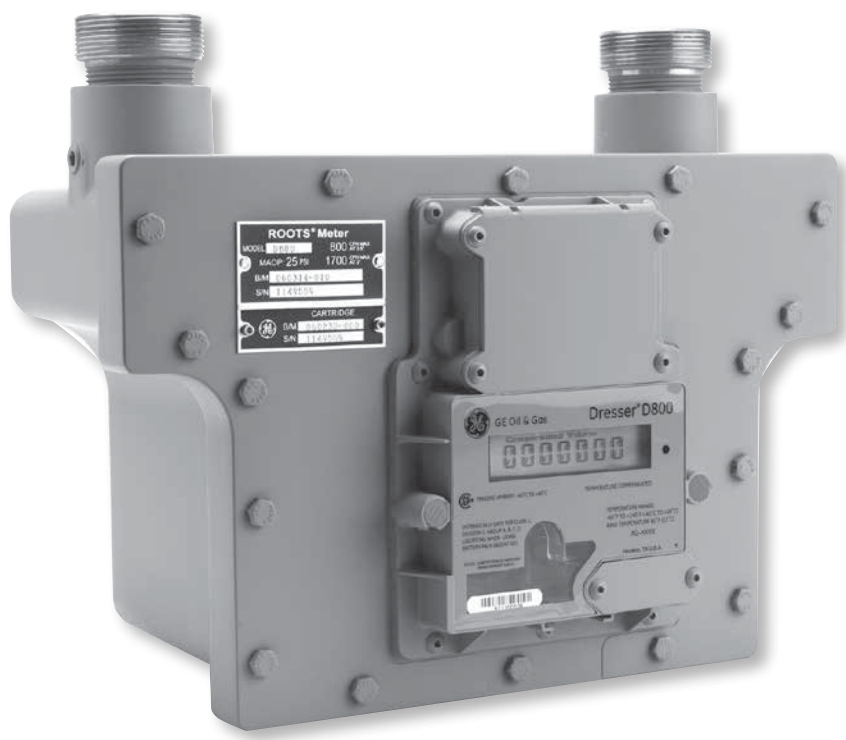
GE Oil & Gas

Dresser* Series D Meter

Models D800 and D1000

Installation, Operation and Maintenance Manual



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1. Introduction

GE Oil & Gas offers improved natural gas measurement accuracy and lower cost of ownership with the Dresser Series D diaphragm replacement meters. The Series D meter provides a legacy of superior long-term rotary meter performance in a compact oil-free design.

The Dresser Series D meter packages proven rotary meter technology into a full feature compact housing for commercial applications. The design encompasses the proven technology of a rotary positive displacement gas meter with two, contra-rotating “figure-8” lobed impellers. A precision measurement cartridge is encased within a rigid housing which is similar in appearance to a commercial diaphragm-type gas meter with threaded inlet and outlet connections matching Class 800 and Class 1000 meter connection standards.

Designed for convenience, the Series D meters mount directly to existing Class 800 and Class 1000 diaphragm meter sets using commonly used connection sizes. Additionally, when compared to a typical 800 or 1000 class diaphragm, the 50% reduction in weight (24 pounds vs. 50 pounds) and 70% reduction in size allows for easier handling whether in the shop, travelling to the job site, or actually installing the meter. This unique design allows for easy replacement of existing diaphragm meters without the need for re-piping, or updates to existing company installation piping standards for new meter sets.

The Series D meters set a new standard in rotary meter performance. With an exceptional average start rate of only 0.30 ACFH (stop rate of .0.15 ACFH) and a rapid ramp to +/- 1% accuracy at only 8 ACFH, the Series D meters ensure a sustained, non-adjustable measurement accuracy from pilot loads up to 1700 ACFH. As with all rotary meters, the accuracy is permanent and non-adjustable, providing years of superior measurement accuracy without calibration.

Two minute Temperature Compensated (TC) proving is a standard Series D feature. While readily tested on common sonic nozzle provers, the Series D meters test equally well on bell provers and transfer provers, including the Dresser Model 5 Transfer Prover. As always, Differential Pressure Testing is a standard Dresser meter capability with test ports conveniently located on the meter inlet and outlet. In short, the versatile Series D meters provide multiple testing capabilities to meet the needs of your organization and regulatory agency with a variety of testing options.

The Series D electronic index enables users to customize the odometer to display up to 20 user selectable screens. Powered by a lithium battery pack, the Series D meter also provides two scalable pulse output signals, a dedicated alarm output and 150 days of hourly logs stored in non-volatile memory. For applications requiring fixed-factor pressure correction, users can program and change the customizable fixed factor.

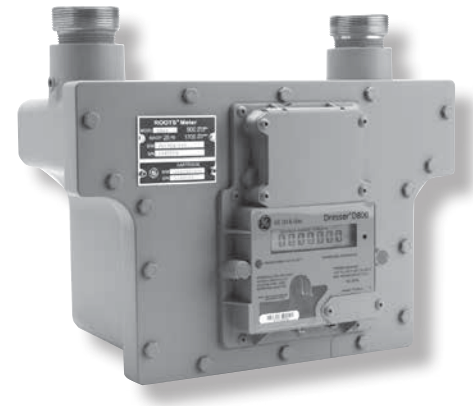

Figure 1.1 - Dresser Series D model D800 Meter

Dresser MeterWare software provides the user interface with the electronics via an IrDA (Infra Red) communication interface. The MeterWare software is compatible with multiple Dresser measurement products.

2. Performance Characteristics

The Dresser Series D meter accuracy is not affected by low or varying line pressures. The meter is suitable for use at pressures ranging from a few inches of water column (w.c.) to the full Maximum Allowable Operating Pressure (MAOP). Due to the structural design of the Series D meter and the proven long term performance of the permanently lubricated bearings, these meters can operate extensively at maximum capacity and the rated MAOP without degrading the meter performance or the meter life expectancy.

The meter base rating is expressed in hundreds of Actual Cubic Feet per Hour (acfh). Displaced volume measurement is completely independent of the gas specific gravity, temperature, and pressure. However, the Series D meter is rated in terms of “1/2 inch of w.c. (gas)” and “2 .0 inches of w.c (gas).” in conformance to industry accepted terminology for rating the capacity of diaphragm meters. In reality, the Series D meter is simply a rotary meter rated at 1700 acfh with a MAOP of 25psig with the added benefit of meeting differential pressure requirements for an 800/1000 Class diaphragm meter at 800/1000 acfh and 1700 acfh.

Sizing of the Series D meter is unlike that of a diaphragm meter as capacity is not affected by specific gravity. Additionally, meter capacity is only limited by the pressure drop when the application has a maximum allowable pressure drop. Typically, the Dresser D800/D1000 meter maintains a lower pressure differential at capacity than equivalent 800/1000 Class diaphragm meters.

The Dresser Series D meter provides exceptional long term, low flow measurement performance, meeting the most stringent performance requirements for Class 1 meters.

3. Receiving, 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
   a. File a claim with the carrier if necessary
   b. Notify your Dresser meter supplier immediately

Do not accept any shipment that has evidence of mishandling in transit without making an immediate inspection of package for damage. If shipped as part of a meter assembly, the meter 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 Dresser meter supplier immediately.

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

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

1. Your purchase order number and/or GE sales order number
2. The product model, serial number and bill of material number
3. A description of the problem
4. Application information, such as gas type, pressure, temperature and flow characteristics

All returns should be packaged in an original-type shipping container, if available, or shipping material that will protect the product.

Our Product Services Department offers professional services for all Dresser Meters and Instruments products. Authorization for return is required for all products shipped to the Factory for repair, calibration, warranty, exchange or credit. To obtain authorization, a Return Materials Authorization (RMA) number for return of Dresser products must be issued. Please contact your Dresser meter supplier.

Storage/Initial Testing

If the product is not tested or installed soon after receipt, store in a dry location in the original shipping container for protection.

4. Use and Limitations

This document provides recommendations where there is no established company procedure or practice.

Dresser meters are designed for continuously measuring and indicating accurate measurement of clean, dry natural gas and other non-corrosive gases at constant or varying flow rates. The Dresser Series D meter has superior rangeability to most small commercial meters and is capable of measuring small pilot loads. Contact your Dresser meter supplier for a list of approved gases or additional performance details.

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

WARNING

This equipment is designed to operate at temperatures between -40° F to 140° F. Prior to going on-site for installation or maintenance, make sure proper safety equipment is worn before handling the equipment and that you are properly dressed for the work site environment temperatures.

WARNING

Beware of sharp surfaces and potential pinch points while performing installation, maintenance and repair procedures. Utilize proper personal protective equipment or protective procedures wherever hazards exist.

5. Recommended Installation/Maintenance Tools

Suggested tools

- Adjustable torque wrench/driver
- 3/16" Allen Wrench
- 3/32" Allen Wrench
- 1/8" Allen Wrench
- Phillips-head screw driver
- Ratchet with 7/16" socket

Infrared (IR) Communications Kit

(Purchased separately)

- IR Sensor (USB connection)
- Holder – IR Assembly
- USB cable
- Magnet
- Dresser MeterWare Software

Elster American Meter SNAP™ Prover Interface

(Purchased separately)

- SNAP IR Prover cable
- Holder - IR Prover cable

Dresser Model 5 Prover Interface

(Purchased separately)

- Model 5 IR Prover cable
- Holder - IR Prover cable

Other prover interface cables under development. Contact factory for more information.

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6. Meter Display

Scrolling through the different screens on the LCD display requires the use of a magnet. The magnet can be purchased in the Communications Kit, P/N 060542-000, or as an individual item, P/N 060541-000. Consult Factory for pricing. The Dresser MeterWare software is also available as a separate item.

Swipe the magnet across the black dot, which is to the right of the LCD display screen, as shown in Figures 6.1 - 6. 2.

Note: the magnet will not change the screen if swiped on another area of the label.

Figure 6.1 - Label on D800 meter

Figure 6.2 - Swipe magnet across the black dot to change the screens

6.1 LCD Screen Displays

1. The default screen is either Compensated Volume or Non-Compensated Volume, depending on customer configuration.
   a. This parameter is the home/default screen.
   b. After a time out of approximately 30 seconds, the home screen always will appear.
2. Repeat the swiping motion of the magnet across the black dot, and the screens always will appear in the following sequential order as shown in Table 1.

   Note: Using the Dresser MeterWare Software, the displayed screens are configured by checking and un-checking the parameter to be displayed. Depending on the meter configuration, some screens may not appear.

Table 1 - Scrolling sequence for meter screen display

Displayed on Screen	Represents	Function
COMPENSATED VOLUME	Compensated Volume	Displays non-compensated volume which has been corrected to standard conditions
NON-COMPENSATED VOLUME	Non-compensated Volume	Displays actual non-compensated volume
LINETEMP	Line Temperature	Displays live line temperature
FIXED P	Fixed Line Temperature	Displays the line pressure as entered by the user
FLOWRATE	Flow Rate	Displays uncorrected flow rate (average of latest 30 seconds of captured data)
MTR INFO	Meter Info	Meter size and type
LEAKTEST	Leak Test	Functional test to determine low flow leakage downstream of the meter
PROVE CV	Compensated Prove Mode	Allows for compensated volume accuracy testing
PROVE UV	Non-compensated Prove Mode	Allows for non-compensated volume accuracy testing
BATTVOLT	Battery Voltage	Displays battery voltage
REM LIFE	Remaining Life	Calculated remaining battery life - shown in months
FIRM REV	Firmware Revisions	Displays the firmware revision that is in the meter at the present time
LCD TEST	LCD Test	Tests all display segments
BATTCHNG	Change Battery	Saves data to memory and resets clock
COMPFCTR	Compensation Factor	Displays the factor applied to non-compensated volume in order to arrive at compensated volume
COMPENSATED RESIDUAL	Compensated Residual	Shows extended compensated volume data beyond the value shown in the compensated volume screen
NON-COMPENSATED RESIDUAL	Non-compensated Residual	Shows extended non-compensated volume data beyond the value shown in the non-compensated volume screen
BASE T	Base Temperature	Displays base temperature as entered by the user
BASE P	Base Pressure	Displays base pressure as entered by the user
ATMOS	Atmospheric	Displays average atmospheric pressure as entered by the user
NCVOLFLT	Non-compensated volume under fault	Displays non-compensated volume that has accumulated since a fault occurred

3. Three to five seconds after the name of the value or the parameter appears, the screen will switch to show you the value of the selected parameter.

6.2 Data Display Screen and Icons

A. Data will be displayed in digital format as shown in Figure 6.3

B. Individual icons will display depending on the function or parameter, and how you have configured the meter using the Dresser MeterWare software. Refer to Section 8 for more information. Refer to Table 2 for Icon descriptions.

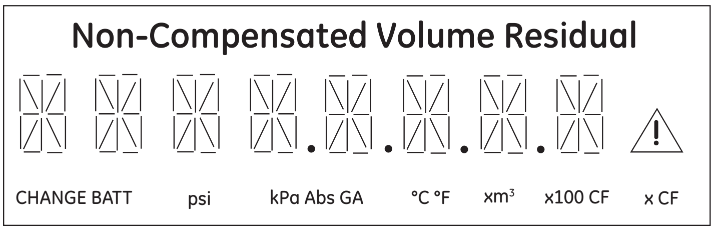


Figure 6.3 - Data Display Screen

Table 2 - Icon descriptions

Icon	Description
CHANGE BATT	Change Battery
psi	Pounds per square inch
kPa	Kilopascal
Abs	Absolute
GA	Gauge
°C	Temperature in Celsius
°F	Temperature in Fahrenheit
x m^3	Times meters cubed
x 100 CF	Times 100 cubic feet
x CF	Times cubic feet
	Alarm/Fault has occurred; consult software manual

6.3 RPM Wheel

A black & white RPM wheel is located under the plastic cover just below the index. The reflective RPM wheel is used to verify impeller rotation which means that gas is flowing, as well as when using an optical photo-sensor (scanner) when testing the meter for accuracy on a proving device. Each revolution of the RPM wheel indicates 0.007407 cf (0.0002098 m^3) of non-compensated gas flow through the meter.

Figure 6.4 - Movement of the RPM wheel indicates impeller rotation

RPM Wheel

7. Installation Procedures

7.1 Meter Installation

WARNING
If equipment is installed/serviced/maintained at elevated heights, ensure proper safe site work practices are in place to prevent fall and drop hazards.

WARNING
For installations in confined spaces, allow adequate room to safely handle product and equipment without causing bodily strain. Also verify proper ventilation is in place to maintain a breathable atmosphere.

Important: Prior to installation view the meter nameplate and ensure the Maximum Allowable Operating Pressure (MAOP) and rated capacity for flow rate meets the installation requirements.

7.1.1 Installation Recommendations

Follow your company guidelines and industry accepted practices.

- In areas of reduced meter visibility, such as meter locations next to parking lots or where the meter is potentially covered by snow, ensure protective devices are in place to prevent damage from automobiles or other large moving vehicles or equipment.
- Prevent debris and moisture from entering the meter to avoid possible damage and restriction of gas flow. As with all rotary meters, a strainer or filter upstream of the meter may be used to help remove contaminants such as pipe sealant, tape and weld slag from the gas stream.

- Piping should be rigid, properly aligned and level. 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 housing.
- 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. Make sure the meter remains level within 1/16" per foot in any direction.
- If the potential exists for over-speed conditions, a restricting flow orifice plate should be installed 2 to 4 pipe diameters downstream of the meter outlet. Warranty does not cover meter failure due to over-speed conditions.
- Protect the meter from snow loading. This includes mechanisms to protect against mechanical strain associated with excessive snow build-up or snow/ice falling from elevated locations such as rooftops.
- Take extra precautions when working in icy or slippery conditions to ensure proper footing and to maintain control of the meter.

7.1.2 Placing Meter in Line – Before Start Up

1. To prevent damage to the meter, make sure the upstream piping is clean of scale, dirt, liquids and other debris by purging the gas line. This is often done by venting the line to the atmosphere.

WARNING
Follow your company procedures for venting gas into the atmosphere as performing this task can create a hazardous environment.

2. Remove the protective caps from the threaded male inlet and outlet fittings (e.g., ferrule or spud) by turning counter-clockwise. To prevent small slivers of plastic from falling into the meter or damaging the spud threads, do not pull or pry the cover from the ferrules.
3. Place a new meter mount swivel washer (gasket) on each swivel nut as shown in Figure 7.1. Ensure the washer is properly installed or the swivels will not seal properly against the meter ferrules (spuds).

Figure 7.1 - Proper installation of washer into swivel

4. Connect the swivel nut on the gas supply side of the line to the meter ferrule (spud) as shown in Figure 7.2. Ensure gas flow is in the same direction as configured on the meter index. (Refer to Section 8 for volume accumulation method.) Hand tighten the nut to the meter ferrule.

Figure 7.2 - Connect meter ferrule into swivel nut on the gas supply side

5. Connect meter outlet to the downstream side of the line as shown in Figure 7.3. Hand tighten the nut to the meter spud.

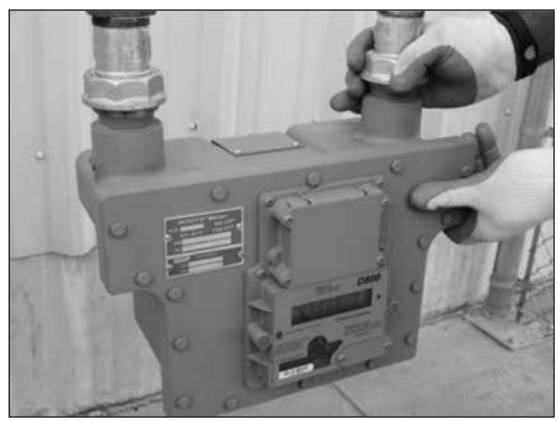


Figure 7.3 - Connect meter outlet to swivel nut on the downstream side

6. In a correct installation, the meter index is parallel to the ground with both meter ferrules (spuds) pointing upward. Refer to Figure 7.4.

