INSTALLATION & OPERATION MANUAL

MODEL TPS1500
Calibration Proving System

Turbines, Inc.™

METER PROVER OPERATION-COMPREHENSIVE

WARNING

Never drop any component of the prover system; carefully place each component in desired location.

The Temperature Probe MUST be removed before installation or removal of transition piping. The probe is easily damaged by any type of shock.

All prover runs are to be made using temperature compensation.

PROCEDURES

Assemble prover piping on the discharge of the trailer to be proved. The prover MUST be supported.

Install the temperature probe.

Connect all wiring to the prover.

Cool down piping by allowing liquid to flow. You may pump off for a short period of time to complete cool down.

DURING COOL DOWN

Note the calibration factor entered on the trailer's totalizer.

Set up the TPS1500 for the prover run.

NOTE: Numerical data will be typed by pressing the desired digit keys. If a mistake is made, press the "**CLEAR/FEED**" key to erase the entire line typed, or press the " ← " key to erase the last number typed. Press the "**ENTER**" key when the number is correct.

INITIAL SET-UP MODE

Depress and Hold "**RESET"** key and turn power **"ON"**
The prover **"SET-UP"** menu will be displayed.

```
1 = Clock      3 = Factor
2 = RTD        4 = More
```
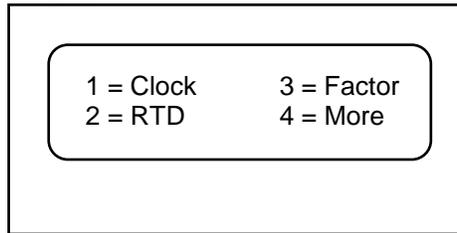
Depress **"PRINT"** key
Set-up ticket will be printed.

Example:

```
        <<<<<<<<>>>>>>>

          Flo-cal setup
        11:20A 12-Apr-13

Product       = Factor
0 - LOX    R = .4063
           T = .779419
1 - LIN    R = .4063
           T = .63051
2 - LAR    R = .4063
           T = .761813
3 - LCO2   R = .4063
           T = .057356
4 - LN20   R =  0
           T =  0
5 - CC02   R = .4063
           T = .057356
6 - MAPP   R =  0
           T =  0
7 - LPG    R =  0
           T =  0
```

Note: Each Prover is factory calibrated for products and engineering units of total as specified by user.
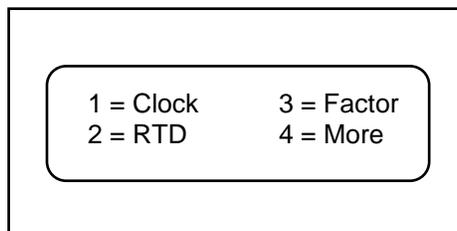
Calibration Factors
Rate is always Gallons per minute (Gm)
$Rfactor = 60/K$
Totalization may be any engineering units.
Tfactor - Engineering Units/K

The prover **"SET-UP"** menu will be displayed. To exit the **"SET-UP"** menu depress **"RESET"** key.

```
1 = Clock      3 = Factor
2 = RTD        4 = More
```
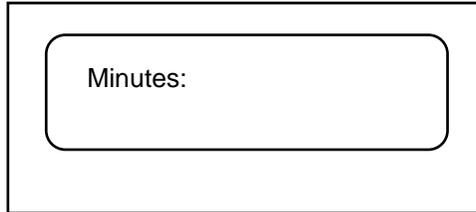
NOTE: Prover is factory calibrated *DO NOT* select Set-up option **"3-Factor"**. If printed set-up data is incorrect, incomplete or missing contact **Turbines R&D at (864)882-4544**.
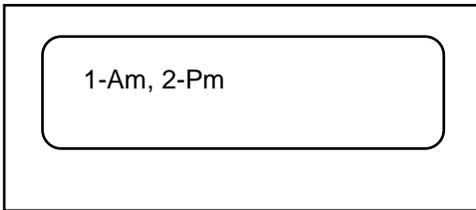
Select **"1-Clock"** by pressing **"1"** key.
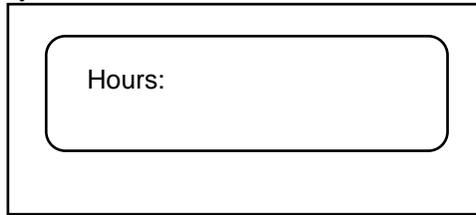
```
┌─────────────────────────────────┐
│  ╭───────────────────────────╮  │
│  │                           │  │
│  │   Hours:                  │  │
│  │                           │  │
│  ╰───────────────────────────╯  │
│                                 │
└─────────────────────────────────┘
```

