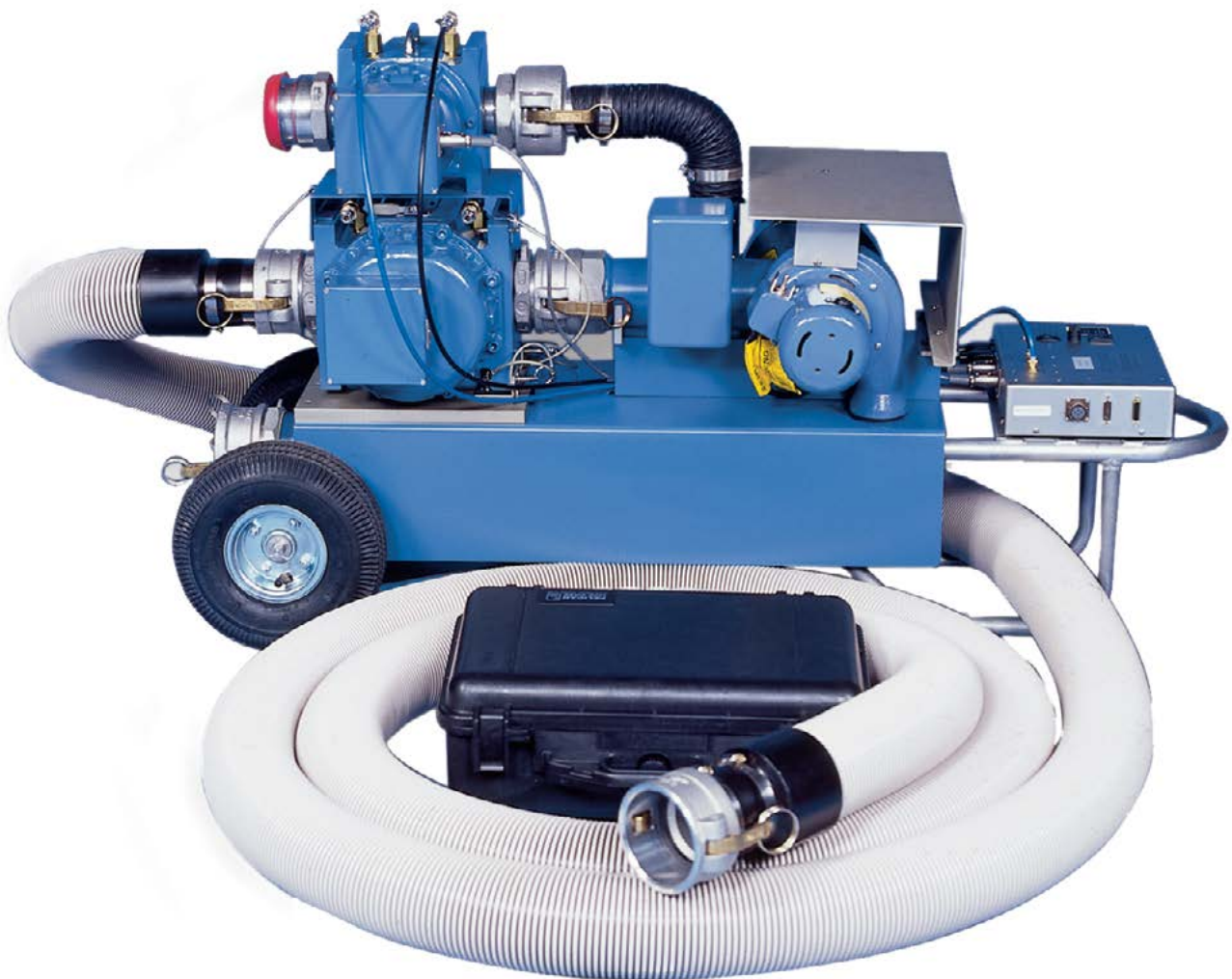


Dresser Meters & Instruments Model 5 Transfer Prover

Hardware Manual

For 2/10M, 10M, and 5M/20M Versions



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List of Symbols Used in This Manual



DANGER indicates a imminently hazardous situation, which, if not avoided, will result in death or serious injury.

DANGER : Indique une situation de danger imminente qui, si elle n'est pas évitée, entraînera des blessures graves ou même la mort.



WARNING indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

AVERTISSEMENT : Indique une situation de danger potentielle qui, si elle n'est pas évitée, peut entraîner des blessures graves ou même la mort.



CAUTION indicates a potentially hazardous situation, which, if not avoided, could result in minor or moderate injury.

MISE EN GARDE : Indique une situation de danger potentielle qui, si elle n'est pas évitée, peut entraîner des blessures mineures ou modérées.

Clarification of a procedure.

CERTIFIED TO:

UL 508 STANDARD FOR SAFETY FOR INDUSTRIAL CONTROL EQUIPMENT.

CSA 22.2 #14 INDUSTRIAL CONTROL EQUIPMENT

1. Introduction

1.1 Receiving and Inspection at time of delivery:

1. Check the packing list to account for all items received.
2. Inspect the shipping container for damage. Record any visible damage or shortages on the delivery record.
3. File a claim with the carrier.
4. Notify your Prover supplier immediately.

DANGER

Do not accept any shipment with evidence of mishandling without making an immediate inspection for damage prior to signing the carrier's delivery record. Do not attempt repairs or adjustments, as doing so may be a basis for voiding all claims for warranty or insurance claim with carrier.

Refuser toute expédition présentant des signes de mauvaise manipulation sans faire une inspection immédiate des dommages avant de signer le bon de livraison du transporteur. Ne tenter aucune réparation ou aucun réglage; le faire peut constituer un motif suffisant pour annuler toutes les demandes de garantie ou de réclamation d'assurance auprès du transporteur.

1.2 General Information

The Dresser Natural Gas Solutions (NGS) Model 5 Prover is an integrated computer controlled system designed for shop or field proving of rotary and diaphragm-type positive displacement gas meters. The Prover is designed for transfer proving utilizing air only as the test medium, and electric blowers mounted on a manifold or a skid provide the test air flow (vacuum).

The Prover system consists of the following major components:

- Master meter(s) as the measurement reference standard
- Pressure and temperature transducers
- Blower(s)
- Flexible hose(s)
- Electronic cables and accessories with a storage case
- A flow rate controller for automatic flow rate adjustment and test sequencing; and computer software for calculations and presentation of the flow test data. The Prover also has the unique capability to test Dresser NGS meters equipped with the Integral Micro Corrector (IMC/C and IMC/W) and other Dresser NGS electronic integrators. A personal computer (not included) is required to run the software.

The software program stores predetermined Field Meter test configurations. It performs all calculations at the end

of each test run and displays the pressure and temperature differentials, Field Meter proof, Field Meter accuracy, and percent error. Test reports may be saved to diskette, the PC hard drive, and/or may be printed. You can configure the software for Imperial or Metric display and storage of data.

The Model 5 10M, 2M/10M Provers are portable units. They may be transported into the field for on-site testing. The Prover is a precision instrument - operate and maintain it in accordance with factory recommendations as outlined in this manual to ensure accurate and repeatable results. Transport it with care and ensure that it is properly secured and covered for protection from moisture and dirt.

This unit is designed for indoor/outdoor usage, but not under rain conditions. The operating temperature is from +32°F to 140°F. Maximum altitude 2000m and an environment of pollution degree 2.

WARNING

The blowers are not explosion proof. Do not operate them when testing in a hazardous area. Do not operate the Prover in the presence of explosive or flammable gasses or an explosion may result. The Prover system is not designed for intrinsic safety.

Les soufflantes ne sont pas à l'épreuve des explosions. Éviter de les faire fonctionner lors d'essais dans une zone dangereuse. Ne pas faire fonctionner l'appareil d'étalonnage en présence de gaz explosifs ou inflammables au risque de provoquer une explosion. L'appareil d'étalonnage n'est pas équipé de protection à sécurité intrinsèque.

1.3 Component List

The following is a complete list and physical description of the items available for the Dresser Model 5 Prover. Your particular order may or may not include all of the components listed below. If any items that you ordered are missing or damaged, call Meters & Instruments at 1-800-521-1114 or 832-590-2303.

CAUTION

Only use manufacturer supplied parts. Failure to follow this instruction may lead to a safety or operational hazard.

N'utiliser que des pièces d'origine. Le non-respect de cette consigne peut entraîner un risque de sécurité ou de fonctionnement.



Figure 1. Dresser Model 5 Prover

1. **Black Accessory Case** – A briefcase-sized, black container used for storing Model 5 Prover accessory equipment.
2. **Prover Software** – 1 Software Media located in the lid of the black accessory case behind the foam padding. It contains the necessary software for operating the Prover.
3. **Computer Cable** – An RS-232 capable data transmission quality cable with a 15-pin connector at one end and a 9-pin connector at the other end.
4. **Field Meter Junction Box** – A rectangular box, approximately 5 x 5 inches. Attached is a 30 ft. cable with a round 12-pin connector at one end.
5. **Field Meter Temperature Probe** – A 6 in. long, 1/4 in. diameter silver tube with a cable extending from it. The end of the cable has a 4-pin connector.
6. **Manual Start/Stop Cable and Button** – A cable with a 5-pin connector at one end and a push button at the opposite end.
7. **25' Power Cord**
8. **Pressure Lines** – 1/4 in. diameter nylon tubing with compression nuts attached to each end. There are four pressure lines - blue for Input, black for Output. One pair of blue and black lines is for the Master Meter(s) and the other is for the field or test meter.
9. **Field Meter P&T (Pressure and Temperature) Adapter** – A brass "T" assembly with a 1/4" NPT threaded end, a compression fitting for the temperature probe and a Quick Disconnect for the Pressure fitting.
10. **Field Meter Pressure Adapter** – An "L" shaped brass pipe fitting with a 1/4" NPT threaded end and Quick Disconnect end that serves as a pressure-dampening device.
11. **Instrument Drive (ID) Pulsar** – A small, aluminum, rectangular box with two 90 degree angled metal feet protruding from the underside, and an L-shaped shaft that extends down between the two metal feet. Included with the ID Pulsar are two mounting clamps.
12. **ID Pulsar Cable** – A cable with a 5-pin connector at either end.
13. **Expandable Hole Plug** – A device used to seal off unused openings in the Blower manifold depending on options ordered.
14. **Cam Lock Cap** – A cam type cap to close off inlet of unused meter(s).
15. **Hose Plug** – A cam type plug to seal hose end.
16. **Prover Hose** – A flexible, ribbed hose with quick disconnects at each end.
17. **Personal Computer (not included)** – A laptop is required for operation of Prover.
18. **Controller** – An aluminum or steel rectangular box with a 6 in. finned heat sink on the side of the box and a number of sockets for electrical and computer connections.
19. **Blowers** – Devices attached to the Prover cart, responsible for producing a source of airflow during Prover testing.
20. **Master Meter(s)** – The reference meter (tertiary standard) with known performance characteristics that is traceable to national and international standards. The Prover may be purchased with one or two Master Meters.
21. **Master Meter Cable** – A cable containing a 6-pin connector at each end.
22. **Master Meter Junction Box** – A rectangular box mounted to the end cover of the Master Meter(s).
23. **Throttle Valve** – An electrical actuator used to aid in the flow rate control for the prover.

Inside Accessory Case (All Provers)

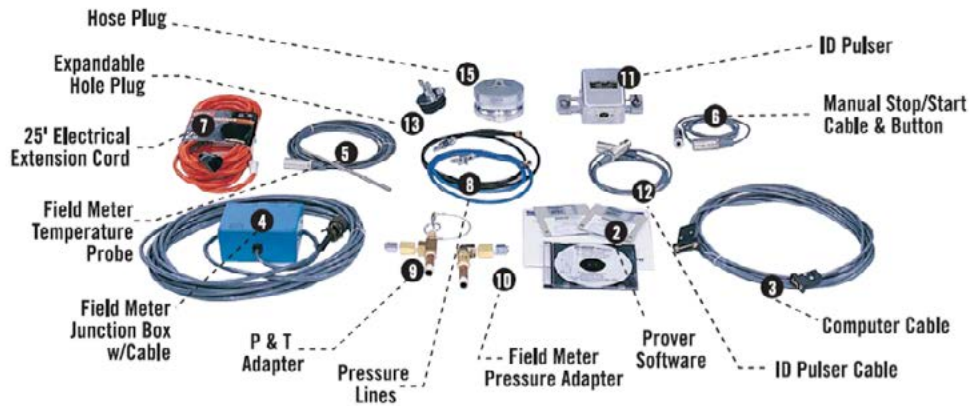


Figure 2. Accessory case items

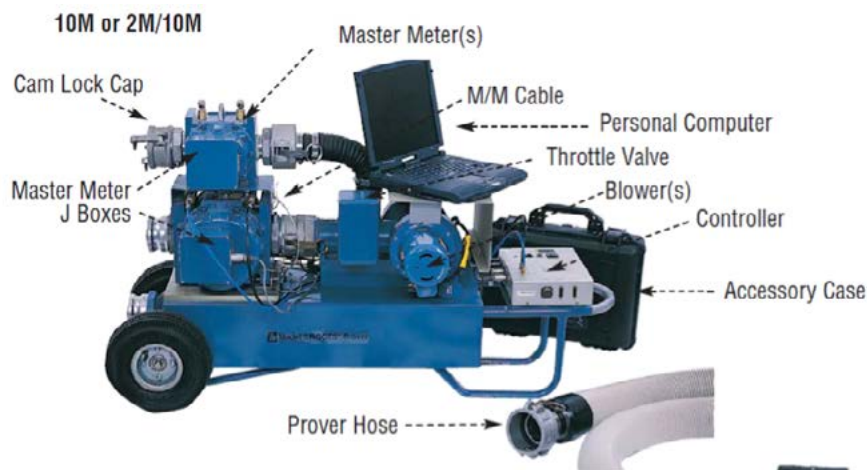


Figure 3. 2M/10M Prover

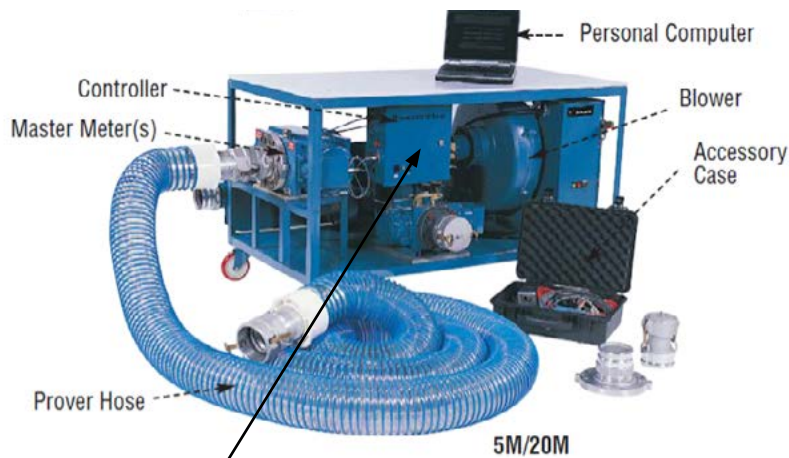


Figure 4. 5M/20M Prover

⚠ DANGER

No external power cables comes to controller box. Connect only to power feed from blower switch panel. Remove any other power cords which may have been accidentally connected.

Aucun câble d'alimentation externe n'entre dans le boîtier du régulateur. Connecter uniquement à l'alimentation électrique du panneau de commutateurs de la soufflante. Supprimer tous autres cordons d'alimentation ayant pu être connectés accidentellement.

1.4 Optional Accessories:

- Optical Scanner
- ROOTS 8C Meter Test Hardware Assembly
- Acoustic Filter
- Inverter
- 3" Quick-disconnect Connector (Female)
- 3" Quick-disconnect Connector (Male)
- SmartProve™ Cable
- USB Serial Port Converter Kit

1.5 Theory of Operation

The Prover operates as a transfer test. The meter under test (Field Meter) registers volume and compares it to the volume registered by a Master Meter. Blowers are used to pull a vacuum, which draws ambient air into the Field Meter and through a connecting hose directly into the Master Meter.

In the normal test set-up, the mass of air passes through the meter under test and then through the Master Meter. Since the Master Meter's characteristics are known, the meter under test can be characterized based on the difference in its performance parameters as compared to the Master Meter. This difference in performance is expressed in terms of accuracy (proof and percent error are also displayed).

1.6 Precautions

- No copies of this disk or any of the information contained there on shall be used for any purpose other than to operate the Dresser Model 5 Prover.
- Do not operate the Dresser Model 5 Prover in the presence of flammable gas or an explosion may result.
- Do not operate the Dresser Model 5 Prover in the rain or while standing in water in order to avoid a potential electrical shock.

- Check upstream and downstream blocking or bypass valves to ensure that they operate properly and are leak tight in the closed position before powering any device.
- Purge all Field Meters (Conventional Meter Proving) of gas prior to testing.



At NO time should power be applied when the Prover is in a possibly explosive atmosphere. Observe all company safety rules, regulations, and procedures.

En AUCUN moment ne convient-il de mettre l'appareil d'étalonnage en marche en atmosphère potentiellement explosive. Respecter toutes les règles de sécurité, les règlements et les procédures de l'entreprise.

- If the Dresser Model 5 Prover is equipped with both the 2M and 10M or the 5M and 20M Master Meters, make certain that the unused Master Meter has the inlet quick-disconnect nipple capped or plugged to prevent any possibility of overspeeding the unused Master Meter.
- For 5M/20M Provers: If "Restart" is pressed during a test, the Prover may restart the main blower with the main valve partially open. If this occurs, a sudden surge of air may apply undue stress to both the Master and Field Meters. Press "Stop" first. Stop the test and allow the main valve to close fully before pressing "Restart."
- When testing Dresser mechanical Temperature Compensated (TC) Meters, make certain to double the standard Pulses/Test value. This is due to the requirement of the special routines for testing Dresser NGS Meters to count transitions instead of pulses. One up and one down transition equal one pulse.

1.7 Specifications (excluding Computer)

	2M/10M	5M/20M
System Accuracy (excluding meter under test)	+/- 0.55%	+/- 0.55%
System Repeatability (excluding meter under test)	+/- 0.15%	+/- 0.15%
Ambient Operating Temp.	+36° to +104°F 2° to +40°C	+36° to +86°F 2° to +30°C
Ambient Storage Temp.	-40° to +140°F -40° to +60°C	-40° to +140°F -40° to +60°C
Humidity	up to 95% non-condensing	up to 95% non-condensing
AC Power		
System	2M 20A (120VAC) 10A (240VAC) ¹	5M 8A (240 VAC)
Blower Capacity		
Single	0 - 7,200 ACFH at 10 inch differential 0 - 200 m ³ /h at 25 millibar differential	0 - 7,200 ACFH at 10 inch differential 0 - 200 m ³ /h at 25 millibar differential
Dual	0 - 14,400 ACFH at 10 inch differential 0 - 400 m ³ /h at 25 millibar differential	0 - 22,000 ACFH at 10 inch differential 0 - 623 m ³ /h at 25 millibar differential
Compliance	Meets FCC Part-15 Requirements Nmi and NIST traceable. UL508 and CSA 22.2 #14	Meets FCC Part-15 requirements Nmi and NIST traceable. UL508 and CSA 22.2 #14
Test Medium	Air	Air
Test Flow Rate	2M Master Meter 35-2300 ACFH 1-65, 1 m ³ /h	5M Master Meter 35-5600 ACFH 1-158 m ³ /h
	10M Master Meter 100 - 10,000 ACFH 2,83 - 283m ³ /h	20M Master Meter 200 - 20,000 ACFH 5 - 566 m ³ /h
Inverter Requirements	2000 Watts	5000 Watts

(additional installation components may be required)

¹With factory supplied step down transformer

Controller Box Specifications

Throttle Valve	120VAC/2AMPS	120vac
Master Meter	5V/0.25A	5V/0.25A
Master Meter	8V/0.25A	8V/0.25A
Blower 1	120VAC/6A	240VAC
Blower 2	120VAC/6A	120VAC
Computer Cable	10VDC/0.5A	10VDC/0.5A
Field Cable	8V/0.10A	8V/0.10A
Field Cable	12V/0.1A	12V/0.1A

Please refer to the Dresser Model 5 Prover Software Manual NGS.MI.0035 for software operating instructions.

2. Equipment Setup

CAUTION

Important: Before setting up your Dresser Model 5 Prover, it is important to review this manual for all operating and safety instructions. Read all instructions within a specific step before executing any of the actions associated with that step. This equipment should only be operated in the manners specified in this manual. Failure to follow this manual may cause the protection provided by the equipment to be impaired.

Important : Avant de paramétrer votre appareil d'étalonnage Dresser Modèle 5, il est important de lire attentivement toutes les consignes de sécurité et d'utilisation contenues dans ce manuel. Lire toutes les instructions relatives à chaque étape particulière avant d'exécuter l'une ou l'autre des mesures correspondant à chacune des étapes. Cet équipement doit uniquement être utilisé de la manière stipulée dans le manuel. Tout manquement aux instructions contenues dans ce manuel peut rendre inutilisables les dispositifs de protection intégrés à l'appareil.

