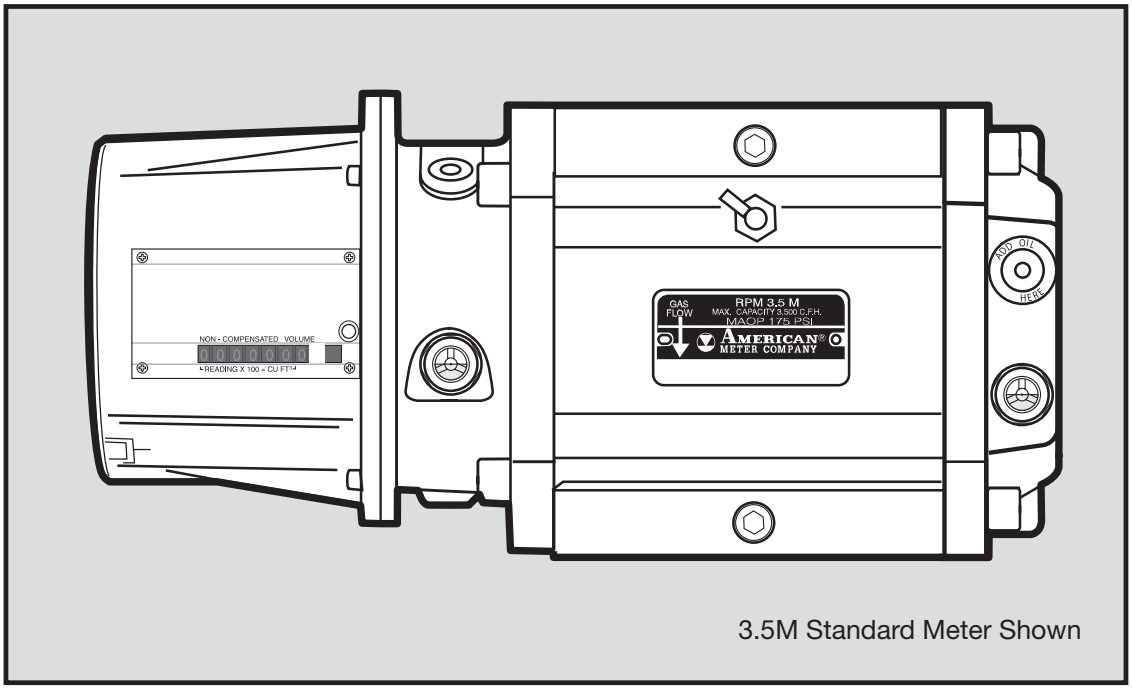
RPM Series Rotary Meter

(Standard, ETC & CMTC)

Installation, Operation, Maintenance

Line Mounted Models



3.5M Standard Meter Shown

AMERICAN METER COMPANY

AMERICAN METER 5 YEAR LIMITED WARRANTY

RPM SERIES ROTARY METERS

American Meter Co. Industrial Products Division (hereafter referred to as the Company) offers to supply Rotary Meters of exceptional design, material and workmanship. The company will correct any defect(s) in material or workmanship occurring during the period of one year after shipment (the "Warranty Start Date") providing the Purchaser has given the company immediate written notice of the defects.

In addition an extended 5-year warranty to the original owner in a permanent meter installation is offered against structural failure and for other identified components (list furnished by writing our general offices) from the Warranty Start Date under normal use, operation and maintenance.

The Company obligation under this warranty is limited at its option to repayment of the purchase price, repair, replacement, or furnishing a similar part upon inspection and confirmation of the defective condition.

THERE ARE NO OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED AND ANY OTHER WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED.

No allowance or reimbursements will be made for repairs or alterations unless made with the written consent first obtained from the Company.

In no event shall the Company liability to the customer, regardless of the reason, exceed the purchase price of the product. No claim of breach of warranty shall constitute a cause for cancellation of this contract or any part thereof.

The Company reserves the right to exclude from this warranty damages caused by any of the following:

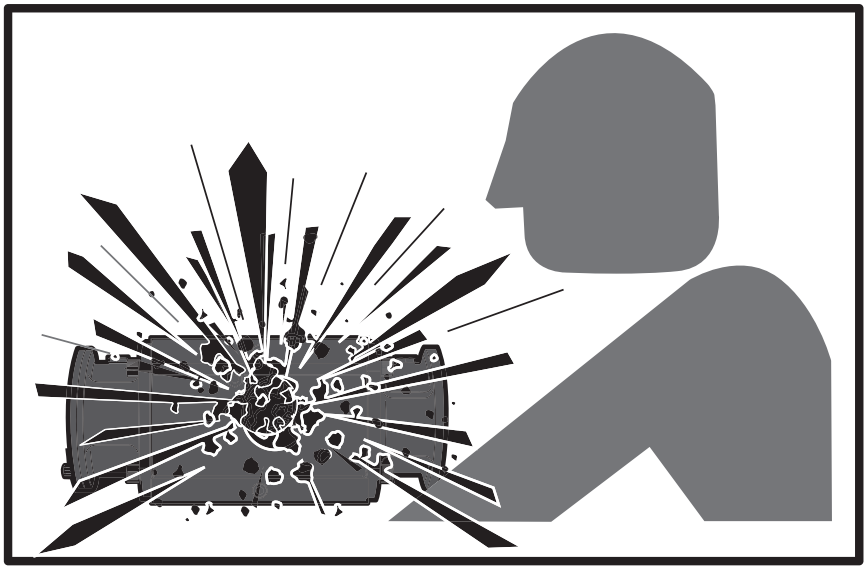
- Overpressurization beyond the badge rating of the meter.
- Snap acting loads.
- Work done, apparatus furnished, repairs or alterations made by others.
- Auxiliary equipment supplied not manufactured by the Company
- Less than specification performance caused by improper gas stream filtration, and improper installation.
- Collision, fire, theft, lightning, vandalism, explosion, natural disaster, or objects striking the meter.
- Misuse of the meter for applications and processes not originally designed for or recommended by the company.
- Corrosion due to improper environmental conditions, chemical treatments, after-market products and chemical reactions.
- Sealants applied as excessive or not recommended by the company.

Laws of the Commonwealth of Pennsylvania are applicable to this warranty.

⚠ CAUTION ⚠

"As a knowledgeable user of American Meter's products, we are sure that you are aware that parts in the Company's meters and regulators contain or are coated with heavy metals such as cadmium, zinc, lead and chromium. Obviously, therefore, repair or refurbishment of this equipment should take into account the presence of these materials and should comply with all state and federal requirements concerning worker protection, proper disposal and safety, including protection against exposure to dust and fumes."

TABLE OF CONTENTS



WARNING - EXPLOSION HAZARD

Read carefully and follow all instructions shipped with this meter. The incorrect installation of this equipment could result in escaping gas, and pose a potential explosion hazard.

Introduction

Meters utilized in the natural gas industry are divided into two general categories: inferential or positive displacement.

The inferential category includes turbine and orifice meters. Turbines are also referred to as velocity meters as they measure the gas velocity flowing through a pipeline.

Meters in the positive displacement category are the diaphragm and rotary types.

Rotary gas meters have been utilized in the industrial and commercial markets for decades and were produced in various designs. For today's gas utility, the rotary's primary application is to fill the flow gap between the diaphragm meter and the turbine meter. Like the diaphragm meter, the rotary meter measures gas with compartments that alternately fill and empty.

In addition to non-residential applications, many production fields or well head users utilize the rotary meter to provide accurate well head measurement at various pressures. When properly sized, installed, and maintained, the rotary meter provides accurate and dependable measurement from low to high pressure applications for many years.

GENERAL DESCRIPTION

The rotary meter is suitable for measuring most types of clean common gases. It is **NOT** intended for handling liquids, acetylene or sewage gas, and its operation/accuracy can be affected by excessive deposits of dirt or other foreign materials carried in the gas stream.

The basic type of rotary meter utilizes two opposite rotating two-lobe impellers. Internally there are no contacting parts in the measurement chamber. As adjusted from the factory, there is usually no wear as long as the meter is kept clean, leveled, and the bearings are properly lubricated.

FEATURES

American Meter's RPM Series Rotary Meters are available in ten (cfh) capacities @ 175 psig (12 bar) MAOP:

- 8.0C
- 9.0C (G16)
- 1.1C
- 1.5M (G25)
- 2M (G40)
- 3.5M (G65)
- 5.5M (G100)
- 7M
- 11M
- 16M (G250)

Introduction

The meters are available in three configurations:

- Standard
- Temperature Compensated (optional) Electronic & Mechanical. See page 3-1 and 3-2 for details.
- Instrument Drive (optional)

All rotary meters are equipped with an uncorrected mechanical counter.

The output end with uncorrected mechanical counter rotates 90° without interrupting pressurized chamber to facilitate vertical or horizontal mounting.

All models/sizes can be easily converted to instrument drive. The universal mounting plate rotates 360° in 45° increments.

Performance characteristics:

- Pressure rating: 175 psig (12 bar) Optional: 200psig (14 bar) or 285 psig (20 bar)
- Proof accuracy: ±1% (U.S. and Canada) ± 2% (Int'l) at low flow rates.
- Rangeability (see Rangeability Chart). ref.: ANSI B109.3 Rotary Gas Meters; Part III; page 10, Accuracy.
- Operating temperature: -40° to 140°F (-40° to 60°C)
- Temperature compensation display: -40° to 140°F (-40° to 60°C)
- Output of 8.0C to 11M is 10 cubic feet per pulse or .1 cubic meter per pulse. 7M & 16M is 1 cubic meter. 16M is 100 cubic feet per pulse.

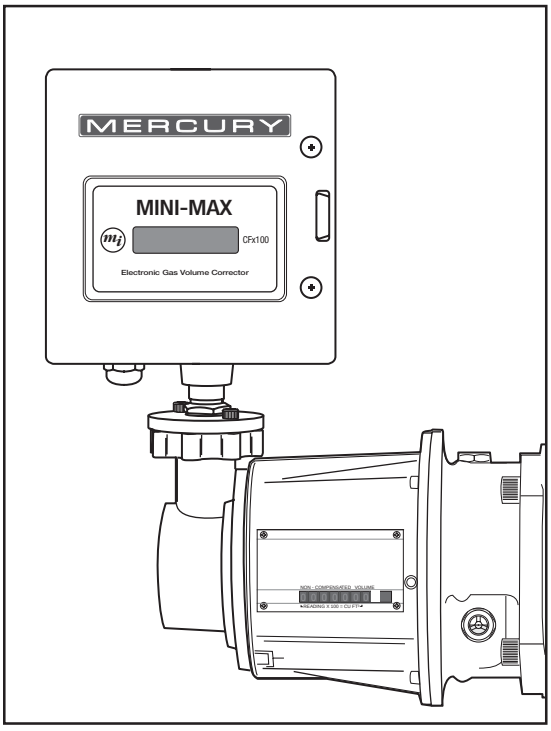


Fig. 1-1 Compensating Module

Rangeability Chart

Note: The numbers listed represent fully assembled production meters using standard proving practice.

Model	Cubic Ft/Hr Start Rate	Rangeability +1%	Rangeability +2%
8.0C/9.0C	<3.0	>30:1	>60:1
1.1C/1.5M	<3.0	>40:1	>75:1
2M/3.5M	<4.0	>75:1	>140:1
5.5M	<4.4	>120:1	>210:1
7M	<5.5	>70:1	>115:1
11M	<5.5	>120:1	>225:1
16M	<7.0	>100:1	>150:1

An optional Electronic Temperature Compensator is also provided. See page 3-1 for details.

STANDARDS

The American Meter's RPM Series Rotary Meter meets the following codes and standards:

- ASME Boiler & Pressure Vessel Code; Section VIII
- ANSI B16.5 Flanged Pipe & Fittings
- ANSI B31.8 Gas Piping
- ANSI B109.3 Rotary Gas Meters (92)
- 49 CFR 192 Min. Federal Safety Standards
- National Safe Transit Association (NSTA-1A-Packaging)
- Underwriter's Laboratory (UL)
- Measurement Canada

PRINCIPLES OF OPERATION

The opposite rotating "figure 8" impellers of a rotary meter operate within a rigid casing that has inlet and outlet gas connections on opposite sides.

The impellers rotate as a result of the pressure drop across the meter as downstream gas is consumed. The rotating impellers separate the flowing gas stream into small segments before the gas enters the downstream piping. These small segments are counted using a gear train which drives the meter index or correcting instrument. See Fig. 1-2.