Enter the correct hour (1-12). The number entered will be displayed on the second line of the display.
Press **"ENTER"** key.

```
┌─────────────────────────────────┐
│  ╭───────────────────────────╮  │
│  │                           │  │
│  │   Minutes:                │  │
│  │                           │  │
│  ╰───────────────────────────╯  │
│                                 │
└─────────────────────────────────┘
```
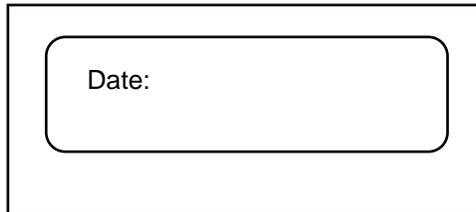
Enter the correct minutes (0-59). The minute entered will be displayed on the second line of the display.
Press **"ENTER"** key.

```
┌─────────────────────────────────┐
│  ╭───────────────────────────╮  │
│  │                           │  │
│  │   1-Am, 2-Pm              │  │
│  │                           │  │
│  ╰───────────────────────────╯  │
│                                 │
└─────────────────────────────────┘
```
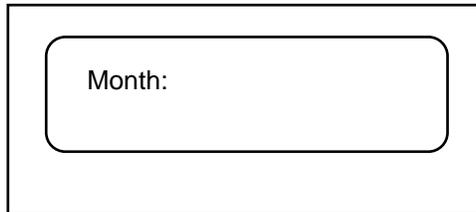
Press **"1"** key if correct time is **"AM"** or Press **"2"** key if correct time is **"PM".**
Press **"ENTER"** key.

```
┌─────────────────────────────────┐
│  ╭───────────────────────────╮  │
│  │                           │  │
│  │   Date:                   │  │
│  │                           │  │
│  ╰───────────────────────────╯  │
│                                 │
└─────────────────────────────────┘
```

Enter the correct date (1-31).
Press **"ENTER"** key.

```
┌─────────────────────────────────┐
│  ╭───────────────────────────╮  │
│  │                           │  │
│  │   Month:                  │  │
│  │                           │  │
│  ╰───────────────────────────╯  │
│                                 │
└─────────────────────────────────┘
```

Enter the correct month (1-12).
Press **"ENTER"** key.
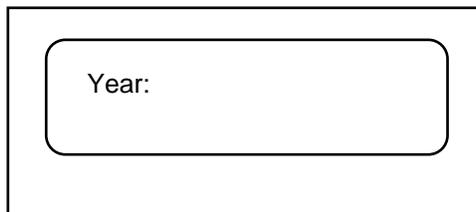
```
┌─────────────────────────────────┐
│  ╭───────────────────────────╮  │
│  │                           │  │
│  │   Year:                   │  │
│  │                           │  │
│  ╰───────────────────────────╯  │
│                                 │
└─────────────────────────────────┘
```

Enter the correct year (1-99).
Press **"ENTER"** key.

"SET-UP" menu will
be displayed:

```
+----------------------------------+
|  +----------------------------+  |
|  |  1 = Clock      3 = Factor |  |
|  |  2 = RTD        4 = More   |  |
|  +----------------------------+  |
|                                  |
+----------------------------------+
```
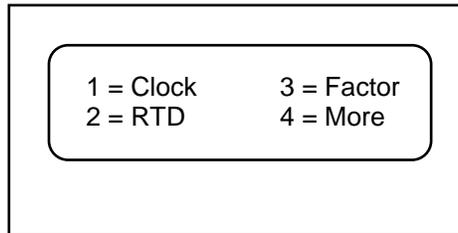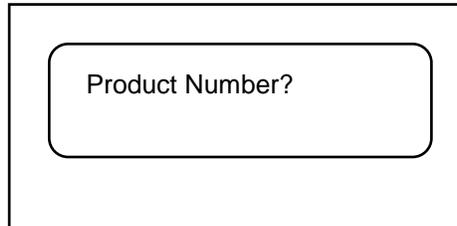
"**2-RTD**" should not be selected. *This is a factory calibration function*.

"3-Factor" <u>NOTE:</u> Prover is factory calibrated. *DO NOT* select **without** contacting **Turbines R&D at (864)882-4544**. Select **"3-Factor"** by pressing **"3"** key.
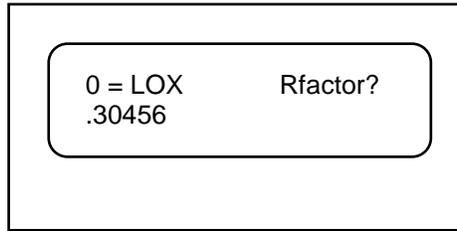 ***NOTE: To exit the **"SET-UP"** menu press **"RESET"** key.