This procedure assumes that the Model 5 Prover (and associated hardware) has been unpacked from its shipping container and is ready to be properly configured for testing.

You do not have to keep the Prover Cart perfectly level when testing, but keep it as level as possible. Maintain Prover Cart in a horizontal position during operation.

CAUTION

This equipment should be maintained and repaired only by factory trained personnel. Failure to follow this directions may result in an injury to personnel or improper functioning of equipment.

Cet équipement doit être entretenu et réparé uniquement par du personnel formé en usine. Le non-respect de ces directives peut occasionner des blessures au personnel ou un mauvais fonctionnement de l'équipement.

Isolate the Field Meter to be tested from any gas before testing. Follow all recommended and/or company safety procedures.

WARNING

For safety reasons, always use positive pressure to purge the Field Meter (meter to be tested) prior to initiating a test using the vacuum test method. Failure to purge a Field Meter can result in severe personal injury and/or equipment damage. See section 4.5 for the Meter Purging Procedure.

Pour des raisons de sécurité, toujours purger le débitmètre (l'appareil sous essai) avec une pression positive avant de lancer toute mise à l'essai sous vide. Le non-respect de cette consigne de purge du débitmètre peut provoquer des blessures graves ou des dommages matériels. Voir la section 4.5 pour la procédure de purge de l'appareil.

2.1 Field Meter Setups

1. Position the Field Meter for testing. Make sure that there are no loose objects or litter in front of the air intake; it functions as a vacuum during testing, and foreign material may be drawn into the Prover.

2.1 A Setup for the 10M or 2M/10M

Connect the 25 ft. flexible Prover Hose to the outlet of the Field Meter and connect the other end of the hose to the inlet quick-disconnect nipple of the appropriate Master Meter. Where possible, put a loop in the hose between attachments to lessen pulsations between the Master Meter and the Field Meter.

Ensure that if the Prover has two Master Meters, the Hose Cap is firmly attached to the inlet quick-disconnect nipple of the unused Master Meter. For Model 5 Provers with only a single 10M Master Meter, install the Expander Hole Plug in the open end of the vertical section of the 2 in. pipe (blower manifold) located between the Blowers and the 10M Master Meter.

2.1 B Setup for the 20M or 5M/20M

1. Connect the 25 ft. flexible Prover Hose to the outlet of the Field Meter and connect the other end of the hose to the inlet quick-disconnect nipple of the appropriate Master Meter. Ensure that if the Prover has two Master Meters, the Hose Cap is firmly attached to the inlet quick-disconnect nipple of the unused Master Meter.
2. Ensure the pressure lines are properly connected from the Controller to the appropriate Master Meter. One end of the blue inlet Pressure Line will connect into the selected Master Meter's inlet pressure fitting and the other end connects into the inlet pressure port on the Controller (labeled IN PRESS). In a similar fashion, one end of the black outlet Pressure Line will connect into the selected Master Meter's outlet pressure fitting and the other end connects into the outlet pressure port on the Controller (labeled OUT PRESS).

WARNING

Electrical power to the Model 5 Prover must be off.

L'alimentation de l'appareil d'étalonnage Modèle 5 doit être coupée.



Figure 5: Instrument Drive Pulser test set-up.

To completely remove power from the Model 5 Prover, disconnect the AC power cable from the Model 5 Prover.

3. If not already factory connected, connect the Master Meter Cable to the appropriate Master Meter Junction Box for the Master Meter being used. Connect the other end of the Master Meter Cable to the connector labeled MASTER METER on the Controller. See page 3 and 4 for the Master Meters and their attached Junction Boxes.
4. Connect the 12 pin Field Meter Junction Box cable connector to the mating 12 pin connector labeled FIELD CABLE on the Controller.
5. Install the P&T (Pressure & Temperature) Adapter into the inlet pressure port for rotary and diaphragm meters and at the outlet pressure port for turbine meters.
6. Install the Field Meter Pressure Adapter into the outlet pressure port of the Field Meter for rotary and diaphragm meters.
7. Insert the Field Meter Temperature Probe into the P&T Adapter's vertical port until the Temperature Probe is in the center of the air stream – then hand tighten the compression fitting. If installing the P&T Adapter into the top of a diaphragm meter, do not to extend the probe to the point where it will engage with the tangent linkage. If opening is not available, install probe in the pipe line as close to meter outlet as possible.

! DANGER

Make sure that the Field Meter Temperature Probe or the meter being tested cannot be damaged due to the positioning of the Field Meter Temperature Probe. Avoid leakage at or around the P&T Adapter or Field Meter Temperature Probe.

S'assurer que la sonde thermique du débitmètre ou l'appareil mis à l'essai ne peut pas être endommagé

en raison de la position de la sonde de température. Éviter toute fuite de, ou autour de, l'adaptateur ou de la sonde de température P&T.

8. Plug the end of the Field Meter Temperature Probe cable into the Field Meter Junction Box connection labeled TEMP.
9. Attach one end of the blue input pressure line to the P&T Adapter (the T-shaped brass piece) at the silver quick disconnect fitting. Attach the other end of the blue input Pressure Line to the port labeled IN PRESS on the Field Meter Junction Box.
10. Attach one end of the black output pressure line to the Pressure Adapter (the L-shaped brass piece) at the silver quick disconnect fitting. Attach the other end of the black outlet pressure line to the port labeled OUT PRESS on the Field Meter Junction Box.
11. Connect the 15-pin connector end of the Computer Cable to the Controller's connector labeled COMPUTER CABLE.
12. Connect the 9-pin connector end of the Computer Cable to the RS-232 serial port of the computer.
13. Connect the female end of the 25 ft. Electrical Extension Cord into the recessed male receptacle located on the front side of the Controller for 110 Volt Provers, or into the 220/240 Volt receptacle of the Power Transformer for 220 Volt Provers.
14. Connect the male end of the 25 ft. Electrical Extension Cord to the proper electrical supply source.

! CAUTION

For 20M Provers the Controller power requirements and large blower power requirements are different and separate. The 20M Prover will come with a special power cord for the large blower. In some cases a different plug may be needed for the 20M large blower power cord than what shipped from the factory. In any case all wiring connections should be

made by a qualified electrician.

Les besoins en alimentation du contrôleur des appareils d'étalonnage 20M et de la grande soufflante sont différents et distincts. L'appareil d'étalonnage 20M est livré avec un cordon d'alimentation spécial adapté à la grande soufflante. Dans certains cas, une prise différente de celle expédiée de l'usine est nécessaire pour le cordon d'alimentation de la grande soufflante 20M. Dans tous les cas, tous les raccords de câblage doivent être effectués par un électricien qualifié.

15. If using an Instrument Drive (ID) Pulser as a test control mode, perform this step then skip to Step 20.

As the drive dog travels around the interior hole of the adapter plate during testing, it is critical that continuous contact is maintained between it and the follow pin. The best way to ensure that this happens is to perform the following Steps a – e carefully before finally securing the ID Pulser to the adapter plate:

CAUTION

Improper alignment and engagement of the instrument drive dog can lead to equipment damage.

Un mauvais alignement et l'engagement du toc d'entraînement peut endommager l'instrument.

- a. Place the ID Pulser over the center hole of the adapter plate. Decide which set of mounting holes in the adapter plate to use to get the ID Pulser shaft most closely centered over the adapter plate and drive dog.
- b. Fasten the ID Pulser to the adapter plate using the two mounting clamps provided. You will need to make fine adjustments to the position of the ID Pulser, so do not tighten the mounting clamps all the way down.
- c. Using a finger, push the drive dog around the inside edge of the adapter plate hole until it is close to the ID Pulser follow pin.

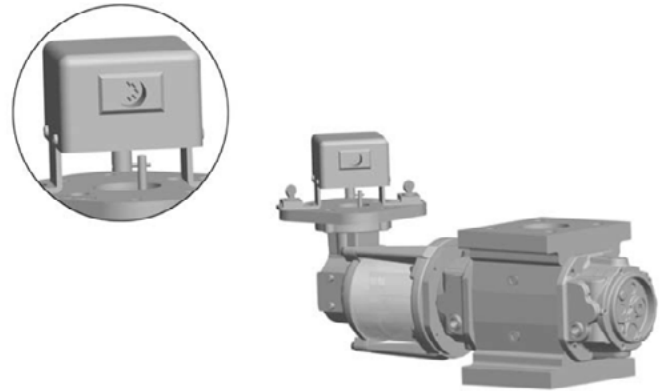


Figure 6: ID Pulser detail of drive dog to follow pin on CD Meter

- d. Again using a finger, try to rotate the ID Pulser shaft in a 360° revolution, both clockwise and counterclockwise. If you can rotate it in a complete circle either way without the follow pin contacting the drive dog, the ID Pulser is not properly positioned. Unscrew the mounting ears and try using a different set of mounting holes on the surface of the adapter plate.
- e. Repeat the previous step until the follow pin makes full contact with the drive dog when the ID Pulser shaft is rotated both clockwise and counterclockwise. As you rotate the ID Pulser shaft in each direction, it is best that the follow pin is blocked by the drive dog at the same point along the follow pins length. For example, if the follow pin contacts the drive dog at the midpoint of the follow pin's length when the ID Pulser shaft is turned clockwise, the same should occur when the ID Pulser shaft is turned counterclockwise.

It is also important that the contact between the follow pin and the drive dog does not occur too closely to the end of the follow pin. This may cause the follow pin to “miss” the drive dog at some point during actual testing. Monitor a full rotation during operation.



Figure 7: Optical Scanner test set-up.

- f. Once you are confident of the contact between the follow pin and the drive dog, tighten down the mounting ears that secure the ID Pulser to the adapter plate.
- g. Plug the Instrument Drive (ID) Pulser cable into the Field Meter Junction Box at the connection labeled ID PULSER.

16. If using an Optical Scanner as a test control mode, perform this step then skip to Step 20.

Note: Mounting the Optical Scanner and positioning the lens relative to the target is critical for the reliable operation of the device. Refer to your Optical Scanner Operations Manual for specific, comprehensive instructions on attaching the scanner to the meter and focusing the light source on the target.

- a. Align the optical scanner as indicated in Figure 5 for Series B3 (see Figures 10 and 11 for Series B2 and A1 respectively) and hand tighten. Refer to Steps c and d for correct focusing and positioning.

Dresser NGS Meters, Series B2 (TQM) and Series B3 (Life-lubed)

- TC Combined Test: Aim the Scanner at the dial containing 10 white and 10 black squares of the temp compensated Volume Odometer dial.
- Uncorrected Test: Aim the Scanner at the dial containing 10 white and 10 black squares of the non-compensated Volume Odometer dial or at the high-speed half black and half white dial.

Note: The distance X shown in Figures 10 and 11 should be approximately 1/2 inch (or about the width of your small finger). Set angle A slightly off-center at approximately 15 degrees.

Dresser NGS Meters, Series A1 (LMMA)

- TC Combined Test: Aim the Scanner at the dial containing 10 white and 10 black sections.
- Uncorrected Test: Aim the Scanner at either dial that is half white and half black.

Note: The distance X shown in Figures 10 and 11 should be approximately 1/2 inch (or about the width of your small finger). Set angle A slightly off-center at approximately 15 degrees.

- b. Plug the Optical Scanner cable into the Field Meter Junction Box at the connection labeled I.D. PULSER.
- c. Focus the light emitted by the Optical Scanner so that the dot displayed on the dial is of uniform brightness and that it does not cross more than one black/white boundary.

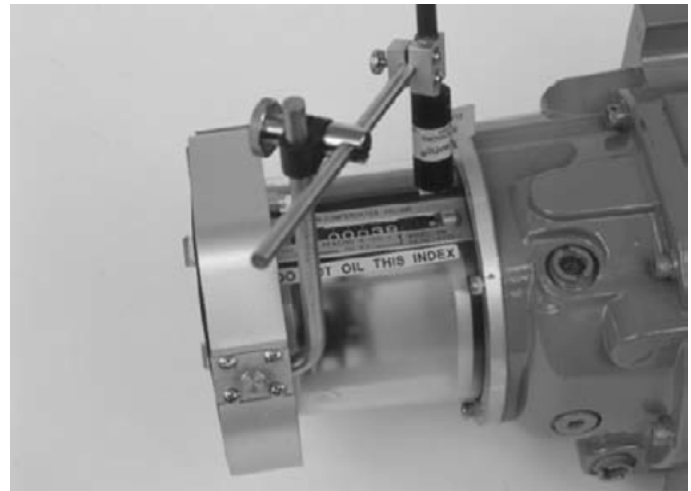


Figure 8: Optional Scanner Relative Positioning and Alignment Series B3 Accessory Unit.

- d. Adjust the Optical Scanner amplifier to ensure that the Amplifier blinks for each transition from white-to black or black-to-white. To properly adjust the amplifier on the Optical Scanner, see the Installation and Operation manual for the scanner. If using a different Optical Scanner, follow the adjustment procedures for that specific model per the operating instructions of that scanner’s manual.

- 17. If using a Manual Stop/Start Cable and Button as a test control mode, perform this step then skip to Step 20.
 - a. Plug the Manual Start/Stop Cable into the Field Meter Junction Box at the connection labeled I.D. Pulser.

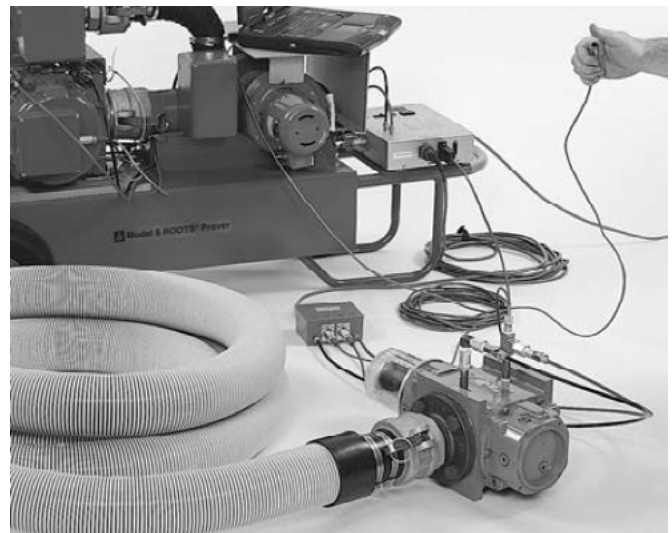


Figure 9: Manual stop/start cable set-up.

- 18. If using a SmartProve™ Interface Cable as a test control mode, refer to SmartProve Installation Manual.
- 19. Hardware set-up is now complete. Push the Controller’s power switch to the ON position and verify that the red power indicator light (located next to the power switch on top of the Controller) is illuminated.

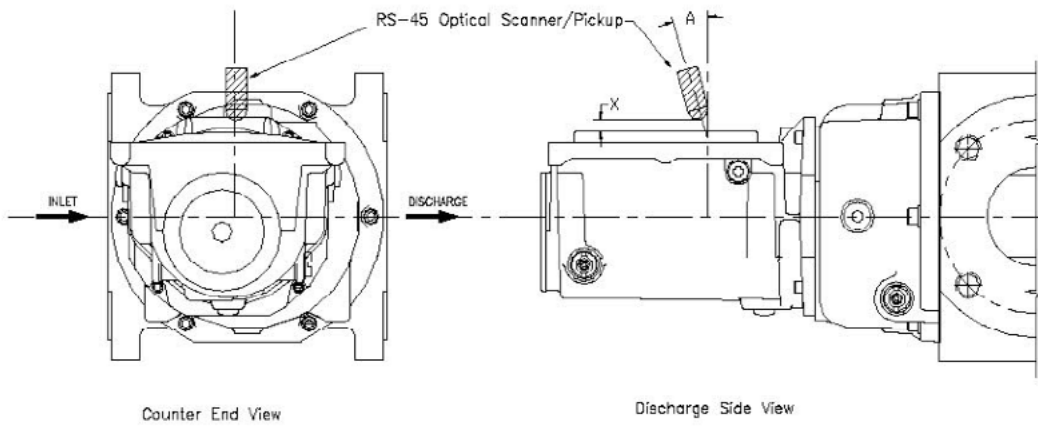


Figure 10: Optical Scanner Relative Positioning and Alignment, Series B2 (TQM) Accessory Unit

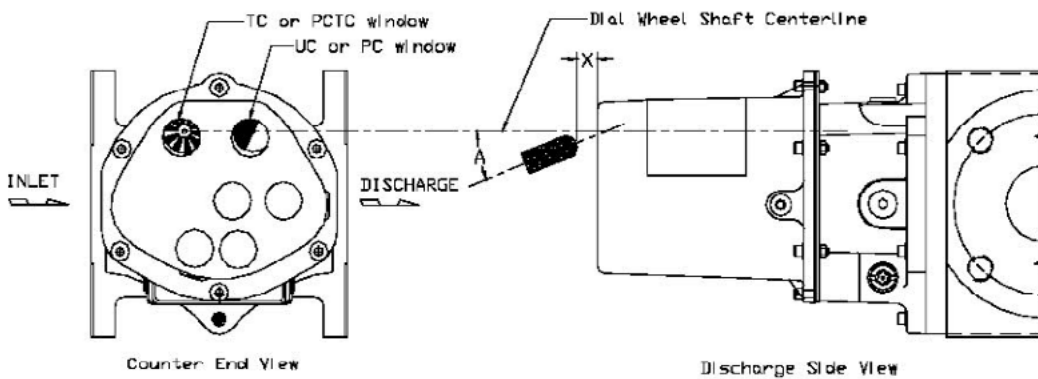


Figure 11: Optical Scanner Relative Positioning and Alignment, Series A1 (LMMA) Accessory Unit

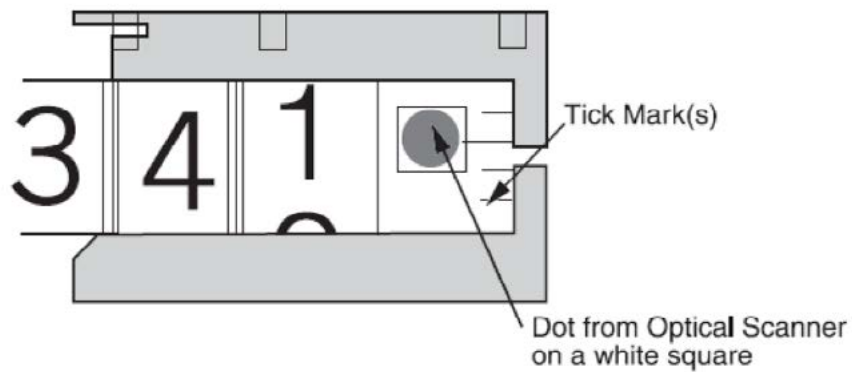


Figure 12: Volume Odometer Test Wheel Series 2 (TQM) or Series 3 (Life Lube)

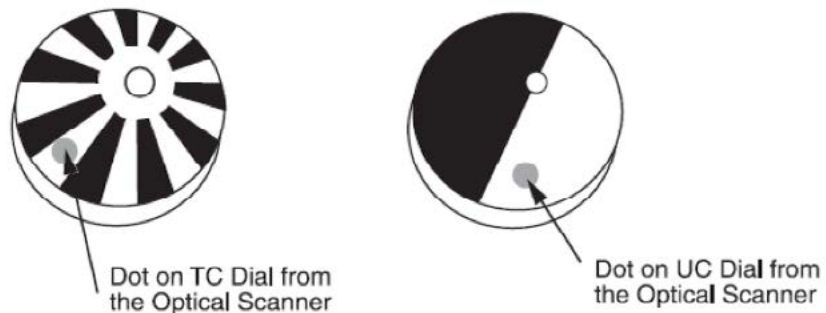


Figure 13: Series A1 (LMMA) Test Dials Optical Scanner

3. Prover Component Calibration

3.1 The Conversion Tool

The Model 5 Prover is always calibrated in English units of measure, but a Conversion Tool has been provided at the bottom of the Prover Calibration Screen. Use this feature to convert various commonly used units of measure to their English unit equivalents.

At the lower left of the Prover Calibration Screen is a box labeled “convert from”. Enter the value for the measurement to be converted, or use the up/ down arrows to the left of the box to increase/ decrease the displayed values. To the right of this box, choose the unit of measure from the drop-down menu. The Conversion Tool will convert from the following units: psi, inches of H₂O, bar, mbar, kPa and inHg. The equivalent units of measure will be displayed along the bottom of the Conversion Tool box.

The Conversion Tool will also convert temperature readings between Fahrenheit and Celsius. Simply enter the °F or °C value to be converted in the proper box, and the program will automatically display the alternate units.

Note: Any changes made must be saved prior to exiting or changes will be lost. To restore the factory installed settings, click on “File” at the top left of screen and select “Factory Defaults.”

1. Open the Model 5 Prover Software.
2. On the upper, left-hand corner, select “Prover Operations” and “Prover Setup” as shown in Figure 14.

