatus or equipment sold. No allowance will be made for repairs or alterations unless made with the written consent first obtained from the Company. Neither shall the Company be held liable or in any way responsible for work done, apparatus furnished, or repairs made by others. Auxiliary equipment supplied hereunder not manufactured by the Company and so identified by the Company is subject to the warranty of the manufacturer thereof and the Purchaser's recourse shall be limited to such other warranty.

RECEIVING, HANDLING AND STORAGE

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

IMPORTANT NOTES

- **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.** All new meters should be checked for free rotation soon after arrival since 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 may be 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 on the meter nipples. The caps will provide reasonable protection against dust.
- When reporting a suspected problem, please provide the following information:
 - Your Sales Order Number and/or Dresser's Order Number
 - Meter Model, Serial Number and Bill of Material Number.
 - 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 ROOTS® 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. Refer to our Return Material Authorization procedure. 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 or for handling acetylene, biogas or sewage gas. Measurement accuracy and life expectancy can be impeded by excessive deposits of dirt or other types of foreign material present in the gas stream.

Operating Principle

As shown in Figure 1, two contra-rotating impellers of two-lobe or "figure 8" contour are encased within a rigid measuring cartridge, with inlet and outlet connections on opposite sides.

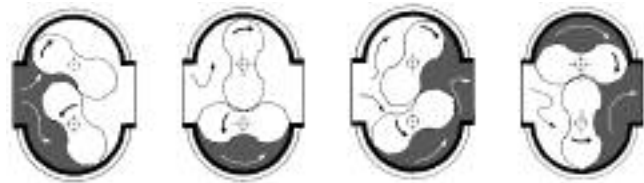


Figure 1

The measurement cartridge is encased in an aluminum housing. Precision machined timing gears keep the impellers in correct relative position. Optimal operating clearance between the impellers, cylinder, and headplates provide a continuous, non-contacting seal.

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 cylinder 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 nonadjustable. 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 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 Meter. The meter operating temperature range is from -40°F to +140°F (-40°C to +60°C).

ROOTS® Meters sizes 5C15 and 8C15 have a Maximum Allowable Operating Pressure (MAOP) rating of 15 psig (103kPa). Every meter is static pressure tested at the factory at twice its MAOP (30 psig/206 kPa) and leak tested at 125 percent of MAOP (18.75 psig/128.75 kPa) in accordance with ASME Boiler Pressure Vessel Codes.

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 Pressure. Refer to the basic meter body nameplate for the MAOP.

Meter accuracy is not affected by low or varying line pressures. 5C/8C15 meters may be used satisfactorily for pressures ranging from a few ounces to full MAOP. The meter base rating is expressed in hundreds (C) of Actual Cubic Feet per Hour (ACFH), or in Cubic Meter per Hour (m³H).

Displaced volume measurement is completely independent of the gas specific gravity, temperature, and pressure. Displaced volume 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.

Major components of the meter are machined or cast from aluminum for a combination of strength and weight reduction. All aluminum parts are anodized, and the measuring chamber and impellers are hard-coat anodized for added corrosion and abrasion resistance.

Lubrication for the main bearings and timing gears is permanent, and no oil should be added.

METER INDEX

Two index options are available. The customer specifies the dial or odometer index when ordering the meter. Readings are in ACFH (m³/h).



Figure 2 - Odometer Index

Figures 2 & 3 - The 5C15 and 8C15 may be ordered for Top or Bottom Inlet, with dial or digital index. Internal pipeline screens are available.

METER INSTALLATION

Piping configurations

Line mounted ROOTS® Meter sizes 5C15 and 8C15 may be installed in either a Top (vertical), Side (horizontal), or Bottom Inlet (vertical) configuration. The preferred or recommended installation is a top inlet in a vertical pipe line with gas flow downward. In a bottom inlet application, a 60 Mesh screen is recommended in the inlet (bottom) connection. Although the design of the impellers tends to make the meter inherently self-cleaning, the top inlet mounting allows gravity to pass dirt, pipe scale, or other debris through the meter.

The installation of tees will allow the meter to be tested while mounted in line using a transfer prover.

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 screen or stainer upstream of the meter to remove liquids and foreign matter (pipe sealant, tape, weld slag, etc.) from the gas stream. A 100 Mesh screen is recommended.