PRODUCT SELECTOR
　　0 = LOX
　　1 = LIN
　　2 = LAR
　　3 = LCO2
　　4 = N20
　　5 = CCO2
　　6 = MAPP
　　7 = LPG

```
+----------------------------------+
|  +----------------------------+  |
|  |                            |  |
|  |  Product Number?           |  |
|  |                            |  |
|  +----------------------------+  |
|                                  |
+----------------------------------+
```

Select desired product and press corresponding key.

```
+----------------------------------+
|  +----------------------------+  |
|  |  0 = LOX        Rfactor?   |  |
|  |  .30456                    |  |
|  +----------------------------+  |
|                                  |
+----------------------------------+
```
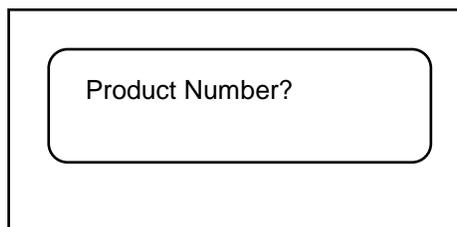
To retain displayed Rfactor: Press **"RESET"** key, display will advance.
To change displayed Rfactor: Press **"CLEAR/FEED"** key. Enter new Rfactor,
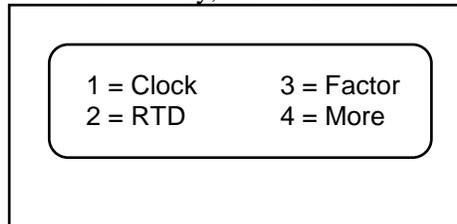 Press **"ENTER"** key, display will advance.

```
+----------------------------------+
|  +----------------------------+  |
|  |  0 = LOX        Tfactor    |  |
|  |  .005076                   |  |
|  +----------------------------+  |
|                                  |
+----------------------------------+
```

To retain displayed Tfactor: Press **"RESET"** key, display will advance.
To change displayed Tfactor: Press **"CLEAR/FEED"** key, Enter new Tfactor,
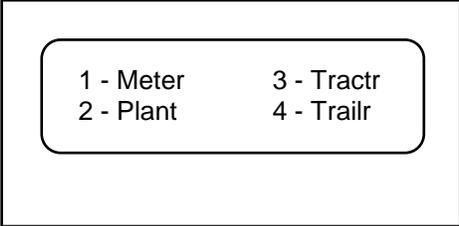Press **"ENTER"** key, display will advance.

```
+----------------------------------+
|  +----------------------------+  |
|  |                            |  |
|  |  Product Number?           |  |
|  |                            |  |
|  +----------------------------+  |
|                                  |
+----------------------------------+
```

To continue **"FACTOR":** Select desired product, press corresponding key.   Repeat.
To exit the **"FACTOR"** menu: Press **"RESET"** key, **"SET-UP"** menu will be displayed:

```
+----------------------------------+
|  +----------------------------+  |
|  |  1 = Clock      3 = Factor |  |
|  |  2 = RTD        4 = More   |  |
|  +----------------------------+  |
|                                  |
+----------------------------------+
```

Select **"4=More"** by pressing **"4"** key. **"MORE"** menu will be displayed.

```
┌─────────────────────────────┐
│  1 - Meter      3 - Tractr  │
│  2 - Plant      4 - Trailr  │
└─────────────────────────────┘
```