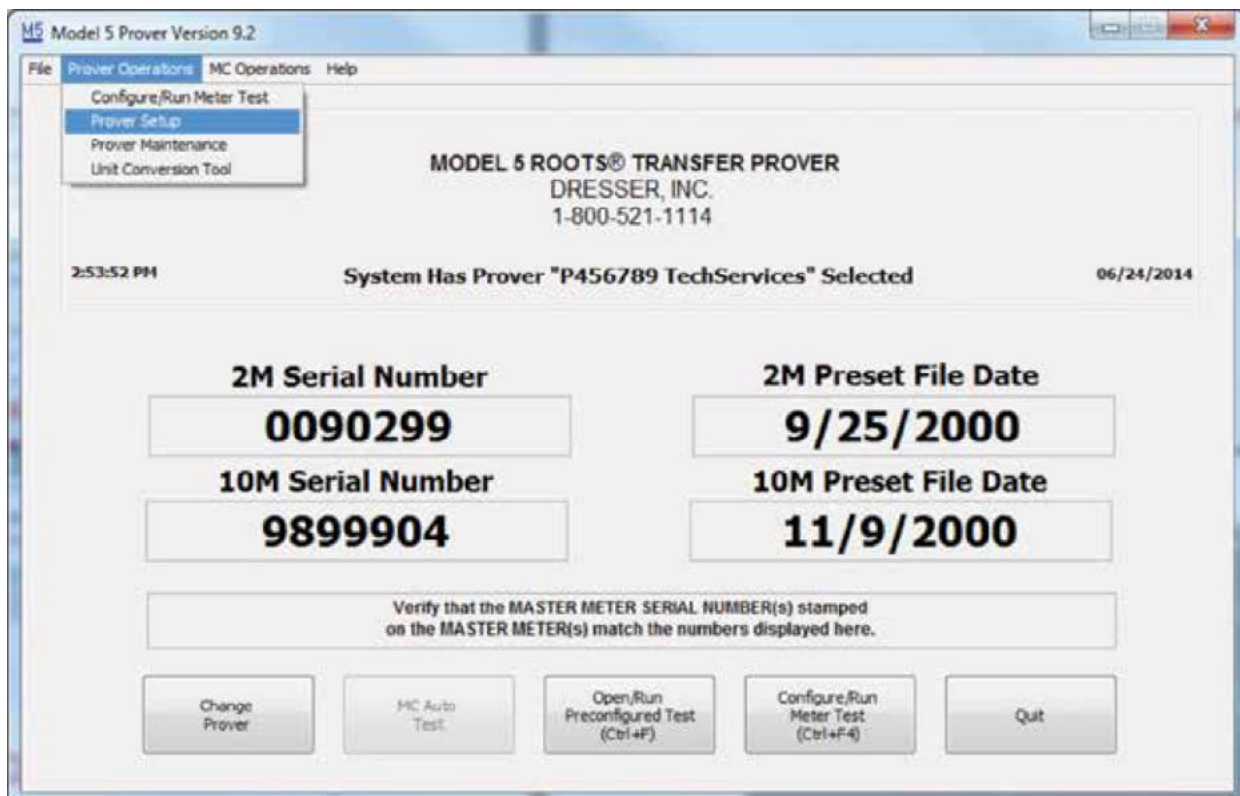


Figure 14: Prover Setup Selection

3. A small dialog box will appear. Enter the password "ROOTS" as shown in Figure 15.

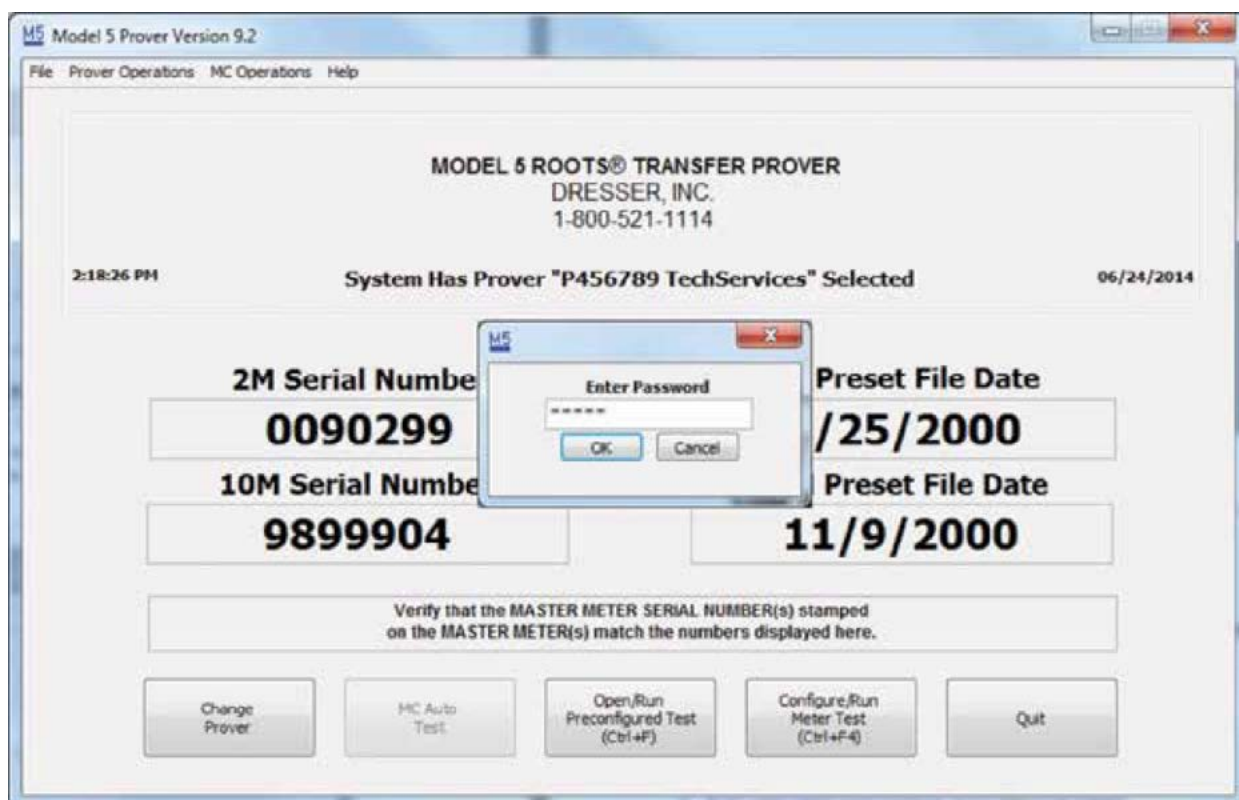


Figure 15: Password Dialogue Box

4. A new window will open. Select "Prover Operations" and "Set Units of Measurement" as shown in Figure 16.

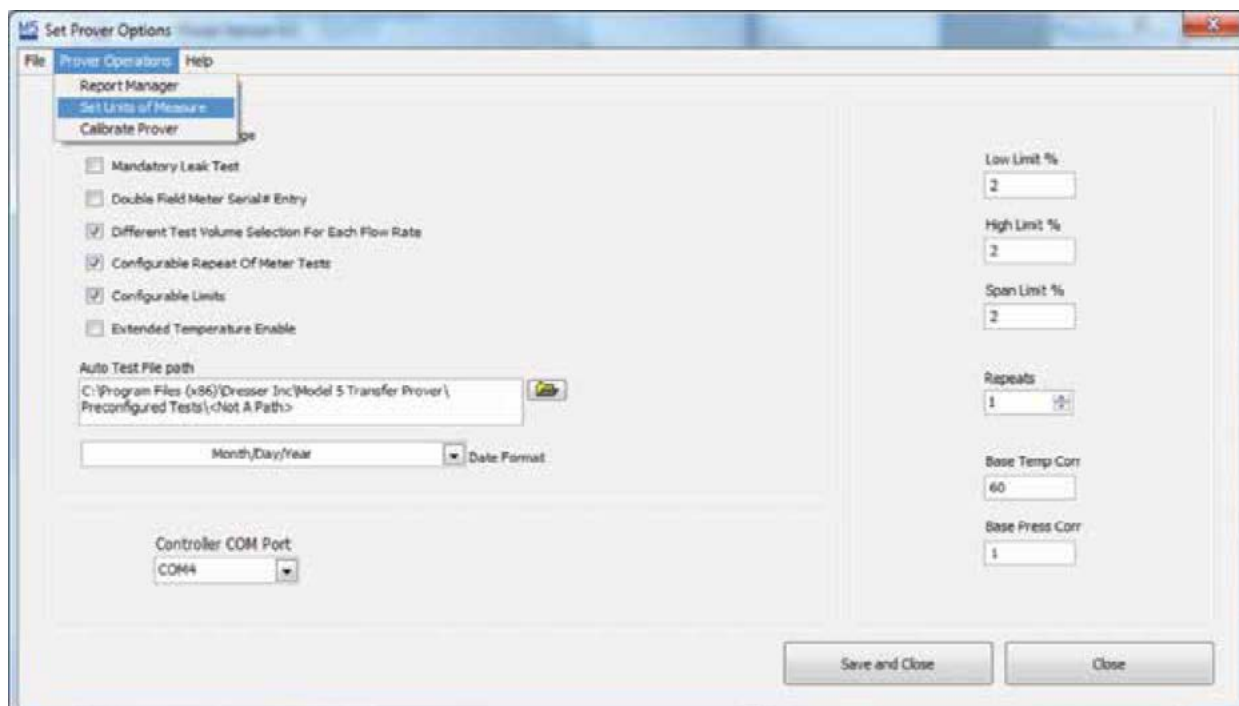


Figure 16: Set Units of Measurement Selection

5. A new window will appear, as shown in Figure 17. Review all the units of measurement available for change.

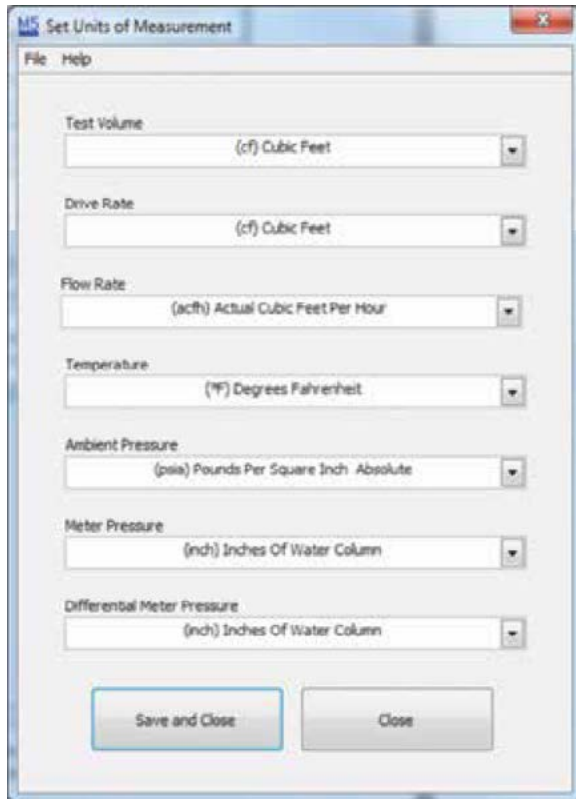


Figure 17: Units of Measurement Window

6. In this example the units of measure for differential meter pressure will be changed. Follow the same procedure for any of the listed drop-down menus. Select the down arrow to reveal available options, as shown in Figure 18. Click the desired unit.

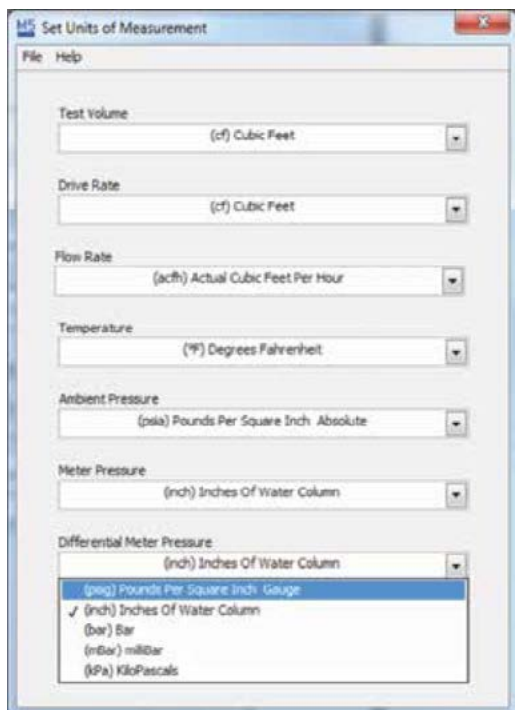


Figure 18: Drop Down Selection

7. The selection should be reflected as shown in Figure 19.

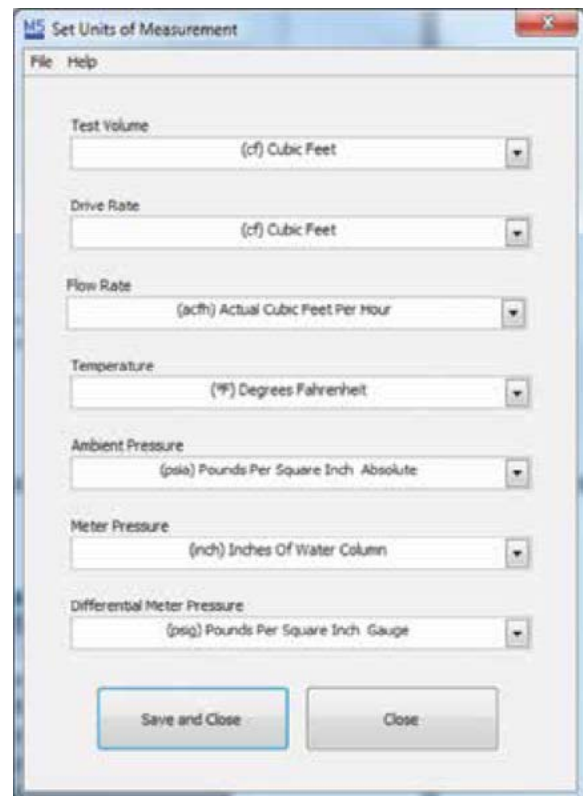


Figure 19: Changed Drop Down Selection

8. Click on the "Save and Close" button as shown in Figure 20. There will be a prompt to confirm the selection.

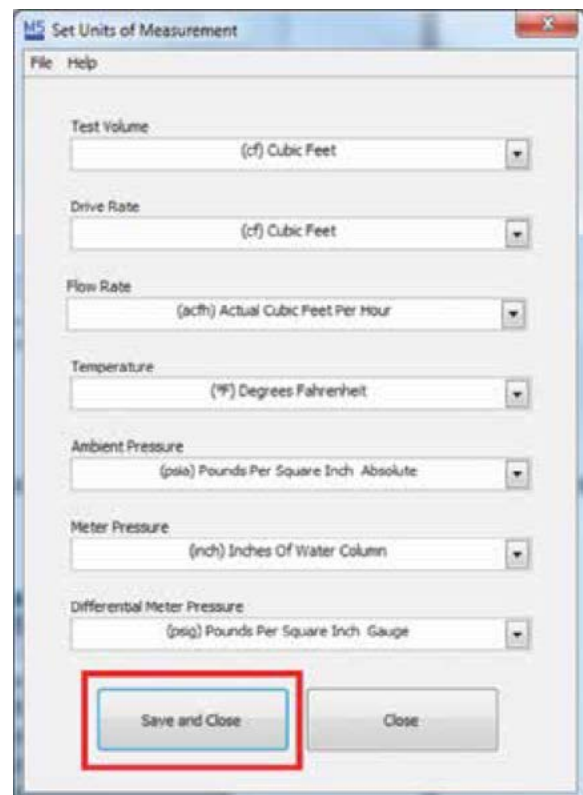


Figure 20: Save and Close

9. On the “Set Prover Operations” window, select “Save and Close” as shown in Figure 21.

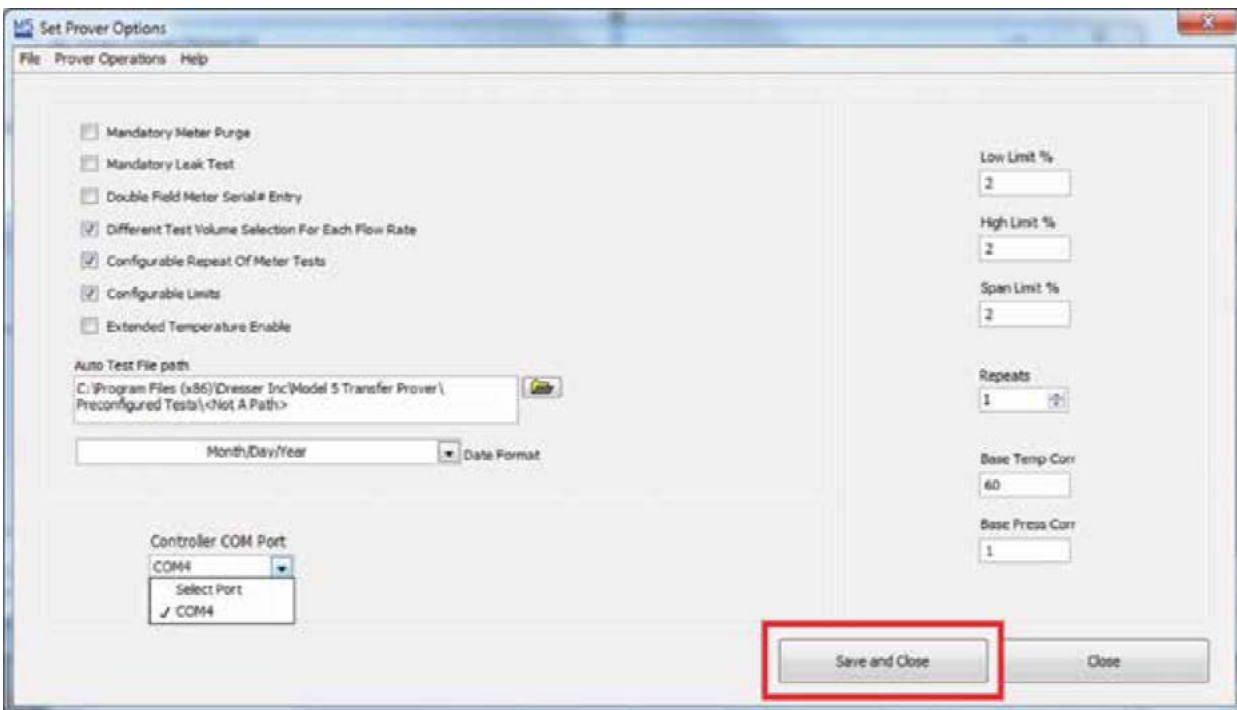


Figure 21: Click “Save and Close”

10. Restart computer.

3.2 How to Calibrate the Atmospheric Pressure Transducer

1. From “Prover Operations”, select “Prover Set Up” as shown in Figure 22.

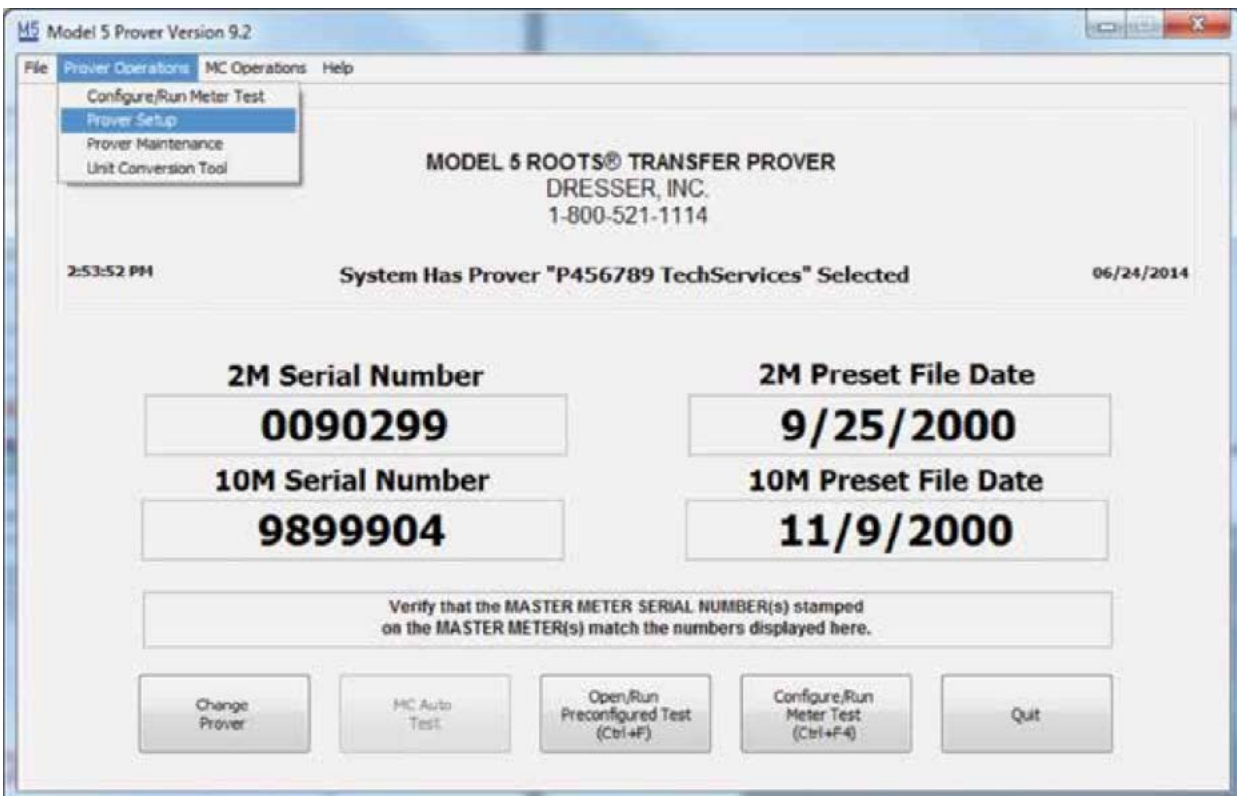


Figure 22: Prover Setup Selection

- Upon selecting "Prover Setup, there will be a prompt to enter a password as shown in Figure 23. The password is "ROOTS". Capitalization is required. Press "OK."