Position 1 As the bottom impeller rotates in a counter-clockwise direction toward the horizontal position, gas enters the space between the impeller and the cylinder.

Position 2 At the horizontal position, a definite volume of gas is contained in the bottom compartment.

Position 3 As the impeller continues to turn, the volume of gas is then discharged.

Position 4 Concurrently, the top impeller rotating in the opposite direction has closed to its horizontal position, confining another known and equal volume of gas.

This process is repeated four times for each complete revolution of the impeller shafts.

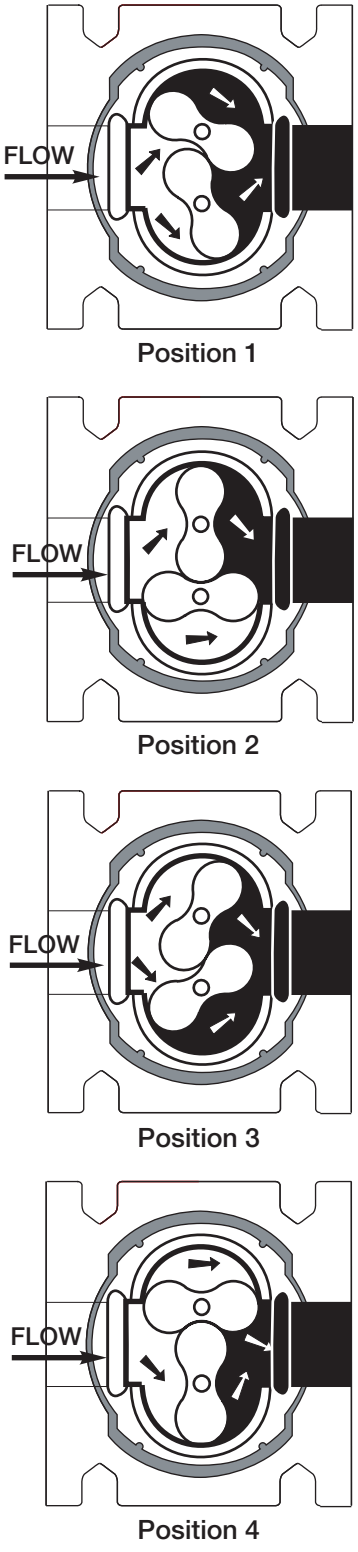


Fig. 1-2 Rotation of Impeller Shaft

SIZING/ACCURACY

There are four considerations to take into account when selecting and sizing a meter:

1. Inlet pressure
2. Required flow
3. Type of customer
4. Required pressure

Additionally, when selecting a rotary meter for a specific installation, the normal minimum and maximum allowable operating pressure (MAOP) should always be considered.

Industry standards recommend sizing rotary meters for 60% of the rated capacity and not lower than 10% of capacity. Because of the “no contacting parts” design, some gas can seep through the meter creating an error at low meter speeds.

AMERICAN METER CO. recommends that the meter be sized so it will **NOT OPERATE** below 10% of its rated capacity for **long periods of time**. Low flow rate error is corrected each time the rotary meter operates at 10% or more of its rated capacity. Above the 10% flow rate, the meter’s accuracy is slightly greater than 100%, and this compensates for possible error at low flow or pilot load flow rates.

EXAMPLE:

The following example depicts an **“average day in accuracy ”** measurement from a rotary meter:

A 5.5M rotary meter measuring natural gas consumption at a bakery that operates 16 hours a day:

Gas Consumption		Meter Accuracy		
16 hrs x 4000 CFH	=	64000 x 100.5%	=	64320
+ 8 hrs x 300 CFH (low flow)	=	2400 x 98.0%	=	2352
24 hrs	=	66400 (actual)	vs.	66672 (registered)

66672 ÷ 66400 Average Daily Accuracy = 100.4%

BASIC REQUIREMENTS

When installing a rotary meter, it can be easy to overlook details that may hinder meter performance and maintenance. Usual emphasis is put on a clean gas flow through the meter by use of filtration and proper inlet and outlet piping. There are some DO'S AND DON'TS that should always be considered when designing a rotary meter set.

- Refrain from using excessive amounts of pipe dope on inlet piping to the rotary meter. Chunks of pipe dope can break loose from screwed fittings and fall onto and in-between impeller lobes, rendering the meter immediately inoperative.
- Check for excess dirt, scale and weld splatters in the pipeline.
- Install an in-line pipe screen filter upstream from the meter to keep debris (i.e., stones, tap shavings, scale, and weld beads) from entering and causing damage to the meter.

  The use of an AMCO 80 mesh strainer is strongly recommended. See the parts list in the back of this document (Page 5.6) for ordering information. The elimination of smaller contaminants (i.e., grit) can be achieved with an AMCO Kleanline™ micron filter.
- If selecting full-port valves for the inlet and outlet piping, always use ball valves that require no, or minimal lubrication to achieve tight shut-off. Excessively greased plug valves will degrade rotary meter performance due to lubricant seeping into the meter.
- AMCO recommends if possible, installing a straight run of pipe without restrictions (i.e., valves, regulators, etc.) for a distance of six pipe diameters on either side of the meter (Fig. 2-1). This optimum set design will prevent a reduction in meter accuracy resulting from a turbulent gas stream.

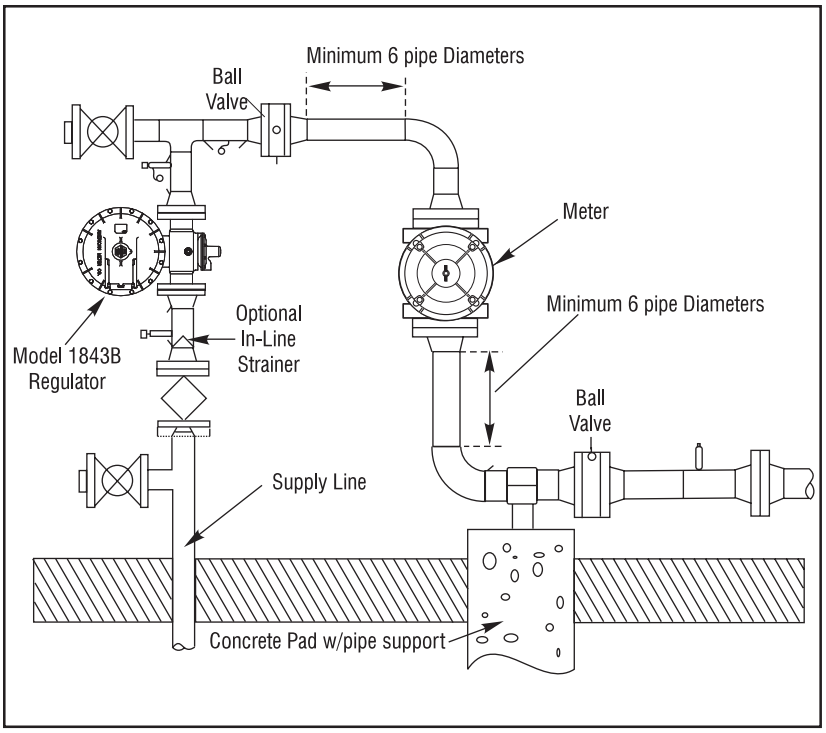


Fig. 2-1 Typical Installation (not to scale)

- Bypass piping can effectively reduce time spent on differential testing and maintenance. If a combined measurement and regulation set is installed, meter testing and regulation inspection can all be completed at the same time with minimum disruption of service.

  Bypass valves should have a tamper proof lock or seal to prevent theft of gas.
- Adequate service (working) clearance around the meter should be maintained to allow easy access for reading the meter indexes. For temperature compensated meters, a 6" clearance space for the temperature probe is necessary to permit the removal of the TC counter module if necessary. Clearances are also required for differential testing access, inspection and normal lubrication maintenance.
- The meter should never be installed so that it is lower than the discharge pipe runs. This would allow the meter to become a sump for condensate and other foreign material.

UNCRATING THE METER

Unpacking instructions are also included in the shipping container.

American RPM Series meters utilize packaging that meet ISTA (International Safe Transit Association) test specifications. Even with the packaging's rugged construction, the meter should be handled with care in transport and storage to protect its factory certified accuracy.

NOTE: If outer package shows evidence of damage through mishandling in transit, NOTIFY the shipper and immediately perform a careful inspection of the meter. FILE a claim with the shipper if damage is indicated and also notify your local AMCO sales office. See Appendix for listing.

NOTE: All packaging has size of meter inside, and an arrow depicting UP.

1. Carefully open the shipping container at the top seam. When cutting the top seam be careful not to cut too deeply into the area where the meter and accessories are lodged.
2. Open up the two top flaps and bend outward.
3. Remove the lubrication kit, instruction manual, and magnetic wand if the meter is equipped with the temperature compensator. The box will also contain the certificate of accuracy documentation. This should be filed for further reference.
4. Remove the center and end cardboard dividers.
5. Carefully grasp the meter by the **center** of the body and lift upward. See Figure 2-2.

   CAUTION: If the meter is equipped with a temperature compensator module, DO NOT LIFT THE METER BY THE COMPENSATOR MODULE ON THE END.
6. Always check new meters for free rotation after removal from the shipping container. This procedure is described in the following section, Check and Start-up.
7. If the meter is not to be installed or tested immediately, return the meter to its shipping container and place horizontally, red arrow pointing UP, in a dry, protected area. **DO NOT** put oil in the meter until it is to be installed.

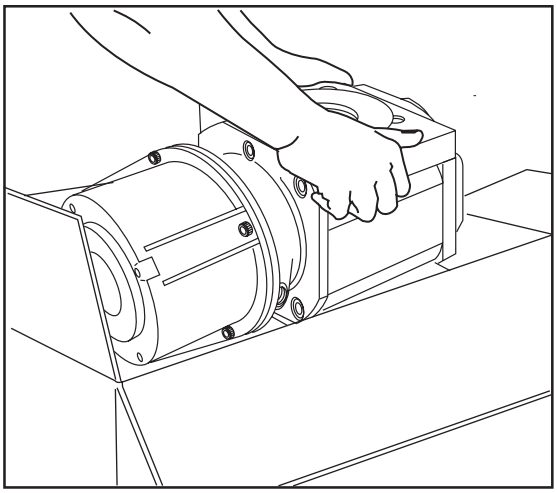


Fig. 2-2 Unpacking the Meter

MOUNTING AND LEVELING

- Proper support is necessary for any gas meter installation. If properly designed it provides stability and a sound base to eliminate vibration to the meter. If the ground surface is unstable, industry standards recommend an 8"x 8"x16" solid block be used to set the inlet and outlet risers. Riser legs should be at 90° angles from the set.
- A rotary meter can be installed horizontally facilitating the change out of an old meter set; however the preferred installation is top inlet in a vertical pipeline. Vertical mounting allows contaminants to be expelled more easily via gravity from the meter.
- A rotary meter should be installed close to 100% level at all times. Deviation from level should not be more than ±1/16" per foot in all directional planes. If the meter is not set level, it is possible to overfill or underfill the oil reservoirs while the oil sight glasses indicate the proper level. Overfilling with oil can cause the meter to read incorrectly due to increased drag on the gears and possible bleeding of oil into the measurement chamber. Under filling meters that are not level can lead to excessive bearing wear and will be evident on differential testing.

CHECK & START-UP OPERATION

The following steps should be utilized to insure a trouble-free start-up of the AMCO RPM Series Rotary Meters.

1. Remove the meter from the shipping carton and inspect for damage that may have occurred during transit. See previous section, Uncrating the Meter procedure.
2. Set the meter on the bottom of the over-turned shipping carton and remove the protective caps from both flange openings.

   CAUTION: Do not let dirt, debris, etc., enter flange openings!
3. Lightly blow into the inlet of the meter. This slight air pressure should cause the impellers to rotate freely and come to a stop slowly. If the impellers do not turn, this indicates a possible foreign object within the measurement cavity and the meter should be returned to the repair shop or manufacturer.
4. Verify that the mating flanges or optional flanges (refer to Figure 2-3), for the meter plus the correct distance (FL) are as close to level; within 1/16" per foot in all directions.