Figure 7.4 - Meter placed in line

7. Ensure the meter is installed without piping strain. Level the meter to within 1/16" per running foot.
8. Use a pipe wrench to tighten the nuts to the meter ferrules as shown in Figure 7.5. There is no torque value for swivels. Proper compression is dependent upon the thickness of the swivel seal (gasket). Tighten until the seal is properly compressed and there are no leaks.

WARNING
Due to the nature of this fastener, no torque value is stated. However under torquing or over-torquing may result in gas leakage due to improper sealing or damage to the meter pressure vessel. Perform a leak test as specified below.

Figure 7.5 - Use a pipe wrench to tighten swivel nuts

9. Before turning on the gas, verify the downstream valve is closed if one is present. Verify all connections have been tightened to the appropriate torque.
10. A Leak Test must be performed immediately after placing in service. Refer to procedures in Section 7.1.3.3. All leak points must be eliminated quickly and before leaving the meter site. Otherwise, remove the meter from service by placing on by-pass or other method.

7.1.3 Meter Start-Up

7.1.3.1 Meter Start-Up for Meter Sets Without a By-Pass

1. Very slowly, open the meter inlet valve just enough to allow gas into the meter. This will allow the meter to pressurize. The RPM Wheel (Figure 6.4) may start to rotate during this process.

   Important: Do not exceed 5 psig/second maximum when pressurizing the meter. Rapid pressurization can cause an over-speed condition which may damage the meter. Resulting damage is not covered by warranty.
2. After the meter is pressurized, follow your company's authorized procedures or common industry practices to leak test the meter and all pipe connections. Soapy water, Snoop® or gas analyzers are commonly used for this procedure. The meter also incorporates a leak test feature as described in Section 7.1.3.3.
3. If a leak is detected, turn the gas off by slowly closing the meter inlet valve (and if present, the meter outlet valve). Make the necessary adjustments to stop the leakage and repeat the meter start-up procedure. If no leaks are detected, continue the start-up procedure.

WARNING
Before making adjustments or working on the meter, slowly depressurize and vent all pressure from the meter set in accordance to company procedures or industry guidelines.

4. If a downstream valve is present, slowly open the downstream gas valve.
5. Ensure gas is flowing through the meter. Let the meter operate at low speed for several minutes. Movement of the RPM Wheel indicates impeller rotation. Listen closely for unusual scraping or knocking sounds. If unusual sounds are present or the RPM Wheel is not turning, shut off the gas flow to the meter as described above. After making the necessary adjustments, repeat the meter start-up procedure. If the meter is operating normally, continue the start-up procedure.
6. Once the meter is operating smoothly, slowly open the inlet valve to the full open position.

7.1.3.2 Meter Start-Up for Meter Sets With a By-Pass

1. Slowly open the downstream valve of the bypass by cracking open the valve for a few seconds and slowly opening the valve to ¼ open over a period of ten seconds. This will pressurize the meter.

   Important: Do not exceed 5 psig/second maximum when pressurizing the meter. Rapid pressurization can cause an over-speed condition which may damage the meter. Resulting damage is not covered by warranty.
2. After the meter is pressurized, follow your company's authorized procedures or common industry practices to leak test the meter and all pipe connections. Soapy water, Snoop® or gas analyzers are commonly used for this procedure. The Series D meters also incorporate a leak test feature as described in Section 7.1.3.3.

3. If a leak is detected, turn the gas off by slowly closing the downstream gas valve. Make the necessary adjustments to stop the leakage and repeat the meter start-up procedure. If no leaks are detected, continue the start-up procedure.

WARNING
Before making adjustments or working on the meter, slowly depressurize and vent all pressure from the meter set in accordance to company procedures or industry guidelines.

4. Crack or partially open the meter inlet valve until the impellers are rotating. Ensure gas is flowing through the meter. Movement of the RPM Wheel indicates impeller rotation. Throttling (slightly closing) the by-pass valve may be necessary to initiate gas flow through the meter.
5. Let the meter operate at low speed for several minutes. Listen closely for unusual scraping or knocking sounds. If unusual sounds are present or the RPM Wheel is not turning, shut off the gas flow to the meter by first closing the inlet valve and then the outlet valve. After making the necessary adjustments, repeat the meter start-up procedure. If the meter is operating normally, continue the start-up procedure.
6. Slowly open the meter outlet valve to the fully open position.
7. Slowly open the meter inlet valve to the fully open position.
8. Once the meter is operating smoothly, slowly close the bypass valve to the fully closed position.

7.1.3.3 Downstream Leak Test Procedures

A common industry practice is to perform a leak test on a meter set after a meter installation. The leak test feature on the Series D meter provides a mean of detecting a leak (or gas flow) at any point downstream of the meter cartridge.

Important: The meter will not detect leaks which are flowing below the start rate of the meter. Flow above 1 cfh is measured at +90% accuracy.

WARNING
When performing a downstream leak test, adhere to Federal, State, Company and Local codes and procedures, as applicable.

There are two methods of performing this test, the RPM Wheel Method, and the electronic method using the LCD screens.

1. Black and White RPM Wheel Method

1. Perform a visual test by looking at the black and white RPM wheel on the meter and ensure it is not rotating as shown in Figure 7.6.

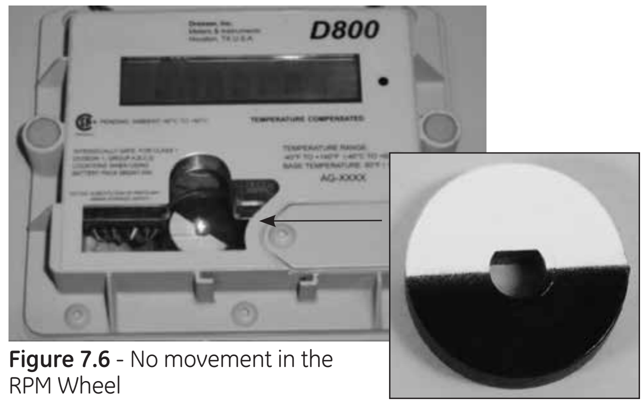


Figure 7.6 - No movement in the RPM Wheel

RPM Wheel

2. If the RPM Wheel is rotating, gas is flowing downstream of the meter indicating a leak (gas flow). The RPM wheel is tied directly to the meter impellers and is therefore extremely sensitive to flow. Each revolution of the RPM Wheel equates to a measured volume of 0.007407 cubic feet (0.0002098 cubic meters) of gas. In comparison, one revolution of the ¼ ft test hand on a Series D meter with a mechanical index is equivalent to 33.75 revolutions of the Dresser D800 RPM Wheel.

2. Electronic Method – Magnetic Interface

If the electronic leak test feature is enabled on the meter, the “LEAKTEST” screen will appear on the display when scrolling. If disabled, use the Dresser MeterWare software to enable the test feature. Refer to the MeterWare manual for additional information.

1. Using the magnet provided in the communications kit, scroll though the LCD screens until LEAKTEST appears on the LCD screen, as shown in Figure 7.7.

Figure 7.7 - Scroll to LEAKTEST screen

2. Hold the magnet on the black dot for 5 seconds until next screen appears and then remove.
3. Leak Test Run screen will appear as shown in Figure 7.8. The leak test procedure will now begin.

   Note: The meter will use a preconfigured test sequence to run the leak test based on acceptable flow/volume limits and time duration. Use Dresser MeterWare to change these parameters. The default is a maximum flow rate of 0.5 cf/hr with a test duration of two (2) minutes.

Figure 7.8 - Leak Test Run Screen

4. Once the leak test procedure is finished, you will see either a Leak Test Pass Screen as shown in Figure 7.9 or a Leak Test Fail Screen as shown in Figure 7.10.

Figure 7.9 - Leak Test Pass Screen

Figure 7.10 - Leak Test Fail Screen

5. The meter will hold the leak test result for 24 hours. To repeat the leak test, first clear the screen by displaying the leak test result and holding the magnet on the black dot next to the display screen. The screen will then return to the Leak Test run screen as shown above.

3. Electronic Method – MeterWare Interface

1. The Leak Test feature is also accessible through the “Advanced” screen of the Dresser MeterWare software as shown in Figure 7.11. This method requires the user to connect to the meter using the IR communication cable.
2. Using Dresser MeterWare allows the operator to both run the leak test as well as adjusting the test parameters as shown in Figure 7.12. After testing, a PASS or FAIL notification is provided on both the computer screen as shown in Figure 7.13 and on the meter as described in the magnetic interface section above.
3. Refer to the Dresser MeterWare manual for additional instructions on running a leak test using the MeterWare interface.

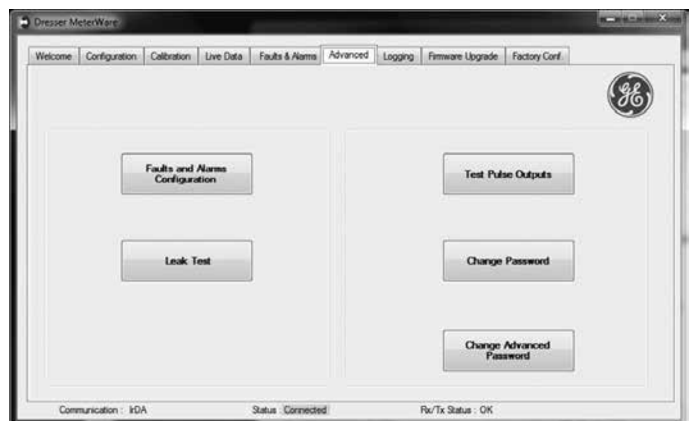


Figure 7.11 - “Advanced” screen of the Dresser MeterWare software

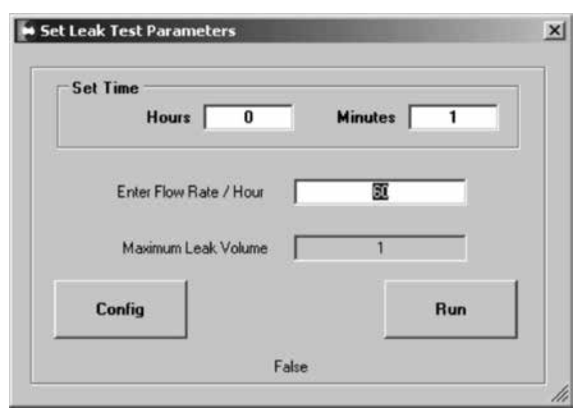


Figure 7.12 - Dresser MeterWare configuration screen for the downstream leak test

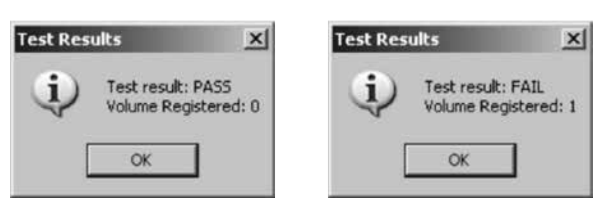


Figure 7.13 - Leak Test Pass/Fail indications in MeterWare

7.2. AMR Installation

7.2.1 AMR Bracket and Cable Preparation

1. If an AMR is not factory installed the AMR mounting brackets will be attached as shown. Reference Figure 7.14 below. Remove the brackets to begin the installation.

Figure 7.14 - AMR mounting brackets as shipped from factory

2. Once you remove the brackets the pulse output cable will be visible as shown in Figure 7.15.

Figure 7.15 - Pulse output cable on backside of meter

3. Loosen the cable gland and pull on the cable till at least 7.5-8" of cable extends out of the cable gland as shown in Figure 7.16. Retighten the cable gland. Torque to 25-27 in. lbs.

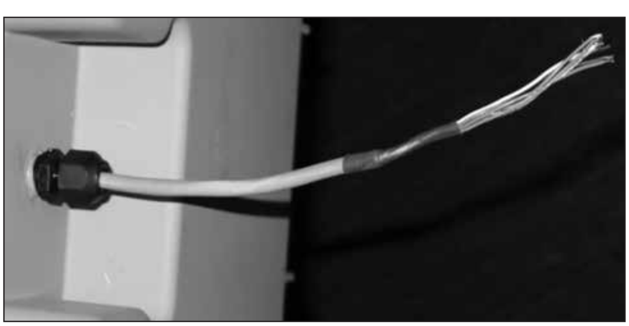


Figure 7.16 - Loosen cable gland and extend the cable out of the gland

4. Flip one bracket over as shown in Figure 7.17 and feed the cable through the holes located at the bend of the mounting brackets. Refasten the brackets to the meter as shown in Figure 7.18.

Figure 7.17 -Properly positioned mounting bracket

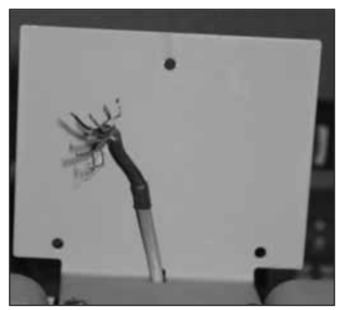


Figure 7.18 -Pull cable through the center hole

7.2.2 Installing an Itron ERT

1. Splice the meter pulse output wires to the ERT.
   If using Pulse Output 1, the green meter wire connects to the red AMR wire and the brown meter wire connects to the white AMR wire. If using Pulse Output 2, the black meter wire goes to the red ERT wire and the white meter wire goes to the white ERT wire.

Note: You do not need to stirp the wire as the Gel Cap splices supplied with the ERT are insulation displacing connection (IDC) type connectors. Use appropriate crimping pliers as shown in Figure 7.19 to properly clamp the splice.

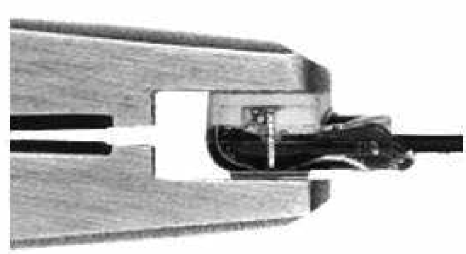


Figure 7.19 - Use proper crimping pliers on Gel Cap splice

2. Once the ERT is properly wired, install the (supplied) cable tie approximately 1/8" from the end of the shrink tubing as shown in 7.20

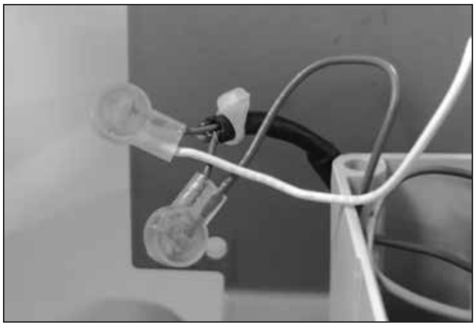


Figure 7.20 - Pulse Output 2 wired to the ERT with a cable tie located near the end of the shrink tubing

3. Slide the cable into the slot on the ERT back plate as shown in Figure 7.21. Ensure the cable tie is towards the inside of the ERT in order to provide a strain relief for the cable. When mounting the ERT assembly to the meter mounting bracket, route the cable across the back plate as shown in Figure 7.22 to prevent pinching the cable.

Figure 7.21 - ERT cable properly routed through the back plate

Figure 7.22 - Meter cable routed across back plate

4. Carefully dress wires into housing and install backplate on the Endpoint using the supplied T15 Torx screws as shown in Figure 7.23.

Figure 7.23 - Attach ERT to backplate with Torx screws

5. Source locally one (1) #8-32 X1/2" screw, two (2) each #8-32X3/4" screws and three (3) #8-32 Kep® nuts (or equivalent) for this step. Insert 1/2" screw into top hole in mounting plate and thread one of the nuts loosely on the end as shown in Figure 7.24.

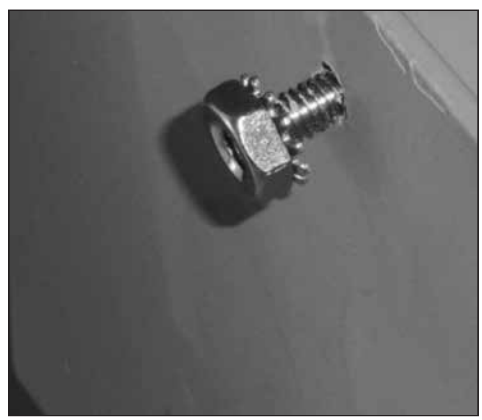


Figure 7.24 - 1/2 screw inserted into top hole of mounting plate

6. By tilting the bottom of the Endpoint away from the mounting plate slide the notched mounting slot under the nut as shown in Figure 7.25. Leave the screw loose for now.

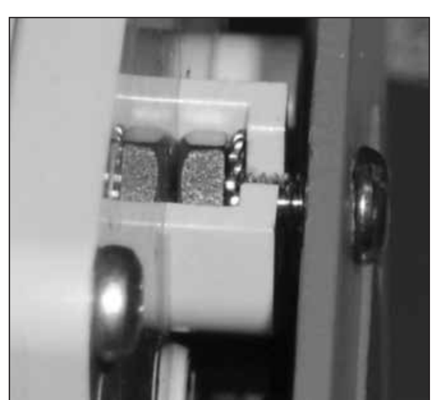


Figure 7.25 - Mounting plate attached to the nut

7. Now install the bottom set of screws and nuts as shown in Figure 7.26. Once all three sets of screws and nuts are installed they can be tightened.

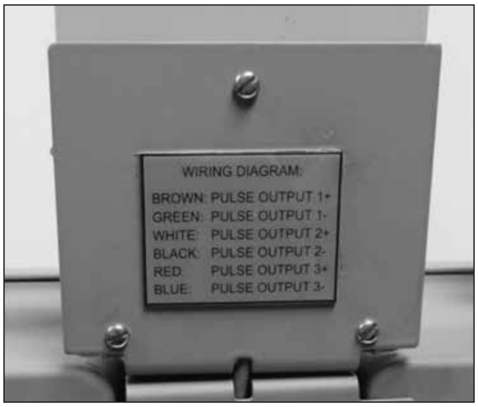


Figure 7.26 - Lower screws and nuts installed

8. Once all hardware is tightened the red tamper seals (supplied) can be installed on the Endpoint Module as shown at Figure 7.27.