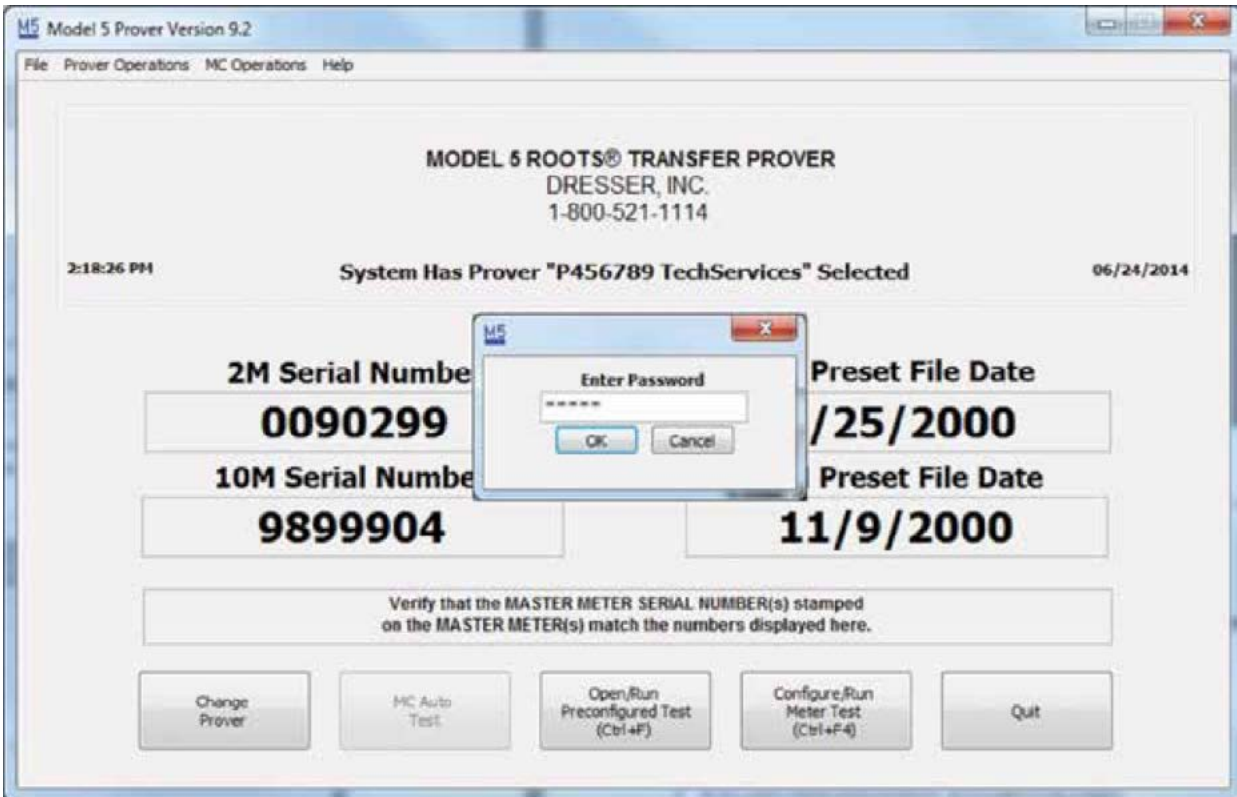


Figure 23: Prover Setup Password

- A second window will appear as shown in Figure 24. Take note of the Control COM Port Field. Notice, only COM Ports in use are available for selection. Select the COM port (Refer to Step 2.)

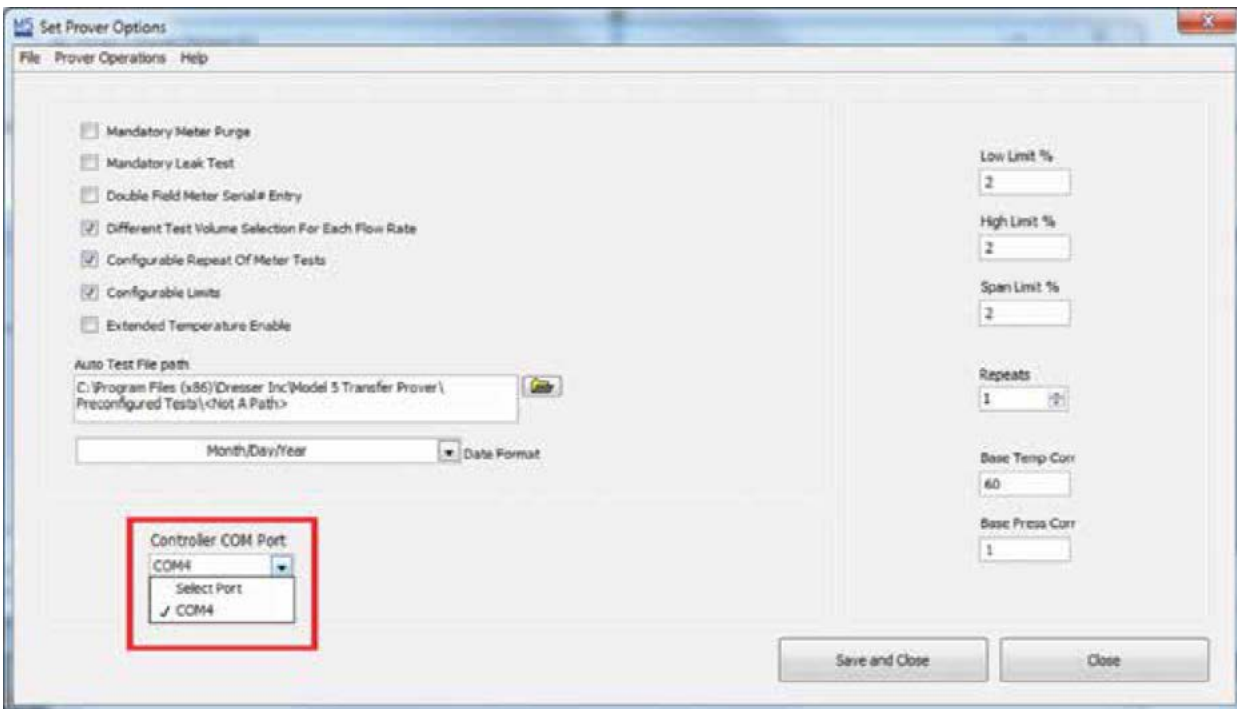


Figure 24: Prover Setup Screen and Controller COM Port

4. When complete, click “Save and Close” as shown in Figure 25.

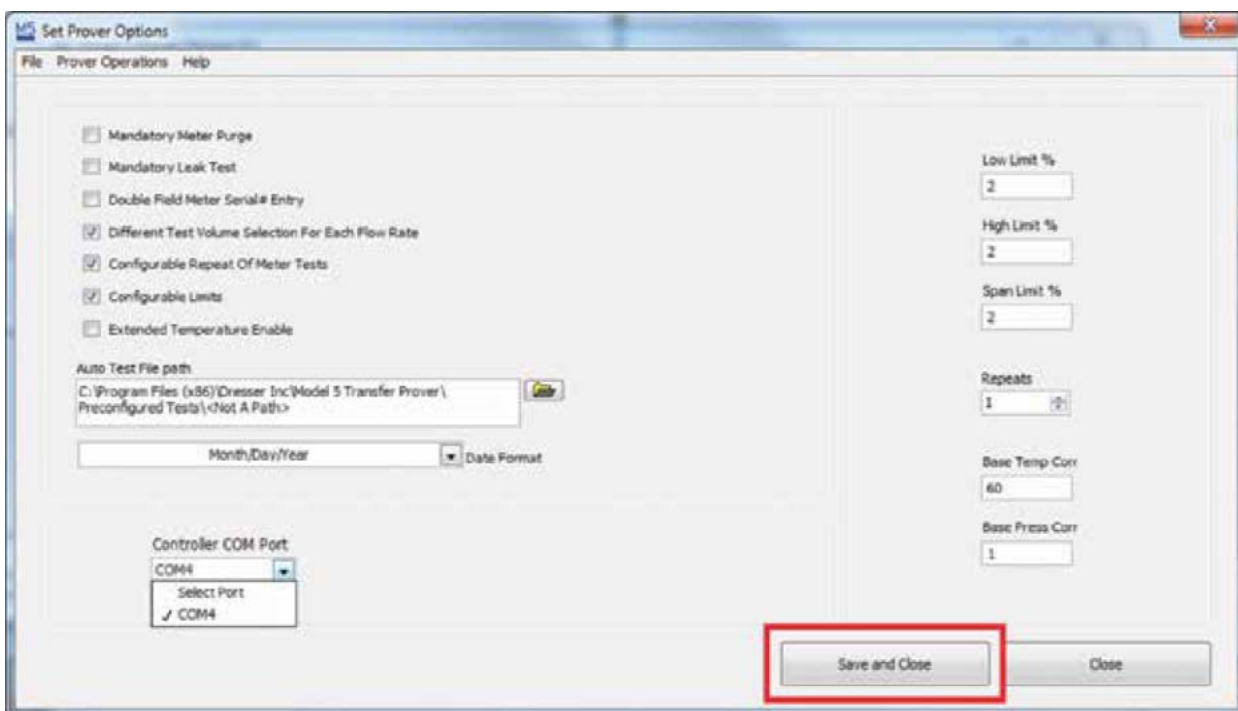


Figure 25: Save and Close

5. Repeat Step 1 and Step 2.

6. Click “Prover Operations”. Then click, “Calibrate Prover” as shown in Figure 26. The password is “DRESSER”.

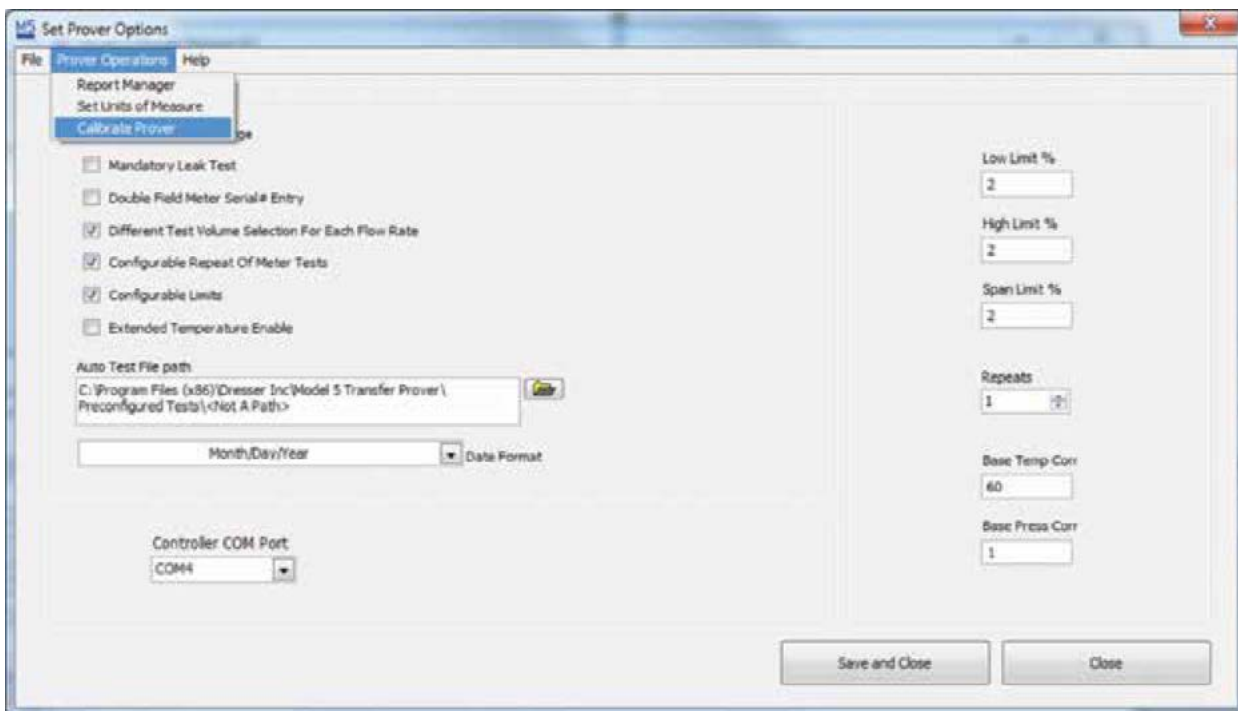


Figure 26: Calibrate Prover

7. A third window will appear as shown in Figure 27. It will warn the user with the following message, "Caution, you are about to change the calibration of your Prover". Click "OK".

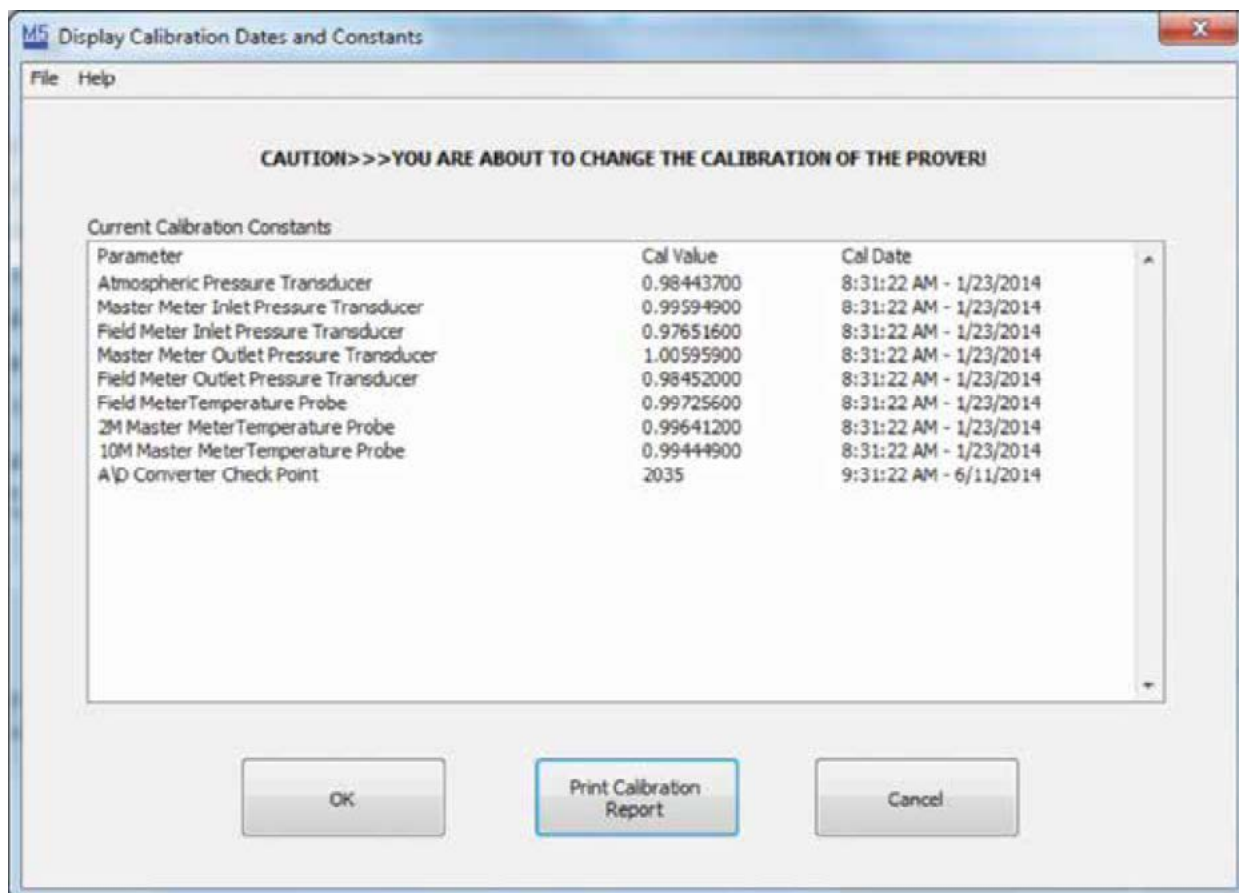


Figure 27: Calibration Warning Window

Help: Refer to Calibration and Preset Files in the Help Index for more information.

- From the Prover Calibration Screen, select the pull down arrow and click "Calibrate Atmospheric Pressure Transducer" See Figure 28.

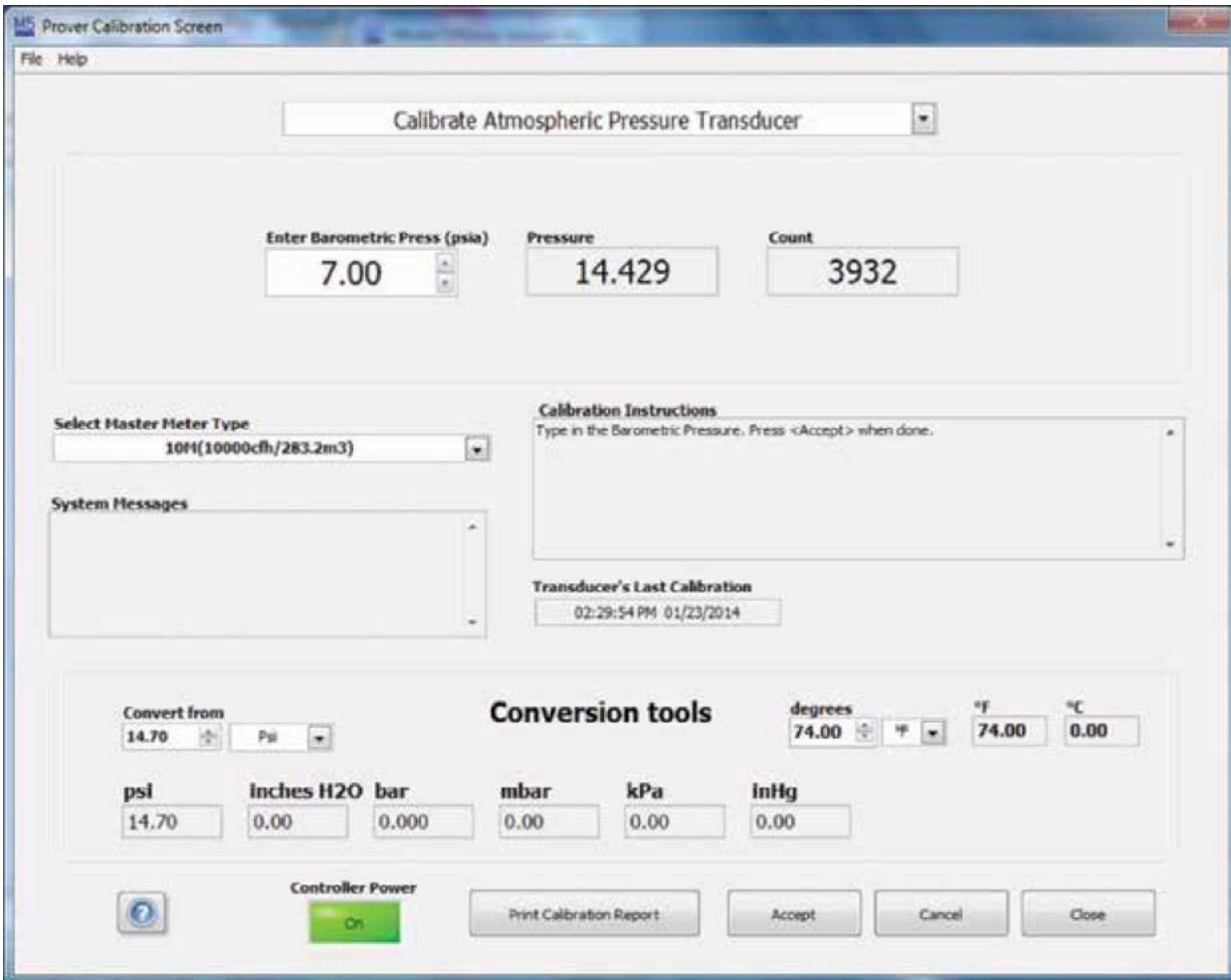


Figure 28: Select Calibrate Atmospheric Pressure Transducer Selection

The box labeled Count indicates a digitized value that represents the amount of pressure sent from the electronic Controller. Also displayed is the current ambient pressure, which was calculated using the value from the most recent Transducer calibration.