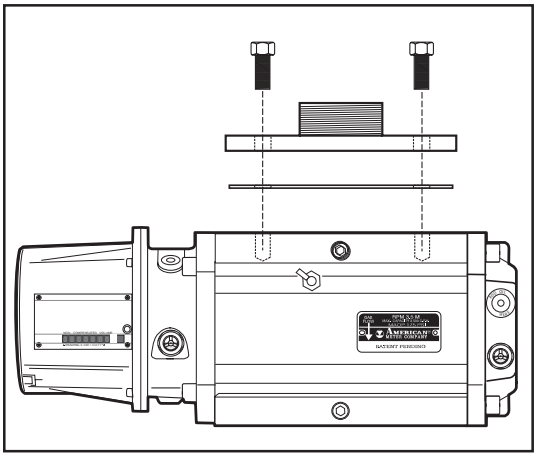


Fig. 2-3 Optional 1 1/2" NPT Flange (9.0 C & 1.5M Only) P/N 52996K001

NOTE: (FL) = Meter + (2) gaskets + 1/16" clearance.

The correct bolt sizes for the RPM series meters is 5/8-11 x 1-3/4" Hex Head. All bolts should be installed with flat washers. Tighten bolts evenly. Do not over torque (max. 80 ft-lbs.)

5. Remove the center pipe plug on the rear gear cover and verify the impellers still turn freely.
6. Fill unit with correct amount of oil. *See "LUBRICATION".*
7. Turn the gas supply on SLOWLY at approximately 1 second per 10 psig maximum. Turning the gas on quickly could potentially overspeed and possibly damage the meter.

   CAUTION: Should the installation be subject to extreme "INSTANT ON" loads, the meter should be protected from overspeeding by a restricting flow orifice plate.
8. Leak test the meter and all connections.

Example: 5.5M

Meter=..... $6\frac{3}{4}$"
Gasket= $\frac{1}{16}$" x 2= $\frac{1}{8}$"
$\frac{1}{16}$"
FL = $6\frac{15}{16}$"

LUBRICATION

Gears and bearings in the rotary meter are lubricated by the "Dip and Splash" method. Sight plugs are located on both ends of the meter. Any sight plug or pipe plug on the end covers can be used for access for filling with oil, depending on the meter mounting. See Fig. 2-4.

⚠ CAUTION: ⚠

Oil sumps at each end of the meter are independent and each must be filled with an EXACT amount of oil as shown on pg. 2-6.

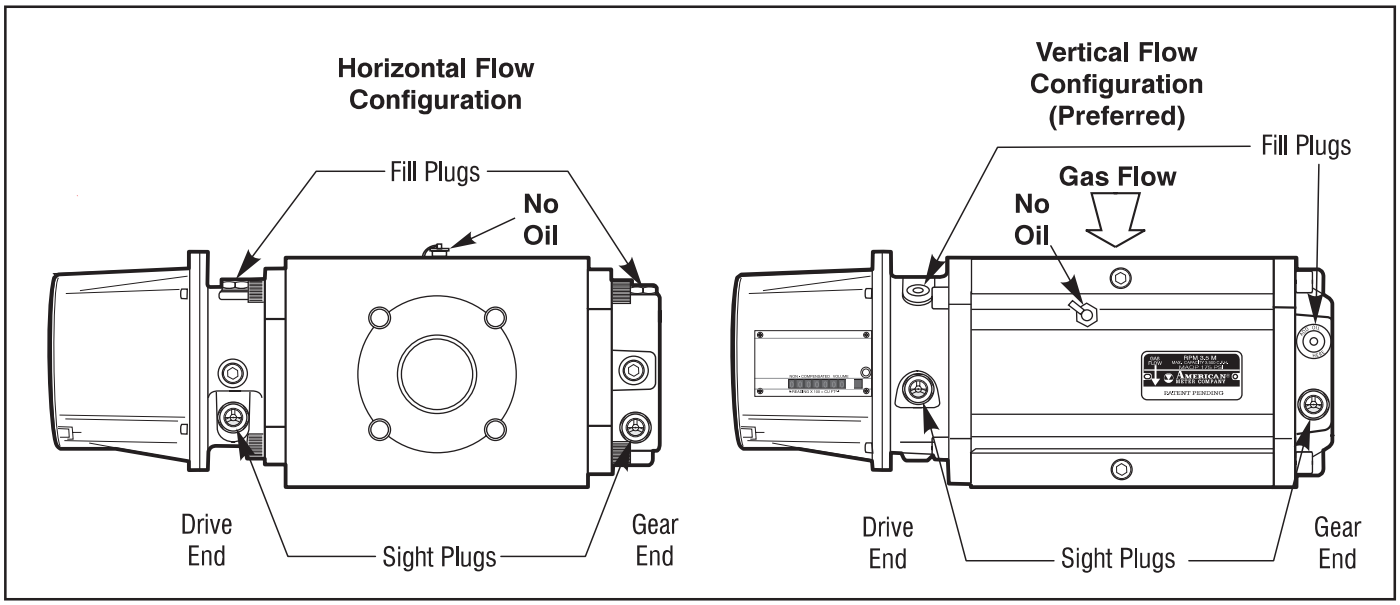


Fig. 2-4 Location of sight plugs

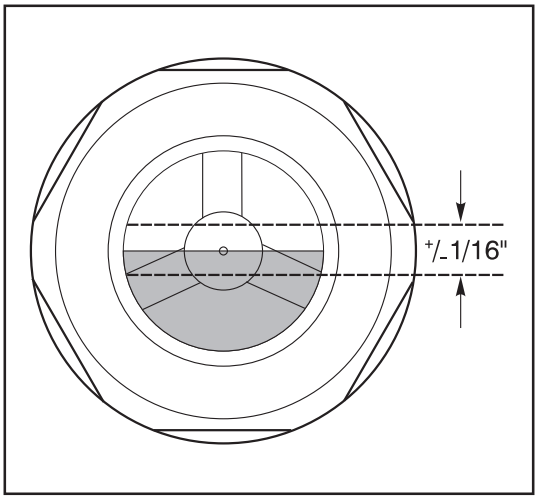


Fig. 2-5 Oil Level

⚠ CAUTION: ⚠

Oil should be visible within 1/16" of the center of the oil level sight plug (Fig. 2-5). After filling, check to verify correct level. Overfilling may result in poor meter performance and under-filling can lead to excessive bearing wear.

Oz.	(CC)
0.9	(26)
1.6	(47)
2.5	(73)
2.7	(80)
2.9	(85)
3.8	(111)
5.6	(165)
5.8	(170)
6.5	(191)
6.6	(195)
6.8	(200)
8.5	(250)

Oil Capacity Metric Conversion

To fill unit with oil:

1. Remove the two top oil sight or pipe plugs on the timing gear and counter covers. Fill the unit with the **EXACT amount** of approved oil (AMCO recommends using SHELL Tellus T oil 15 or TEXACO Aircraft Hydraulic #15). Reference the required **EXACT** capacities from the chart shown below.
2. Reinstall the two oil sight or pipe plugs.

For quantities refer to the capacity chart (below) for vertical or horizontal mounting by meter size.

RPM Oil Level Capacity Chart (EXACT Amounts)

	Vertical			Horizontal		
Meter Size	Drive (oz.)	Gear (oz.)	Total (oz.)	Drive (oz.)	Gear (oz.)	Total (oz.)
RPM 9.0C	6.6	5.6	12.2	2.9	2.9	5.8
RPM 1.5M	6.6	5.6	12.2	2.9	2.9	5.8
RPM 3.5M	3.8	2.7	6.5	1.6	0.9	2.5
RPM 5.5M	3.8	2.7	6.5	1.6	0.9	2.5
RPM 7M	8.5	6.8	15.3	5.5	2.2	7.7
RPM 11M	8.5	6.8	15.3	5.5	2.2	7.7
RPM 16M	8.5	6.8	15.3	5.5	2.2	7.7

Note: An 8 oz. bottle of oil is provided with the meter. AMCO recommends the use of SHELL Tellus T oil 15 or TEXACO Aircraft Hydraulic #15 lubricating oil.

WARNING: The filling should be NOT done while the meter is in service. The end covers of the sight plugs are pressurized. If the meter is in service and filling is necessary, bleed off the line pressure before removing sight plug. The use of the optional "PETE'S PLUG" allows oil to be added under pressure during normal maintenance.

Oil changes should be made when oil appears dirty (black) or diluted. Oil should be changed one year after installation and every five years thereafter unless differential testing indicates teardown for cleaning.

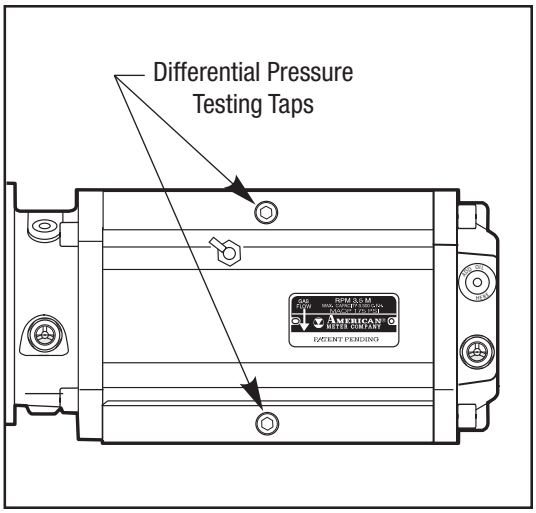
To change the oil:

1. De-pressurize the meter.
2. Remove the **bottom** pipe plug.
3. Fill from the top pipe plug or sight glass opening using the EXACT amounts in the capacity chart.

DIFFERENTIAL TESTING:

Meter accuracy, regardless of the manufacturer, is unlikely to improve with use. Therefore it is important to develop performance standards on the meter at installation so those standards can be monitored at a future point in time.

Differential testing is used to determine changes in the meter after installation. The test is performed using a differential pressure manometer under actual conditions of gas flow rate, line pressure and specific gravity. In lieu of a transfer prover, differential testing gives a good indication of the operational condition of the meter. It does not indicate meter accuracy.



AMERICAN METER CO. furnishes a test report with each rotary meter enclosed in the shipping carton. The test report indicates percent rated capacity, accuracy, proof and differential pressure for various flow rates of the meter. This test report also is kept on file by AMCO for the life of the meter.

The Appendix of this manual includes a blank chart. The installer can record a performance curve on initial start-up of the meter. The installer should plot a point on the chart for each differential at each level of capacity tested. Three points are required within the 25% to 100% range to establish a representative curve at installation, after 5/10 years and after solvent flushing. Refer to Fig. 2-6.

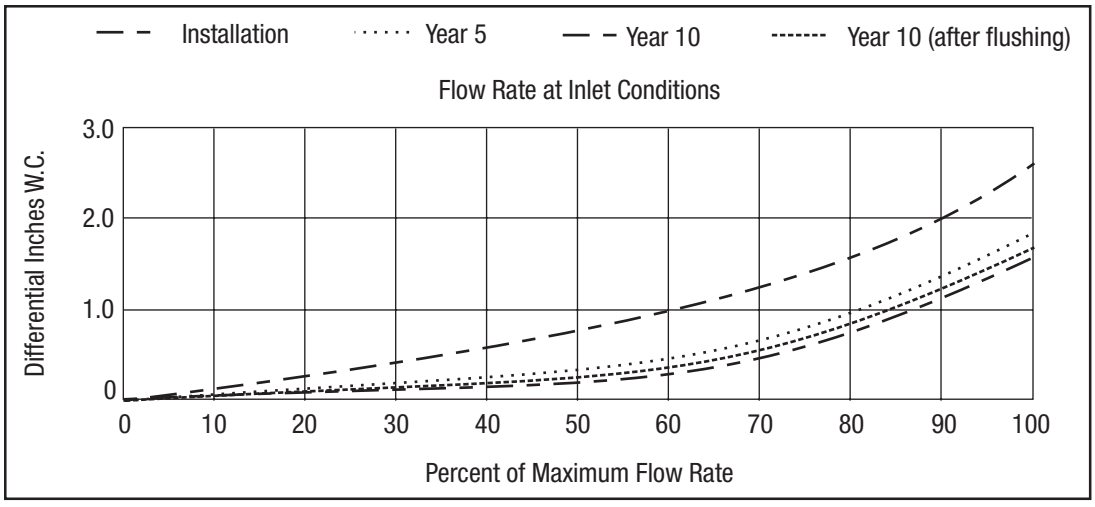


Fig. 2-6 Plot of Differential Testing

Field testing on gas below 15 psig can be compared directly with AMCO factory test results on air as indicated on the furnished accuracy test report. It is always important to test the meter under the actual conditions of gas line pressure and

DIFFERENTIAL TESTING: CON'T.

specific gravity that will exist in service. This is particularly important when line pressure is above 15 psig so that a direct comparison with later tests can be made. Although as previously stated, accuracy cannot be directly determined by differential test.