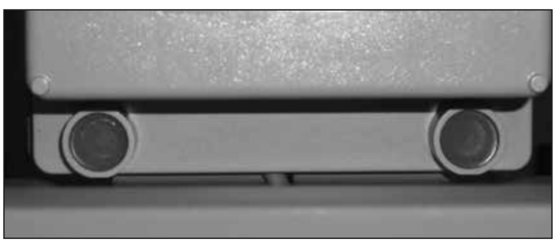


Figure 7.27 - Red tamper seals installed

7.3 Pulse Output Connections

7.3.1 Meter Configuration

Each Dresser Series D meter comes standard with two (2) low frequency pulse outputs (Pulse Outputs 1 and 2) representing volumetric information for remote data collection. Pulse Output 3 is reserved for fault and alarm signals.

The pulse output cable is routed through a cable gland located at the back of the meter. The output location is recessed and covered by a protective plate as shown in Figure 7.28.

Figure 7.28 - Pulse output cable is covered by a protective plate

Using the Dresser MeterWare software, the Corrector pulse output allocation is configured in the Volume configuration screen, as shown in Figure 7.29. Refer to this screen to verify proper configuration. Refer to the MeterWare Manual for complete operating instructions.

Note: Some customers will have their meter configured by the factory. Verify your company policy prior to making any configuration changes.

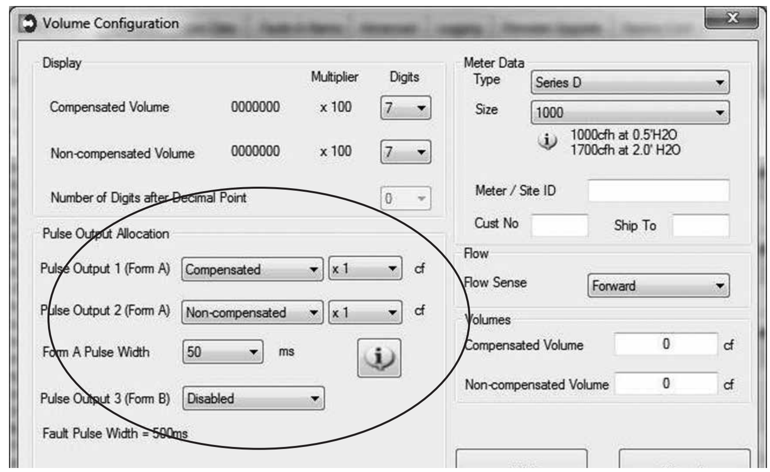


Figure 7.29 - Volume Configuration screen in Dresser MeterWare

To ensure that your pulse outputs are properly wired, the MeterWare software has a test function available on the **Advanced** screen, as shown in Figure 7.30.

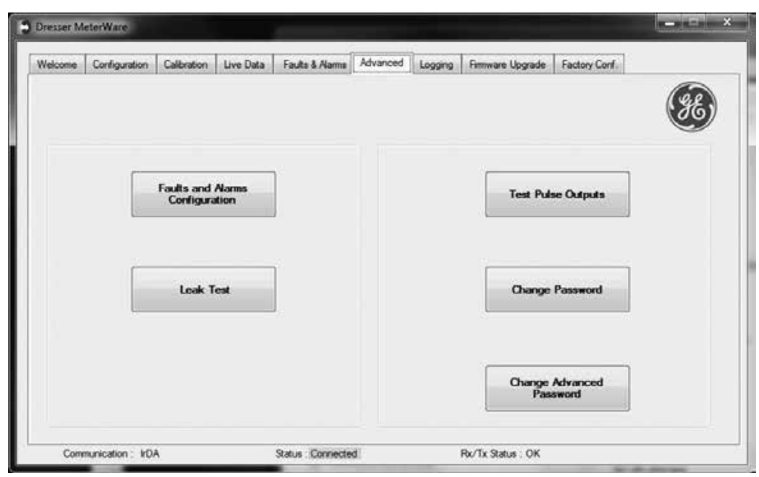


Figure 7.30 - Advanced Screen in MeterWare Software

Once you click the **Test Pulse Outputs** button, a screen will appear as shown in Figure 7.31. Click Yes to proceed with the pulse output test. For further information, refer to the MeterWare Manual.

Figure 7.31 - Send test Pulses screen in Dresser MeterWare

Note: For more information on configuring and testing pulse outputs, consult the Dresser MeterWare manual.

7.3.2 Pulse Output Wiring Instructions for Hazardous Locations

To maintain compliance with CSA certification, use a suitable Intrinsic Safety barrier for a Class 1, Division 1 hazardous area for groups A, B, C and D:

1. Do not exceed the following input values for the barrier device:
   a. Vi=8.2V   b. Ii=10ma
2. The OUTPUT and power handling capability of a barrier should not exceed:
   a. Vout=30V   b. Iout=50ma

For hazardous areas, use a recommended barrier such as Turck Brand IM1-12EX-T Single Channel or IM1-22 EX-R Dual Channel Barrier or an equivalent.

WARNING

Ensure properly licensed/trained professionals are used to install equipment if installed in hazardous locations containing explosive atmospheres. All local codes and standards shall be maintained during installation.

WARNING

Products certified as intrinsically safe installations shall be:

- **Installed, put into service, used and maintained in compliance with national and local regulations and in accordance with the recommendations contained in the relevant standards concerning potentially explosive atmospheres.**
- **Used only in situations complying with the certification conditions shown in this document and after verification of their compatibility with the zone of intended use and the permitted maximum ambient temperature.**
- **Installed, put into service and maintained by qualified and competent professionals who have undergone suitable training for instrumentation used in areas with potentially explosive atmospheres.**

A wiring output guide is conveniently located on the cover plate located at the back of the meter as shown in Figure 7.32. This information is also contained in Table 1. For wiring products in hazardous locations, refer to the wiring guide in Figure 7.33.

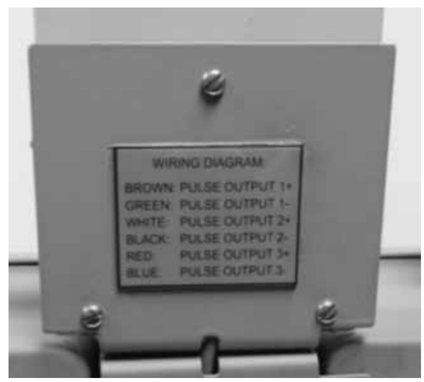


Figure 7.32 - Cover Plate with Wiring Guide

Table 1 - Pulse Output Cable

Output	Name	Wire Color	Pulse Type
Pulse Output 1 (+)	PO1 (+)	Brown	Form A
Pulse Output 1 (-)	PO1 (-)	Green	
Pulse Output 2 (+)	PO2 (+)	White	Form A
Pulse Output 2 (-)	PO2 (-)	Black	
Pulse Output 3 (+)	PO3 (+)	Red	Form B
Pulse Output 3 (-)	PO3 (-)	Blue	
Drain	(Drain)	Bare Wire	

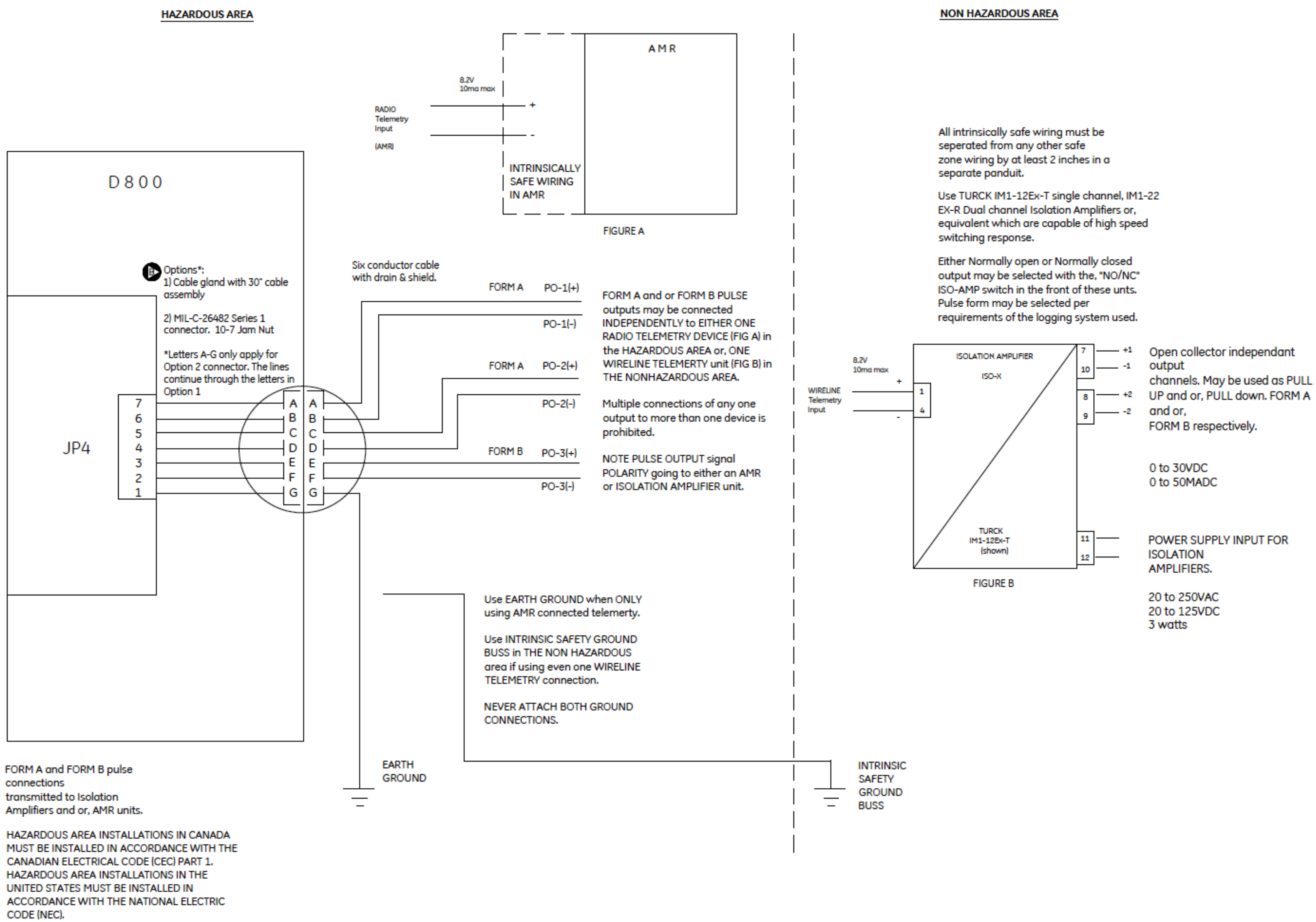


Figure 7.33 - Wiring diagram for hazardous locations, 060792-000

8. Meter Operation

Dresser MeterWare is the computer software which connects your computer to the meter. The software provides the capability to configure the meter, as well as download logged data and update the meter firmware. An infrared cable using the IrDA protocol connects the MeterWare to the meter.

Once MeterWare is connected to the meter, a Live Data screen displays current operating conditions. The Volume Configuration screen provides the ability to adjust volume information, such as odometer readings and pulse output configurations. Also, Faults and Alarms are configurable and the screens that are displayed on the meter Liquid Crystal Display (LCD) are selectable.

For detailed information on the installation and operation of the MeterWare user terminal interface, consult the MeterWare User Manual.

8.1 Volume Measurement

8.1.1 Imperial or Metric Measurement Options

The LCD display is set through the Dresser Meterware software and is user configurable.

Configurable items are:

- Volumetric units
- Temperature (Fahrenheit or Celsius)
- Fixed Factor Pressure (PSI or Kpa)

8.1.2 Volume Detection

Volume from the meter cartridge is detected via a volume input board. This volume input board utilizes the same Wiegand sensor technology used in the Dresser* solid-state pulsers and the magnetic pickups used to detect volume on the Dresser* Integral Micro Correctors, Model IMC/W2.

There are 5 volume accumulation methods based on the capability to read either the forward or reverse flow directions. The five volume accumulation methods are shown in Table 1 below.

Table 1 - Volume Accumulation Methods

Volume Accumulation	Measured Flow Source		
	Forward	Reverse	Calculated Flow
Forward minus (-) Reverse	✓	✓	Volume in Reverse flow is subtracted from the volume calculated in Forward flow.
Reverse minus (-) Forward	✓	✓	Volume in Forward flow is subtracted from the volume calculated in Reverse flow.
Reverse	X	✓	Volume in Reverse flow only is calculated. All flow in the Forward direction is ignored.
Forward	✓	X	Volume in Forward flow only is calculated. All flow in Reverse direction is ignored
Forward plus (+) Reverse	✓	✓	Volume in Reverse and Forward flow are calculated. Calculated volume is the total of all flow in both directions.

Note: The factory default method for volume accumulation is Forward plus (+) Reverse in order to allow for mounting in either flow direction and to prevent "rollback" of the volume count. Refer to the MeterWare manual to change the accumulation method.

8.1.3 Volume Sample Frequency

Volume is sampled every 30 seconds.

8.1.4 Volume Update Frequency

All parameters on the LCD are updated every 30 seconds.

8.1.5 Pulse Output Frequency

Volume pulses are provided in real time.
The Form A outputs are configurable by:

- Volume per pulse
- Pulse width
- Imperial or metric

The Form B fault/alarm pulse output is not configurable and provides a 500 ms pulse every 30 seconds when a fault or alarm is present.

8.2 Temperature Measurement

Temperature is measured using a Class A, PT1000 precision RTD and is sampled every 30 seconds. In normal operation, the accumulated temperature Corrected Volume total is updated every 30 seconds and is displayed in standard cubic feet (SCF) or normal cubic meters (nm^3) over the temperature measurement range of -40°F to + 140°F (-40°C to +60°C).

The total ambient temperature effect is less than 0.1°F (0.05°C) over the entire temperature range. Additionally, temperature measurement accuracy is graduated over the measurement range as shown in Table 2.

Table 2 - Temperature measurement accuracy over the temperature measurement range

Temperature Range	Measurement Accuracy
-40 to 32° F (-40 to 0° C)	+/- 0.4 ° F (+/- 0.2° C)
32 to 140° F (0 to 60° C)	+/- 0.5 ° F (+/- 0.3° C)

The units of measure (°F or °C) and the reference base temperature are configurable using the Dresser Meter-Ware software.

Note: The default base temperature is 60°F for imperial applications and 15°C for metric applications.

For ease of calibration, there is a provision in the Dresser MeterWare software to perform a single point temperature field calibration. Consult the MeterWare manual for details.

8.3 Flow Rate Measurement

Flow rate is accessed by scrolling to Flow Rate screen on the meter display screen as described in Section 6.

The flow rate for the meter is an average value based on the last 30 seconds of stored uncorrected volume data. Since the data collected by the meter is updated and stored every 30 seconds, there is always a slight delay in the timing of the displayed results ranging anywhere from 1 to 29 seconds until the results are updated again.

When the gas flow is fairly steady, the flow rate information is accurate. However, when the flow rate is shifting, there is a notable amount of error calculated by the meter depending directly on how rapidly and how much the gas flow is actually changing. As long as the flow through the meter set is fairly steady, the flow rate provided by the meter is valid for testing the differential pressure across the meter.

In summary, the flow rate indication is recent (but not instantaneous) and is based on the average flow rate of the last 30 seconds of saved information.

8.4. Faults and Alarms

8.4.1. Faults

A Fault is a problem with the meter electronics hardware or the firmware.

Fault types:

- Temperature: when the temperature probe is faulty or disconnected from the meter electronics.
- Volume: when the volume input board has a problem such as a bad sensor.
- Internal operations: when there is a software bug or failure within the microprocessor. This also may occur when memory access fails.
- Low Battery: when the battery voltage drops be low 2.7 V.

8.4.2. Alarms

Alarms inform the user when line temperature or flow rate has moved above or below the desired limits; the limits are user configurable using the Dresser Meter-Ware software.

Alarm Types:

- High Temperature Alarm Limit: when temperature goes above the user defined limit.
- Low Temperature Alarm Limit: when temperature drops below the user defined limit.
- High Flow Rate Alarm Limit: when flow rate goes above the user defined limit. Default high flow alarm allows for a 20% overspeed.
- Low Battery Alarm: when the battery voltage drops below 3.0 V. (not user configured)

8.4.3. LCD Display Notices

When an Fault or Alarm is active, the LCD display will show a caution symbol as shown in Figure 8.1.

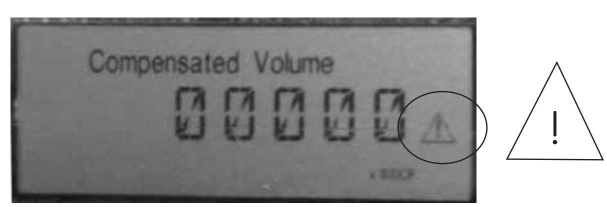


Figure 7.31 - Fault/Alarm symbol as displayed on LCD Screen

Scroll through the LCD displays, using the magnet provided in the Communications Kit, until the relevant Fault or Alarm is displayed. Faults and Alarms are displayed on the LCD screen as listed in Table 3.

Table 3 - Fault and Alarm types

	Screen Display	Represents
Faults	T FLT	Temperature Fault
	VOL FLT	Volume Fault
	INT FLT	Internal Operations Fault
	CHANGE BATT	Low Battery Fault
Alarms	HIGHT. AL.	High temperature alarm
	LOWT. AL.	Low temperature alarm
	HIGHFL. AL.	High flow rate alarm
	VL IN. AL.	Volume input alarm
	L BATT AL.	Low battery alarm

8.4.4 MeterWare Notices

Faults and alarms are also listed on the Live Data screen in the Dresser MeterWare software as shown in Figure 8.2 and Figure 8.3. When a Fault or Alarm is present, the value is highlighted in red.