Do not install a lubricated gas valve directly before a meter, as excess valve lubricant or other foreign material can stop impeller rotation.

If over-speed conditions can occur, a restricting flow orifice plate should be installed 2 to 4 pipe diameters downstream of the meter outlet. Contact Dresser Roots Meters & Instruments for sizing, pricing and availability. Warranty does not cover over-speed conditions.

Placing Meter in Line

1. Before installing a meter:

Make sure the upstream piping is clean. During this procedure, use extreme caution and follow recommended company procedures.

Remove the plastic protective caps from both meter nipples prior to meter installation.

Insure the impellers turn freely and no objects or contaminants are in the measuring chamber.



Figure 3 - Dial Index

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 nameplate (i.e., arrow pointing downward for Top Inlet)
3. Install the meter without piping strain to prevent a binding of the casing and impellers.
4. Check the orientation of the meter with a level. The meter must be level within 1/16" per foot (5mm/m) in any direction, side to side, front to back.

Meter Start-Up

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 overspeed 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 of 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 "Half Foot" dial. If movement is present, go to step c. If the dial is not turning, verify gas is being delivered to the meter. If gas is flowing to the meter inlet and the dial is not moving, go to step e.
- 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 "Half Foot" dial is not turning, place the meter in bypass. Slowly depressurize and vent all pressure the meter set before checking for piping misalignment, piping strain, torsion, or other related problems. Once the problem has been 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 authorized procedure or common practice to leak test the meter and all connections. Soapy water, Snoop® and gas analyzers are commonly used for this procedure.



INSPECTION AND MAINTENANCE

Lubrication

NO LUBRICATION IS REQUIRED. This meter incorporates permanently lubricated bearings and gears.



Meter Level

Since the meter is supported entirely by the gas pipe line, movement of the piping through accident, settling of the ground or other causes can impede meter operation and accuracy. Refer to "INSTALLATION" procedures. Make sure the meter remains level within 1/16" per foot (5mm/m) in any direction, side to side, 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 - If there is any evidence of dirt or dust in the meter, a suggested method for removal is to windmill the impellers (at a speed less than maximum capacity) by injecting controlled compressed air from a nozzle into the meter inlet.

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 prover, transfer prover, sonic nozzle prover, and critical flow proving. The Differential Pressure 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. It is accepted by many State Utility Commissions as a means of periodically substantiating that the original accuracy of a meter has remained unchanged.

Differential Pressure 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 pressure. 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 can be tolerated without affecting meter accuracy at the higher flow rates (25% and above) by more than 1 percent. Supportive technical data is available, upon request.

A differential pressure test consists of a series of differential pressure readings taken across the meter at several gas flow rates within the meter's capacity range. 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. Multiple curves may be necessary for meters under varying pressure conditions.

When less than 15 PSIG (100kPa Gauge), 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. Published data is representative of typical product production.

Establishing Base Line Curves - Developing an original differential or baseline curve is recommended at the time of meter initial installation. At least three (3) test points are required at gas flow rates from 25% to 100% of meter capacity. 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.

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 (i.e. 5,10 and 15 psig). An increase in flow rate, line pressure or specific gravity will cause an increase in the differential.

After developing a base-line 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 meter chamber.

Test Procedure - the test is performed using a ROOTS® Smart manometer, or other differential pressure test equipment with an indicating scale range of about 0.9" (150mm) 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.

(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 on line pressure, follow applicable safety rules and wear appropriate protective apparatus.

1. Install the pressure differential indicating device into the meter inlet and outlet differential taps. Install a pressure gauge or other pressure standard on the inlet side of the meter 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, or approximately 25 percent of meter 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 m³/h):

$$\text{Index Rate} = \frac{\text{Cubic Feet}}{\text{Test Time (sec)}} \times 3600$$

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

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

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 base line 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 assistance regarding meter inspection and/or repair, please call the Product Services Department, your Customer Service Representative, local Sales Representative, or Distributor and request a Return Material Authorization (RMA).