Test results have indicated that an increase of up to 50% in differential pressure can be tolerated without affecting meter accuracy at flow rates of 25% and above.

There are three things that can potentially affect a meter's accuracy which would also affect the differential test results:

1. Change in the "Static Displacement"
2. Enlargement of clearances between moving parts
3. Internal resistance increase

Change in the "Static Displacement"

The U.S. National Bureau Of Standards Paper 1741, "TESTING LARGE CAPACITY GAS METERS," pg. 187, states:

> "The Static Displacement of a Rotary gas meter appears to be almost unaffected by deposits, even those resulting from unpurified gas. Hence, having once been determined, it will seldom be necessary to redetermine."

Enlargement of clearances between moving parts

There is NO wearing of internal parts because the moving parts have NO direct contact with other surfaces. Hence clearances DO NOT change between the body and the impellers.

Internal resistance increase

Internal resistance is the most critical factor in the effects on meter accuracy because any significant increase in resistance will increase the pressure drop across the meter.

The most common causes of an increase in internal resistance are: dirt, pipe dope, thread shavings between impellers, worn bearings bending torque on the body, and heavyweight or excessive amounts of oil.

If the differential test **at the time of installation** is found to be 50% greater than what was indicated on the AMCO factory test results, the meter should be taken out of service and

DIFFERENTIAL TESTING: CON'T.

returned to your local AMCO sales representative for replacement under the terms of the WARRANTY described previously.

If the differential test during normal maintenance and after prolonged service is found to be more than 50%, the meter should be taken out of service for cleaning.

A simple flushing with mineral spirits, kerosene or your company approved solvent should easily remove the foreign materials within, and bring the meter back into acceptable specification.

If the flushing operation fails to bring the meter into specification, the unit should be returned to your approved meter repair shop for tear down and bearing replacement. AMCO recommends draining the oil from the meter end caps after blowdown to atmosphere, to prevent oil from splashing onto the impellers during transport.

While there is no nationally established time period for testing, some states have formally adopted differential rate test periods. Aside from these states, a five year test interval is generally considered acceptable.

Recommended frequency of differential testing:

1. At the time of installation
2. Twelve months after initial installation
3. Every 5 years thereafter

NOTE: Always consult your company policy or state/country commissions for specific time intervals on differential rate test periods.

See sample Differential Test Chart on page 2-10.

See Maximum Allowable Differential Pressure Charts at psig. by meter size on pages 2-10, 2-11 & 2-12.

Sample Differential Rate Test Data

Meter Model 5.5M Mfg. Serial No. 975342 Utility Serial No. _____
Location _____ Date Installed 1/1/97 Register Reading _____

Line Press.	Gas Temp	Sp. Grav.	Volume Measured	Run TIme	Rate CFH	Diff. Pressure Ins. W.C.	% Chg.	Date
Initial Test - New Meter								
2 psig	60ºF	.6	10 cf	29s	1250	.1	-	1/1/97
2 psig	60ºF	.6	10 cf	14s	2500	.3	-	1/1/97
2 psig	60ºF	.6	10 cf	8s	4750	1.3	-	1/1/97
Periodic Check Tests								
2 psig	60ºF	.6	10 cf	29s	1250	.14	40	3/17/00
2 psig	60ºF	.6	10 cf	14s	2500	.4	33	3/17/00
2 psig	60ºF	.6	10 cf	8s	4750	1.5	15	3/17/00
2 psig	60ºF	.6	10 cf	29s	1250	.2	100	3/25/05
2 psig	60ºF	.6	10 cf	14s	2500	.7	133	3/25/05
2 psig	60ºF	.6	10 cf	8s	4750	2.2	69	3/25/05
2 psig	60ºF	.6	10 cf	29s	1250	.12	20	3/26/05
2 psig	60ºF	.6	10 cf	14s	2500	.35	17	3/26/05
2 psig	60ºF	.6	10 cf	8s	4750	1.4	8	3/26/05

AMCO 8.0C/9.0C Rotary Meter - Maximum Allowable Differential Pressure

Percent Capacity	Flowrate (CFH)	ATM	15 psig	30 psig	45 psig	60 psig	90 psig
5	45	0.015	0.015	0.015	0.015	0.015	0.015
10	90	0.03	0.03	0.03	0.03	0.03	0.03
20	180	0.045	0.06	0.045	0.06	0.06	0.09
30	270	0.06	0.09	0.075	0.09	0.12	0.135
40	360	0.09	0.105	0.135	0.15	0.18	0.24
50	450	0.12	0.12	0.165	0.165	0.225	0.3
60	540	0.15	0.18	0.21	0.225	0.255	0.33
70	630	0.21	0.27	0.3	0.315	0.375	0.45
80	720	0.27	0.315	0.42	0.45	0.525	0.63
90	810	0.315	0.345	0.465	0.57	0.645	0.81
100	900	0.36	0.375	0.54	0.66	0.795	1.08
110	990	0.405	0.42	0.63	0.78	0.69	1.125
120	1080	0.465	0.495	0.645	0.795	0.975	1.335

AMCO 11C/1.5M Rotary Meter - Maximum Allowable Differential Pressure							
Percent Capacity	Flowrate (CFH)	ATM	15 psig	30psig	45 psig	60 psig	90 psig
5	75	0.015	0.045	0.045	0.045	0.06	0.06
10	150	0.015	0.06	0.06	0.075	0.09	0.105
20	300	0.03	0.09	0.105	0.12	0.15	0.165
30	450	0.06	0.12	0.255	0.27	0.3	0.42
40	600	0.09	0.18	0.21	0.21	0.225	0.33
50	750	0.12	0.255	0.27	0.27	0.3	0.42
60	900	0.15	0.33	0.435	0.42	0.465	0.54
70	1050	0.21	0.345	0.465	0.54	0.675	0.9
80	1200	0.27	0.375	0.525	0.615	0.87	1.2
90	1350	0.315	0.42	0.585	0.705	0.945	1.275
100	1500	0.42	0.45	.069	0.825	1.095	1.32
110	1650	0.54	0.51	0.78	1.005	1.2	1.425
120	1800	0.6	0.615	0.975	1.08	1.305	1.575

AMCO 2.0M/3.5M Rotary Meter - Maximum Allowable Differential Pressure							
Percent Capacity	Flowrate (CFH)	ATM	15 psig	30psig	45 psig	60 psig	90 psig
5	175	0.03	0.03	0.045	0.045	0.06	0.75
10	350	0.06	0.06	0.09	0.105	0.12	0.15
20	700	0.12	0.18	0.24	0.27	0.48	0.36
30	1050	0.21	0.24	0.345	0.585	0.54	0.72
40	1400	0.3	0.548	0.675	0.675	0.72	0.99
50	1750	0.42	0.75	0.975	0.84	1.335	1.65
60	2100	0.6	0.93	1.125	1.14	1.875	2.175
70	2450	0.885	0.96	1.2	1.65	2.22	2.85
80	2800	1.08	0.975	1.44	2.25	2.475	3.57
90	3150	1.26	1.05	1.65	2.475	2.88	4.47
100	3500	1.5	1.095	2.025	2.85	3.15	4.65
110	3850	1.68	1.65	2.4	3.075	3.75	5.25
120	4200	1.86	2.025	2.925	3.6	5.025	6.15

AMCO 5.5M Rotary Meter - Maximum Allowable Differential Pressure							
Percent Capacity	Flowrate (CFH)	ATM ATM	Volume 15 psig	Run 30psig	Rate 45 psig	Diff. Pressure 60 psig	90 psig
5	275	0.015	0.06	0.06	0.06	0.06	0.75
10	550	0.045	0.075	0.09	0.105	0.12	0.135
20	1100	0.12	0.15	0.165	0.21	0.255	0.285
30	1650	0.165	0.285	0.33	0.42	0.465	0.3
40	2200	0.27	0.435	0.54	0.525	0.6	0.48
50	2750	0.375	0.57	0.6	0.72	0.975	0.6
60	3300	0.54	0.66	0.75	0.975	1.23	0.9
70	3850	0.645	0.75	0.9	1.2	1.575	1.425
80	4400	0.84	0.9	1.5	1.575	1.65	2.1
90	4950	1.02	1.08	1.77	1.965	2.55	2.85
100	5500	1.2	1.2	2.025	2.37	2.625	3.9
110	6050	1.38	1.47	2.475	3.075	3.45	5.1
120	6600	1.65	1.95	3.075	3.75	4.65	6.9

7.0M Differential Pressures												
%	Atmospheric		15 psi		30 psi		45 psi		60 psi		90 psi	
5	0.02	in wc	0.05	in wc	0.02	in wc	0.06	in wc	0.07	in wc	0.06	in wc
10	0.03	in wc	0.08	in wc	0.05	in wc	0.10	in wc	0.13	in wc	0.11	in wc
20	0.12	in wc	0.11	in wc	0.14	in wc	0.23	in wc	0.29	in wc	0.36	in wc
30	0.20	in wc	0.15	in wc	0.23	in wc	0.30	in wc	0.39	in wc	0.50	in wc
40	0.28	in wc	0.27	in wc	0.40	in wc	0.50	in wc	0.70	in wc	0.96	in wc
50	0.28	in wc	0.48	in wc	0.66	in wc	0.85	in wc	1.06	in wc	1.49	in wc
60	0.39	in wc	0.69	in wc	1.20	in wc	1.30	in wc	1.60	in wc	1.90	in wc
70	0.55	in wc	1.08	in wc	1.51	in wc	1.94	in wc	2.40	in wc	2.86	in wc
80	0.79	in wc	1.20	in wc	1.70	in wc	2.27	in wc	2.85	in wc	3.36	in wc
90	0.97	in wc	1.24	in wc	1.93	in wc	2.57	in wc	3.32	in wc	3.91	in wc
100	1.01	in wc	1.42	in wc	2.10	in wc	2.84	in wc	3.64	in wc	4.30	in wc
110	1.14	in wc	1.58	in wc	2.32	in wc	3.19	in wc	4.16	in wc	4.91	in wc
120	1.37	in wc	1.78	in wc	2.48	in wc	3.70	in wc	4.51	in wc	5.30	in wc

11.0M Differential Pressures												
%	Atmospheric		15 psi		30 psi		45 psi		60 psi		90 psi	
5	0.03	in wc	0.04	in wc	0.06	in wc	0.06	in wc	0.05	in wc	0.09	in wc
10	0.03	in wc	0.10	in wc	0.08	in wc	0.10	in wc	0.13	in wc	0.17	in wc
20	0.17	in wc	0.12	in wc	0.23	in wc	0.29	in wc	0.30	in wc	0.48	in wc
30	0.19	in wc	0.25	in wc	0.39	in wc	0.50	in wc	0.60	in wc	0.94	in wc
40	0.30	in wc	0.34	in wc	0.51	in wc	0.76	in wc	0.93	in wc	1.29	in wc
50	0.39	in wc	0.63	in wc	0.87	in wc	1.20	in wc	1.47	in wc	1.74	in wc
60	0.55	in wc	1.04	in wc	1.52	in wc	2.03	in wc	2.40	in wc	2.86	in wc
70	0.72	in wc	1.39	in wc	2.09	in wc	2.73	in wc	3.55	in wc	4.26	in wc
80	0.86	in wc	1.48	in wc	2.15	in wc	3.02	in wc	3.90	in wc	4.66	in wc
90	1.52	in wc	1.75	in wc	2.65	in wc	3.13	in wc	4.25	in wc	4.93	in wc
100	1.41	in wc	1.96	in wc	2.97	in wc	4.05	in wc	4.89	in wc	5.76	in wc
110	1.72	in wc	2.19	in wc	3.40	in wc	4.65	in wc	5.63	in wc	6.60	in wc
120	2.16	in wc	2.15	in wc	4.15	in wc	5.50	in wc	6.61	in wc	7.73	in wc

16.0M Differential Pressures												
%	Atmospheric		15 psi		30 psi		45 psi		60 psi		90 psi	
5	0.05	in wc	0.28	in wc	0.28	in wc	0.28	in wc	0.28	in wc	0.43	in wc
10	0.07	in wc	0.83	in wc	1.11	in wc	1.11	in wc	1.16	in wc	1.16	in wc
20	0.31	in wc	0.83	in wc	1.27	in wc	1.44	in wc	1.50	in wc	1.72	in wc
30	0.72	in wc	0.91	in wc	1.33	in wc	2.22	in wc	2.36	in wc	3.88	in wc
40	0.90	in wc	1.11	in wc	1.39	in wc	2.49	in wc	3.05	in wc	4.71	in wc
50	1.17	in wc	1.25	in wc	1.66	in wc	3.32	in wc	4.71	in wc	6.37	in wc
60	1.48	in wc	1.66	in wc	1.91	in wc	4.43	in wc	5.13	in wc	6.82	in wc
70	1.72	in wc	1.86	in wc	2.16	in wc	4.57	in wc	5.40	in wc	7.09	in wc*
80	1.89	in wc	1.94	in wc	2.33	in wc	4.71	in wc	5.82	in wc	7.79	in wc*
90	2.12	in wc	2.22	in wc	2.49	in wc	4.99	in wc	6.10	in wc*	8.17	in wc*
100	2.32	in wc	2.49	in wc	2.77	in wc	5.35	in wc	6.93	in wc*	9.00	in wc*
110	2.62	in wc	2.77	in wc	4.16	in wc	6.10	in wc	8.04	in wc*	9.59	in wc*
120	3.41	in wc	3.60	in wc	5.13	in wc	7.20	in wc	8.59	in wc*	10.14	in wc*

* Values are calculated from the average change in pressure at specified percent flow rate.