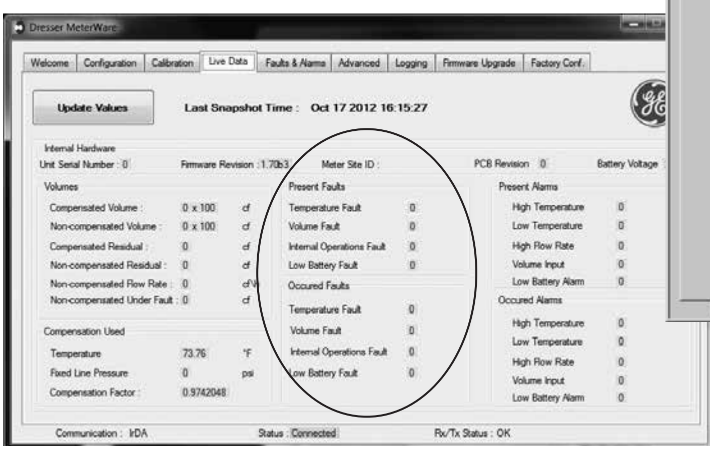


Figure 8.2 - Live Data Screen showing Faults in Dresser MeterWare Software

Figure 8.3 - Live Data Screen showing Alarms in Dresser MeterWare Software

In order to clear existing Alarms and Faults, connect the D800/D1000 to the Dresser MeterWare software and clear the items in the "Faults and Alarm" tab as shown in Figure 8.4. For more information on these features, refer to the MeterWare Manual.

In order to clear faults and alarms without using the MeterWare software, use the magnet to scroll to the LCD TEST value screen and after 20 seconds the FLT AL screen will appear. Hold the magnet on the black dot for at least 6-10 seconds and this will clear the occurred faults and occurred alarms[1].

[1] Please note this will not clear present faults or present alarms as these will remain active until the fault or alarm is resolved.

Note: If a battery fault is present, the battery must be disconnected and reconnected (or replaced) to eliminate the fault. If the battery is replaced be sure to reset the battery life clock. Refer to Section 9.5 for complete instructions on accessing and replacing the battery.

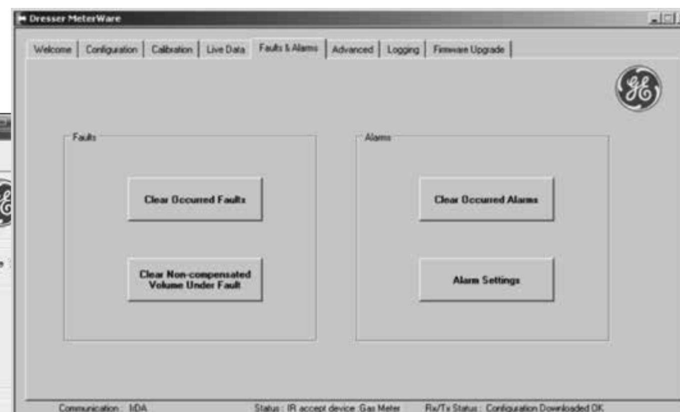


Figure 8.4 - Faults and Alarms Screen as displayed in Dresser MeterWare

8.4.5 Fault and Alarm Pulse Outputs

The meter is capable of providing a pulse output when a Fault or Alarm is present. This feature is configurable in the Volume Configuration screen of Dresser MeterWare. (The Volume Configuration screen is reached by selecting the "Configuration" tab in MeterWare and then selecting the "Volume" box.)

Pulse Output 1 and Pulse Output 2 provide a Form A (Normally Open) pulse when "Fault" is selected for the output. A pulse output is provided every 30 seconds when a Fault or Alarm is present. The pulse width is selectable as 50, 150, or 250 ms.

Unlike the other two pulse outputs, Pulse Output 3 is a dedicated Form B (Normally Closed) switch and is configured for a 500 ms pulse. There are only two settings for the pulse output; either "Disabled" or "Fault". No pulses are provided when disabled, but when the "Fault" feature is selected a pulse is provided once every 30 seconds whenever a Fault or Alarm is present.

When a fault of any kind is present in the D800/D1000:

- The pulse outputs for Compensated and/or Non-Compensated volume will not pulse out.
- Any pulse output configured to be a Fault pulse will function as an alarm/fault pulse output.
- All pulse outputs will continue to perform as configured, if an alarm is present.

If the D800/D1000 is configured to utilize the "Fixed Temperature Under Fault" function to correct when the unit has a Temperature Fault, then the Compensated and Non-Compensated Volumes:

- Continue to increment and be displayed on the LCD
- Are logged in the Logged Data Reports

If the D800/D1000 is not configured to utilize the "Fixed Temperature Under Fault" function and a Temperature Fault occurs, then the Non-Compensated volume only continues to be logged in the "Non-Compensated Volume Under Fault" register, and will be displayed as the same on the LCD, if that parameter is enabled at time of unit configuration.

8.5 Logging Features

8.5.1. Data Log

Data logs are recorded hourly. The meter maintains 150 days of hourly logs on a first in first out (FIFO) basis. The Data Logging feature is not configurable.

The user can decide how many days of hourly logs to download using the Dresser MeterWare software.

8.5.2. Logged Parameters

The meter has non-volatile memory. If the unit experiences battery failure, all logs obtained within the last hour of operation are retained and are available and ready for use as soon as power is restored. In addition, the configuration is stored in non-volatile memory and is not lost in the event of main battery failure.

Data logs (order dependent) are continually stored in the memory on an hourly basis consisting of these 24 parameters:

- Log Number
- Log Date & Time
- Compensated volume
- Non-compensated volume
- Compensation factor
- Non-compensated volume under fault
- End temperature
- Battery voltage
- Present fault – temperature
- Present fault – volume
- Present fault – internal operation
- Present fault – low battery
- Occurred fault – temperature
- Occurred fault – volume
- Occurred fault – internal operation
- Occurred fault – low battery
- Present alarm – high temperature
- Present alarm – low temperature
- Present alarm – high flow
- Present alarm – low battery
- Present alarm – volume input
- Occurred alarm – high temperature
- Occurred alarm – low temperature
- Occurred alarm – high flow
- Occurred alarm – low battery
- Occurred alarm – volume input

8.5.3. Audit Log

The audit log includes a tracking facility that details parameter changes that affect billing. This log maintains the most recent change and the original information. Historical changes beyond the most recent change are not retrievable. The audit log cannot be deleted. Changes are recorded in the audit log, which include:

- Parameter changed
- Date and time the change occurred
- Old value
- New value

Parameters captured in the audit log are:

- Meter type
- Meter size
- Revolution/Unit volume
- Flow sense
- Temperature units
- Base temperature
- Temperature model
- Fixed temperature
- Pressure units
- Base pressure
- Atmospheric pressure
- Pressure factor
- Fixed pressure
- Pressure mode
- Compensated multiplier
- Non-compensated multiplier
- Pulse output 1
- Pulse output 2
- Pulse output 3
- Pulse output 1 selected
- Pulse output 2 selected
- Pulse output 3 selected
- Telemetry form A pulse width
- Compensated volume
- Non-compensated volume
- Non-compensated volume under fault
- Pressure calculation type
- User temperature calibration offset
- High temperature alarm limit
- Low temperature alarm limit

Both the data logs and the audit log are saved as a CSV (comma-delimited) file to expedite easy import into spreadsheets such as MS Excel™.

9. Maintenance Procedures

9.1 Meter Lubrication

No lubrication is required. This meter incorporates permanently lubricated bearings and gears.

9.2 Cleaning Meter and Instrument Housing

Clean the meter and Instrument housings with hot water and soap or Isopropyl alcohol.

Important: Aromatics, Ketones, and Chlorinated hydrocarbons will damage the plastic cover. Do not use acetone, carbon tetrachloride, etc.

9.3 Temperature Probe Replacement

1. Use a 1/8" Allen wrench to remove the two button head cap screws on the temperature probe cover located on the lower right hand side of the meter as shown in Figure 9.1 and then pull out the temperature probe as shown in Figure 9.2.

Figure 9.1 - Remove two button head screws

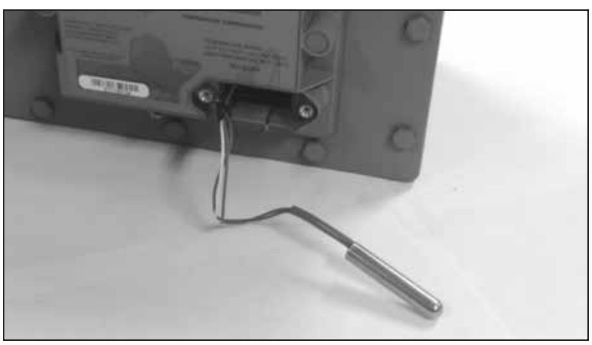


Figure 9.2 - Temperature probe removed from compartment

2. Remove the temperature probe by pressing and releasing the black connector as shown in Figure 9.3 and then attach the new temperature probe to the black connector and push the probe back into the probe well as shown in Figure 9.4.

Figure 9.3 - Press and release the black connector to remove temperature probe

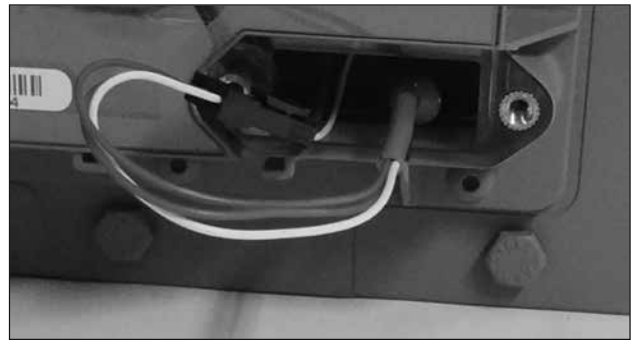


Figure 9.4 - Push new probe back into probe valve

5. Once the new probe has been installed, place a new gasket onto the TC probe cover as shown in Figure 9.5 and attach the temperature probe cover by using a 1/8" Allen wrench to screw the two button head cap screws. Torque screws to 10-12 inch pounds.

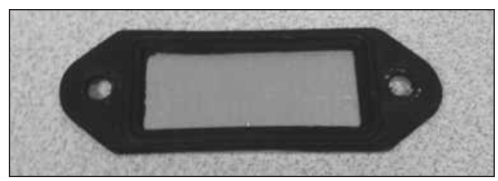


Figure 9.5 - Gasket placed on temperature probe cover

Important: Prior to returning the meter to service, the temperature probe requires calibration. Refer to the MeterWare manual for the procedure to perform a single point calibration of the temperature probe. This procedure requires a stable and accurate temperature reference device for comparison. Allow enough time for the temperature to stabilize between the new probe and the reference temperature device. For the best results, submerge the new temperature probe and the reference temperature probe in a temperature controlled liquid bath.

9.4 Instrument Replacement

9.4.1. Instrument Removal

1. To replace the instrument, remove the two rock seals on the front cover. Use a screw driver to punch a hole in the seals as shown in Figure 9.6. Next, use a 1/8" Allen wrench to remove the 4 (#10-24) screws on the battery compartment as shown in Figure 9.7. Pull out the battery and remove it by unhooking the connector as shown in Figure 9.8.

Figure 9.6 - Remove rock seals.

Figure 9.7 - Remove 4 screws on battery compartment

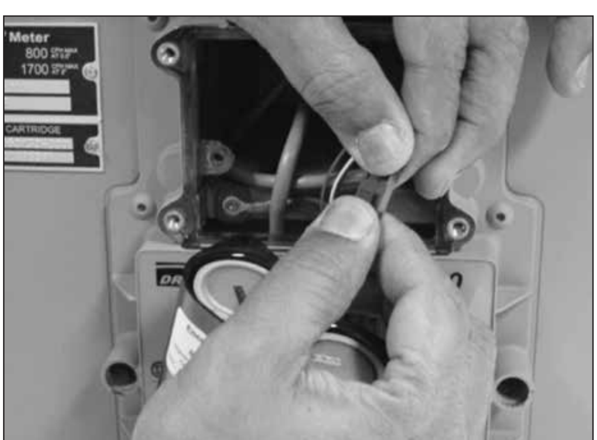


Figure 9.8 - Remove battery

2. Remove the nine (#10-24) screws on the Index and gently pull the index away from the meter as shown in Figure 9.9.

Figure 9.9 - Pull index away from the meter

3. Use a 1/8" Allen wrench to remove the two (#10-24) screws on the AMR plate on the top of the meter as shown In Figure 9.10. Gently loosen the cable gland nut on the back of the meter as shown in Figure 9.11. Afterwards, gently pull the cable all the way out of the cable gland.

Figure 9.10 - Remove AMR plate

Figure 9.11 - Loosen cable gland connector

4. Use a 3/32" Allen wrench to remove the (#4-40) screw connecting the green ground wire as shown in Figure 9.12.

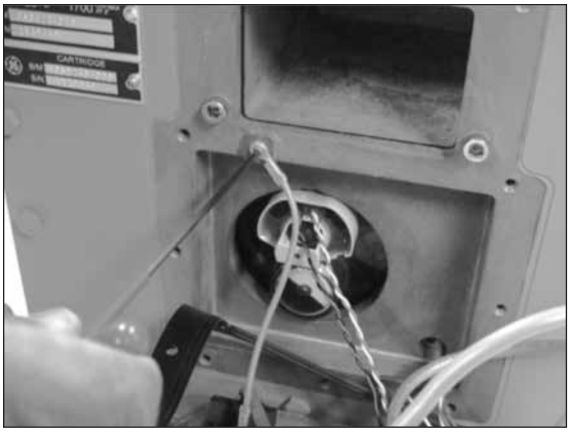


Figure 9.12 - Remove green ground wire

5. Gently pull out the Wiegand assembly from its location as shown in Figure 9.13

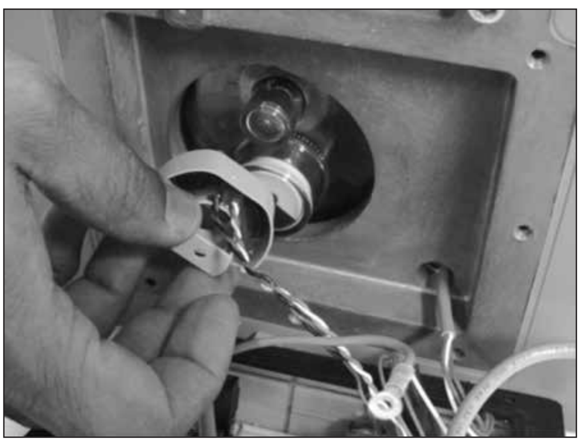


Figure 9.13 - Remove Wiegand assembly.

6. Remove the temperature probe by pulling the probe out from the probe well.
7. After this step, the cover is completely disconnected from the meter.

9.4.2. Instrument Installation

1. To install the new instrument, place a new gasket on the meter – lip side up, as shown in Figure 9.14.

Figure 9.14 - Place gasket onto meter

2. Run the gray pulse output cable through the front of the meter and through the back of the cable gland as shown in Figures 9.15 and 9.16.

Figure 9.15 - Pulse output cable

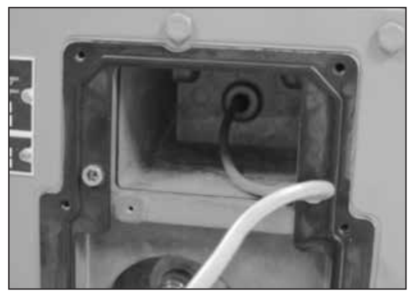


Figure 9.16 - Run cable though back of meter

3. On the back of the new index, be sure the Wiegand wires are placed inside the white holder as shown in Figure 9.17.

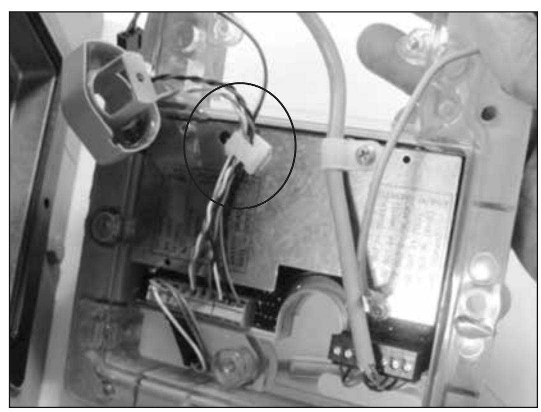


Figure 9.17 - Wiegand wires placed inside holder

4. Place the Wiegand assembly into the location shown in Figure 9.18. Push the Wiegand assembly all the way onto the amber colored cover.

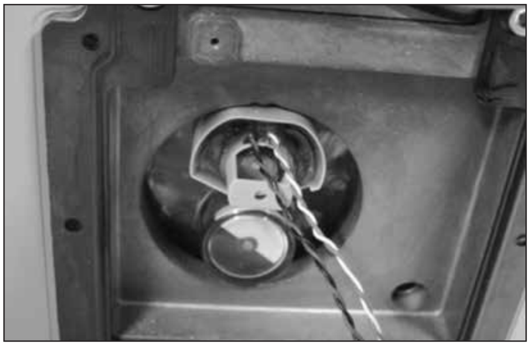


Figure 9.18 - Place Weigand into compartment

5. Use a 3/32 Allen wrench to attach the (#4-40) screw to the green ground wire back onto the meter as shown in Figure 9.19.

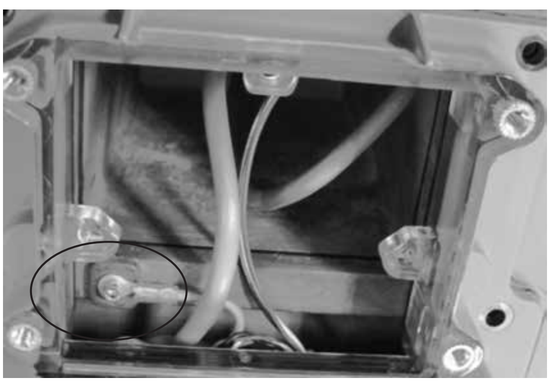


Figure 9.19 - Attach green ground wire

6. Route the temperature probe out of the TC probe opening on the index cover as shown in Figure 9.20. This will prevent the probe leads from becoming trapped behind the instrument housing.