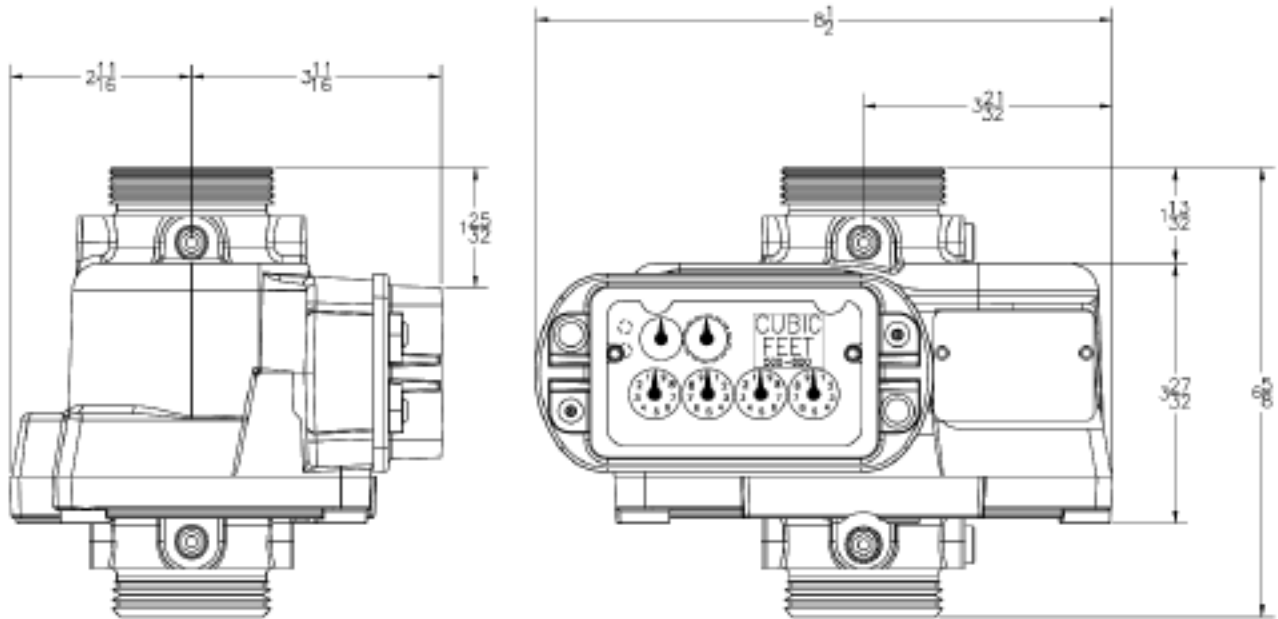
Proving Operations

Conventional scanning methods may be used with the 5C15 and 8C15 index in meter proving. The standard index for these meters is a circular (dial) index similar to that found on residential diaphragm meters. The preferred method is to focus a photocell or scanner on the "Half Foot" test hand. Each revolution represents 1/2 cubic foot of volume.

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 "Placing Meter in Line on page 4.
	2	Obstruction in Screen or Strainer.	Clean screen or strainer.
	3	Index or Half-foot dial does not turn.	No gas flow. Open valve or remove obstruction per Item #1.
Low Volume Registration	4	Meter Oversized for Load.	Use Proper Meter Size.
	5	Leak at Meter Bypass.	Check Bypass and Valves.
	6	Meter Internal Friction.	See "High Differential" below.
High Differential	7	Build-up of deposits in Measuring Cartridge.	Replace or Return to Dresser's Product Service Department.
	8	Worn Bearings or Sleeves.	Replace or Return to Dresser's Product Service Department.
	9	Impellers Rubbing Cartridge or Headplates, or Meter Out of Time.	Rotate impellers manually to check for binding or rubbing. Remove obstructions and/or Time the Meter. Check the meter level.
Vibration/Noise	10	Piping misalignment or strain.	Remove Piping Strain, Level Meter.
	11	Impellers Rubbing Casing.	See items #7 & #8.
	12	Contaminant's in Measuring Chamber.	See item #7.

NOTE: Also refer to Installation, Operation and Maintenance procedures within this manual for possible solutions.





Dresser Roots Meters & Instruments

Dresser, Inc.

P.O. Box 42176
Houston, Texas 77242-2176
website: www.dresser.com

Inside US Ph: 800.521.1114 Fax: 800.335.5224
Outside US Ph: 832.590.2303 Fax: 832.590.2494
www.rootsmeters.com