WHY TEMPERATURE CORRECTION?

All commercially used non-temperature compensated natural gas meters are designed to meter gas at 60°F (15.6°C)(base temperature). At 40°F (4.4°C), that meter actually passes 1.04 cubic feet for every one cubic foot registered. When this happens, the customer receives 4% more gas than they are billed for.

If we use the example of the day in the life of a 5.5M Rotary Meter at the bakery as depicted on page1-4 of this manual; lack of temperature compensated metering can be costly in lost and unaccounted for gas delivery.

EXAMPLE:

The average temperature of metered gas in February in New England, is 40°F (4.4°C) which is a 4% change in volume from the 60°F base temperature (± 5°F = 1% change in volume).

In the 28 days of February the non-compensated rotary meter registered 1,866,816 ft^3 of gas; however, because the flowing gas temperature was 40°F (4.4°C) the bakery could have received 1,941,489 ft^3; a loss to the utility of 74,673 ft^3 of gas for the month unless corrected for at the time of billing.

At $.70 per 100 $ft.^3$, the financial loss to the utility for **one month gas delivery to the bakery** if uncorrected was **$522.71**, more than the original cost of the "optional add on" Temperature Compensator module to the meter.

Correction at billing time can also be inaccurate as flowing gas temperatures can fluctuate by the hour during normal gas delivery. Temperature Compensation of the meter is by far the $mart choice.

GENERAL DESCRIPTION

Electronic Temperature Correction (ETC) Module Mercury Instruments – a name synonymous with quality and reliability in the natural gas industry – now offers its affordable Mini-Max® T corrector for the RPM Series American Meter rotary meter.

Obtain maximum performance and value with compact electronic precision and reliability. Use the Mini-Max® T to reduce your costs of gas measurement and enhance the efficiency of your rotary meter operations.

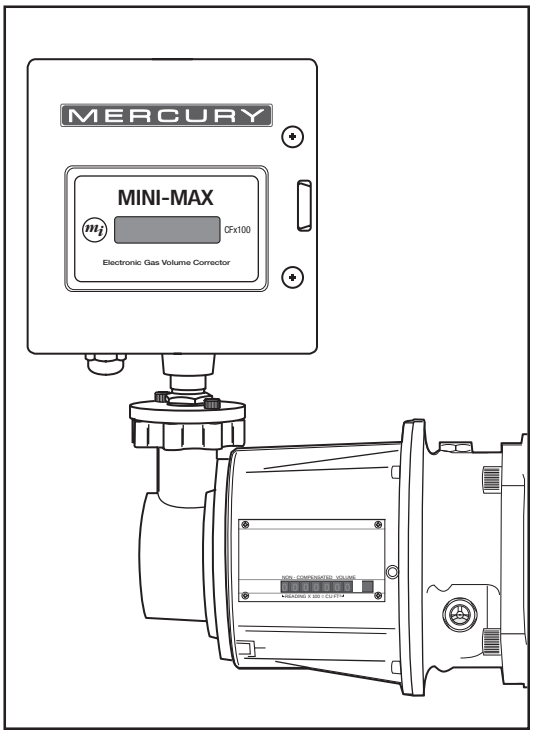
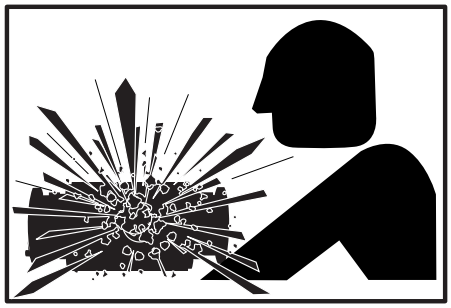


Fig. 3-1 RPM Temperature Compensator

The optional Mercury electronic temperature corrector and mounting can rotate 360° at 90° increments to accommodate readings at any meter position. For additional Mercury products and features, see AMCO bulletins SB5500 or DS5600.



WARNING
EXPLOSION HAZARD

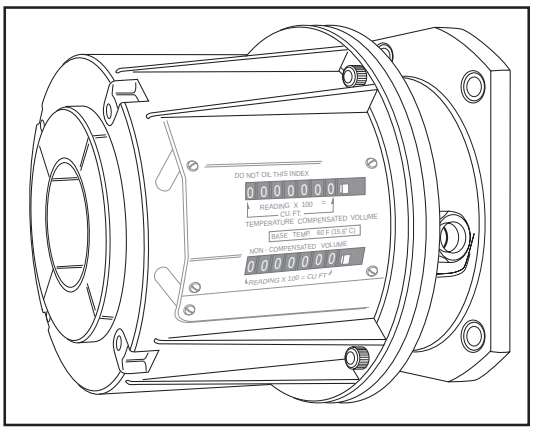


Fig. 3-3 Standard CMTC Compensator

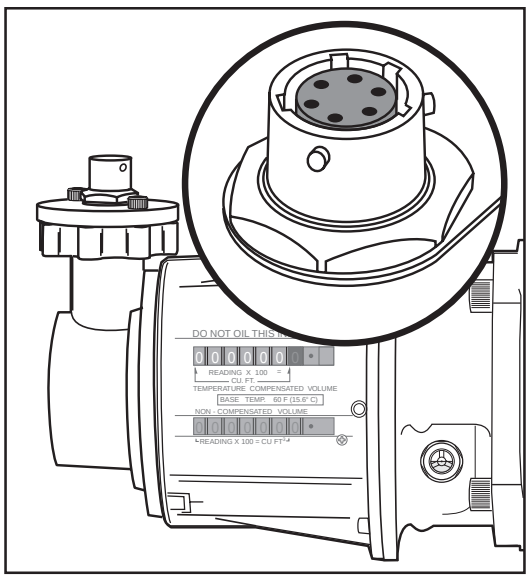


Fig. 3-4 CMTC w/Pulse Output - Military Connector Shown

FEATURES & PERFORMANCE

The Mini-Max® T mounts directly to the RPM Series Rotary Meter (field or factory). It features a live LCD display of input gas temperature from -40^0 to 150^{0}F (-40^0 to 65.5^0 C). It offers membrane push-button and user-configurable alphanumeric LCD for display of : test, uncorrected volume, corrected volume, fixed-set pressure, live temperature, battery voltage, live flow, and electronic uncorrected backup. In addition, the Mini-Max® T features programmable call-in (scheduled and alarms), field programmable firmware through serial port (flash memory), two form-A volume pulse outputs and one form A alarm pulse outputs, an audit trail memory of 40 days of daily-corrected volume, uncorrected volume, average pressure and average temperature. It also has low power requirements – 4 years+ on 4 D-cell alkaline batteries. An optional 4-20mA output and messenger modem is also available.

Read carefully and follow all instructions shipped with this meter. The incorrect installation of this equipment could result in escaping gas, and pose a potential explosion hazard.

CMTC GENERAL DESCRIPTION

The new CMTC* RPM® Series gas meter provides flowing gas-volume registration continuously and mechanically corrected to the standard base temperature of 60 degrees F. Continuous compensation output allows for greater accuracy, as the adjustment input is a linear function proportional to the temperature changes of the flowing gas. Quicker reaction time to temperature changes occur with the CMTC liquid filled temperature transducer directly in the gas stream when compared to other bi-metal sensor designs shielded within a thermowell. The new American Meter CMTC Accessory unit is an addition to the current RPM accessory line. The CMTC accessory is only intended for use on the RPM Series of rotary meters from American Meter and is also available in metric sizes. The CMTC has been designed to provide many years of maintenance-free service.

OPTIONS

The Continuous Mechanical Temperature Compensator is available in three configurations:

- Standard CMTC on meter (Fig. 3-3).

- CMTC with pulse output mounting capability (Fig. 3-4).
- CMTC with instrument drive accessory. This option would allow the mounting of a pressure compensating index providing full mechanical temperature and pressure compensation or the addition of other pulse output devices. (Fig. 3-5).

- **WARNING: The American Meter CMTC is designed to drive a maximum of 10 in-oz. of torque. Devices that require more torque may cause premature failure of register.**
- **WARNING: DO NOT oil this index.**
- **NOTE/CAUTION: Each CMTC accessory is identical on all size RPM Series Rotary meters with the exception of the (4) colored set gears. These colored set gears are unique to each size meter due to the required capacities (SCFH) and accuracy requirements of ± 1%. Each CMTC accessory is marked with the size of the meter on which it is to be mounted.**
- **DO NOT interchange a CMTC accessory to another meter without making sure the meters are of the same size. For example: 3.5M to 3.5M is permitted. However, 3.5M to 7M is NOT permitted.**

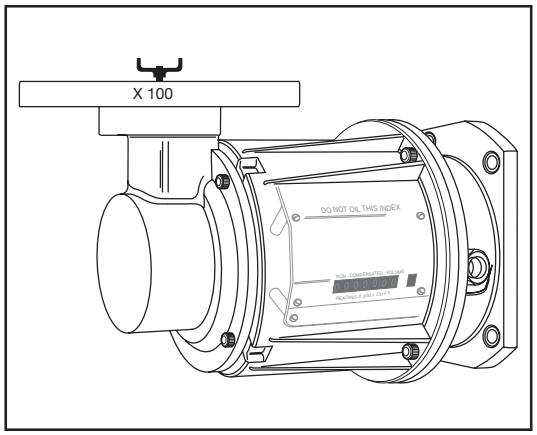


Fig. 3-5 Standard with Instrument Mounting Drive Accessory (optional X10 or X100)

STANDARD & CMTC ODOMETER FACE PLATE(S) BASIC OPERATION

The Standard index counter only displays uncorrected volume (Fig.3-6). The CMTC index counters display both compensated (corrected) volume in white numbers (top set of counters) and non-compensated (uncorrected volume) in shaded blue numbers (lower set of counters) (Fig. 3-7). The CMTC index and Standard index is available in English and metric versions.