Figure 9.20 - Temperature probe extended through the front of the instrument cover

7. Use a 1/8" Allen wrench and the 9 screws to place the index cover on the meter. Torque the screws to 10-12 inch pounds. Make sure no wires are pinched between the gasket and the instrument.
8. Pull the pulse output cable all the way though the cable gland as shown in Figure 9.21 to ensure the cable is not pinched.

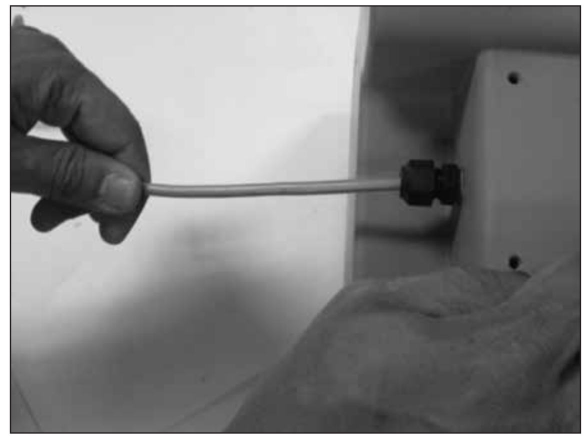


Figure 9.21 - Pull pulse output cable through gland

9. Reconnect the battery to the instrument power cable. Refer to section 9.5.1 for detailed instructions. Place the battery inside the compartment by aligning the pins into the holes as shown in Figure 9.22.

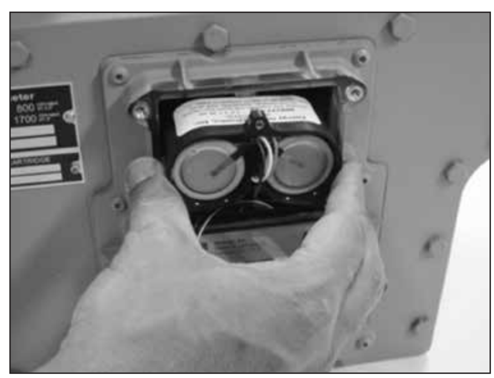


Figure 9.22 - Place battery inside compartment

10. Place the new gasket on the battery cover as shown in Figure 9.23 and assemble the battery cover onto the battery compartment using the 1/8" Allen wrench to screw in the 4 (#10-24) screws. Torque screws to 10-12 inch pounds.

Figure 9.23 - Gasket placed on battery cover

11. Push the temperature probe all the way into the probe well as shown in Figure 9.24.

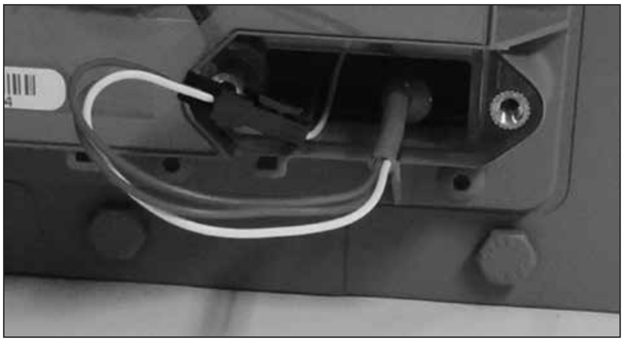


Figure 9.24 - Push temperature probe into probe well

12. Place a new gasket onto the TC probe cover as shown in Figure 9.25 and attach the cover by using a 1/8" Allen wrench to screw the two button head cap screws. Torque screws to 10-12 inch pounds.

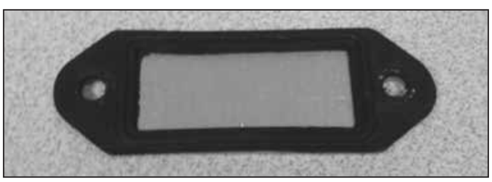


Figure 9.25 - Gasket installed on temperature probe cover

13. Push the gray pulse output cable back into the meter until the exposed wires are close to the cable gland nut as shown in Figure 9.26.

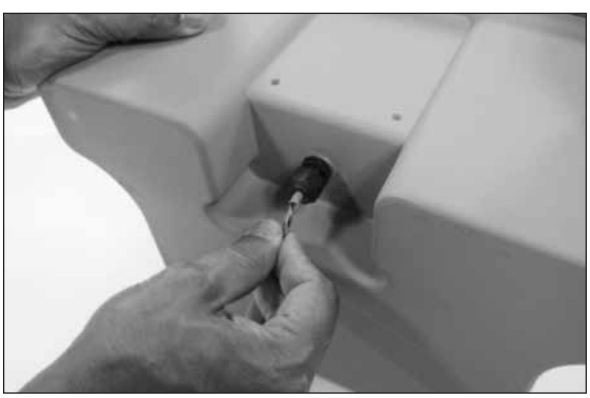


Figure 9.26 - Push pulse output cable back into the meter

14. Hand tighten the cable gland nut until it is firmly tight. Do not exceed 15 inch pounds of torque.

15. Use a 1/8" Allen wrench to attach the two (#10-24) screws on the AMR plate on the top of the meter as shown In Figure 9.27. Torque screws to 10-12 inch pounds.

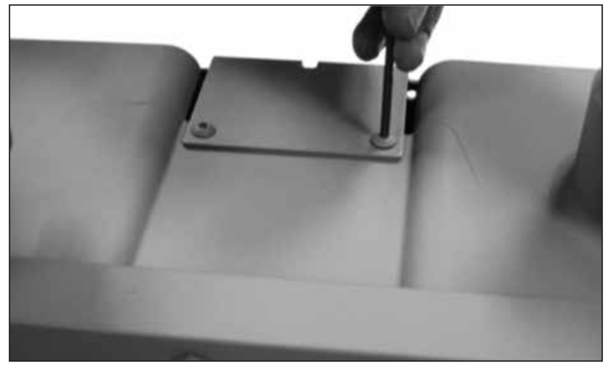


Figure 9.27 - Attach AMR plate to the meter.

9.5 Battery Maintenance

The electronics are powered by a battery pack consisting of two Lithium Thionyl Chloride batteries having an average life of 20-years. The actual length of the battery life will depend upon the conditions of use. Battery life is calculated assuming continuous flow at 50% of the meter's maximum capacity. Temperature affects battery life. As an example, battery life expectancy for cooler climates such as Minneapolis, MN, are calculated at 20+ years, while warmer climates such as Las Vegas, NV, have a calculated battery life of 15+ years.

The state of the battery pack is monitored and the meter generates either a low battery alarm or fault before the batteries are discharged. A low battery alarm is generated when the battery pack voltage drops below 3 volts and an alarm icon in the form of a triangle is generated on the LCD of the unit. A low battery fault is generated when the battery pack voltage drops below 2.7 Volts and a "CHANGE BATT" message appears on the LCD of the unit. The period of time between the Low Battery Alarm and the Low Battery Fault is approximately 90 days.

9.5.1 Battery Replacement

WARNING

Ensure properly licensed/trained professionals are used to install the battery if installed in hazardous locations containing explosive atmospheres. All local codes and standards shall be maintained during installation. Batteries SHALL BE:

- **Installed, put into service, used and maintained in compliance with national and local regulations and in accordance with the recommendations contained in the relevant standards concerning potentially explosive atmospheres.**
- **Installed by qualified and competent professionals who have undergone suitable training for instrumentation used in areas with potentially explosive atmospheres.**

1. Using a 1/8 Allen wrench, remove the 4 (#10-24) screws holding the cover in place as shown in Figure 9.28.

Figure 9.28 - Remove 4 screws on battery cover

2. Grab the battery and pull the pack outwards, as shown in Figure 9.29. The battery pack is held in position by three locating dowel pins.

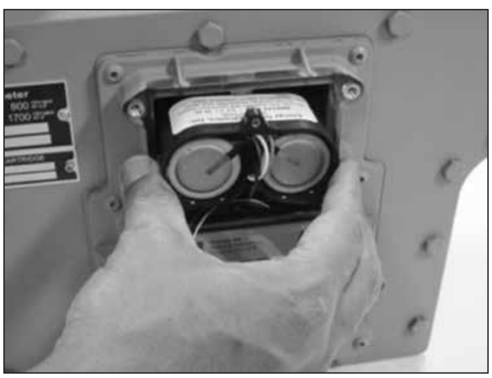


Figure 9.29 - Remove battery pack

3. Disconnect the wiring between the battery back and the main circuit board as shown in Figure 9.30.

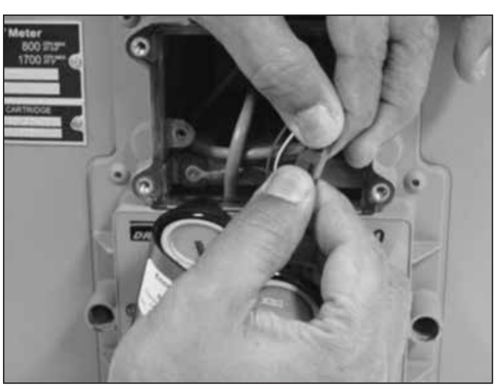


Figure 9.30 - Disconnect the wiring

4. Connect the main circuit wire to a new battery pack.
5. Insert the new battery pack into position, using the three dowel pins for proper alignment as shown in Figure 9.31. Push gently until the pack is in place.

Figure 9.31 - Battery pack in place

6. Place a new gasket (P/N 060309-000) onto battery cover and place the cover onto the electronics housing.
7. Insert the four screws into position and turn until touching the cover. Tighten in a cross-pattern to a maximum torque of 10-12 inch pounds.

9.6 Removing Meter From Service

WARNING

If for any reason the meter must be removed from service after pressurizing the meter, safety precautions must be strictly adhered to in accordance with established company and/or regulatory guidelines and procedures.

Slowly depressurize and vent all pressure from the meter set before working on the meter. Release pressure at a rate less than 5 psig/second.

9.7 Cartridge Cleaning and Replacement

9.7.1 Measurement Cartridge Removal

1. Remove the instrument from the meter. Refer to Section 9.4.1 for detailed instruction on removing the Instrument.
2. Use a ratchet with a 7/16" socket to remove the 16 bolts on the front of the meter as shown in Figure 9.32.

Figure 9.32 - Remove the 16 bolts

3. Use a 3/16 Allen wrench to remove the two remaining (1/4"-20) screws near the battery compartment as shown in Figure 9.33.

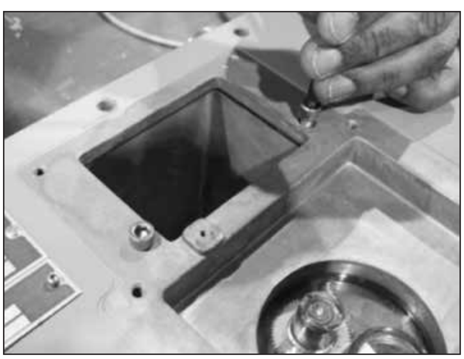


Figure 9.33 - Remove two (1/4"-20) screws

4. Once all the screws are removed, pull off the front enclosure as shown in Figures 9.34 & 9.35.

Figure 9.34 - Pull front enclosure off

Figure 9.35 - Front enclosure removed

5. Use a 1/8" Allen wrench to remove the 3 (#10-24) screws on the amber colored measurement cartridge end cover as shown in Figure 9.36.

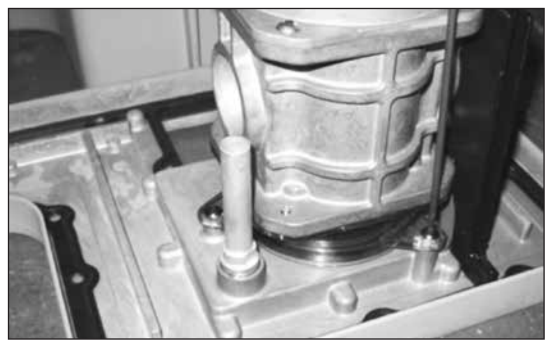


Figure 9.36 - Remove 3 (#10-24) screws

6. Use a 1/8" Allen wrench to remove the 4 (#10-24) screws on the main gasket as shown in Figure 9.37.

Figure 9.37 - Remove 4 (#10-24) screws on main gasket

7. Remove the cartridge and the black main gasket as shown in Figures 9.38 & 9.39. Discard the main gasket as a new gasket is always preferred to provide proper sealing.

Figure 9.38 - Remove Cartridge

Figure 9.39 - Remove main gasket

9.7.2 Cleaning and Flushing Measurement Cartridge

1. After removing the measurement cartridge, a suggested method for cleaning is to windmill the impellers at a speed less than maximum capacity while injecting low pressure, dry compressed air from a nozzle into the meter cartridge inlet. Spray a small of an approved non-toxic, non-flammable solvent through the meter cartridge.

WARNING

Keep hands and fingers clear of the rotating impellers and timing gears to avoid severe pinch point injuries.

Important: Use only a small amount of solvent for cleaning the meter cartridge. Large amounts of solvent will damage the meter bearings.

2. Use compressed air to completely dry the meter, being careful not to over-speed.

9.7.3 Measurement Cartridge Installation

WARNING

Torque all bolts and fasteners as specified. Under torquing or over-torquing may result in gas leakage due to improper sealing or damage to the meter pressure vessel.

1. Place front enclosure face down on the work bench. Place a new o-ring (P/N 000568-151) in the o-ring groove on the cartridge cover as shown in Figure 9.40 and align the new cartridge on the front enclosure as shown in Figure 9.41.

Figure 9.40 - Place O-ring on amber cartridge cover

Figure 9.41 - Proper alignment of measurement cartridge

2. Using a 1/8” Allen wrench, reinstall and snug the three #10-24 x ½” button head screws holding the measurement cartridge to the front enclosure as shown in Figure 9.42. Tighten the screws to 10-12 in lbs torque. Use a torque wrench when actually tightening the screws.

   Important: Press and hold the measurement cartridge firmly in place while tightening the screws to prevent the o-ring from moving. An unseated o-ring will cause a leak path. Also, by holding the measurement cartridge in place the load across the measurement cartridge end cover is more evenly distributed.

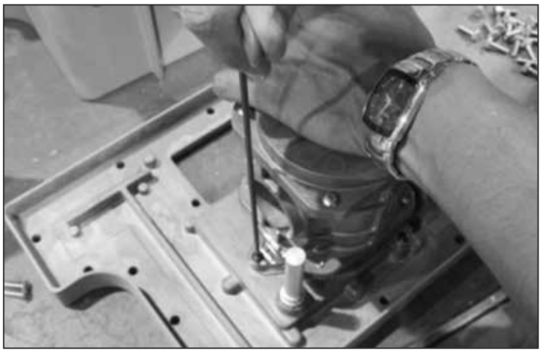


Figure 9.42 - Install new cartridge

Important: DO NOT over torque screws as this may cause damage to the amber colored measurement cartridge end cover.

3. Replace the main gasket with a new gasket (P/N 060133-000). Apply grease to the inside of the main gasket and then place the gasket on the rib next to the cartridge. Place the aluminum washer plate against the gasket as shown in the Figure 9.43. Using a 1/8" Allen wrench, tighten the #10-24 X1" screws to 10-12 in. lbs torque.

   Note: Before installing the screws, press the gasket on the top as shown in Figure 9.44 to compress the gasket onto the front enclosure and to help align the screw holes in the gasket with the mating holes on the measurement cartridge.

Figure 9.43 - Apply grease to gasket

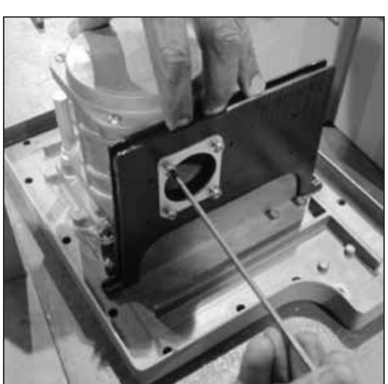


Figure 9.44 - Tighten (#10-24) screws

4. Apply grease to the outside rim of the rear enclosure as shown in Figure 9.45.

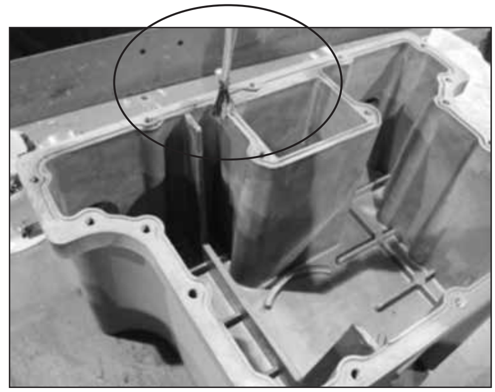


Figure 9.45 - Apply grease to rear enclosure

5. Place the new rubber flat gasket on the cover with the lip seated in the groove of the rear enclosure and apply more grease to the flat gasket as shown in Figure 9.46.

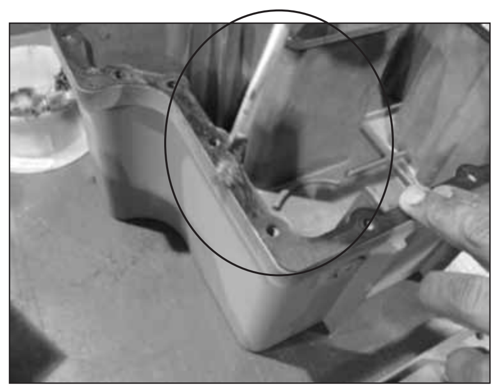


Figure 9.46 - Apply grease to back side of flat gasket

6. Place the front enclosure assembly by aligning the slots on gasket with ribs on rear enclosure as shown in Figures 9.47 & 9.48.