Select **"1-Meter"** by pressing **"1"** key.

```
┌─────────────────────────────┐
│  Meter:                     │
│                             │
└─────────────────────────────┘
```
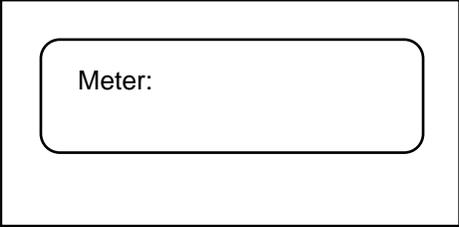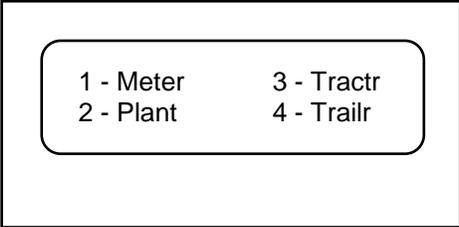
Press **"CLEAR/FEED"** key: Enter serial number of turbine meter under test,
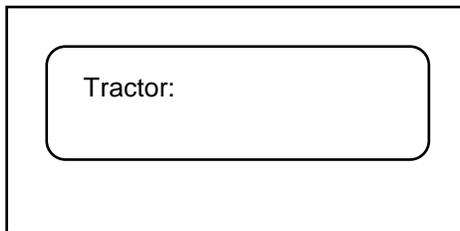Press **"ENTER"** key: **"MORE"** menu will again be displayed.

```
┌─────────────────────────────┐
│  1 - Meter      3 - Tractr  │
│  2 - Plant      4 - Trailr  │
└─────────────────────────────┘
```
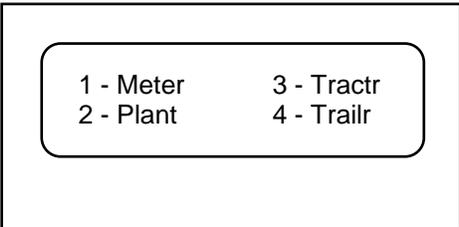
Select **"2=Plant"** by pressing **"2"** key

```
┌─────────────────────────────┐
│  Plant:                     │
│                             │
└─────────────────────────────┘
```
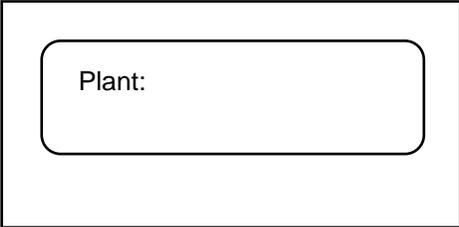
Press **"CLEAR/FEED"** key.   Enter Plant number, Press **"ENTER"** key.
"MORE" menu will again be displayed.

```
┌─────────────────────────────┐
│  1 - Meter      3 - Tractr  │
│  2 - Plant      4 - Trailr  │
└─────────────────────────────┘
```

Select **"3 - Tractr"** by pressing **"3"** key.

```
┌─────────────────────────────┐
│  ╭───────────────────────╮  │
│  │                       │  │
│  │   Tractor:            │  │
│  │                       │  │
│  ╰───────────────────────╯  │
│                             │
└─────────────────────────────┘
```

Press **"CLEAR/FEED"** key.   Enter Tractor number, Press **"ENTER"** key.
"MORE" menu will again be displayed.
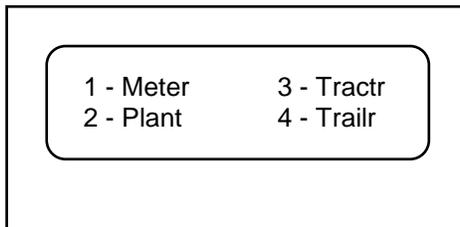
```
┌─────────────────────────────┐
│  ╭───────────────────────╮  │
│  │  1 - Meter    3 - Tractr│ │
│  │  2 - Plant    4 - Trailr│ │
│  ╰───────────────────────╯  │
│                             │
└─────────────────────────────┘
```

Select **"4 - Trailr"** by pressing **"4"** key.
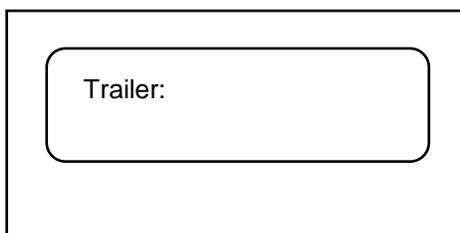
```
┌─────────────────────────────┐
│  ╭───────────────────────╮  │
│  │                       │  │
│  │   Trailer:            │  │
│  │                       │  │
│  ╰───────────────────────╯  │
│                             │
└─────────────────────────────┘
```

Press **"CLEAR/FEED"** key.   Enter Trailer number, Press **"ENTER"** key.
"MORE" menu will again be displayed.
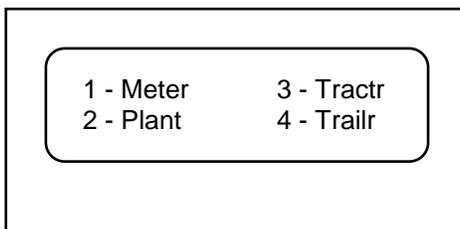
```
┌─────────────────────────────┐
│  ╭───────────────────────╮  │
│  │  1 - Meter    3 - Tractr│ │
│  │  2 - Plant    4 - Trailr│ │
│  ╰───────────────────────╯  │
│                             │
└─────────────────────────────┘
```

Press **"RESET"**. **"SET-UP"** menu will again be displayed:
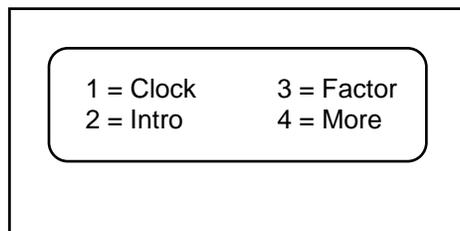
```
┌─────────────────────────────┐
│  ╭───────────────────────╮  │
│  │  1 = Clock    3 = Factor│ │
│  │  2 = Intro    4 = More  │ │
│  ╰───────────────────────╯  │
│                             │
└─────────────────────────────┘
```

Initial set-up is complete, Press **"RESET"** key to change to the **OPERATING SET-UP MODE**.