The CMTC as referenced above implements a unique method of shielding specific odometer digits from the meter reader. The CMTC uses translucent shields which tint, but do not completely shield, the desired digit(s). The CMTC has two odometers. The top odometer represents temperature compensated volume and is marked as such in red text to clearly distinguish it from the non-compensated odometer. Again the top or compensated odometer has one digit furthest to the right tinted to reduce its readability, with the remaining six digits marked in red text as reading in hundreds of cubic feet. The bottom odometer represents non-compensated volume and is marked in black text. Every digit on the bottom, or non-compensated

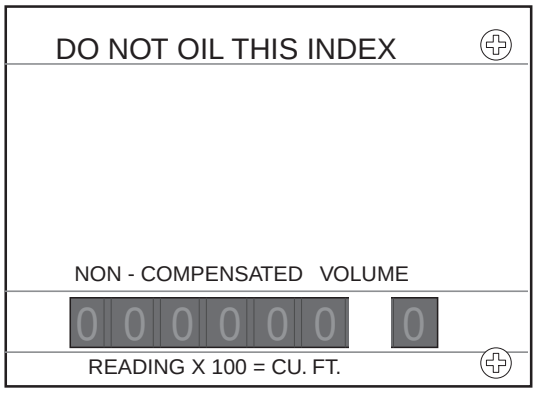


Fig. 3-6 Standard Odometer Face Plate - English Shown

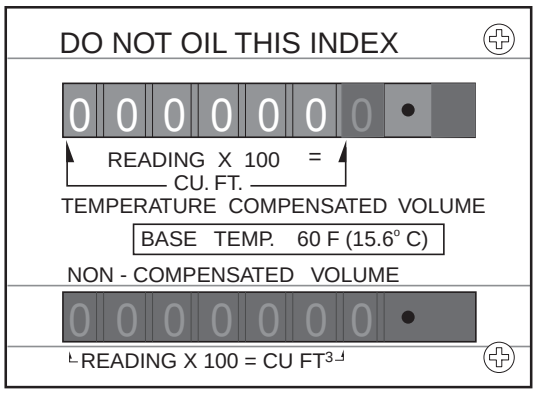


Fig. 3-7 CMTC Odometer Face Plate

odometer, is tinted to reduce readability. The combination of tinting and clear marking makes it simple to read the correct volume reading.

VERTICAL/HORIZONTAL INSTALLATION

All Standard and CMTC meters are capable of a vertical or horizontal installation. In both cases, the odometer face plate on the temperature compensator aligns with the meter badge on the body of the rotary meter. It is not possible to rotate the mechanical temperature compensator separate from the meter. Should your application require the meter to function in an opposite gas flow direction, you will need to specify this when placing your order or see instructions on page 3-5.

Vertical position (vertical/downward flow of gas): Odometer face plate of the CMTC is facing the front of the meter, matching the meter badge serial number plate. The CMTC is positioned left with respect to the meter.

Horizontal position (horizontal/left to right flow of gas): Odometer face plate of the CMTC is facing the top of the meter, matching the meter badge serial number plate. The CMTC is positioned left with respect to the meter.

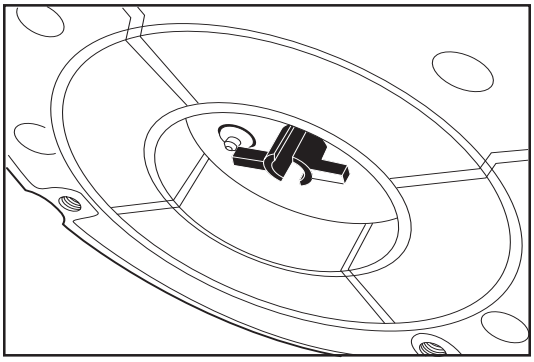


Fig. 3-8 Wriggler

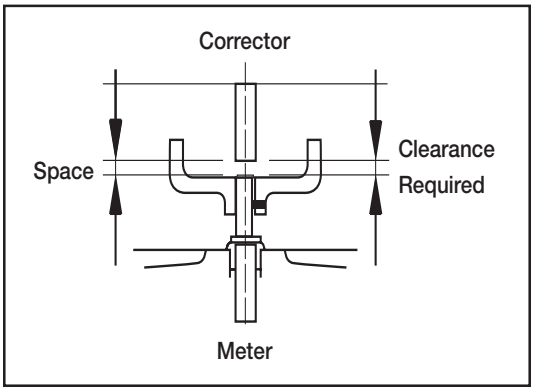


Fig. 3-9 Wriggler Clearance

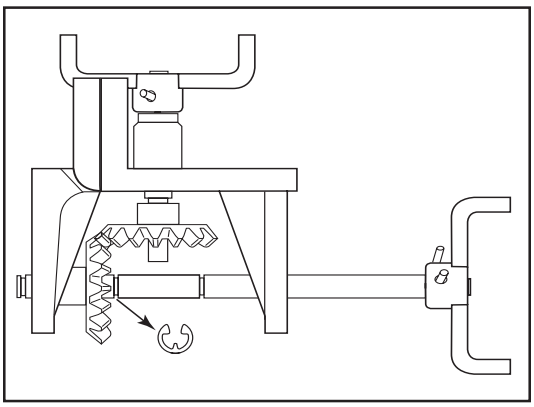


Fig. 3-10 Removing Retaining Ring

ADDITIONAL PULSE OUTPUT DEVICES

For those applications requiring additional pulse output devices the CMTC provides a direct mechanical drive connection for such devices called a “wriggler” (Fig. 3-8) This wriggler is exposed for third party accessory connection such as a pulse output device through a circular opening in the end of the Lexan cover or at the top of the instrument drive mounting accessory.

Proper spacing between the wriggler and accessories is necessary to ensure unit does not bind or break. Refer to figure 7 for proper clearances. When installing all devices, make sure the wrigglers are in line and mate properly. **Continuous downward force on the meter wriggler will cause damage to meter register and premature failure.**

It should be noted that AMCO’s CMTC is capable of driving devices requiring up to 10 in-oz. maximum of torque. **Attaching devices requiring more torque for operation may cause premature failure of register.**

WRIGGLER ROTATION DIRECTION

Illustration shown is 1:1 gear ratio. The factory default rotation direction of the wriggler is in a clockwise direction when looking down on the Instrument Drive from above. Should the installation of your pressure correcting or pulse output device require counter clockwise rotation of the wriggler, follow the procedure below. Before attaching the Instrument Drive, loosen the (2) socket head cap screws holding the angle bracket assembly to the inside of the Instrument Drive and remove from the Instrument Drive housing. Remove the retaining ring from the metal shaft (Fig.3-10). Slide the angle bracket to the right (Fig. 3-11 (1)) Next slide the shaft to the right (Fig. 3-11 (2)) being careful not to lose the nylon gear riding on shaft. Remove the nylon gear (Fig. 3-11 (3)). Flip gear horizontally and replace on shaft making sure the flat machined surface of the shaft mates with corresponding flat on inside of gear. Reattach retaining ring to the left of gear (Fig. 3-12). Next, slide the right side of angle bracket back to its original position ensuring its alignment with grooved surface just above the top gear (Fig. 3-12). Note: the shaft will follow in this step. Make sure it aligns properly with corresponding hole in left angle bracket. Finally, remount the angle bracket assembly into the Instrument Drive housing and install housing to CMTC.

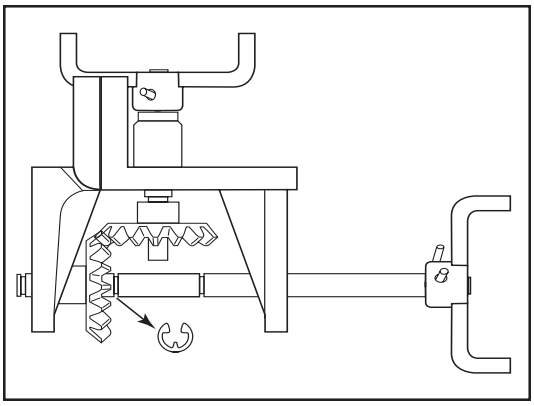


Fig. 3-10 Removing Retaining Ring

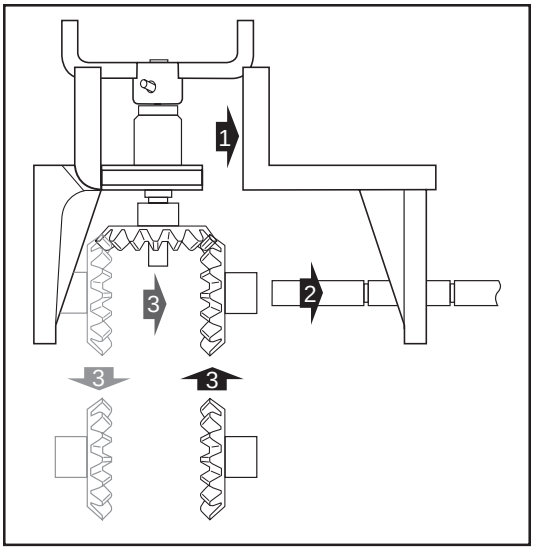


Fig. 3-11 Repositioning of Gear

REVERSE FLOW CONVERSION

All meter sizes come shipped from the factory with components which will allow for the conversion to reverse flow application. To convert a new meter from standard gas flow configuration to reverse flow configuration (upward or right-to-left)(Fig. 3-17), follow all instructions below carefully. Should you have an older RPM Series rotary gas meter which needs to be converted for reverse flow application, contact American Meter Company for a Reverse Flow Kit (see page 3-7).

WARNING: If meter is in service, it must be depressurized and oil drained from the drive side case cover.

Step 1: Remove metric socket head cap screws from case cover and set aside. (Fig. 3-13) During cover removal, the rubber O-ring may fall loose. If so, simply reinstall it into the groove on the underside of the case cover.

Step 2: Remove the 1/16" allen head screw and magnet holder. (Fig. 3-14)

Step 3: Loosen set screw and remove spur gear with roll pin/

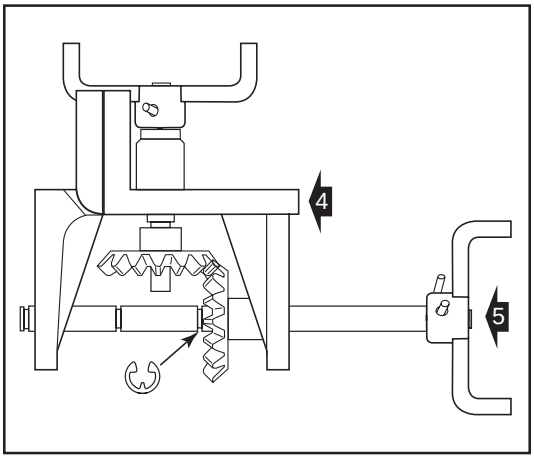


Fig. 3-12 Replacing Retaining Ring

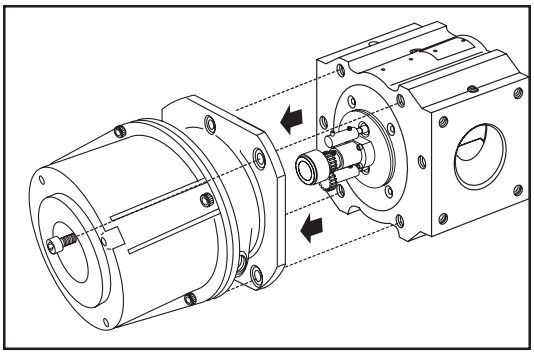


Fig. 3-13 Removing Case Cover

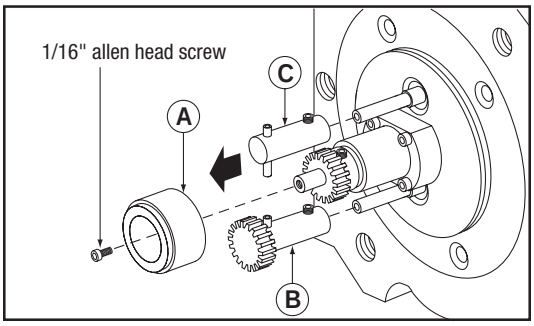


Fig. 3-14 Removing Magnet Assembly (A), Oil Slinger (B) & Oil Slinger Hub (C)

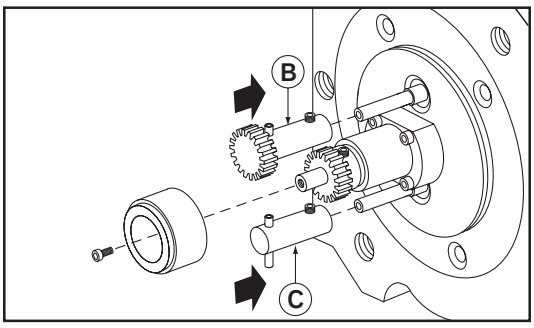


Fig. 3-15 Replacing Oil Slinger (B) to top shaft & Oil Slinger Hub (C) to bottom

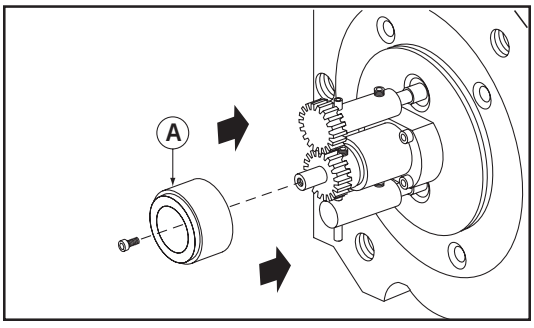


Fig. 3-16 Replacing Magnet Assembly

oil slinger (B) from bottom impeller shaft. (Fig. 3-14)

Step 4: Loosen set screw and remove oil slinger hub (C) from top impeller shaft. (Fig. 3-14)

Step 5: Install oil slinger (B) that had been removed from bottom shaft in step 3, on opposite impeller shaft (top), sliding it towards the meter body until the gears properly engage. (Fig. 3-15) Tighten set screw to 15 in-oz.