Figure 9.47 - Aligning gasket slots with ribs

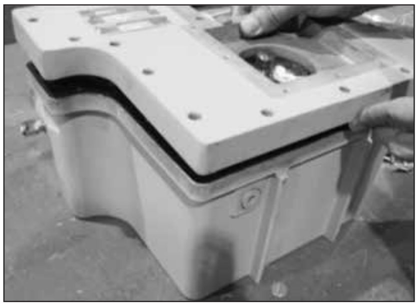


Figure 9.48 - Place front enclosure assembly onto rear assembly

7. Use a ratchet with 7/16" socket to tighten the 16 bolts. Tighten bolts on opposite sides of the meter to ensure an even distribution of load on the gasket. Finish tightening the bolts by using a torque wrench to verify 7-8 ft.lbs torque on each bolt.
8. Install two (2) ¼"-20 screws in the recessed area of the housing as shown in Figure 9.49. (Note: These bolts are covered by the Instrument Housing when the meter is fully assembled.) Use a 3/16" Allen wrench to tighten 7-8 ft. lbs torque.

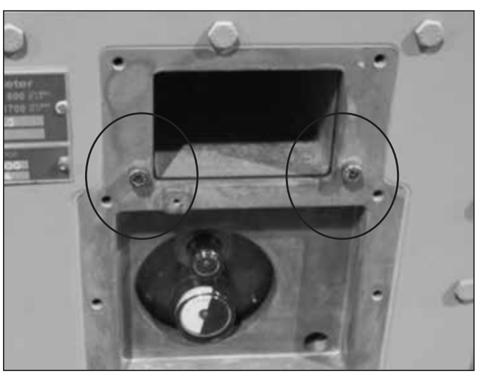


Figure 9.49 - Two front enclosure bolts are located under instrument housing

WARNING
Torque the cover bolts as specified. Under torquing or over-torquing may result in gas leakage due to improper sealing or damage to the meter pressure vessel.

9. Change the cartridge nameplate since cartridge is replaced. Please use a 3/32" Allen wrench to change out the nameplate. Refer to Figure 9.50. **Note:** On new meters, the cartridge badge is attached to the "ROOTS Meter" badge. The badge is scored so the "CARTRIDGE" portion of the badge will break off when bent.

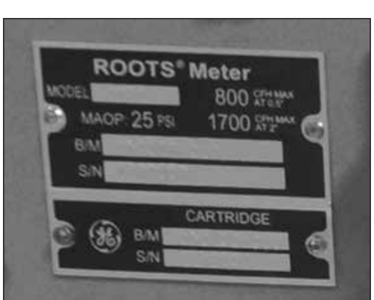


Figure 9.50 - Change cartridge nameplate

10. Refer to Section 9.4.2 to install the Instrument.
11. After the meter is reassembled, follow your company's authorized procedures or common industry practices to leak test the meter using either air or a dry inert gas. Soapy water, Snoop® or a leak test tank are commonly used for this procedure.

9.8 Cleanout Plug

Due to the design of the meter, the possibility exists for liquids or debris to collect in the meter housing. A cleanout is located at the bottom of the meter on the left hand side as shown in Figure 9.51.

WARNING
Shut off the gas supply to the meter and follow appropriate procedures to relieve the pressure from the meter set prior to removing the cleanout plug. Safety precautions must be strictly adhered to in accordance with established company and/or regulatory guidelines and procedures.

Slowly depressurize and vent all pressure from the meter set before working on the meter. Release pressure at a rate less than 5 psig/second.

Use a 1/4 inch hex wrench to remove the plug from the meter. After the liquids and/or debris are removed from the meter, inspect the o-ring on the clean out plug and replace if damaged. Reinstall the plug, torque to 8 foot pounds, pressurize the set according to proper start-up procedures and then check the plug for leaks.

WARNING
Torque the clean out plug as specified. Under torquing or over-torquing may result in gas leakage due to improper sealing or damage to the meter pressure vessel.

After the meter is pressurized, follow your company's authorized procedures or common industry practices to leak test the meter. Soapy water, Snoop® or gas analyzers are commonly used for this procedure.

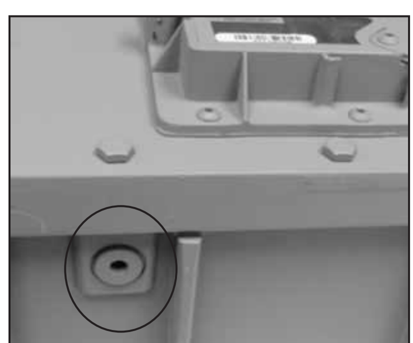


Figure 9.51 - Clean out plug on bottom of meter

10. Testing Procedures

The Series D meter is easily tested for accuracy using several industry accepted methods, including sonic nozzle, bell and transfer provers. A proving cable is available for testing the meter using the same IrDA (infrared) interface used for communication with the meter. The prover cable allows for rapidly testing Compensated and Non-Compensated accuracy on the Dresser Model 5 prover and the Elster American SNAP® Proving Systems. (Contact the factory for compatibility with other systems.) A black/white rpm wheel is also allows for testing the non-compensated accuracy using an optical scanner.

The Differential Rate Test is unique to rotary meters and is an accurate and convenient method of determining the meter's condition by comparing the meter's performance to previous or original performance records. Differential testing is accepted by many State regulatory agencies as a means of periodically substantiating the original accuracy of a meter has remained unchanged. The Series D meter provides upstream and downstream ports for differential testing as well as the capability of displaying the gas flow rate on the LCD screen.

Prover testing and differential testing procedures for the meter are outlined in the following segments.

10.1. Configure for Prove Mode

This section details how to configure the meter to go into the prover test mode. If you are able to scroll to a screen stating "PROV C.V" (for compensated testing) or to "PROV NC.V" (for non-compensated testing) the meter is already configured for prover testing.

If the meter is already configured for testing, the following steps are not necessary. Proceed to the next section.

1. Using the Dresser MeterWare software, go to the **Configuration** screen (Figure 10.1), and select **Customize LCD**, which will open the **LCD Settings** screen.

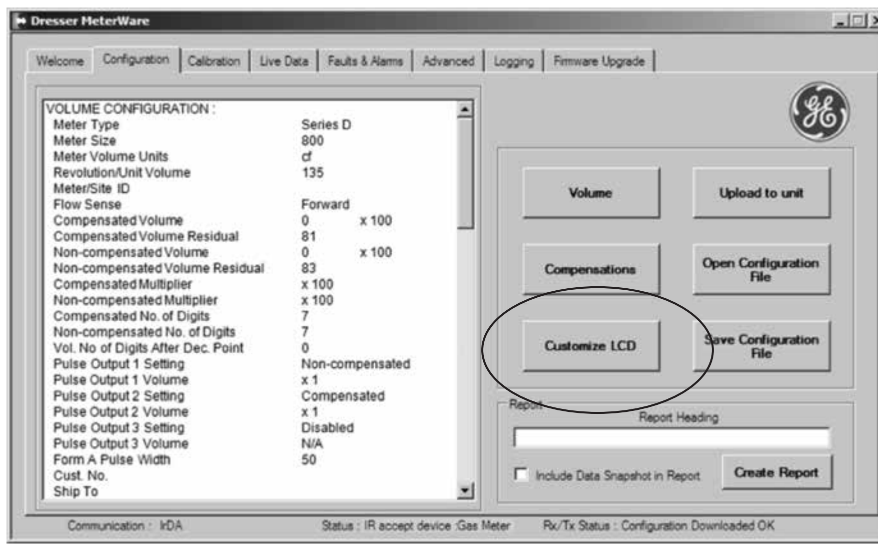


Figure 10.1 - Configuration screen in Dresser MeterWare

2. From the **LCD Settings** screen (Figure 10.2), choose either **Compensated Prove Mode** or **Non Compensated Prove Mode,** or both, and then select OK to return to the **Configuration** screen.

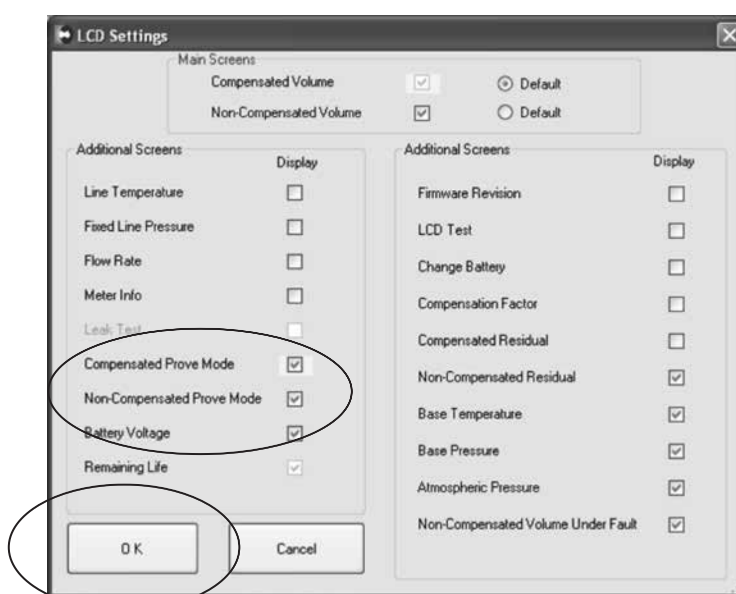


Figure 10.2 - LCD Settings screen in Dresser MeterWare

SNAP® is a registered trademark of Elster American Meter.

3. Once back on the Configuration screen (Figure 10.3), select Upload to unit.

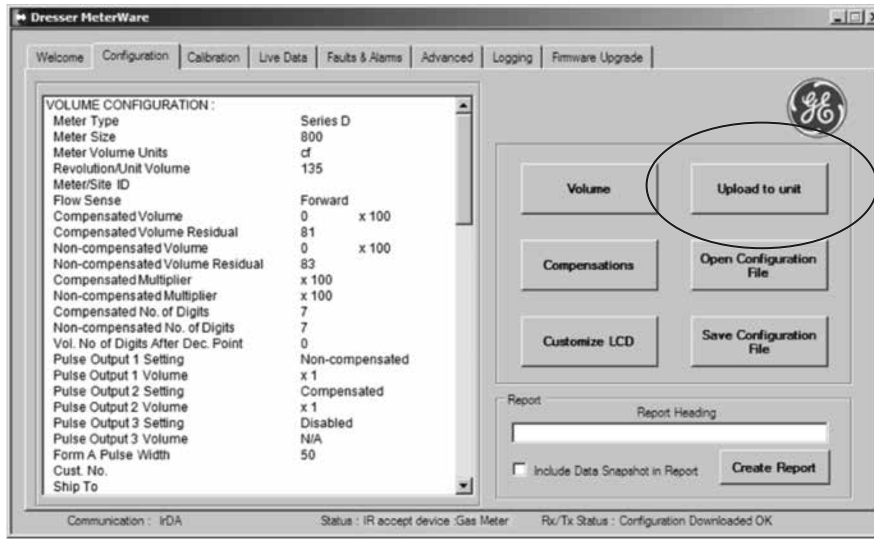


Figure 10.3 - Configuration screen in Dresser MeterWare

4. The chosen prove mode can then be selected on the LCD screen display of the meter.

10.2. Placing into Compensated Prove Mode

1. Using the magnet, swipe across the black dot, which is to the right of the LCD display screen, until the screen displays PROV C.V (Figure 10.4), and then stop swiping.

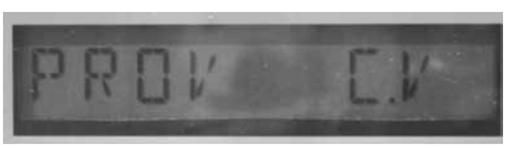


Figure 10.4 - LCD screen displays **PROV C.V**

2. After five seconds, the display will change to PROVE I.C.V (Figure 10.5).

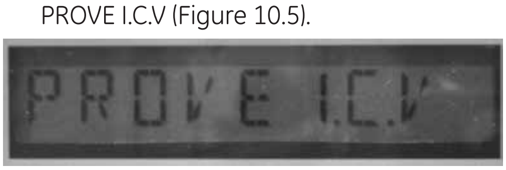


Figure 10.5 - LCD screen changes to **PROVE I.C.V**

3. Hold the magnet for about five seconds on the black dot until the display changes to **PRVE_CO.R** (Figure 10.6).

   The meter is now ready to be proved using the compensated volume output.

Figure 10.6 LCD screen changes to **PRVE CO.R**

4. Exit Prove Mode by holding the magnet on the black dot for five seconds.

10.3 Placing into Non-Compensated Prove Mode

1. Swipe the magnet across the black dot until the screen displays **PROV NC.V** (Figure 10.7), and then stop swiping.

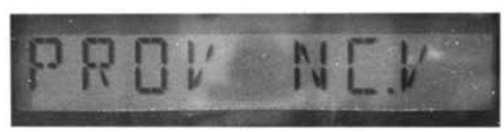


Figure 10.7 - LCD screen changes to **PROV NC.V**

2. After five seconds, the display will change to **PROVE I.U.V** (Figure 10.8).

Figure 10.8 - LCD screen changes to **PROVE I.U.V**

3. Hold the magnet for about five seconds on the black dot until the display changes to **PRVE_NC.V** (Figure 10.9).

   The meter is now ready to be proved using the non-compensated volume output.

Figure 10.9 - LCD screen changes to **PRVE_NC.V**

4. Exit Prove Mode by holding the magnet on the black dot for five seconds.

10.4 Proving with the Elster American SNAP Prover

10.4.1 Configuring SNAP Series II and II Version with Legacy Software Platforms

1. The first step of the process is to create a meter test file in the prover. In order to do this you need to log into the system as a supervisor.
2. Once logged in as a supervisor you then click on "PROVE METER", then click on "SELECT METER TYPE", then click on the "OTHER" for the manufacturer. Click on any one of the meters that are listed on the "OTHER" manufacturer category and click on the "CHANGE SPECS" and then click on the "ADD METER" button. This will clear all of the areas or change them to zeros.
3. Every box needs to be filled in with data, remember to click the "ENTER" button after each input to save the data in each box. The following list is an example of the type of data listed in each field.

Meter Name:	D800	D1000
Proof Open:	100	100
Proof Check:	100	100
Proof Other:	100	100
Rate Open:	800	1000
Rate Check:	80	100
Rate Other:	400	500
Revs Open:	4	4
Revs Check:	2	2
Revs Other:	3	3
Exercise Revs:	2	2
Jog Rate:	100	100
Revs/Unit Volume:	1	1
Max Diff Set Point:	0.5	0.5
Tolerances Pos:	1	1
Tolerances NEG:	-1	-1
Slope:	1	1
Repair:	2	2
Meter Size:	S	S

4. Once every field is updated with the correct data, click on "SAVE SPECS," you should see the caption "SPECS SAVED" in the blue caption box. If this did not auto fill the meter file was not saved. Retry until the meter test file is saved.
5. When you exit the test setup screen, you should see the meter test file in the "OTHER" manufacturer category. After you verify the meter test is added, install the meter on the test bench. (Refer to Section 10.4.3)
6. Exit out to the test screen and then continue the normal process for running a test. Refer to Section 10.4.4 for more information on running a test.

   Note: on SNAP Series II Provers, the Series D meters must be tested using a Large Meter Kit for flows greater than 500cfh.

10.4.2 Configuring SNAP Series II and II Version with MMX Software Platforms

1. The first step of the process is to create a meter test file in the prover. In order to do this you need to log into the system as a supervisor.
2. From the main screen click on "SPECIAL FUNCTIONS", then click the "EDIT CONFIG FILES" button. Next click the "EDIT METER FILE" button. Make sure you are in the "Other" category in the "Mfr Type" area on the upper part of the screen.
3. Click on "ADD METER" and fill in the areas. Every box requires data. The MMX prover leaves information in each box, so change the areas requiring updates.

   NOTE: You will need to hit the "ENTER" button every time a new value is input. The following list is an example of the type of data listed in each field.

Meter Name:	D800	D1000
Proof Open:	100	100
Proof Check:	100	100
Proof Other:	100	100
Rate Open:	800	1000
Rate Check:	80	100
Rate Other:	400	500
Revs Open:	4	4
Revs Check:	2	2
Revs Other:	3	3
Exercise Revs:	2	2
Jog Rate:	100	100
Revs/Unit Volume:	1	1
Max Diff Set Point:	0.5	0.5
Tolerances Pos:	1	1
Tolerances NEG:	-1	-1
Slope:	1	1
Repair:	2	2
Meter Size:	S	S

4. Once the fields on this screen are updated, click on "SAVE SPECS," you should see the caption "SPECS SAVED" in the blue caption box. If this did not auto fill the meter file was not saved. Retry until the meter test file is saved.

5. Install the meter on the test bench. (Refer to Section 10.4.3)
6. Exit out to the test screen and then continue the normal process for running a test. Refer to Section 10.4.4 for more information on running a test.

   NOTE: on SNAP Series II Provers, the Series D meters must be tested using a Large Meter Kit for flows greater than 500cfh.

10.4.3. Installation of Meter On Bench

1. Install the meter on the prover table and adjust the meter arms to fit the appropriate height and width of the meter as shown in Figure 10.10. On the Series III prover, extensions are required for the meter connections due to shorter height of the meter. Utilize the correct meter connections per what is installed on the meter. (Example: If you ordered 45LT connections on the meter use the 45LT swivels on the prover.)

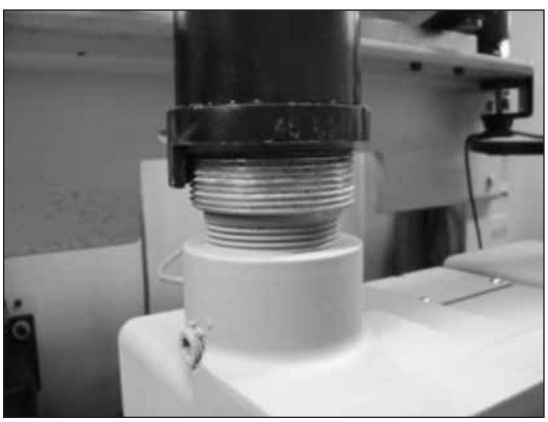


Figure 10.10 - SNAP connections properly fitted to meter

2. Install the "optic" IrDA test cable to the meter and the prover as shown in Figure 10.11. The black box should slide into the adapter for the IrDA slot on the bottom of the electronic index for the meter.