- In the box labeled Enter Barometric Pressure (psia) enter a value that represents the current atmospheric pressure in pounds per square inch absolute. Press <Enter>.

Note: If pressure has been gauged with an instrument that uses units other than psia, use the Conversion Tool at the bottom of the screen to convert to psia units.

- Click on the <Accept> button at the bottom of the screen to save the new calibration setting.

Note: The uncertainty of your pressure standard should be less than +_2 psia. A greater uncertainty factor can result in a poor calibration of the Atmospheric Pressure Transducer.

3.3 How to Calibrate the Master Meter Inlet Pressure Transducer

1. From the Prover Calibration Screen, select the pull down arrow and click “Calibrate Master Meter Inlet Pressure Sensor Transducer.” Refer to Figure 29.

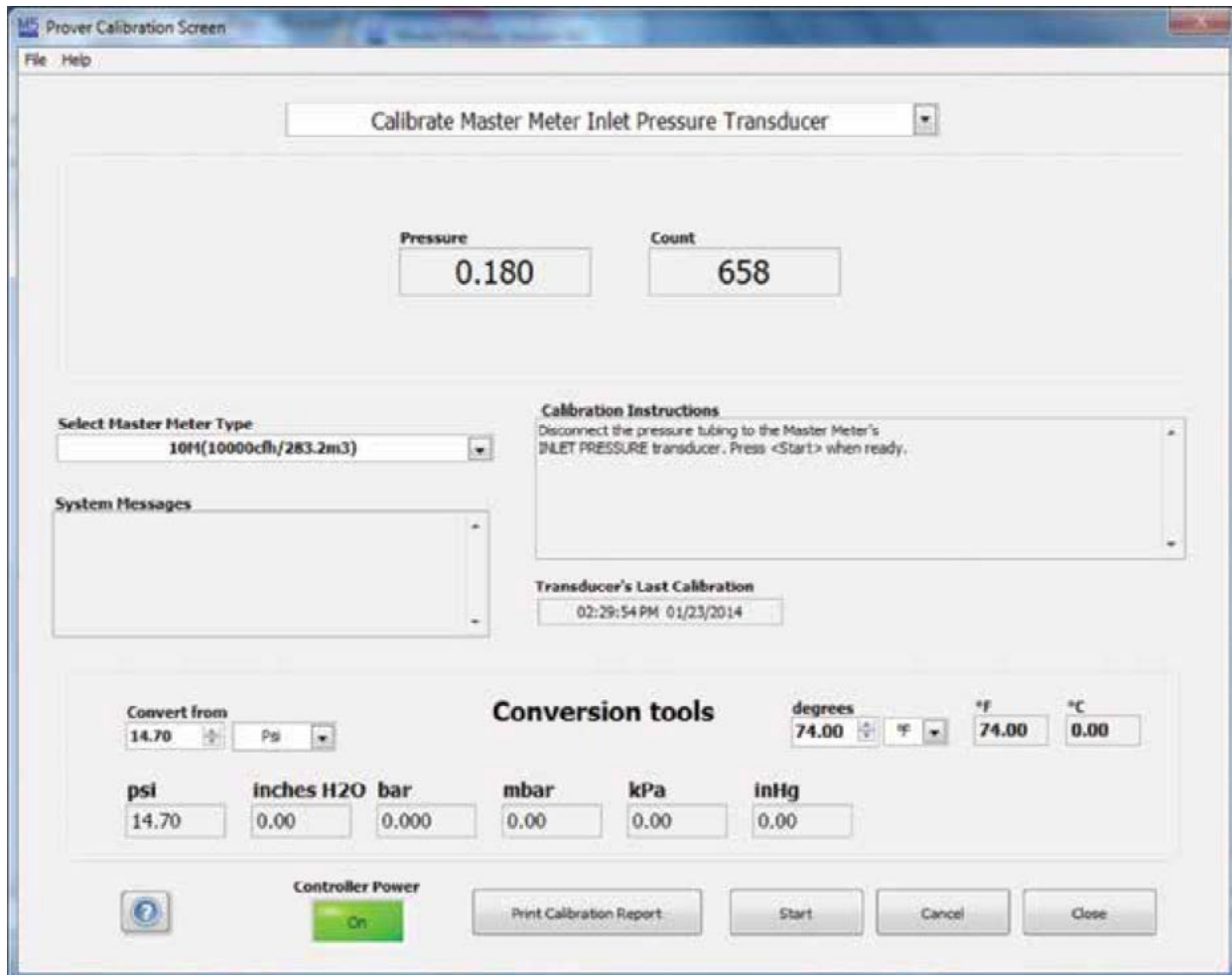


Figure 29: Select Calibrate Master Meter Inlet Pressure Transducer Selection

2. Connect the Master Meter Cable to the Master Meter to be calibrated.
3. Make sure that the proper meter capacity is selected in the box labeled “Select Master Meter Type”.
4. Disconnect the Master Meter’s inlet pressure line from the Controller at the port labeled IN PRESS (inlet pressure). This will expose the transducer to atmospheric pressure.
5. In the box labeled “Count” is a scaled value which represents the analog pressure signal sent from the electronic Controller. Once the displayed pressure reading stabilizes around zero, press <Accept> to zero the transducer.
6. Re-connect one end of the Master Meter’s pressure line to the to the Controller at the port labeled IN PRESS. (This is the same line that was disconnected in Step 3.)
7. Disconnect the Master Meter inlet pressure line at the Master Meter inlet pressure port.
8. Attach the pressure standard and pressure source to the disconnected end of the Master Meter inlet pressure line.
9. Use the pressure source to apply a 5.000 ± 0.05 inch water column vacuum to the Master Meter inlet pressure line. The reading on the pressure standard will be approximately -5.000 inches and will appear in the box labeled “Pressure (inch)”. This is the current Meter pressure, and the negative value of the reading indicates the presence of a vacuum.
10. After the displayed reading has stabilized, click on the <Accept> button at the bottom of the screen to complete and save the recalibration.

3.4 How to Calibrate the Field Meter Inlet Pressure Transducer

1. From the Prover Calibration Screen, select the pull down arrow and click “Calibrate Master Meter Inlet Pressure Sensor Transducer.” Refer to Figure 30.

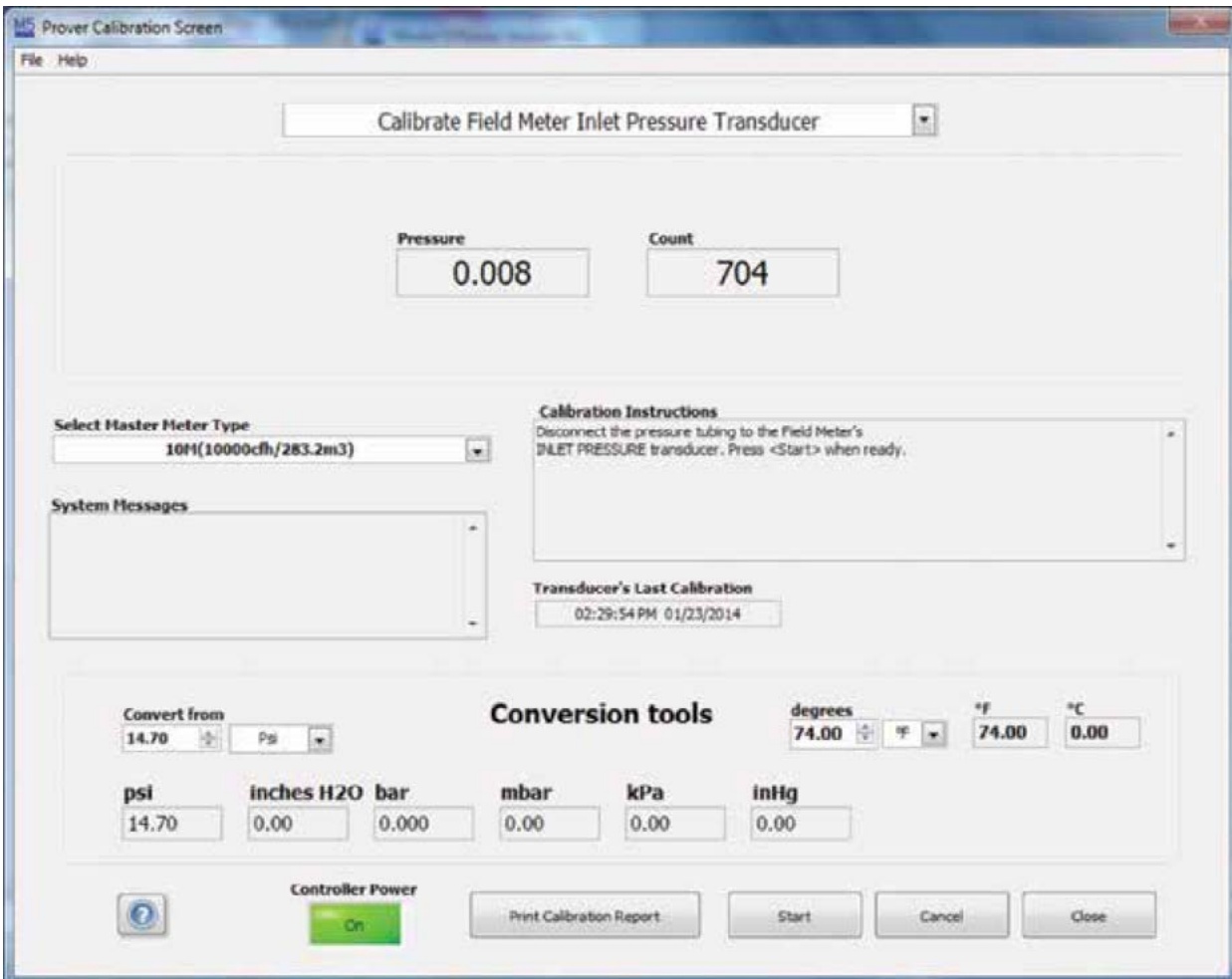


Figure 30: Select Calibrate Field Meter Inlet Pressure Transducer

2. Disconnect the pressure line from the Field Meter inlet pressure port and from the Field Meter Junction Box at the port labeled IN PRESS (inlet pressure). This will expose the transducer to atmospheric pressure.
3. In the box labeled “Count” is a scaled value which represents the analog pressure signal sent from the electronic Controller. Once the displayed pressure reading stabilizes, press <Enter> to advance to the next step.
4. Re-connect one end of the pressure line to the Field Meter Junction Box at the port labeled IN PRESS. This is the same line that was disconnected in Step 2.
5. Attach the pressure standard and pressure source to the open end of the Field Meter inlet pressure line.
6. Use the pressure source to apply a 5.000 ± 0.05 inch water column vacuum to the Field Meter inlet pressure line. The reading on the pressure standard will be approximately -5.000 inches and will appear in the box labeled “Pressure (inch)”. This is the current Meter pressure, and the negative value of the reading indicates the presence of a vacuum.
7. After the displayed reading on the pressure standard and the count reading has stabilized, click on the <Accept> button at the bottom of the screen to complete and save the recalibration.

3.5 How to Calibrate the Master Meter Temperature Probe

1. From the Prover Calibration Screen, select the pull down arrow and click "Calibrate Master Meter Temperature Probe." Refer to Figure 31.

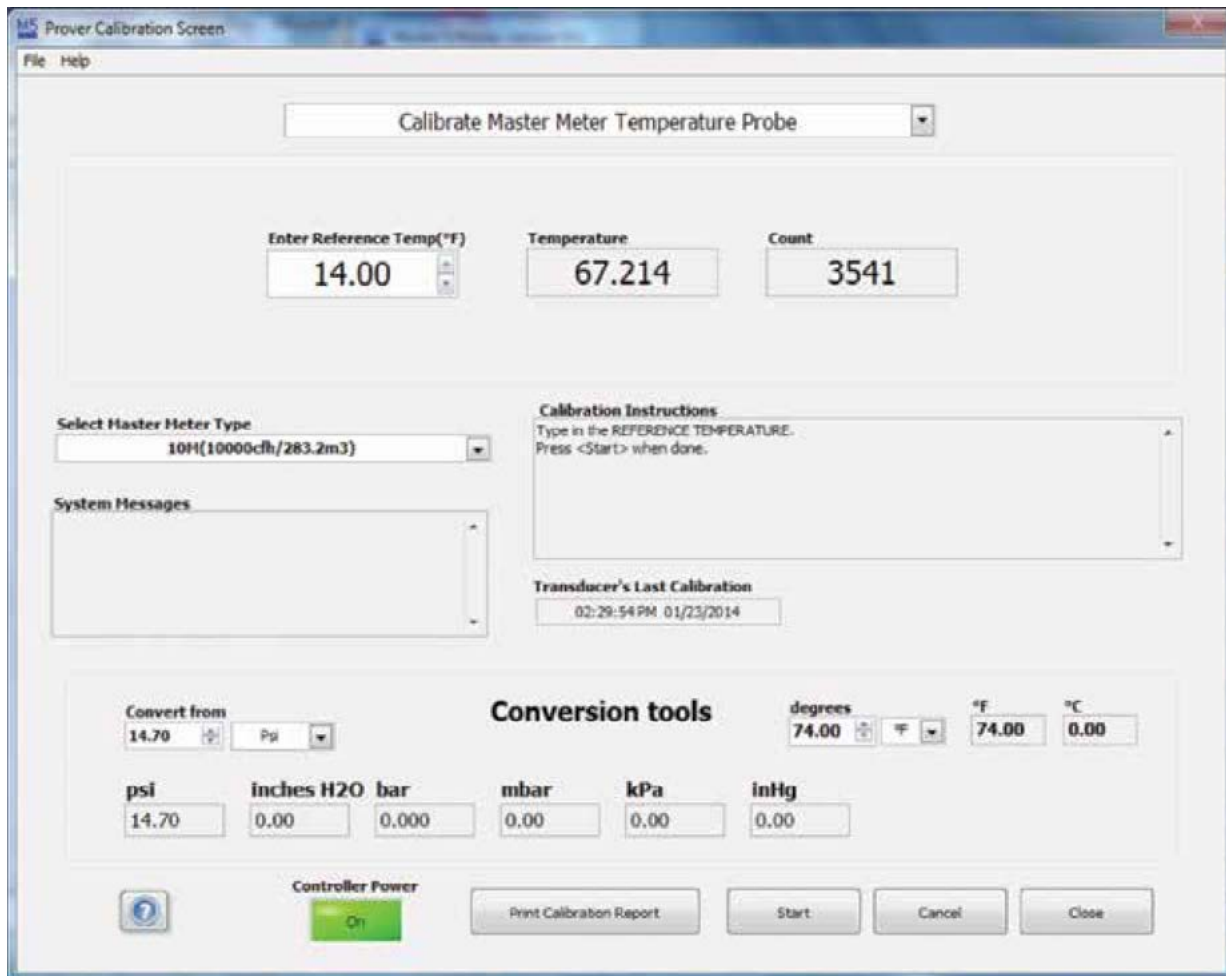


Figure 31: Select Calibrate Master Meter Temperature Probe

2. Remove the four screws holding the cover plate on the Master Meter Junction Box.

All Master Meters:

3. Connect the Master Meter cable to the Master Meter to be calibrated.
4. Make sure that the proper meter capacity is selected in the box labeled "Select Master Meter Type".
5. Remove the Master Meter temperature probe from its well. Do not disconnect any wiring.
6. Using a rubber band, attach the Master Meter temperature probe to a sensing device that will serve as a temperature standard. Immerse both into a liquid container that is already at the temperature at which the test will be conducted. Make sure that the liquid is gently stirred to equalize the temperature throughout the container.

It is important that there is no greater than $\pm 1^{\circ}\text{F}$ difference between the temperature of the liquid in the container and the testing temperature. In addition, ensure that the temperature of the liquid in the container is extremely stable and that the temperature standard has an uncertainty of no more than $\pm 0.20^{\circ}\text{F}$.

Before completing the next step, make sure that both the reference temperature and the value displayed in the box labeled Count have stabilized.

7. Type in the reference temperature as measured by the temperature standard, then click on the <Accept> button at the bottom of the screen.
8. The Calibration Instructions box on the screen now indicates to remove the Master Meter temperature probe and let it stabilize. Leave both the temperature probe and the temperature standard in the liquid container, and click on the <Accept> button at the bottom of the screen.

The recalibration of the Master Meter temperature probe is now complete and the new setting and current date are saved.

9. Remove both the Master Meter temperature probe and the temperature standard from the liquid container. Remove the rubber band holding them together and carefully dry both probes.
10. Re-insert the Master Meter temperature probe into its well and secure it in place.
11. Re-attach the Master Meter cover plate and tighten all four screws.

3.6 How to Calibrate the Field Meter Temperature Probe

1. From the Prover Calibration Screen, select the pull down arrow and click "Calibrate Field Meter Temperature Probe." Refer to Figure 32.

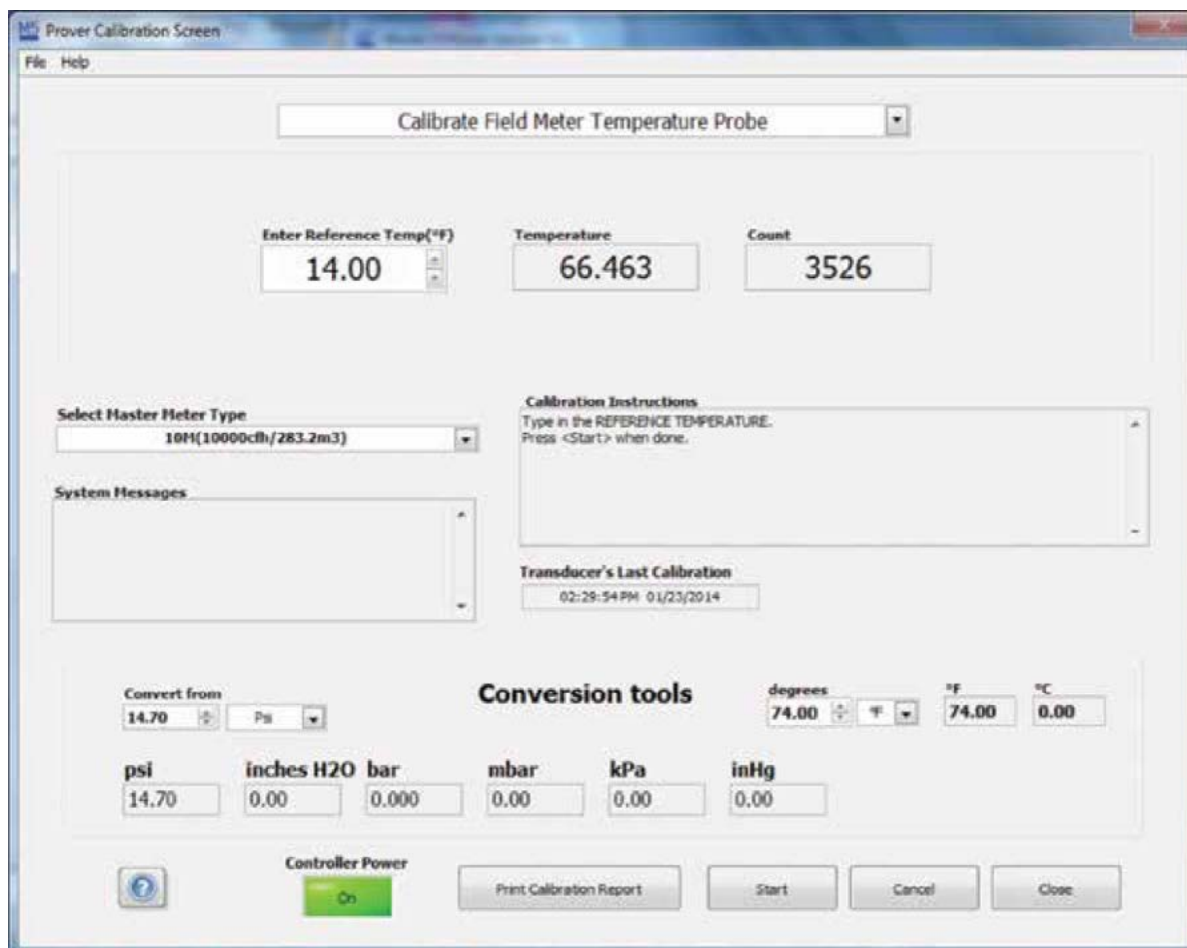


Figure 32: Select Calibrate Field Meter Temperature Probe

2. Make sure that the Field Meter Junction Box cable is connected to the Controller.
3. Connect the Field Meter temperature probe to the Field Meter Junction Box at the port labeled TEMP PROBE.
4. Using a rubber band, attach the Field Meter temperature probe to a sensing device that will serve as a temperature standard. Immerse both into a liquid container that is already at the temperature at which the test will be conducted. Make sure that the liquid is gently stirred to equalize the temperature throughout the container.