Step 6: Install oil slinger hub (C) that had been removed from top shaft in step 4, on opposite impeller shaft (bottom). Tighten set screw to 15 in-oz. (Fig. 3-15)

Step 7: Reinstall magnet holder assembly with allen head screw using Loctite 222 to the centering shaft threads. Tighten flat head screw to 15 in-oz. (Fig. 3-16)

Step 8: Rotate the meter impellers to assure that proper assembly has been made.

Step 9: Remount case cover making sure that its sealing O-ring is properly in its groove. Install four socket head cap screws and tighten to 100 in-lbs. for 9.0C and 1.5M meters or 150 in-lbs for 3.5M, 5.5M, 7M or 11M meters.

Step 10: Orient manufacturer's badge to show gas flow arrow to the adjusted direction.

Step 11: Refer to Instruction Manual IM 5750 supplied with meter to continue with standard rotary mounting instructions.

Reverse Flow kits are available for older meters in the field by ordering the part numbers as listed in the table on page 3-7.
Note: Each reverse flow kit contains oil slinger/hub, associated set screw for mounting and new meter badge.

PROVING OPERATIONS

The permanently lubricated Continuous Mechanical Temperature Compensator (CMTC) provides a means for convenient standard-scanning methods used for performing meter proving. The adjustment of the compensated odometer is continuous therefore, does not require consideration of adjustment bursts provided in some devices. The odometer wheel positioned at the right hand side next to the 10 cu. ft. number wheel on both odometers, non-compensated and compensated, can be scanned through the number wheel aperture of the odometer housing. The odometer wheels, also referred to

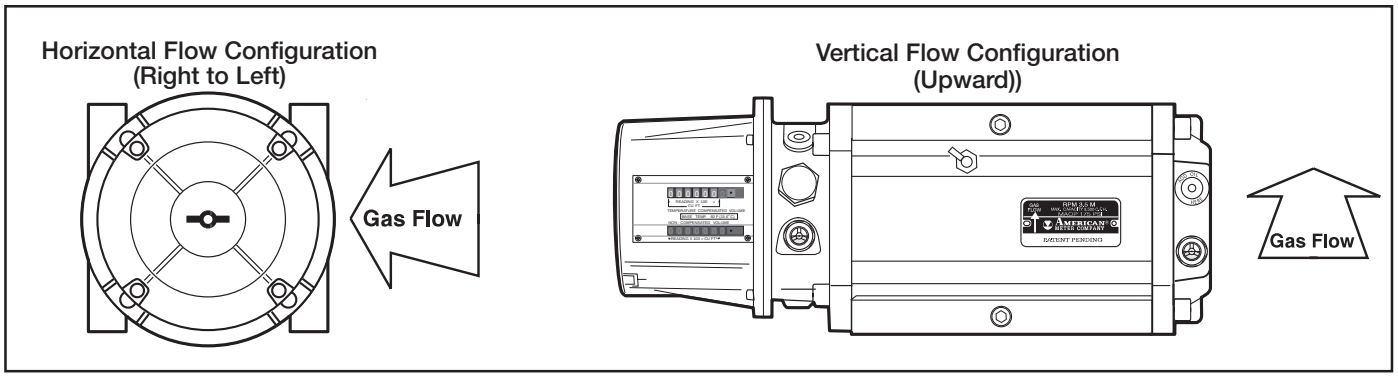


Fig. 3-17 Gas Flow Diagram For Reverse Flow Configuration

as proving wheels, provided for scanning, feature a white square “target-mark” used for scanning. One revolution of both wheels, non-compensated and compensated, represents 10 cubic feet (between the target-mark on the wheels). Accessibility for scanning through the clear plastic cover is provided.

An alternate volume scanning is provided for the compensated volume at the CMTC center drive shaft coupling visible and accessible for scanning through the clear area of the cover end face. The coupling features a white “target mark” that provides 10 cubic feet compensated volume between two target-marks representing one revolution. The volume per revolution of the odometer wheels and center drive used for scanning is identical for all meter sizes.

Reverse Flow Kits

Meter	Kit Part Number
8.0C	52918K001
9.0C	52918K001
11C	52918K001
1.5M	52918K001
2M	52920K007
3.5M	52920K007
5.5M	52921K001
7M	52932K001
11M	52945K001
16M	N/A

Proving the CMTC Meter on a Dresser Model 5 Transfer Prover (Corrected Volume)

There is no need to remove the CMTC Lexan cover. Place the optical sensor in position to read the 10 ft. proving wheel on the far right of the Corrected Volume odometer faceplate. The proving wheels of both odometers feature red dots in 1 cubic foot increments, a red rectangle 5 cubic foot mark, in addition to the white square “target-mark” to ease visual verification of rotation. Connect the upstream and downstream pressure taps. Connect the temperature probe to the upstream side.

On the Roots PC Prover executable file:

1. Configure and run a meter test
2. Prover Capacity: 2M, 5M, 10M, 80M *(select one capacity depending on the size of meter to be tested)*
3. Test Control Mode: ID OPTO or Manual *(select one depending on the type of pick-up being used. Ex.: OPTO= optical pick-up)*

4. Meter Output: UC, **TC**, PC, PCTC *select Diaphragm TC (continuously compensated)*
5. Pulses/Test Volume: **2** Pulses, 20 cu. ft. minimum *(recommended depending on size of meter)*
6. Flow Rates: 100%, 60%, 30%, 10% (recommended)
   Ref. 1.5M meter capacities: 1500, 900, 450, 150
7. Base Temperature: 60^0 F.
8. Conduct the test.

Temperature-Compensating Accuracy

The CMTC accessory can provide a temperature correcting accuracy of gas volume within +/-0.5% with respect to the theoretical correction for a flowing gas temperature range of -20° F to 120° F. The accuracy test of the CMTC accessory is determined by operating the device with the temperature transducer sense bulb submersed in a temperature stabilized bath using test points according to ANSI B109.3 Para. 6.12.1.2.3 Type III.

A combined accuracy test, meter with CMTC accessory, at flowing gas temperature according to ANSI B109.3 Para. 6.12.1.2.1 Type I is a standard factory test. Attainable combined accuracy over a range of 20° F to 100° F is within +/-1%.

CMTC Operational Check

1. Using an accurate certified temperature-measuring device, record the stabilized gas (or air) temperature flowing directly into the meter inlet port.
2. Compare that reading to the acclimated meter's CMTC indicating temperature dial on the front of the meter under the lexan cover. Both readings should agree within +/- 4^0 F.
3. Example A) If both readings were the same i.e. 60^0 F (15.6^0 C) and a volume of 200 ft^3 was ran across the meter, both the uncorrected and corrected register readings would both increase by 200ft^3. Reason why? All commercially used, non-temperature compensated natural gas meters are designed to measure gas flow(s) at 60^0 F (15.6^0 C). Therefore, a temperature compensated meter at 60^0 F (15.6^0 C) should measure the "same increase in volume" on both of its corrected and uncorrected register displays.
4. Using Charles Law (Basic Gas Laws) which states the Volume of given mass of gas is directly proportional to its absolute temperature with the equation:
   (Where 60^0 F = 520^0 on the Rankine temperature scale)

$$\frac{\text{Base Temp Rankine}}{\text{Gage Temp (F degrees)} + 460^0 \text{ F}} = \text{Volume Multiplier}$$

Therefore:

$$\frac{60^0\ F + 460^0\ F = 520\ R\ (base\ temp.)}{60^0\ F + 460^0\ F = 520\ R\ (gage\ temp.)} = 1\ (Volume\ Multiplier)$$

5. Example B: Using the above equation with a temperature variant from 60^0 F base Temperature. Lets say the air flowing into the meter is ambient shop air with the meter also acclimated to 72^0 F (22.2^0 C).

Therefore:

$$\frac{60^0\ F + 460^0\ F = 520\ R}{72^0\ F + 460^0\ F = 532\ R} = .977\ (Volume\ Multiplier)$$

If you ran 200 ft^3 across the meter at 72^0 F, your uncorrected reading would show a 200 ft^3 increase whereas the temperature corrected reading would only increase by 195.4 ft^3 (200 X .977).

6. Remember, the colder the gas (air) temperature from 60^0 F base temperature, the greater the Volume Multiplier will be. Example: Using 40^0 F (4.4^0 C) gas or shop air;

Therefore:

$$\frac{60^0\ F + 460^0\ F = 520\ R}{40^0\ F + 460^0\ F = 500\ R} = 1.04\ (Volume\ Multiplier)$$

If you ran 200 ft^3 across the meter at 40^0 F, your uncorrected reading would show a 200 ft^3 increase whereas the temperature corrected reading would increase to 208 ft^3 (200 X 1.04).

METER SHOP TEST PROCEDURES

A meter shop motor driven test fixture will be needed for the following test procedure. Place the case cover/bulb and bellows transducer/temperature compensator assembly in a temperature bath to regulate the transducer temperature with recirculating fluid. (Fig. 3-18)

Set the motor on the test fixture to engage the spur gear driving the cylinder. Position the photogate sensors to read the proving wheels (white bar with no numbers) on the compensated and uncompensated indices. These sensors are to be connected to electronic counters that display the time between each rotation of the proving wheel.

60^0 Temperature Bath

Set the bath temperature to 60^0 F. Set the motor output speed on the test fixture to approximately 350 R.P.M. Zero the counters and record the time for each index to count pulses as indicated on the following page.

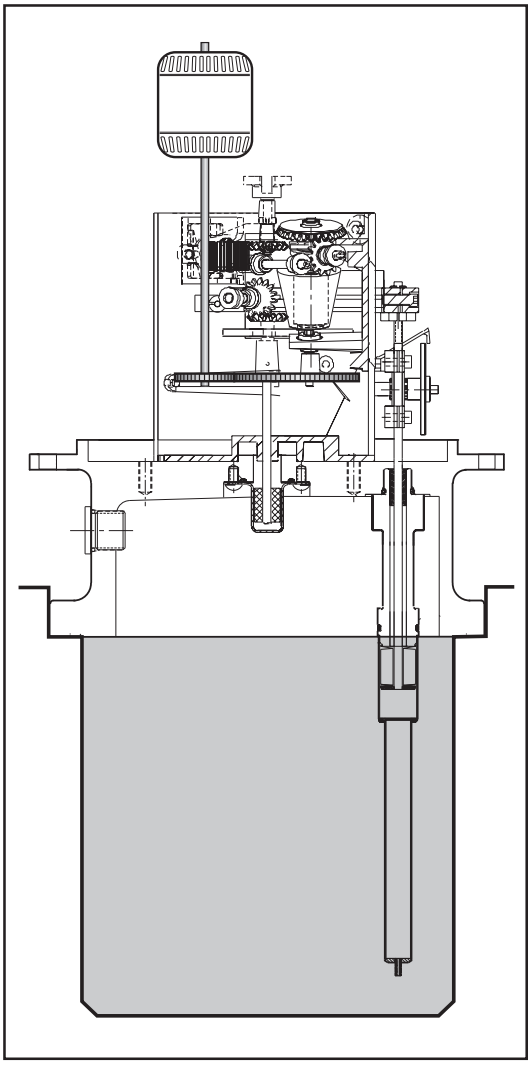


Fig. 3-18 Meter Shop Test Fixture

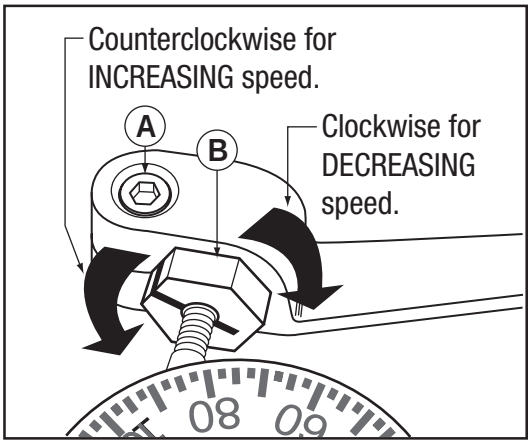


Fig. 3-19 Adjustment Bracket & Collar

Temperature Error Factor

9.0C	3 counts	100.59 seconds
1.5M	3 counts	107.8 seconds
3.5M	3 counts	109.5 seconds
5.5M	3 counts	102.9 seconds
7.0M	5 counts	100.8 seconds
11.0M	5 counts	102.48 seconds

\+ Error = Over-registration - Error = Under-registration

Adjusting for Temperature Error Factor

If the Corrected counter is indicating a faster time than the Uncorrected counter, loosen the #4-40 socket head cap screw (A) in the adjustment bracket and turn the adjustment collar (B) clockwise. (Looking at the hex face as shown in Fig. 3-19) If the Corrected counter is indicating a slower time than the Uncorrected counter, turn the adjustment collar counter-clockwise.