Figure 10.11 - IrDA Proving cable installed on meter

3. Once the cable is connected to the meter the other end is connected to the optical outlet port (J4) on the prover as shown in Figure 10.12. This is a keyed 9 pin connector which can only install in one orientation.

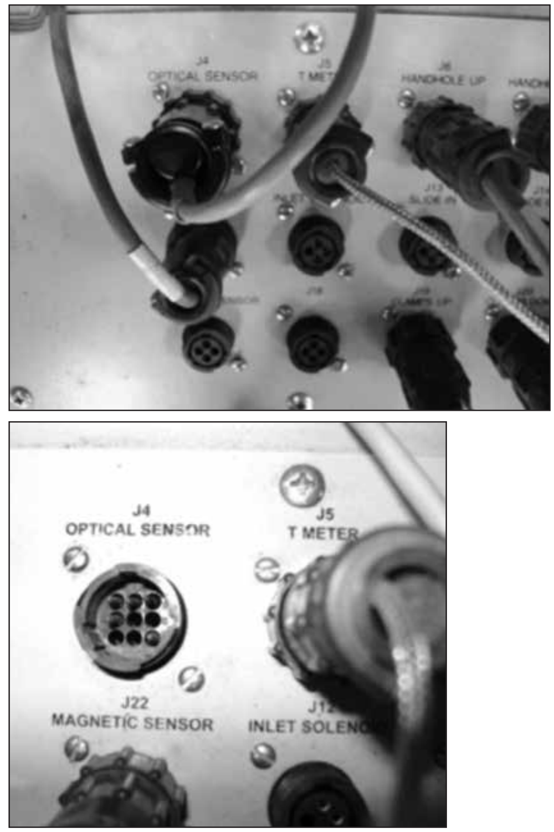


Figure 10.12 - Optical sensor port (J4) with and without the connector.

Note: If you just set up the "D800/D1000" meter test and exited you should see the "METER" area in the center of the screen that stated that the test is for the "D800/ D1000". If you were testing another meter prior to the D800/D1000 then you will need to click on "SELECT METER TYPE" and the click on the "OTHER" button and then click on the "D800/D1000" meter, then click "EXIT" and now you should see "D800/D1000" in the "METER" area.

10.4.4 Testing Modes

The following sections explain the testing modes for the meter. The meter provides the capability to test both the compensated and non-compensated accuracy with the IrDA prover cable.

10.4.4.1 Testing Compensated Accuracy

1. If testing the compensated accuracy of the meter the following steps need to be completed:

   TC

   %PROOF, % ERROR or % ACCY – depending on company standards

   INTEST or OUTTEST – depending on how the company tests

   ENGLISH

   Either 2-RATE or 3-RATE

   OPTIC

   INDEX 1
2. Once each of the fields is set then you need to fill in the required screens on the left side of the prover display screen to enable the "PRESS CLAMP BUTTONS" button. Click on the "PRESS CLAMP BUTTONS" button to start the tests. You will need to press both clamp buttons at the same time to lower the arms to the meter.
3. Place the meter into the Compensated Prove mode. (Refer to Section 10.2 for information assistance.) Once the meter goes into prove mode the red light will switch from a flashing red light to a solid red light as shown in Figure 10.13. Now the meter test will start.

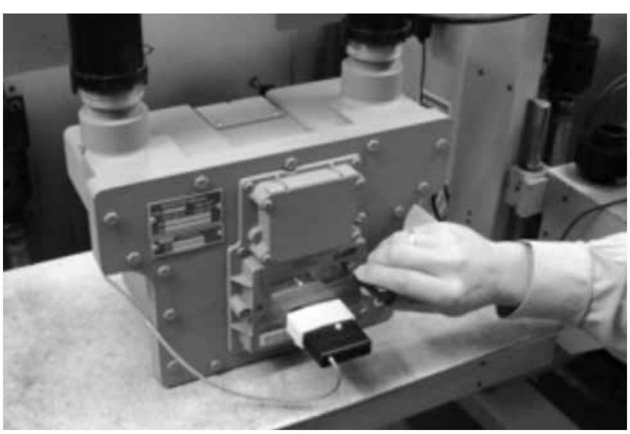


Figure 10.13 - Light on IrDA cable indicates connection is established

4. Once the meter tests are complete you can press the "ACCEPT" button and the meter test will be saved.

10.4.4.2 Testing Non-Compensated Accuracy

1. If you are testing the non-compensated accuracy the center buttons will need to say:

   REG

   %PROOF, % ERROR or % ACCY – depending on company standards

   INTEST or OUTTEST – depending on how the company tests

   ENGLISH

   Either 2-RATE or 3-RATE

   OPTIC

   INDEX 1
2. Once each of the fields is set then you need to fill in the required screens on the left side of the prover display screen to enable the "PRESS CLAMP BUTTONS" button. Click on the "PRESS CLAMP BUTTONS" button to start the tests. You will need to press both clamp buttons at the same time to lower the arms to the meter.
3. Place the meter into the Non-Compensated Prove mode. (Refer to Section 10.3 for information assistance.) Once the meter goes into prove mode the red light will switch from a flashing red light to a solid red light as shown in Figure 10.14. Now the meter test will start.

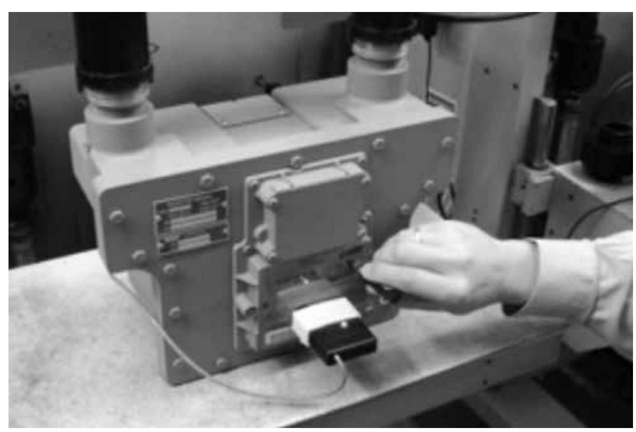


Figure 10.14 - Light on IrDA cable indicates connection is established

4. Once the meter tests are complete you can press the "ACCEPT" button and the meter test will be saved.

10.5 Proving with Dresser Model 5 Transfer Prover

10.5.1 Establish IrDA Cable Connection

A. Insert the IR prover cable holder in the open slot under the meter label, as shown in Figure 10.15.

B. Attach the cable connector of the IrDA to the ID Pulser connection port on the Prover field meter junction box, as shown in Figure 10.16.

C. Turn on the power switch of the Model 5 Prover, and wait for light on the IrDA to turn on and start flashing.

D. Once the meter is put into "Prove Mode," the flashing light changes to a solid light, as shown in Figure 10.17.

Figure 10.15 - IrDA adapter placed into slot

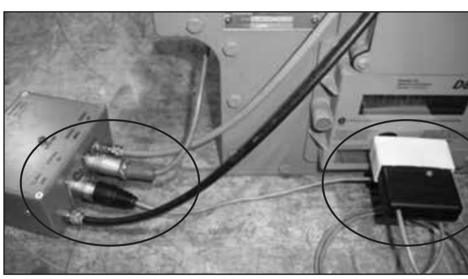


Figure 10.16 - Connect IrDA to the meter and Model 5 Prover

Figure 10.17 - Light indicating connection established

10.5.2. Model 5 Prover Software Configuration

The Model 5 Prover software must be set up as circled on the left side of the screen shot in Figure 10.18. The TC options box must also be set for Diaphragm TC for all meter sizes, as circled in Figure 10.18. For reference, the values for the prover configuration are explained in Section 10.5.3.

Note: The recommended pulses per test and test volume are shown in Table 1 according to meter capacity. Using the shown values will allow for a test lasting a minimum of the factory recommended 30 seconds. If your Model 5 Prover is not equipped with a 2M master meter, you will not be able to test below 100 cfh. If this is the case, the minimum flow rate for testing a meter rated at 800cfh is 100cfh. Still use a minimum of 2 pulses with a minimum test volume of 2 cubic feet.

Click start and the prover test will begin to run.

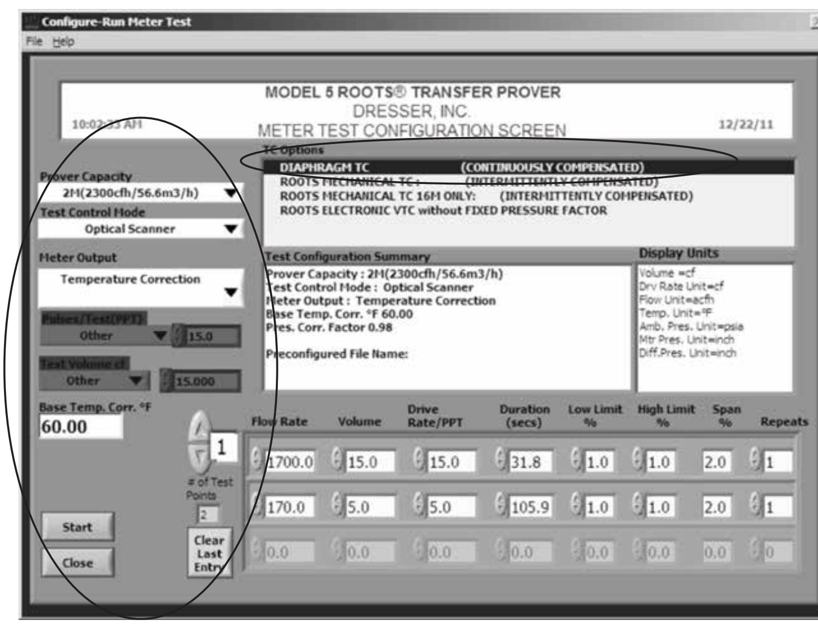


Figure 10.18 - Prover Configuration screen for Model 5 Prover software

Table 1- Recommended prover configuration settings based on meter size

Meter Differential	Flow Rate (% of Maximum Flow Rate			
	100%		10%	
	Min. # of Pulses	Min Test Volume	Min. # of Pulses	Min. Test Volume
1/2" w.c (0-800CFH) (0-1000CFH)	10	10	2	2
2" w.c. (0-1700CFH)	15	15	5	5

10.5.3 Explanation of Prover Configuration Screen

10.5.3.1. Left Side of Prover Configuration Screen

- Prover Capacity: Select "10M (10,000cfh/283.2 m3)" for flow rates above 100 cfh. For flow rates between under 35 cfh and 100 cfh, select the "2M (2,300cfh/65.1 m3)" master meter if the prover is equipped with this option. This will allow for testing a meter rated at ½" w.c. at 10% capacity (80 CFH)
- Test Control Mode: Select "Optical Scanner"
- Meter Output: Select "Temperature Correction"
- Pulses/Test (PPT): Select "Other". Also select the pulses per test based on Table 1. This information is entered in the small box attached to the right of the "Pulses/ Test" box.
- Test Volume cf: Select "Other". In the small box on the right, enter the same number as the value input in the "Pulses/Test (PPT)". This is necessary since one pulse = 1 cf.

10.5.3.2. Top Right side of Prover Configuration Screen

- TC Options: Select "Diaphragm TC (Continuously Compensated)

10.5.3.3. Bottom Portion of Prover Configuration Screen

- Flow Rate: Enter the desired flow rate for the first test.

  Note: The "Volume" and "Drive Rate/PPT" and other boxes will automatically populate based on the information provided on the left side for the Prover Configuration Screen.

10.5.4 Adding Test Points

- Flow Rate: To add additional test points, enter the desired flow rate in the next available box in the "Flow Rate" column.
- Volume: Enter the desired test volume. Suggested values are provided in Table 1.
- Drive Rate/PPT: As stated previously, the drive rate will always match the volume.
- The remaining boxes in the row will auto populate based on the current prover default settings.
- Start this process again to continue adding additional test points. Always start with the highest flow rate and progress downward to the lowest flow rate.

  Note: When entering values, always move to the next box by either hitting "Enter" or using the cursor. Using "Tab" will cause errors in the test configuration.

  Note: Contact factory to request pre-configured test files if preferred.

11. Differential Testing

Only a change in the internal resistance of a meter can affect its accuracy. Any increase in the resistance to flow will increase the pressure drop between the inlet and outlet of the meter, thus increasing the differential pressure drop. This is why the meter differential pressure drop appears as a prime indicator of meter condition.

Although accuracy is not directly determined by a differential test, testing has shown that an increase of up to 50 percent in the differential pressure, at the higher flow rates (25% and above), can be tolerated without affecting meter accuracy by more than 1 percent. Supportive technical data is available upon request.

Figure 11.1 - Differential pressure taps are located on the inlet and outlet connectors

11.1 Establishing Baseline Curves

Developing an original differential baseline curve is recommended when the meter is first installed. Since any change in flow rate, line pressure or specific gravity will cause a change 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 11.2, the resulting 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.

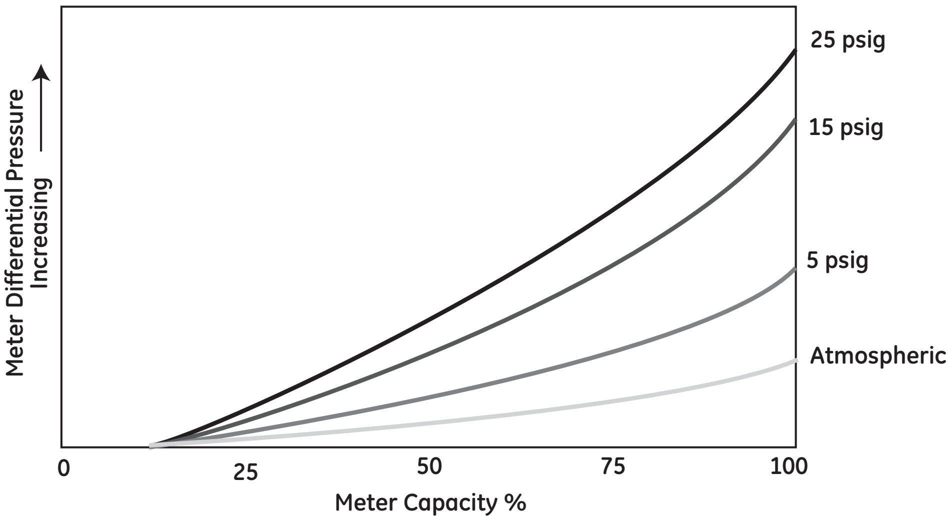


Figure 11.12 - Differential Curves change as pressure increases

To help with record keeping, a data chart like the one shown in Figure 11.3 will allow the technician to compare new test data to older data. A test under actual operating conditions will provide the most reliable data for future checks of a meter's operating condition. This is particularly important when the line pressure is higher than 15 PSIG (200 kPa Absolute). Since meter differential pressure increases with line pressure, multiple curves may be necessary for meters under varying line pressure conditions.

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 11.3 - Having a single data chart fo each meter provides detailed history of differential rate tests for future use

11.2 Differential Test Procedure

Testing requires differential pressure test equipment with an indicating scale range of at least 20 inches of water column. The testing device should have bypass valving and must be pressure rated for the maximum metering line pressure for the test. Pressure lines should be connected to the 1/4" meter inlet and outlet pressure taps located on the meter body as shown in Figure 11.1. Differential test plugs can be permanently installed in the pressure taps to facilitate testing. A pressure gauge is also recommended to verify pressure readings.

The meter is able to display the flow rate when the meter is operating at a fairly steady rate of flow. (Refer to Section 8.3 regarding the Flow Rate display.)

WARNING

When the meter is pressurized, follow applicable safety rules and use appropriate personal protective equipment.

1. Install the pressure differential test equipment 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 already a part of the test equipment.
2. If possible, use the meter set valve(s) to adjust the flow rate in the lower capacity range or no less than 25 percent of the meter's rated capacity. Let the flow rate stabilize.
3. Use a magnet to scroll the LCD display to "FLOW RATE". The screen will display the calculated flow rate after approximately 5 seconds. Convert the calculated flow rate to a percentage of meter rated capacity

   % Meter Capacity = FLOW RATE x 100

   (Base Rating)

   Note: The base rating is determined using the meter rating of 800 acfh at 0.5" w.c. or 1700 acfh @ 2.0" w.c.
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 - 4 at a minimum of three different flow rates, each between 25% and 100% of meter capacity. An 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 this is for the baseline curve, plot and save the curve for future reference. If this is a subsequent test and the pressure differential compares against the baseline curve within acceptable limits, return the meter to full service. If the pressure differential is not within acceptable limits or has increased by 50% above the values on the baseline curve, remove the meter for inspection and if needed, for service.

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. If the differential pressure increases by more than 50 percent above the original value, then inspect the meter for causes for resistance. The usual causes are binding impellers, worn bearings, or contaminates such as dirt or valve grease in the metering chamber.

For Factory repairs and/or inspection, please call your Customer Service Representative or your Dresser meter supplier to request a Return Material Authorization (RMA).

12. Upgrading Instrument Firmware

Using the Dresser MeterWare software and the IrDA cable assembly, which is part of the communications kit, you have the option to upgrade current firmware revision to newer revision levels.

Note: The IrDA cable assembly must be held firmly in place when attempting to upgrade firmware revision levels. If the upgrade is interrupted while in process, the firmware in the unit will be corrupted, and the unit will need to be returned to the factory for reprogramming.

12.1 Attaching IrDA cable

Refer to Figure 12.1 for the proper placement of the IrDA cable for the meter.