It is important that there is no greater than $\pm 1^{\circ}\text{F}$ difference between the temperature of the liquid in the container and the testing temperature. In addition, ensure that the temperature of the liquid in the container is extremely stable and that the temperature standard has an uncertainty of no more than $\pm 0.20^{\circ}\text{F}$.

Note: Before completing the next step, make sure that both the reference temperature and the value displayed in the box labeled Count have stabilized.

5. Type in the reference temperature as measured by the temperature standard, then click on the <Accept> button at the bottom of the screen.

- The Calibration Instructions box on the screen now indicates to remove the Field Meter Temperature probe and let it stabilize. Leave both the temperature probe and the temperature standard in the liquid container, and click on the <Accept> button at the bottom of the screen. The recalibration of the Field Meter temperature probe is now complete and the new setting and current date are saved.
- Remove both the Field Meter temperature probe and the temperature standard from the liquid container. Remove the rubber band holding them together and carefully dry both probes.

3.7 How to Calibrate the Master Meter Outlet Pressure Transducer

- From the Prover Calibration Screen, select the pull down arrow and click “Calibrate Master Meter Outlet Pressure Sensor.” Refer to Figure 33.

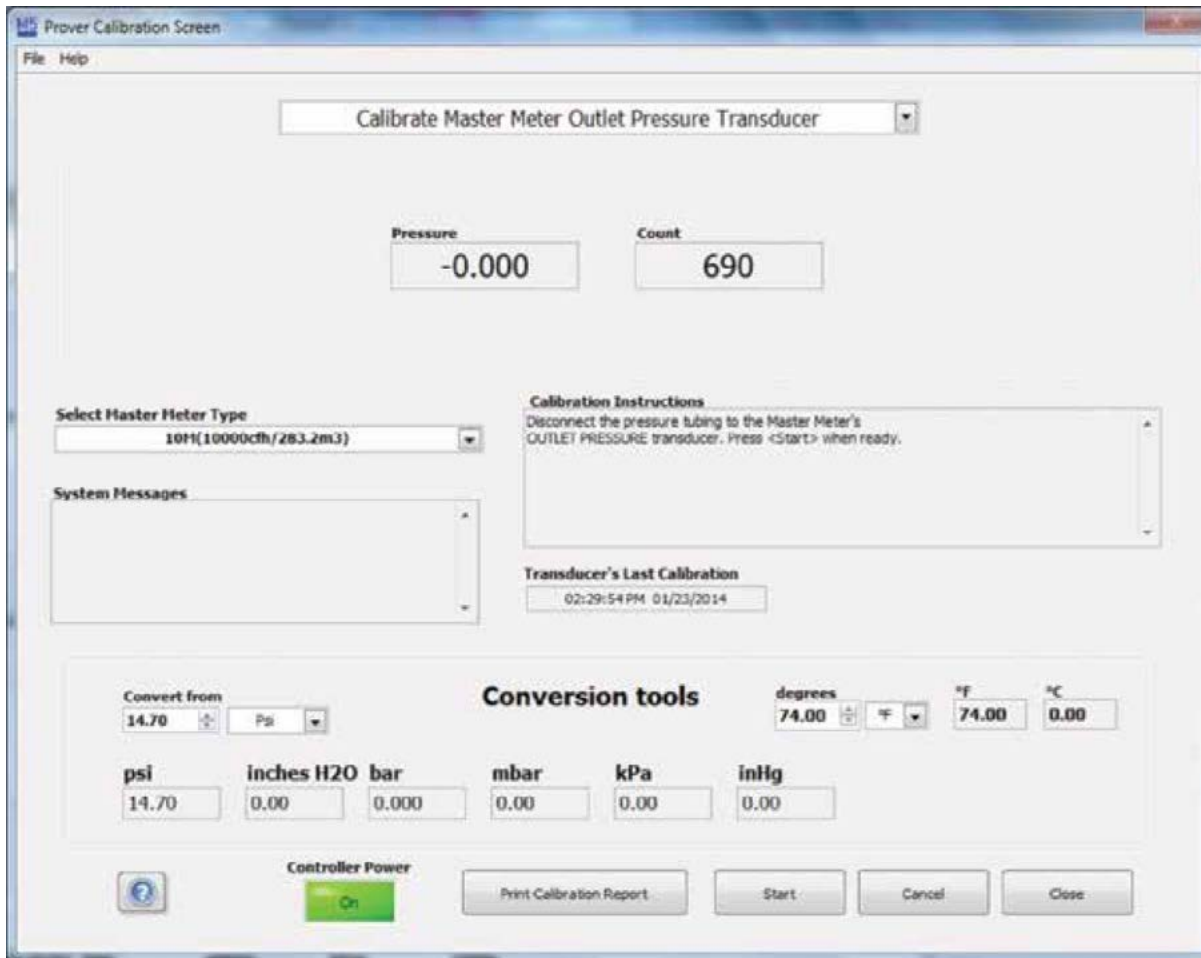


Figure 33: Select Calibrate Master Meter Outlet Pressure Transducer

- Connect the master meter cable to the master meter to be calibrated.
- Make sure that the proper meter capacity is selected in the box labeled “Select Master Meter Type”.
- Disconnect the Master Meter’s outlet pressure line from the Controller at the port labeled OUT PRESS (outlet pressure). This will expose the transducer to atmospheric pressure.
- In the box labeled “Count” is a scaled value which represents the analog pressure signal sent from the electronic Controller. Once the displayed pressure reading stabilizes around zero, press <Accept> to zero the transducer.
- Re-connect one end of the Master Meter’s pressure line to the Controller at the port labeled OUT PRESS. (This is the same line that was disconnected in Step 3.)
- Attach the pressure standard and pressure source to the disconnected end of the Master Meter outlet pressure line.
- Use the pressure source to apply a 5.000 ±0.05 inch water column vacuum to the Master Meter outlet pressure line. The reading on the pressure standard will be approximately – 5.000 inches and will appear in the box labeled “Pressure (inch)”. This is the current Meter pressure, and the negative value of the reading indicates the presence of a vacuum.

- After the displayed reading has stabilized, click on the <Accept> button at the bottom of the screen to complete and save the calibration.

3.8 How to Calibrate the Field Meter Outlet Pressure Transducer

- From the Prover Calibration Screen, select the pull down arrow and click "Calibrate Master Meter Outlet Pressure Sensor." Refer to Figure 34.

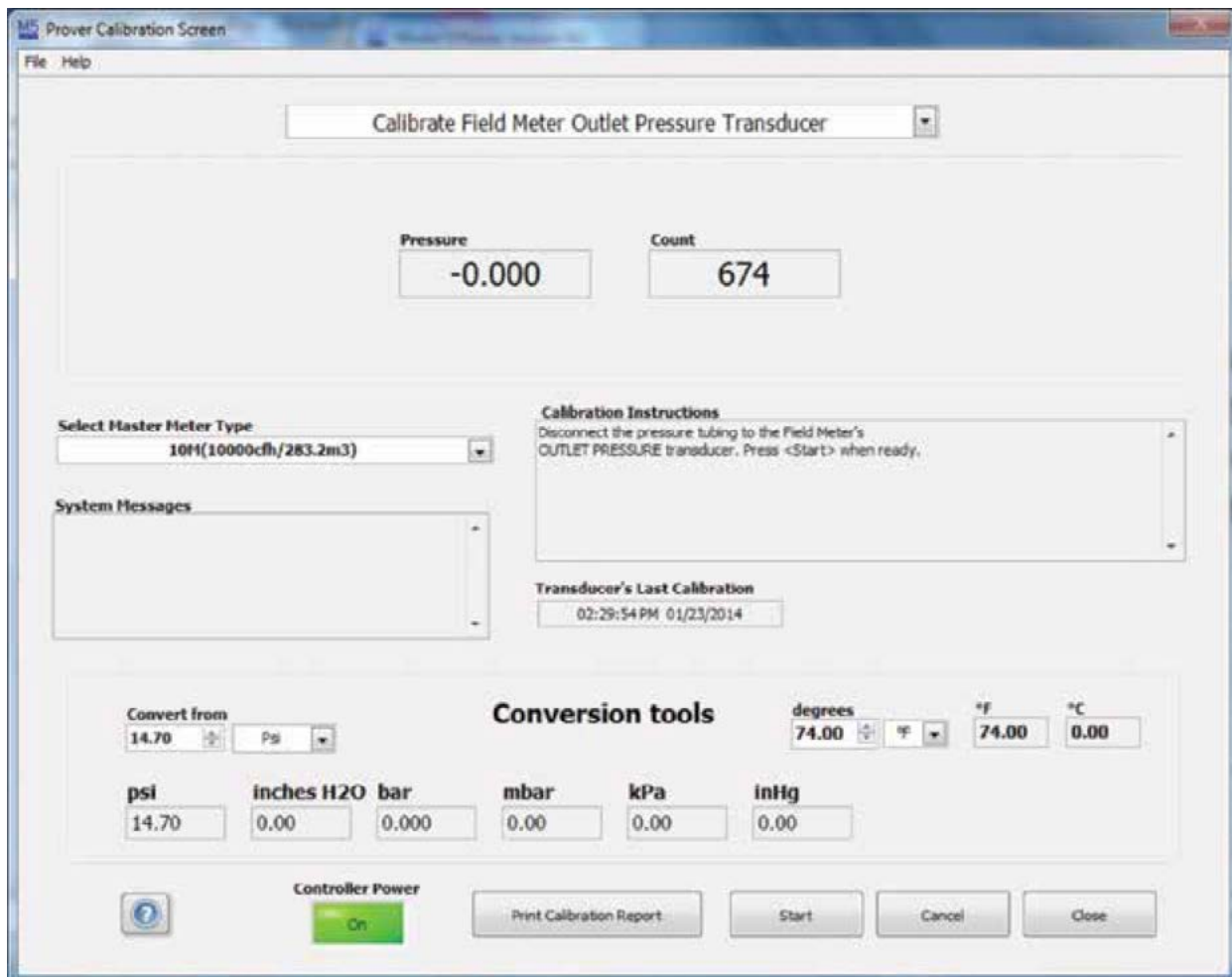


Figure 34: Select Calibrate Field Meter Outlet Pressure Transducer

- Connect the Field Meter cable to the Controller.
- Disconnect the pressure line from the Field Meter outlet pressure port and from the Field Meter Junction Box at the port labeled OUT PRESS (outlet pressure). This will expose the transducer to atmospheric pressure.
- In the box labeled "Count" is a scaled value which represents the analog pressure signal sent from the electronic Controller. Once the displayed pressure reading stabilizes around zero, press <Accept> to zero the transducer.
- Re-connect one end of the pressure line to the Field Meter Junction Box at the port labeled OUT PRESS. This is the same line that was disconnected in Step 3.
- Attach the pressure standard and pressure source to the open end of the Field Meter outlet pressure line.
- Use the pressure source to apply a 5.000 ± 0.05 inch water column vacuum to the Field Meter outlet pressure line. The reading on the pressure standard will be approximately -5.000 inches and will appear in the box labeled "Pressure (inch)". This is the current Meter pressure, and the negative value of the reading indicates the presence of a vacuum.
- After the displayed reading has stabilized, click on the <Accept> button at the bottom of the screen to complete and save the calibration.

4. Prover Maintenance

! DANGER

There are no serviceable parts in this unit. All repairs must be done at the factory. Failure to follow this instructions may result in injury or other losses.

L'unité ne comporte aucune pièce réparable. Toutes les réparations doivent être effectuées à l'usine. Le non-respect de ces directives peut entraîner

des lésions corporelles ou même la mort.

Click on Prover Operations at the top of the Startup screen. Select Prover Maintenance (<Ctrl+F6>) from the drop-down menu to initiate the Maintenance screen. From this screen, several system checks may be performed that will help to ensure the best performance and safest operation of the Model 5 Prover. Refer to Figure 35.

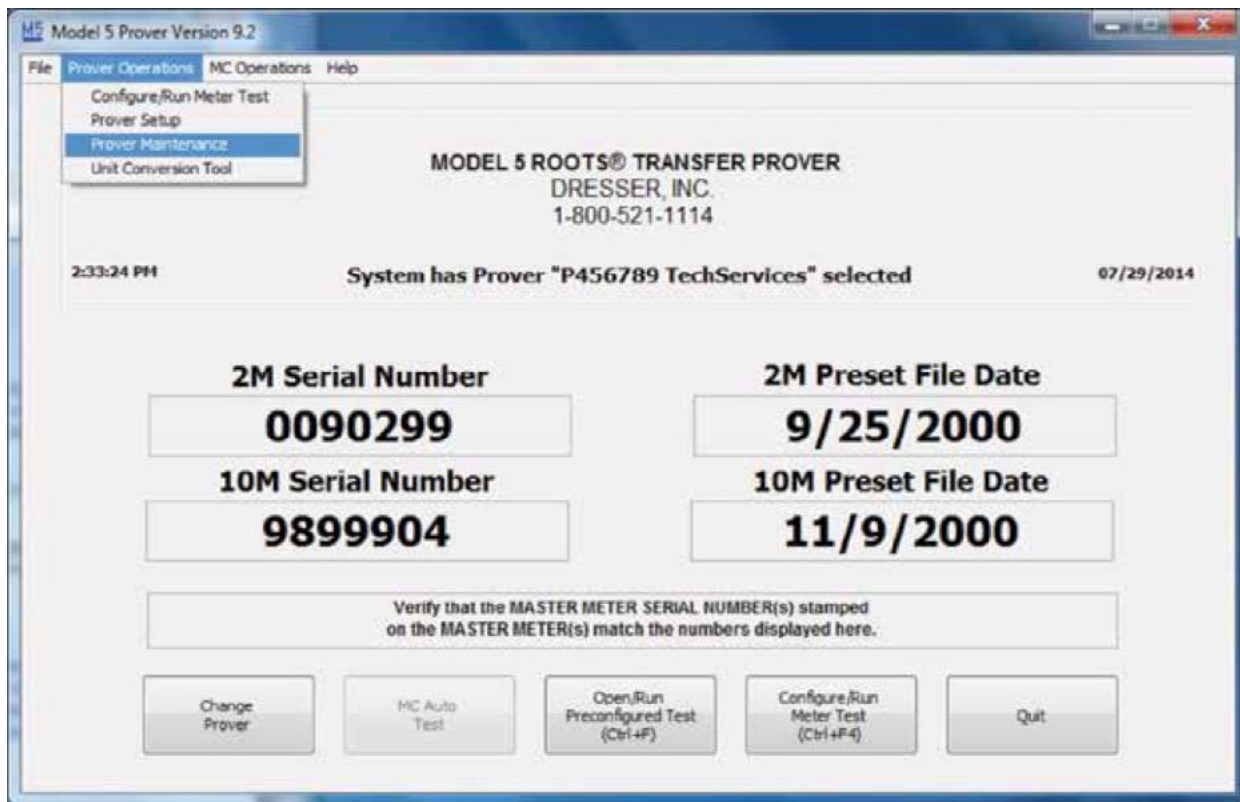


Figure 35: Prover Maintenance Selection

In addition to performing service tests, the user can keep track of the operational hours since the Master Meter(s) were last serviced. By default, the Prover Self Test will display first when the Maintenance screen is opened. Click on the up/down arrow keys at the left side of the Test box to scroll through and select the desired test.

4.1 Master Meter Hours of Operation

At the top of the Maintenance screen shows the hours of operation of each Master Meter. This important record can be used to monitor time periods between service functions or to initiate factory recertifications.

Note: Reinstalling the software resets the hours.

The hours of operation are activated when a meter test starts (any time the blowers turn on). With the mouse, click on the appropriate Master Meter.

Note: The hours of operation section does not take into account the speed or the cleanliness of the air or the environment with which the blowers and Master Meters must operate.

4.2 Prover Self Test

Select "Prover Self Test" from the pull-down menu under the Hours of Operation.

This test verifies operation of major electronic components of the Model 5 Prover. The user is prompted for information to setup and start the Self Test. The Prover Self Test starts and runs a predetermined test volume at a fixed flow rate. Clicking on the Close button aborts the test and will return the user to the Maintenance menu. Clicking on the Start button at the bottom of the screen will initiate the test sequence. Refer to Figure 36.

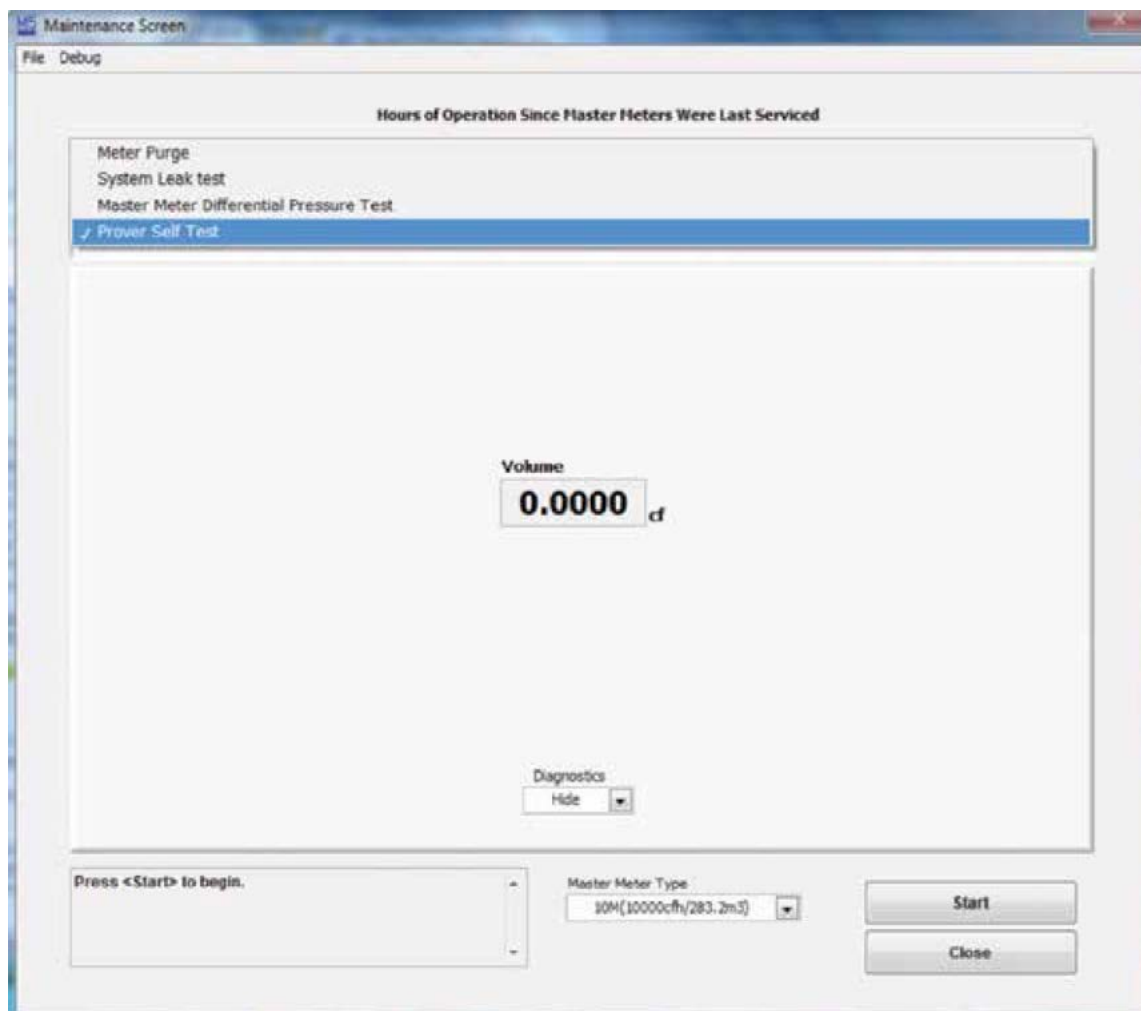


Figure 36: Prover Self Test Selection

CAUTION

All Provers except 2M/10M: Allow time for the main valve to close prior to pressing the Start button. The Prover Self Test is a short system test. Information is sent to the Controller and a test is started with a flow rate of approximately 50% of the Master Meter’s capacity. Specific results are

expected at the end of the test. If the results of the test vary from the expected values by more than a slight percentage, a failed message will be displayed. If the test results are as expected, a passed message is displayed. This does not test the Field Meter pulser components, but the field cable must be connected to the Controller and the Field Meter temperature probe must be connected to the Field Meter junction box.