Three quarters (3/4) turn of the adjustment collar results in an error exchange of approximately 1%. Tighten the #4-40 Socket head cap screw after the adjustment is made. Again, zero the counters and record the time for each index to count pulses as listed in the Temperature Error Factor table above.

Reset the counters to count 50 pulses and record the average temperature over the length of the test.

Calculate the temperature factor error from the table on the previous page. If the error is less than +/- 0.75% the calibration process for this temperature bath is complete. If the error is equal to or greater than +/-0.75%, repeat the adjustment procedures on the adjustment bracket and recalculate temperature error factor.

0^0 Temperature Bath

Set the bath temperature to 0^0 F. Keep the motor output speed on the test fixture at approximately 350 R.P.M. Zero the counters and record the time for each index to count appropriate number of pulses for the meter size. An acceptable temperature error factor is less than +/- 0.85%. If the error factor exceeds this rate, repeat the steps in **Adjusting for Temperature Error Factor** above.

120^0 Temperature Bath

Set the bath temperature to 120^0 F. Keep the motor output speed on the test fixture at approximately 350 R.P.M. Zero the counters and record the time for each index to count appropriate number of pulses for the meter size. An acceptable temperature error factor is less than +/- 0.67%. If the error factor exceeds this rate, repeat the steps in **Adjusting for Temperature Error Factor** above.

MAINTENANCE

The following items should be inspected during routine field visitations to the meter site:

- Listen for abnormal sounds in the meter such as squeaks or grinding.
- Check all pertinent oil level sight plugs for correct volume and black or gray oil discoloration.
- Analyze the meters general condition: look for damage to the outer case due to vandalism, vehicles, weld burns, steam/water drippage, etc. Is there indication of excessive vibration?
- Is the meter still level within ±1/16" per foot in all directional planes?
- Is there any deformation or strained inlet-outlet piping?
- Examine and clean all upstream strainers and filters.
- Check the rotary meter drive output for binds, i.e., ratcheting movement, no registration.
- Check the instrument drive for binds.
- Check the temperature compensator for accuracy, digital display, battery life remaining, and low battery warnings.
- Clock the meter for passage of predetermined volume of gas by using the dial on the register with the stop watch.
- Differential pressure test @ 20%, 50% and 80% using a accurate test gauge.

Record all pertinent data on the maintenance record included in the Appendix.

Inspection & Maintenance

Meter

PROBLEM	PROBABLE CAUSE	SUGGESTED ACTION
Excessive vibration:	Build-up of foreign material on impellers	Clean by flushing or replacement of replacement of parts
	Misalignment	Level Meter
	Worn Bearings	Replace/return to meter shop
	Worn Gears	Replace/return to meter shop
	Impellers contacting body	Rotate manually to verify free spin. Remove obstructions. Check for level.
High Differential	Heavyweight or too much oil?	Check level and condition
	Dirt deposits on impellers	Remove dirt by flushing
	Impellers out of time	Retime impellers. Remove and return to shop for disassembly
	Impellers contacting body	Rotate manually to verify free spin
Low Registration	Upstream or bypass leak	Check all valves for leakage
Non Registration	Drive pin has sheared to accessory unit	Check for sheared pin
	Bind in the accessory unit	Start and stop meter; if counter or instrument does not operate, there is accessory failure.
	Obstruction within meter or associated piping	Remove obstructions to rotation or flow. Remove meter and flush as necessary.

The following accessories are available from American Meter for the American RPM Series Rotary Meter. Only qualified technicians should attempt installation procedures to the meter or the accessory unit. The American Meter Company can assist you with all rebuilding or repair of your meter at our factory. Part prices are available upon request.

To order parts for the meter or accessory, please contact your sales office and be prepared to specify the following information:

METERS- Model No. (Example 3.5M), Serial No. (From badge) 96 C0000149.

ACCESSORY-Model No. (Example 3.5M), Type of Unit (Temperature Compensator)

INSTRUMENT DRIVE ACCESSORY KIT

The addition of an instrument drive accessory to an existing RPM Standard or CMTC Rotary meter require the replacement of the existing Lexan register cover with one allowing access to the wriggler drive. For more information contact your sales office. To install the instrument drive remove the four (4) allen-head screws which secure the clear lexan cover and replace with register cover having wriggler access. Make sure the largest clear window is placed over register counter(s). Tighten 4 screws.

The Instrument drive kit will include the drive, O-ring and 4 allen-head mounting screws. Install the O-ring over the shoulder of the Lexan cover and place the instrument drive unit against Lexan cover to allow proper alignment of mounting holes. Install 4 supplied allen head screws and tighten (Fig. 5-1). Take care not to over tighten.

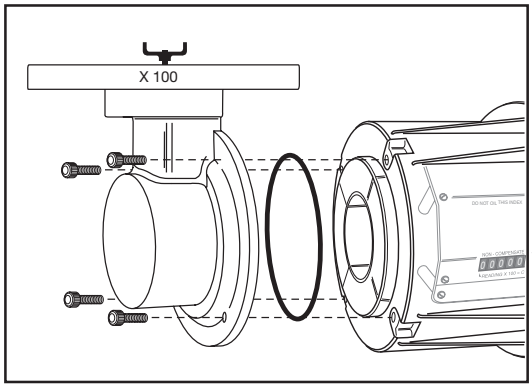
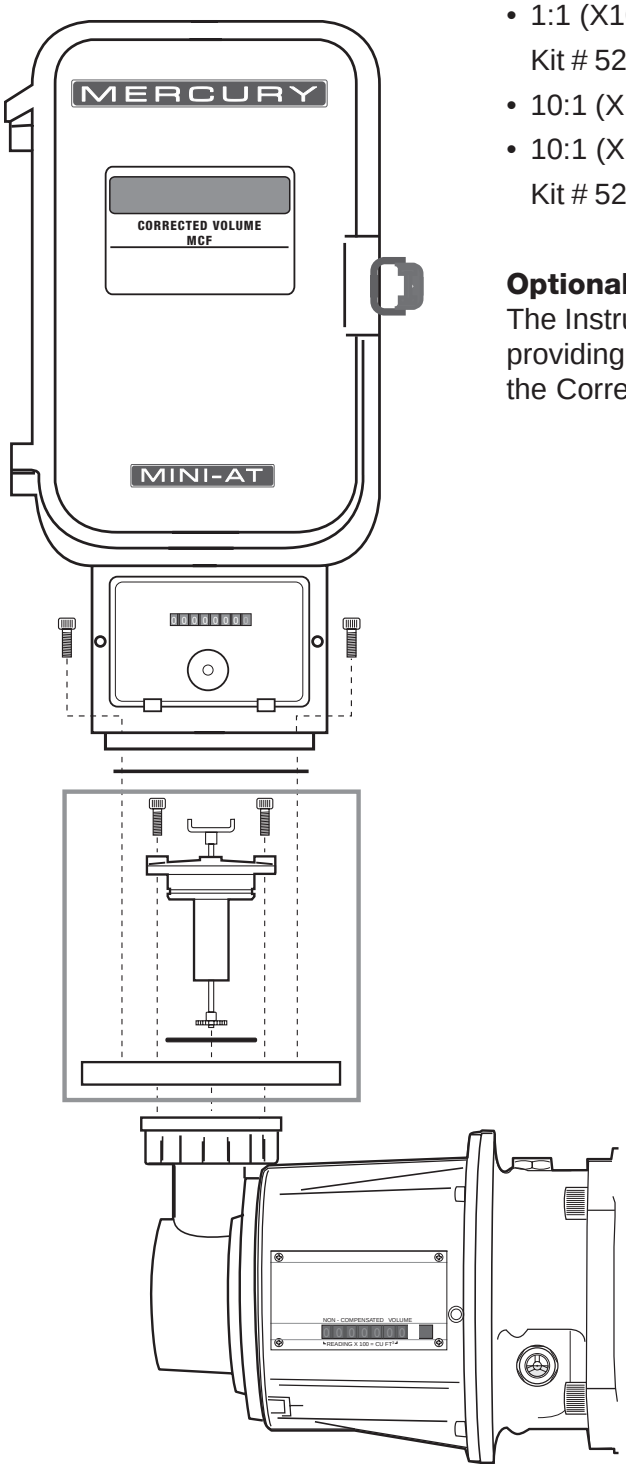


Fig. 5-1 Installing Instrument Drive Kit (optional X10 or X100)

Instrument Drive



Optional Instrument Drive Kit(s).

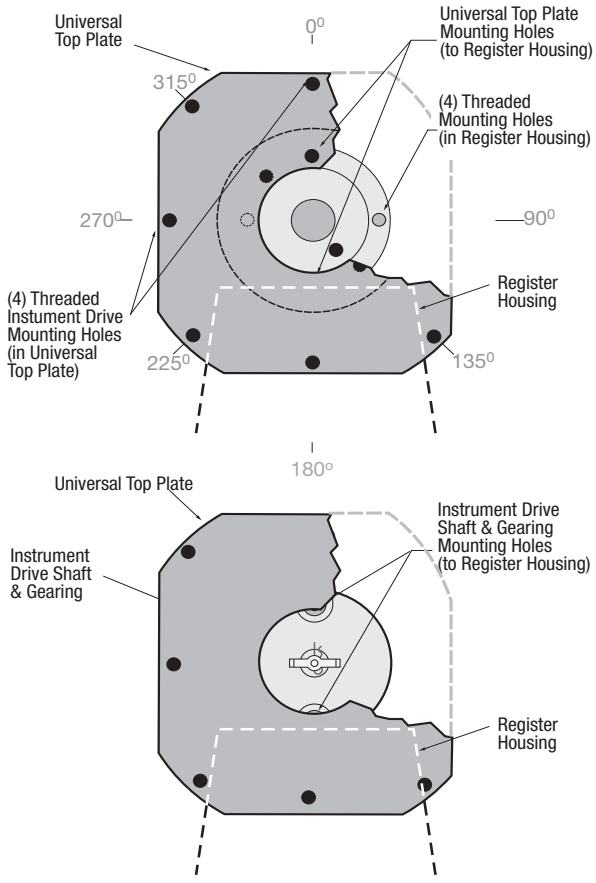
4 different options which should be clarified prior to placing orders:

- 1:1 (X10) Clockwise wriggler rotation - Kit # 52994K051
- 1:1 (X10) Counter-clockwise wriggler rotation - Kit # 52994K052
- 10:1 (X100) Clockwise wriggler rotation - Kit # 52994K053
- 10:1 (X100) Counter-clockwise wriggler rotation - Kit # 52994K054

Optional Instrument Drive and Corrector Installation.

The Instrument Drive Kit can be rotated 360^0 on the meter providing 8 different locations allowing for vertical positioning of the Corrector.

Top View
Universal Top Plate & Register Housing



DIFFERENTIAL-RATE TEST DATA

Meter Model _____ Serial No. _____ Utility Serial No. _____

Location _____ Date Installed _____ Register Reading _____

Lines Press.	Gas Temp.	Sp. Grav.	Volume Measured	Run Time	Rate CFH (m3/h)	Diff. Pressure		Date	Tester
						Ins. W.C. (mm W.C.)	% Chg.		
INITIAL TESTS - NEW METER									
PERIODIC CHECK LIST									

Meter Model _____ Serial No. _____

MAINTENANCE RECORD

Date	Service