Figure 12.1 - Proper Installation of IrDA cable to the meter

12.2 Establishing Communication

1. From the Welcome Screen in the MeterWare software, select the **Firmware Upgrade** tab refer to Figure 12.2.

Figure 12.2 - Firmware Upgrade Tab

2. From the next screen, click Select File. Refer to Figure 12.3.

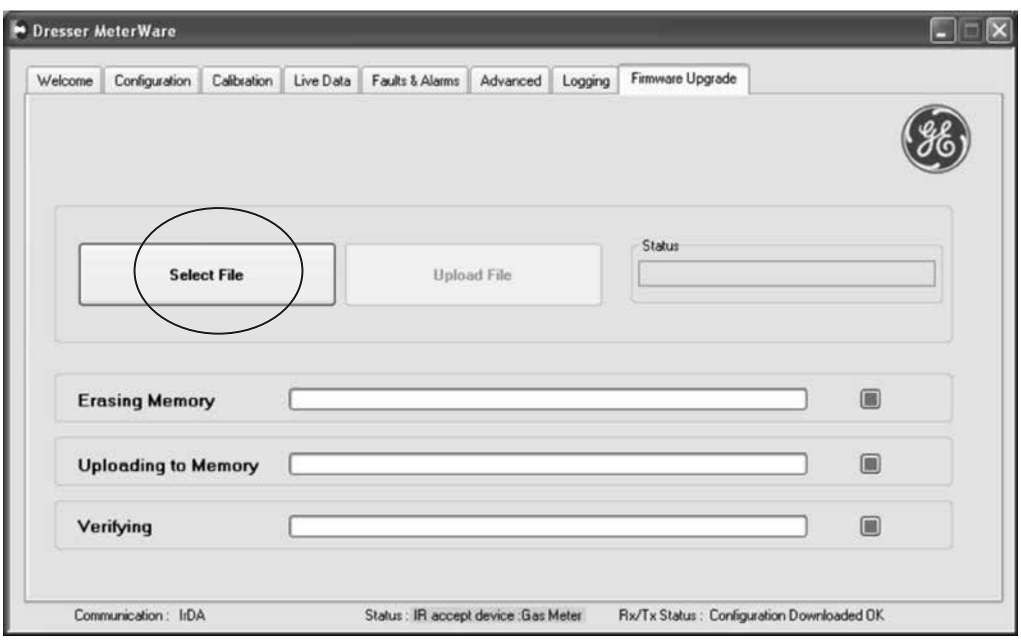


Figure 12.3 - Firmware Upgrade Screen

3. From the Open screen, select the appropriate firmware upgrade file ending in ".hex," which in this example is "SW-0294-U3-1.67a.hex." Refer to Figure 12.4.

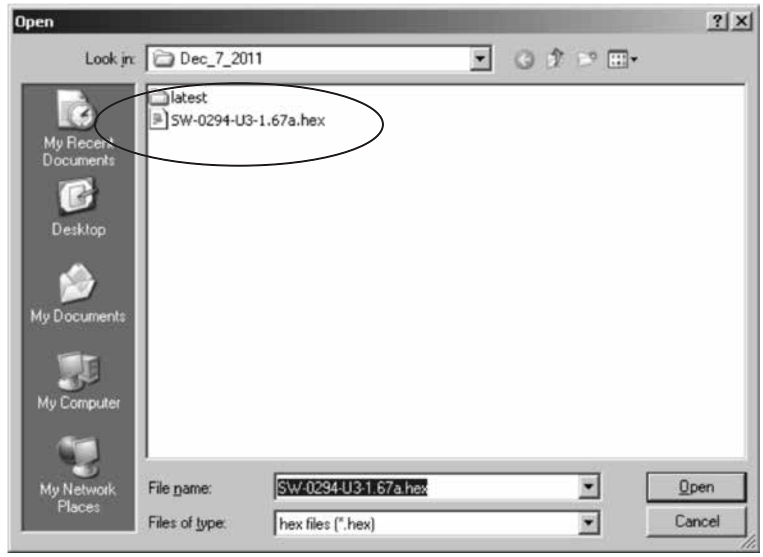


Figure 12.4 - Select the .hex file

4. The **Enter Password** screen will open, prompting for a password. Refer to Figure 12.5.

   The password is the **Advanced** password. The Advanced password is a numeric only password. The default advanced password is the number zero (0). If this password is changed by the user, the user should make note of the new password and keep this in a safe place.

Figure 12.5 - Enter the Advanced Password

5. Select **OK** and the firmware upgrade will begin.
6. In the **Status** box on the Firmware Upgrade screen, the message **In Progress** will appear. Refer to Figure 12.6.

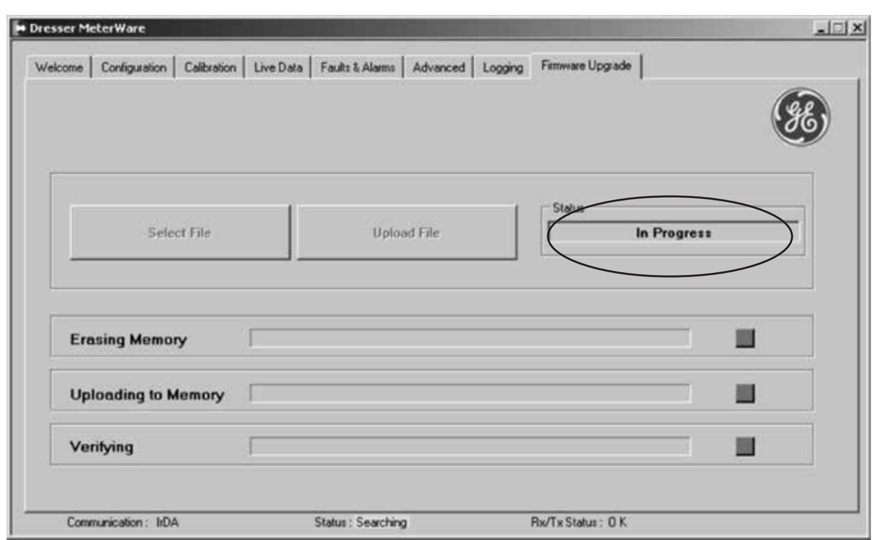


Figure 12.6 - MeterWare software showing In Progress status

7. The software also begins to search for the **BootLoader,** which is necessary to upgrade the firmware. Refer to Figure 12.7.

   The **Status** area at the bottom of the screen shows progress locating the BootLoader, moving from **Searching** to a yellow highlighted message when the device is in range and a green highlighted messaged when located.
8. Once communication is fully established, the firmware upgrade begins.

Figure 12.7 - Device in Range: BootLoader

12.3 Firmware Upgrade Process

1. There are three status bars, which will move across the screen as each of the three steps is completed. Refer to Figure 12.8.
   - Erasing Memory: the current firmware in the unit must be erased.
   - Uploading to Memory: once the previous firmware is erased, the unit is ready to accept the new firmware and begins the process.
   - Verifying: confirms that the new firmware has been uploaded properly
2. The square to the right of a particular function will change from red to green, confirming that a particular step in the firmware upgrade process has been completed, and the function can move to the next step.
3. When the firmware upgrade is complete, the three squares are green and the screen displays the message **Firmware updated successfully.** Refer to Figure 12.9.

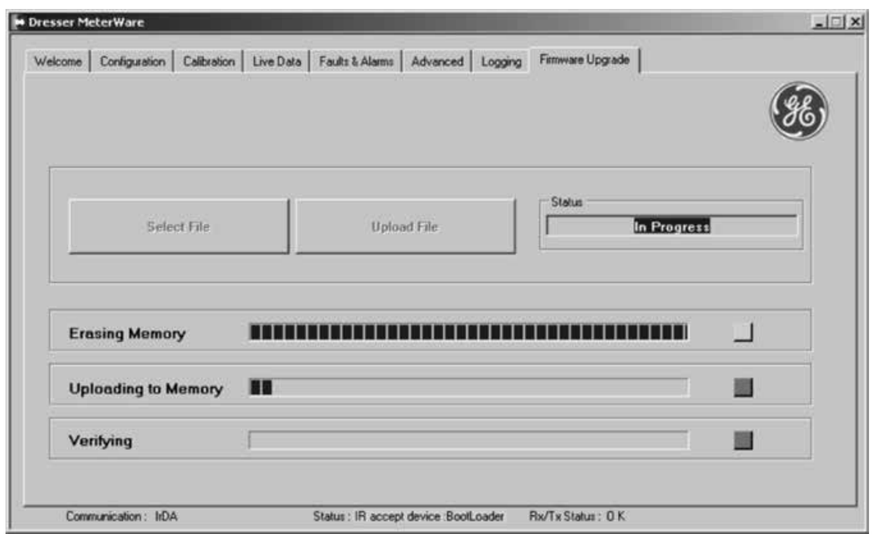


Figure 12.8 - Progression of three steps for uploading the new firmware to the unit

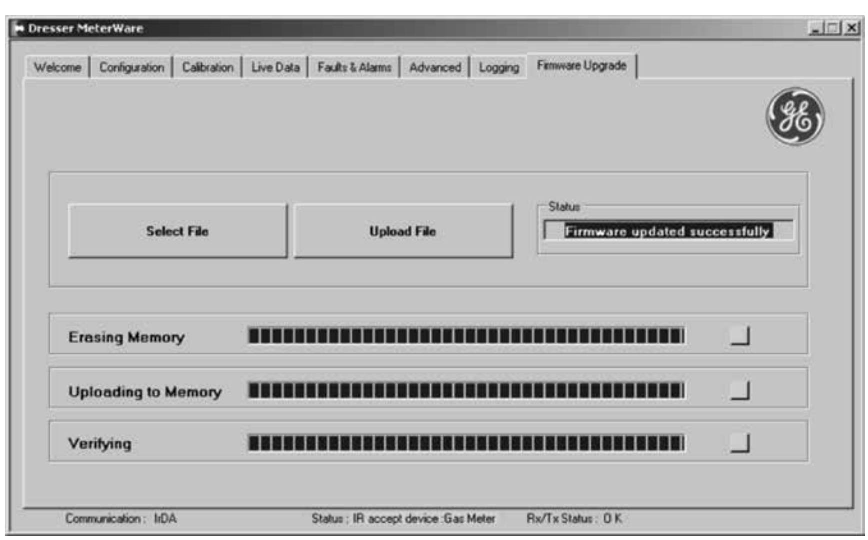


Figure 12.9 - Firmware upgrade is complete.

13. Specifications

Physical:

- Overall Dimensions: 14-3/4" X 12" X 8"
- Net Weight: 24 lb
- Connection Configuration: Top in /Top out, 11" center to center
- Connections: 30 LT/45 LT/#3, #4 Sprague, #5 Sprague/1-1/2" FNPT
- MAOP: 25 PSIG
- Operating Temperature Range: -40 to 140°F (-40 to 60°C)
- Gas Application: Clean, Non-Corrosive Dry Gas

Display:

- Display Type – LCD with 10mm digits
- Capacity Registration – 5, 6, 7, or 8 digit
- Screens – 20 (user selectable)
- Screen scrolling – magnetic switch

Temperature Measurement System (Electronic Index):

- Extremely stable Class A, PT1000 RTD
- Range: -40 to 140°F (-40 to 60°C)
- Total Ambient temperature effect: Less than 0.1°F (0.05°C) over entire temperature range
- Pressure Compensation: Programmable Fixed Factor

Temperature Accuracy:

Table 1: Temperature measurement accuracy over the temperature measurement range

Temperature Range	Measurement Accuracy
-40 to 32° F (-40 to 0° C)	+/- 0.4 ° F (+/- 0.2° C)
32 to 140° F (0 to 60° C)	+/- 0.5 ° F (+/- 0.3° C)

Computational Accuracy:

- Computation: +/- .25% of compensated volume reading

Data Logging:

- Data Logging – 150 days of hourly logs
- Logged Data – Time Stamp, Compensated Volume, Non Compensated Volume, Line Temperature, Battery voltage, Faults and Alarms
- Audit Trail – Parameter, Time Stamp, Old Value and New Value
- Data exportable to Microsoft® Excel®

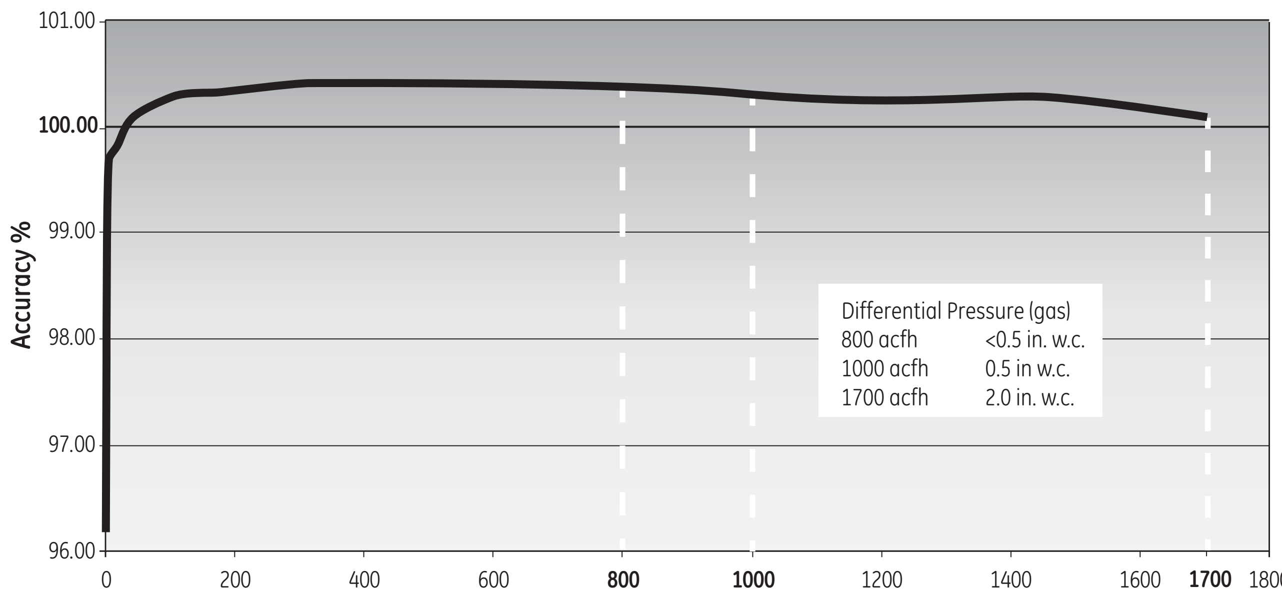
Power:

- Battery Pack – Lithium Thionyl Chloride Pack with protective circuitry
- Voltage Range: 3.0 -3.7 V DC
- Nominal Battery Life – 20 years
- Battery Access- Field Replaceable
- Battery life remaining indicated in months
- Flash memory for permanent information retention without power

Meter Performance:

Low Flow Performance	
Accuracy	
0.30 CFH (start rate)	
1 CFH	90%
2 CFH	95%
5 CFH	98%
8 CFH	99%
12 CFH	100%

Rangeability			
Range	800 CFH	1000 CFH	1700 CFH
1%	100:1	125;1	212:1
2%	160:1	200:1	340:1
3%	266:1	333:1	566:1



NOTE: The performance data shown is averaged and is indicative of meter performance. Individual meter characteristics may vary.

Testing:

- Proof verification:
  - Compatible with most sonic nozzle provers using IrDA or pulse output or Black and White flag.
  - Black/White RPM wheel for flow detection and testing Uncorrected proving on most provers.
  - Model 5 Prover compatibility using IrDA interface / prover interface box / Black and White flag. Two (2) minute proving with a Model 5

Communication:

(Optical reading port requires optical probe and Dresser MeterWare software (data downloads, programming, Firmware upgrades))

- Pulse Type: two user-selectable Form A Outputs
- Output Representation: Compensated, Non-Compensated, Fault or Disabled
- Pulse Rate: User Scalable (x 1, x 10, x 100 or x 1000 cu. ft)
- Pulse Duration: User Scalable (50, 150 or 250 ms)
- AMR type: Any Form A pulse collector such as Itron ERT
- Dedicated Fault Output: Form B (500 ms pulse duration)
- Isolated Outputs
- Max Input Voltage: 8.2V

Flow Selection:

- Forward, Reverse, Forward – Reverse, Reverse – Forward, Forward + Reverse

Alarms:

- High/Low Temperature
- High Flow
- Low Battery

Faults:

- Temperature
- Volume
- Low Battery
- Internal Operation

Regulatory Standards:

- B109.2, B109.3, LMB-EG-09E
- OIML, MID, EN1359
- EN 60529 for degrees of protection
- EN 61000-6.1, 2, 3, 4
- Safety approvals: CSA C22.2 No 213 Class 1 Div 1 Group A, B, C, D
- Metrology Approvals: Measurement Canada Approval AG-0514

14. Meter Capacity

Sizing of the Series D meter is unlike that of a diaphragm meter as capacity is not affected by specific gravity.

Operating Pressure			Base Rating (cfh)			Base Rating (m^3/h)		
			800	1000	1700	22,7	28,3	48,1
psig	kpa	bar	Corrected Capacity (scfh)			Corrected Capacity (Nm^3/h)		
0.25	1.7	0.02	800	1000	1700	22,7	28,3	48,1
1	6.9	0.07	836	1045	1777	23,7	29,6	50,3
3	20.7	0.21	945	1181	2008	26,8	33,4	56,8
5	34.5	0.34	1054	1317	2239	29,9	37,3	63,3
10	68.9	0.69	1325	1656	2816	37,6	46,9	79,7
15	103.4	1.03	1597	1996	3393	45,3	56,5	96,0
20	137.9	1.38	1868	2335	3970	53,0	66,1	112,3
25	172.4	1.72	2140	2675	4547	60,7	75,7	128,7

15. Warranty

Contact factory for the latest revision of Terms and Conditions for Sale of Products and Services Form ES 104.

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).

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