Tous les appareils d’étalonnage sauf 2M et 10M : Prévoir quelque temps pour la fermeture de la soupape principale avant d’appuyer sur le bouton Démarrer. L’auto-essai de l’appareil d’étalonnage consiste en un court essai du système. Les données sont transmises au contrôleur et un essai est lancé avec un débit d’environ 50 % de la capacité du débitmètre étalon. Des résultats précis sont rendus à la fin de l’essai. Si les mesures d’essai varient d’un léger pourcentage par rapport aux résultats prévus, un message d’échec s’affiche. Si les résultats des essais sont concluants, un message de réussite s’affiche. Ce test ne s’applique pas aux composants du générateur d’impulsions du débitmètre, mais le câble de champ doit être connecté au contrôleur et la sonde de température doit être connectée à la boîte de jonction de l’appareil.

CAUTION

The Prover hose should not be connected to the Field Meter in order to prevent any possibility of over-speeding the Field Meter.

Le tuyau de l’appareil d’étalonnage ne doit pas être connecté au débitmètre afin de prévenir toute possibilité que ce dernier passe en

surrégime.

4.3 Master Meter Differential Pressure Test

Note: Refer to Master Meter Differential Pressure Test in the Help Directory for additional information.

Select “Master Meter Differential Pressure Test” from the pull-down menu under the Hours of Operation.

This test measures the differential pressure between the Master Meter inlet pressure transducer (blue 1/4” pressure line) and the Master Meter outlet pressure transducer (black 1/4” pressure line) at the entered flow rates. Normally this test is run with no hose or Field Meter connected to the Master Meter being tested.

The user will have the choice of running a factory preconfigured test sequence or a custom test in which the user will be prompted to enter the Prover capacity and desired flow rates manually. Enter these flow rates into the row of gray boxes that runs across the screen. The test will start and display the differential pressure between the inlet and the outlet of the selected Master Meter. The differential pressures are calculated for the approximate flow rates entered during the differential pressure test’s configuration and displayed on the left side of the computer’s screen. Differential pressure test results are dependent on how the meter is connected. Refer to Figure 37.

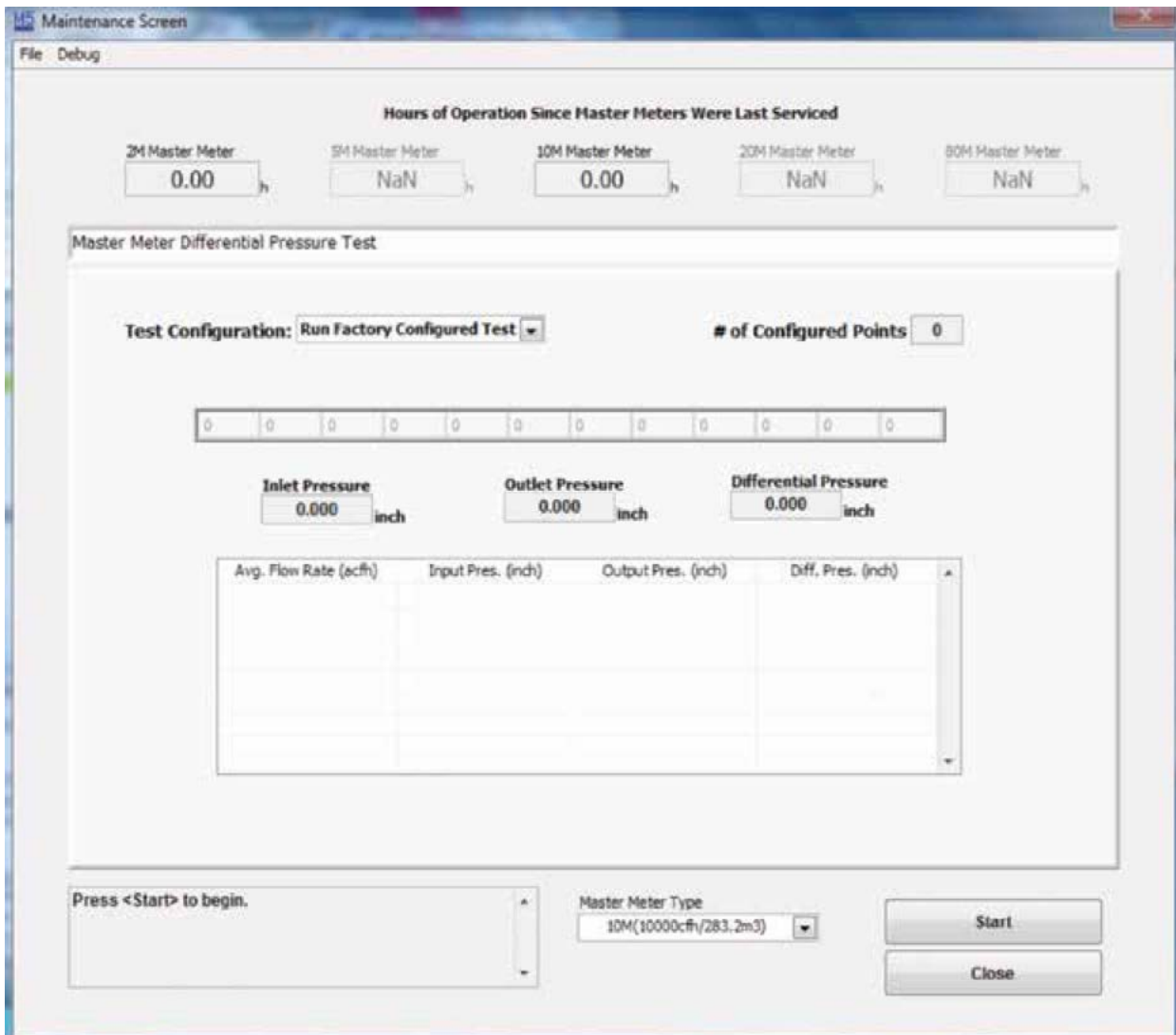


Figure 37: Master Meter Differential Pressure Test Selection

After successful completion of the differential test, a box will appear that will signal completion. At this point the user can print/save the data. The file will be stored in a comma delimited text file in the Data subdirectory under the Model 5 Transfer Prover directory that was created when this software was installed.

4.4 System Leak Test

Refer to Leak Test in the Help Directory for additional information. Select “System Leak Test” from the pull down menu directly under the Hours of Operation. Refer to Figure 38.

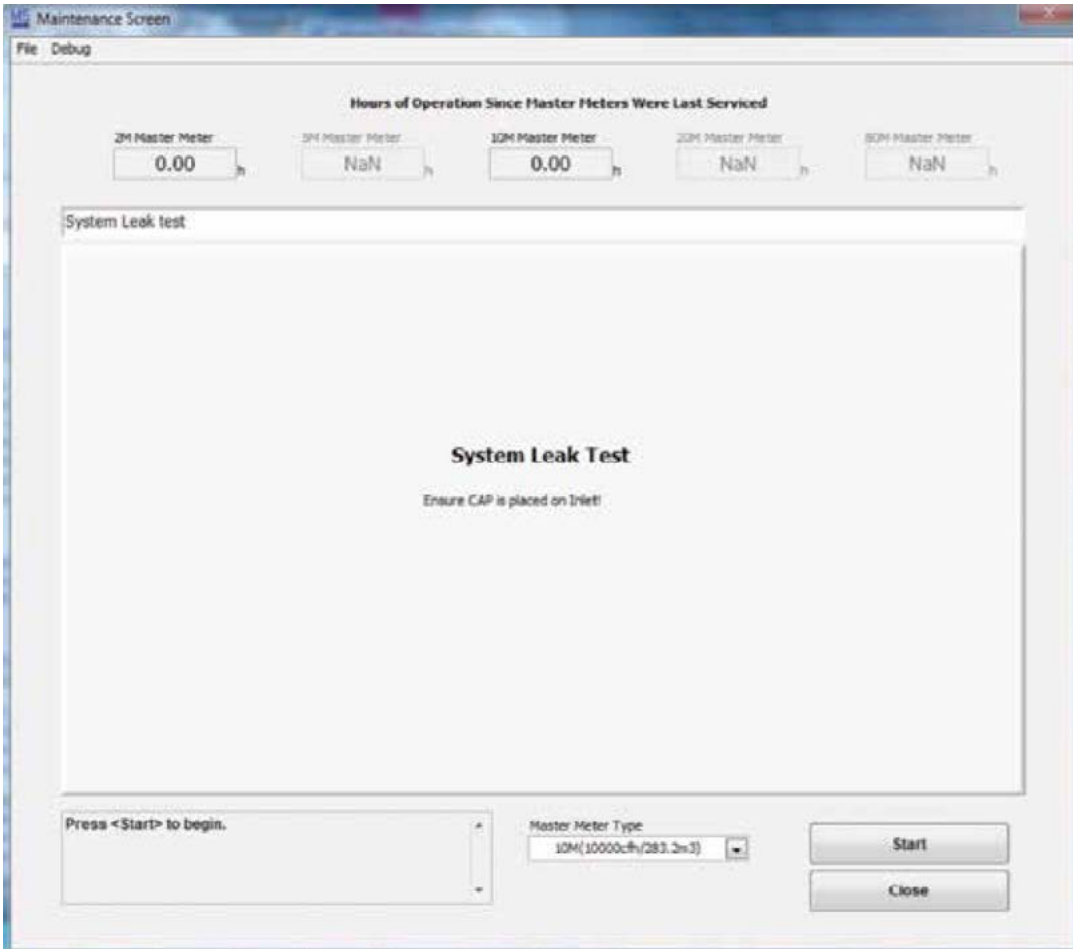


Figure 38: System Leak Test Selection

Perform a leak test to help determine if and where a leak is present in the Prover system. Leakage during a Field Meter test will result in a lower Accuracy (higher Corrected Proof) reading than that typically expected. The volume registered by the meter under test is compared to the volume registered by the Master Meter. In an Automatic test, the Field Meter starts and stops the test according to the test volume selected in the software configuration. Perform a leak test using either the automatic vacuum test or positive pressure method.

Important: Place a Dust Cap over the inlet of the Field Meter and secure in place. If a Dust Cap is not available, use a mating flange and gasket, or another method that will produce an air tight seal at the opening of the Field Meter inlet.

To configure the Model 5 Prover 2M/10M for a leak test, connect the Prover as for testing a meter.

Select either the 10M/283.2m3 or the 2M/56.6m3 Prover capacity in the Master Meter Type drop down menu near the bottom-right of the Maintenance screen. Click on the Start button to initiate the 3-second reasonability test prior to starting the leak test. A Passed or Failed message is displayed on the computer screen, at the end of the test. The Controller will stop the test afterwards.

A Passed or Failed error message will be displayed at the end of each test. If the computer doesn't receive the single pass/fail indicator from the Controller; the blowers may stop without any messages being displayed. If this condition occurs, restart the leak test by first selecting Cancel Test and then clicking on the Start button again. If the mandatory leak test option has been selected in the Prover options menu, the leak test must Pass before any other tests may be performed.

Note: 20M Provers only: Allow time for the main valve to close prior to pressing the start button.

4.5 Meter Purge

Select “Meter Purge” from the pull-down menu under the Hours of Operation.



An explosion may occur if the Prover is operated in the presence of explosive or flammable gases. Always purge the Field Meter and all associated piping prior to running any test. The Prover is not intrinsically safe.

Utiliser l'appareil d'étalonnage à proximité d'une source de gaz explosif ou inflammable peut provoquer une explosion. Toujours purger le débitmètre et toutes les conduites connexes avant d'exécuter un essai. L'appareil d'étalonnage n'est pas équipé de protection à sécurité intrinsèque.

The Field Meter and associated piping may be purged of all flammable gas with a hand-held blower or by using the blowers on the Model 5 Prover. Observe any and all applicable company safety procedures and rules for purging the meter and piping.

If the blowers on the Prover will be used for purging the Field Meter and associated piping, connect as follows:

If the Prover has two Master Meters, make certain the quick-disconnect nipple cap is plugging the unused Master Meter's inlet quick-disconnect nipple.

1. Isolate/remove the Field Meter from the gas line and allow any released gas to dissipate. The Field Meter must be open to atmosphere at both the inlet and the outlet.
2. Install a quick-disconnect nipple in the piping on the inlet side of the Field Meter, or directly to the inlet of the Field Meter if the Field Meter has been removed from all piping.
3. Connect one end of the flexible hose to the single exhaust/outlet male quick disconnect nipple that is marked “Purge”. The exhaust is located at the end of the tank. Connect the other end of the flexible hose to the quick disconnect nipple installed at the inlet side of the Field Meter. The outlet of the Field Meter must be open to the atmosphere so as to allow air to flush any gas from the meter and any associated piping.
4. Observe all company safety procedures and rules for purging meters, and make the proper connections listed above. Place the Model 5 Prover as far from the Field Meter as possible. Place the exhaust from the Field Meter as far as possible from the Prover's blowers. The software must be configured for a meter purge, which is accomplished in either of two ways.
5. Select Prover Maintenance from the Prover Operations drop down menu, then select Meter Purge. Select the appropriate Master Meter type from the drop down menu near the bottom right of the screen. Enter the single flow rate at which to purge the meter into the box in the middle of the screen. Click on the Start button to activate the blowers for the meter purge. Refer to Figure 39.

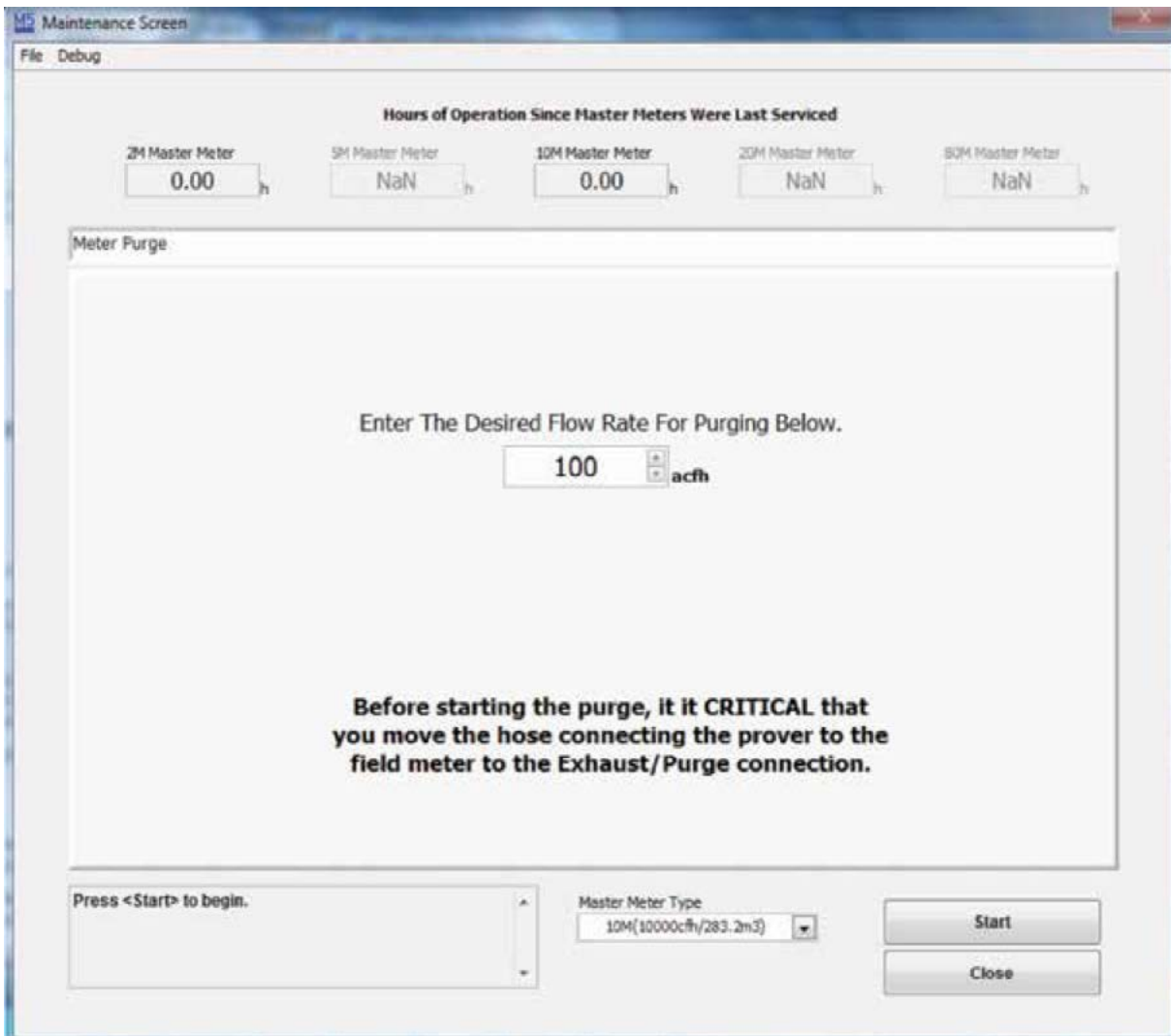


Figure 39: Meter Purge Selection

Important: Do not over-speed the Field Meter.

6. Allow the meter and the associated piping to purge for the required period to remove all flammable gas from the piping and the vicinity of the Model 5 Prover.
7. Select Stop to stop the blowers once the piping, meters, hoses, and the immediate area are clear of gas.

4.6 Maintenance Recommendations

To maintain a high standard of accuracy for the Prover, it is strongly recommend that the complete proving system be returned to the factory for Remanufacture & Recertification using one or more of the following criteria:

1. As dictated by State regulatory agency or Company procedure.
2. Every three to five years, depending upon Prover system condition and frequency of use.
3. Check the Master Meter differential against the original factory differential curve supplied with the new or recertified Master Meter. As long as the differential remains within the limit of 1.0" w.c. at 50% of flow (10,000 acfh) of the value shown on the original curve, the meter accuracy is considered unchanged. For the 5M, the differential should not exceed 0.5" w.c. at 50% of flow.
4. Return the Master Meter to the factory for Remanufacture & Recertification if any of the following conditions are applicable: The differential does not meet the criteria in item #3 (above) at any time or after completing the recommended maintenance procedures, or reference Meter tests results consistently exceed $\pm 0.5\%$ as compared to the original curve.

4.7 Maintenance Check List

4.7.1 Master Meter Inlet Screen

Inspect the Master Meter inlet screen prior to each test.

1. Use a vacuum cleaner to remove debris.
2. Always remove the screen from the Master Meter before cleaning with solvent or attempting to clean by blowing with air through the screen.

4.7.2 Master Meter(s)

Visually inspect the impellers for damage and dirt build-up a minimum of once each month.

1. Remove from the Prover Cart before cleaning.
2. A clean lint free cloth may be used to wipe contamination from the impellers.
3. Do NOT use any type of solvent to flush dirt from the Master Meter.
4. Blow clean, dry compressed air through the Master Meter.

4.7.3 P&T Adapter and the Field Meter Pressure Adapter and All Master Meter Pressure Adapters

Check at least once a month for dust, moisture or contamination.

1. Seal the non-quick disconnect end of the Adapter(s).
2. Apply a pressure of 10 inches of water column to the quick disconnect end of the Adapter(s).
3. Quickly open the sealed end of the Adapters and record-time.
4. Record the time when the pressure in the previously sealed end is equal to ambient pressure.
5. If the time between steps 4 and 3 is less than two (2) minutes, the Adapter is in good condition. If the time is greater than two (2) minutes, replace the Adapter.

4.7.4 Reference Meter Testing



Unplug the extension cord from the Controller.

Débrancher la rallonge du contrôleur.

1. Use a Reference Meter as a standard to monitor the Prover system for changes that could affect test results. The documented history of performance is the baseline for continuous comparisons.
2. When inspecting and characterizing the performance of the Master Meter(s), compare and plot the results against the historical baseline with an acceptable tolerance (i.e., $\pm 0.55\%$).
3. Perform the Reference Meter test on an occasional basis (weekly, monthly, etc.) to ensure Proper prover system condition and repeatability. Run tests any time Field Meter tests are consecutively out of tolerance or there is the suspicion of problems.
4. The Reference Meter should be inspected and its performance characterized at least once every six (6) months by an independent verification agency to ensure the proper operation of the Model 5 Prover.



Note: The following Blower Inspection Instructions do not apply to the large blowers for the 20M Provers. Those blower motors should be inspected and maintained by fully trained and qualified personnel.

Remarque : Les instructions suivantes relatives à l'inspection de soufflante ne s'appliquent pas aux grandes soufflantes des appareils d'étalonnage 20M. Les moteurs de soufflante doivent être inspectés et entretenus uniquement par du personnel compétent et qualifié.

4.7.5 Blowers



Turn the Controller power "OFF" and remove Master Meter(s).

Mettre le contrôleur hors tension (OFF) et déposer le ou les appareils de mesure étalon.

1. Inspect the tightness of the Blower armature brush caps at least once every three (3) months. Carefully re-tighten the brush caps if they are loose, or replace. Switch blower plug connection to the controller once a month to ensure equal wear on both blower brushes.
2. Inspect the armature brushes for wear at least every 400 hours of operation, or as required by apparent changes in sound and arcing. A significant increase in heat can be generated by brushes less than 1/2 inch in length, increasing current and resulting in a premature failure of the blower(s).
3. Remove brush and measure length of square carbon. It should be 1/2" or longer. If not it must be replaced.
4. Install the brush.
5. Re-attach the armature brush caps.
6. Exchange #1 blower to #2 blower each month for averaged usage on the main blower #1.
7. Turn each Blower off by moving its individual power switch to the "OFF" position.
8. Unplug each Blower power cord from the Blower ports (labeled "BLOWER 1" and "BLOWER 2") on the Controller.
9. Plug each Blower power cord (one at a time) into a 120 VAC electrical power source.
10. Turn the corresponding Blower power switch to the "ON" position.
11. The Blower motor bearings are good if the motor sounds "smooth".
12. Repeat the above steps (1 through 11) for the other Blower.

4.7.6 Prover Cart

10M Only

1. Check the air pressure in the Prover Cart's tires at least once a year. Maintain tire pressure at 30 psig.

All Provers

2. Clean the frame, wheels, tool box, and exterior surfaces of the Master Meter(s) with a damp cloth and compressed air, as needed.
3. Inspect the inside of the Silencer(s) at least once every three (3) months for obstructions and loose noise absorbing material.
4. Inspect all cables for frays. Replace as required.

4.7.7 Accessories

1. Inspect all flexible hoses, caps, and plugs for damage. Replace as required.
2. Clean the quick-disconnect couplings once every three (3) months using a degreaser. If the quick disconnect is removed from the Master Meter, apply a thin film of aluminum anti-seize compound on the male threads before reinstalling.
3. Once a month, inspect all electrical cables for damage and to ensure that the connectors are clean and pins/contacts are straight.
4. Inspect the Instrument Drive (ID) Pulser for damage prior to and after each use.
5. Inspect the Optical Scanner for damage prior to and after each use.

4.8 Common Operation Problems

4.8.1 Prover doesn't stabilize at the proper Flow Rate

For 2M/10M Systems

The most likely cause would be a problem with the valve mechanism. Some examples of this include a sticking solenoid, valve, or valve linkage; a worn, damaged, or improperly adjusted valve linkage; or an obstruction in the valve, valve piping, meter(s), silencer, or hose(s). A malfunction by the Blower or the Blower's Controller may also be the cause. For suspected Blower problems, try swapping the Blower power cords where they connect into the Controller. Try turning the Controller off and then back on to reset the electronics. Then reconfigure or reselect the test settings, restart, and rerun the test. Flow Rate surging is typically due to insufficient back pressure in the system, which causes the valves to open too far. Blowers at maximum power usually means that there is a restriction somewhere in the system or that the solenoid-operated butterfly valve is not opening properly.

For 5M/20M Systems

The most likely cause is a malfunction in the motorized gate valve, slip clutch, or gear reduction mechanisms. Turning the power switch off and then back on causes the Controller to energize the valve positioning motor to close the gate valve. The slip clutch must not slip until the gate valve is fully closed. Once the valve closes, the slip clutch should slip for several seconds.

One or more of the Blowers comes on without initiating a test

The Blower(s) are controlled by the electronics in the Controller. If one of the triacs controlling the Blower(s) operation shorts or leaks, the Blower may start or run faster than it is supposed to. Usually turning the Controller off, waiting a few seconds, then turning it back on will correct the problem. If the problem persists, contact the factory for assistance.

4.8.2 The test stops shortly after the Blowers start (the Blowers start and then stop almost immediately)

If the Controller gets no indication that the Master Meter's impellers have started rotating, the Controller will stop the test once the Blowers start. No error messages appear but the test ends with no indication other than that the Blowers have stopped. This commonly occurs after a Leak Test if the seal at the inlet of the Field Meter was not removed. The error could also occur upon initial start up if the shipping seals have not been removed from the Master Meter(s) and the air exhaust(s) port. It could also occur if debris or trash restricts air flow or locks up the Master Meter. Insufficient power can also cause this problem.

4.8.3 The Prover software or the computer locks up

If this happens, make note of where and how the malfunction occurred and what keys were pressed.

Be able to describe exactly what appeared on the screen before and after the problem occurred. Try turning the computer and the Controller off, wait several seconds, and turn both of them back on again; then attempt to duplicate the problem. Make certain that at least 32 megabytes of RAM memory are available to the Prover software. Try opening other software programs that are installed on the computer (for example a spreadsheet or a word processing program) to verify that the computer is fully functional. If the computer itself does not appear to be the problem, try reinstalling the Prover software from the original disk (or the backup of the original disk). If the problem persists, contact the factory for assistance.

4.8.4 Accuracy is out of specification

The accuracy will not be what it is supposed to if the Field Meter needs servicing. Factors that affect the accuracy of a transfer Prover include the length and volume of the hose, elbows, and transitions; the size and interaction between the Field and Master Meters; where the pressures and temperatures are measured; and the stability of the testing environment. Pressure pulsations commonly occur when transfer testing Field Meters. These pulsations or resonant points can be rather pronounced at certain flow rates under otherwise normal operating conditions. The effects of these resonant points can be minimized by increasing or decreasing the flow rate slightly. Acoustical filters are available to reduce or eliminate the effects of pulsations and resonance. Contact the factory for details.

4.8.5 Accuracy varies when conducting outdoor meter testing

An unstable operating environment can have a noticeable effect on meter test results. The most common effect can be seen when testing meters outside in direct sunlight. The sun's warmth can heat the air traveling through the Flexible Hose so that by the time the air reaches the Master Meter, an increase of 20 degrees Fahrenheit is quite possible. The Master Meter may remain very close to the ambient air temperature and change only very slowly, while the temperature of the air traveling through the Flexible Hose fluctuates rapidly as clouds, wind, and/or shade affect it. The measured Master Meter temperature, even though situated in the center of the air stream, may not exactly match the actual temperature of the measured volume inside the Master Meter's measuring chamber. These effects can be reduced significantly by shading the Flexible Hose and insulating it as much as possible from dramatic temperature changes above or below ambient conditions.

4.9 Troubleshooting Error Messages

4.9.1 "FAILURE TO REACH FLOW RATE"

This error appears in the upper right corner of the test screen if the Controller has not reached the configured flow rate within a specified amount of time after the Master Meter temperature has stabilized. Possible causes are that the Blower(s) are not turned on or plugged into the Controller; or that there is a restriction in the piping, meters, the silencer, or the Flexible Hose(s). Check and clean the screens at the inlet of the Master Meter(s) regularly. Problems with the valves, the valve solenoid, or valve linkages may also generate this error. Make sure the connector plug from the valve solenoid is attached into the Controller at the connector labeled THROTTLE VALVE. Notice what the displayed flow rate actually is to determine whether or not a problem exists. The appearance of this message does not prevent the start of a test, nor does it necessarily mean there is a problem with the Prover. It merely indicates that it took longer than the typical amount of time to reach the desired flow rate.

4.9.2 "CAUTION: TEST DURATION BELOW RECOMMENDED 30 SECOND MINIMUM"

This message displays any time a meter test is configured and/or completed where the test duration is less than 30 seconds. It is merely a reminder that the best results are obtained using tests that are configured to run for at least 30 seconds in duration. The test data is sampled once each second, so a test lasting at least 30 seconds yields better results than tests of a shorter duration.

4.9.3 "WARNING"

This message appears under any one of the temperature or meter pressure transducer displays in the Meter Test Screen. If this error displays it means that the transducer's output exceeded the "normal" limits of the transducer's operation. If more than one Flexible Hose is connected between the Field and Master Meters, or if a restriction in the hose develops, etc., this message will appear. This is only an indication that a problem may exist, not that a transducer has failed. Once this message appears, it does not go away until the next configured test starts or until the current configured test is restarted. The test continues, and the results are calculated using the averaged test data regardless of the appearance of the message. Refer to Pressure Reasonability Settings in the Help Directory for additional information. Contact the factory for assistance if necessary.

4.9.4 "FATAL ERROR"

This message appears under any one of the temperature or meter pressure transducer displays in the Meter Test Screen. This message will appear when the transducer's

value, immediately above the displayed message, is beyond the operable limits of the individual transducer. Once the message appears it forces the termination of the current test. The condition must be corrected before proper operation of the system may resume. Contact the factory for assistance if necessary.

4.9.5 "COMMUNICATION ERRORS"

This message displays during the running of a test. The software monitors the data transmissions from the Controller to the computer. If for any reason even one of these one-second interval data transmissions is not received or is not processed properly, this message will appear in the middle of the screen. The message will remain on the screen, through the up to 6 individual test runs, until the software clears the currently displayed screen. The message appears and remains even if only one transmission was not processed out of hundreds. Occasional displays of this message can be considered acceptable. The test can continue and it should complete normally; however, Dresser NGS Meters & Instruments recommends repeating tests where this message has appeared. Missed data transmissions that occur during an actual test will advance the error message's counter, while the duration counter is incrementing. Data transmissions that occur outside of an actual test merely display the error message but do not increment the error message's counter. One out of 30 transmissions should not affect the results significantly. If the error message appears frequently, the source of the problem should be identified and corrected. Contact the factory for assistance.

4.9.6 "A/C INPUT FREQUENCY TO HI/LOW"

This message appears whenever the supply power's frequency varies beyond specified limits. The warning message goes away automatically once the problem is no longer detected by the Controller's electronic circuitry. This problem typically appears when generators are used as the Prover's power source.

Appendix

A. Measurement Uncertainty of the Dresser Model 5 Prover

In meter testing, it is important to understand the realities of measurement accuracy and acceptable system error. This is commonly referred to as measurement uncertainty. The American National Standard for Rotary Type Gas Displacement Meters, ANSI B109.3, PART VII, Test Methods and Equipment, 7.2 Measurement Reference Base states: "The final authority for all standards of measurement in the United States is the National Institute of Standards and Technology (NIST) ..." Part VII, 7.5.3 Accuracy addresses "Accuracy of Test Standards," "Uncertainties of Observations," and "Uncertainties in Method of Test." This often over-looked subject is an important component of measurement standards, test equipment and test methods. Part VII, Test Methods and Equipment, 7.6 Calibration of Meter Testing Systems, 7.6.1 General, second paragraph states: "Meter testing systems shall be calibrated when first installed, and following alterations, damage or repairs which might affect accuracy. To assure that the accuracy of the meter testing systems is maintained on a continuous basis, a daily leakage test shall be made and a periodic accuracy indication with a test meter of known accuracy shall be made. If the test results differ by more than ± 0.5 percent from the test meter accuracy, the cause of the error shall be determined and necessary corrections made prior to reuse of the system."

Secondary test devices such as Bell or Piston type provers traceable to NIST are recognized by the Natural Gas Industry as having an accuracy of $\pm 0.25\%$. These provers are used to establish the accuracy presets for a transfer prover Master Meter – a tertiary test device (third removed from NIST traceability). The accumulated errors of all three standards, as well as the errors of the associated equipment must be considered when analyzing meter test results.

What does this mean? A test could result in an indicated meter accuracy of 101.25% and still be considered accurate and within specification. How? By adding in the uncertainty

of the prover. A prover testing at the high end of its accuracy band ($\pm 0.55\%$) and a meter testing at the higher end of its specification (i.e., 100.7%) would have a combined theoretical error of + 1.25% ($100.55 \times 100.7 + 100$).

As recommended by ANSI, a test meter of known accuracy (Reference Meter) should be used in problem identification and resolution. A factory-certified accuracy curve is supplied with each ROOTS reference meter. To characterize the performance of the Transfer Prover System, a reference meter should be tested on the prover and the test results then plotted and/or compared against the historical baseline data. This is best method for a quick prover operational check and verification of repeatability.

Errors associated with measurement of pressure, temperature and flow rate contribute to the overall uncertainty of the testing process. Assuming that all factory recommended test procedures are followed, the test environment is within the specified tolerances, and all associated equipment is in proper working order - the overall uncertainty of the Prover system can exceed the system design or specified accuracy. A significant reduction in uncertainty can be accomplished by: (1) calibrating the equipment under the conditions that it will be used during testing; (2) ensuring that the test points do not correspond to a flow condition that would cause resonance; and (3) by using larger test volumes.

Note: It is extremely important that the meter(s) to be tested is/are stored (soaked) for a minimum of eight hours in the stable environment in which the testing will be conducted. Meter soaking and test environment stability allow the probe well temperature to equalize to the temperature of the air flowing through the meter. Significant increases in uncertainty (greater errors) can occur if the meter is not properly conditioned prior to testing or if the test environment is not stable during testing. During field testing, consideration must be given for the induced errors due to unstable or averaged temperatures during a test sequence.

The ISO Guide method for calculating measurement uncertainty should be used to determine the total overall uncertainty.

B. TC Unit Operational Check

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

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

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

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

Procedure for the TC Unit Operational Check

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

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

2. Record the temperature displayed by the Accessory Unit's temperature probe. The indicated temperature is visible through the accessory housing window located above the odometers.

Compare to the readings taken in step 1. Both values should agree within $\pm 4^{\circ}\text{F}$.

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

3. Observe the Temperature Compensated volume odometer. When the odometer stops turning after an intermittent compensating cycle, record the last 3-digit reading (Ci) indicated on the odometer, PLUS the value indicated by the graduated marks on the test wheel. Read as a whole number. (See the Sample Counter Reading in Figure 40 below.)

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

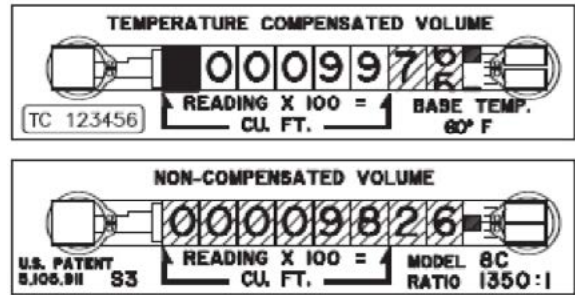


Figure 40 - A reading of 9756 would be the number recorded for TC unit operational check.

4. After the Compensated Volume odometer has cycled 25 times and stopped, record the last 3 digits of the Temperature Compensated odometer (Cf), PLUS the graduated wheel estimation as described in Step 3 on previous page.
5. Use the calculation described in the next section (Calculating Theoretical Counts) to determine the Theoretical Number of Counts (TNC) for the indicated temperature recorded in Step 1.
6. Calculate the percent accuracy of the TC Unit with the following equation:

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

Example: Assume the gas temperature is 53.0°F , and from Figure 22, the initial odometer reading (Ci) = 9756. We then allow the odometer to cycle 25 times and record the final reading. We will further assume the final odometer reading (Cf) = 12295.

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

From Table 1, the Theoretical Number of Counts (TNC) = 2534.1.

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

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

Calculating Theoretical Counts

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

Where TB = Base Temperature (Typically 60° F)

TA = Actual Gas Temperature

Therefore:

Theoretical Number of Counts (TNC) =

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

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

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

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

C. Combined Accuracy Test (TC)

To run a combined accuracy test, follow the “Equipment Set-up” and the “To Configure And Run A Meter Test” procedures.

Note: It is extremely important that the temperature environment in which the test will be conducted is stable. Temperature fluctuations of 1°F can easily result in a ±0.2 percent error in the test results.

For manually start/stopped tests, a large enough test volume should be selected to compensate for any error introduced by the operator. Typically, a configuration where +/- 1.0 cubic foot per 1000 cubic feet of test volume equates to an error of less than +/-0.1%.

Meter Capacity	TC Option Selection	Pulses/Test (PPT)	Test Volume
8C-11M	Mechanical TC	400	200 CF
16M	16M Only Mechanical TC	400	2000 CF
(8C-3M) (G16-G65)	Mechanical TC 8C-3M	400	2 m ³
(5M-16M) (G160-G250)	Mechanical TC 5M-16M	400	20 m ³

The drive rate of the TC unit refers to the volume of gas measured for each complete cycle of the least significant digit of the compensated odometer (the furthest right wheel). TC odometers have 10 segments; each segment is equal to 1/10th of the drive rate. If the TC's drive rate = 10 CF, the total number of segments seen by the scanner during a 200 CF test would be 200. When “MECHANICAL TC” or “MECHANICAL TC 16M ONLY” is selected it causes the Prover

Confirm the BASE TEMPERATURE of the temperature compensated meter is entered correctly for the BASE TEMPERATURE CORRECTION field. The BASE TEMPERATURE is usually 60°F or 15°C for most meters, but other base temperatures can be used.

Testing Continuously Compensated meters:

Make the following configuration settings in the test configuration screen:

Click TEST CONTROL MODE, and select the appropriate selection; ID, OPTO – Optical Scanner/IRDA, or MANUAL. When selecting the METER OUTPUT, select TC and highlight the “DIAPHRAGM TC” inside the “TC Options.” For Diaphragm meters select a test volume large enough to ensure full rotations of the Instrument drive, tangents and linkages per the meter manufacturer’s minimum requirements. This will help assure more accurate and repeatable results.

Testing Intermittently Compensated Dresser NGS Meters:

Dresser NGS recommends using either the RS-PB or RS-LCD optical pickup to test Dresser MECHANICAL TC meters. The ID PULSER unit should not be used to test intermittently compensated meters, as results can vary widely.

Make the following configuration settings in the test configuration screen:

Click TEST CONTROL MODE, and select “OPTO.” When selecting the METER OUTPUT, select TC and highlight the “MECHANICAL TC” or “MECHANICAL TC 16M ONLY” inside the “TC Options.”

Connect the Dresser TC meter as for testing standard or non-TC meters. Testing with the RS type optical scanner, Dresser recommends the following minimum test volume values to equate to 400 PULSES/TEST, for each appropriate meter size corresponding to the appropriate TC option:

Software to count transitions from black to white and back rather than complete pulses or blocks. Two transitions make up each pulse. This is why you must double the number of pulses for all MECHANICAL TC options listed above. If you would normally enter 200 PPT for an uncorrected meter, for a temperature compensated meter test you would enter two times 200, or 400 PPT.

Table 1 - Temperature Cycle Testing -Theoretical Number of Counts (TNC) for specified temperature in degrees Fahrenheit (°F) and degrees Celsius (°C). Based on 25 Temperature Compensation Cycles.

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

ROOTS™ Prover Model No. 5 Parts List and Accessories

Description	Meter Size	Part Number
Tool Box/Large Black Accessory Case	1	012849-000
Field Meter Pressure Adapter	1	052579-000
Field Meter Pressure & Temperature Adapter	1	052580-000
Field Meter Temperature Probe	1	051998-000
Field Meter Instrument Drive Pulser	1	052191-000
Field Meter Instrument Drive Pulser Cable	1	051993-000
Manual Start/Stop Cable	1	052485-000
Blue Pressure Tubing	2 – 48"	011290-001
Black Pressure Tubing	2 – 48"	011290-002
25' Electrical Extension Cord	1	012850-000
Computer Cable to Controller	1	052017-000
Field Meter Junction Box 30' (requires calibration)	1	052000-000
3" Aluminum Hose Plug	1	011323-008
Cable Master Meter to Controller	1 – 45"	051992-000
Cable Master Meter to Controller (Extended Length)	1 – 25'	051992-100
3" Kamlock Cap	1	012444-000
Thumb Screw (included w/pulser)	2	011501-002
Clamp for holding ID Pulser (included w/pulser)	2	042991-000
Blower	2	052188-000
Blower Brushes	4	046894-000
25' Prover hose	1	043441-000
Hose Gasket	2	013287-000
10M Master Meter	1	058259-100
10M Master Meter Temperature Probe	1	051999-002
2M Master Meter Assembly	1	058332-101
2M Master Meter Temperature Probe	1	051999-001
Conversion Kit From 10M to 2M/10M	1	052288-004
Quick Disconnect Shut Off Valve	4	012844-002
Knurls (Flareless Fitting)	4	012796-003
Controller	1	052013-001
Resettable Circuit Breaker	1	013355-000
Triac Board - 10M and Mobile 5	1	058326-100
Triac Board (Expandable) 5M/20M and 80M	1	058326-110
Triac Board (Expansion) 5M/20M and 80M	1	058326-120
Solenoid	1	012840-003
Pulsation Dampener (Snubber)	4	012505-003
Seal Fitting for Temperature Probes	3	012918-001
Cart Tire and Wheel	2	011900-000
Acoustic Filter	1	052899-000
RS-PB Scanner Kit	1	052519-200
RS-PB Scanner Assembly	1	051997-200
Inverter Vanner - Trusine	1	012966-000
Male Quick Disconnect Nipple for Hose Adapter	1	011321-001
Female Quick Disconnect Nipple for Hose Adapter	1	011322-001
Smart Prove & USB to Serial Port Convertor	1	058860-100
Smart Prove Cable (only NOCD)	1	058687-000
Field Meter Junction Box 60' (requires calibration)	1	052000-100

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