SET-UP OPERATING MODE

```
          **Flo-Cal**

11:20A          12-Apr-13
```

```
     Press any key
     to continue
```
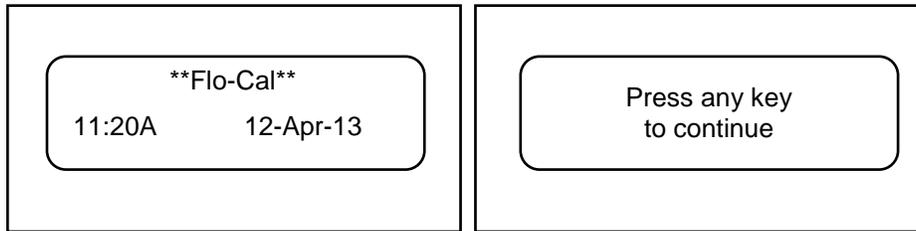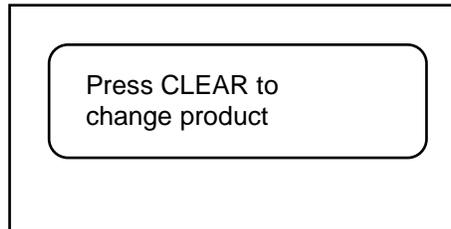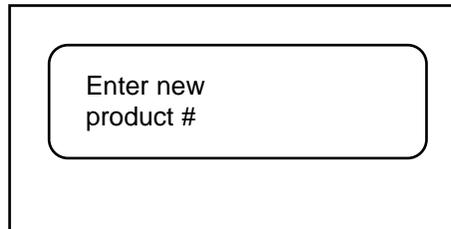
TPS1500 will alternate these 2 displays until **"RESET"** is pressed.
Correct product must be displayed in the upper left hand corner.

```
LIN            No T/C
Gm 0           GO PROVE
```
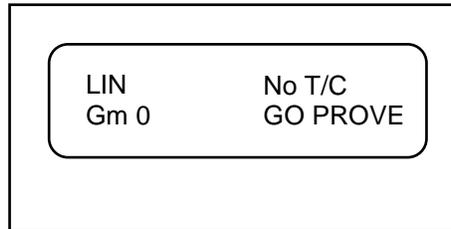
To change product, press **"←"** key.

```
Press CLEAR to
change product
```

Press **"CLEAR/FEED"** key.

```
Enter new
product #
```
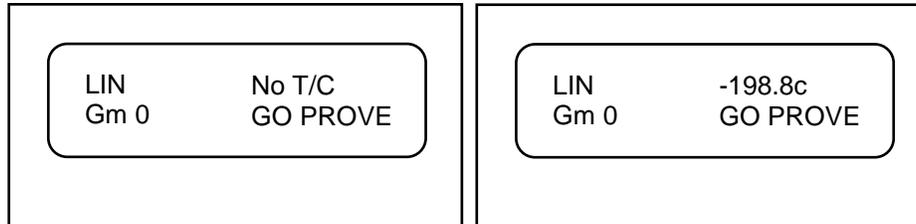
Enter product number desired:

```
        PRODUCT SELECTOR
            0 = LOX
            1 = LIN
            2 = LAR
            3 = LCO2
            4 = N20
            5 = CCO2
            6 = MAPP
            7 = LPG
```

With correct product displayed, check in upper right hand corner of the display for a temperature reading or the words **"No T/C"**. If **"No T/C"** is displayed, press the **"TC TOGGLE"** key to switch on the temperature compensation.

```
LIN            No T/C
Gm 0           GO PROVE
```

```
LIN            -198.8c
Gm 0           GO PROVE
```

**All prover runs are to be made using temperature compensation.
If **"+426H" is displayed, the temperature probe or cable is open.
If **"-270.9L" is displayed, the temperature probe or cable is shorted.

PROVING MODE

Cool down is verified by the temperature display. The temperature displayed along with a small **"c"** indicates the prover piping is cooled down. The temperature displayed with **"H"** indicates temperature is high; with **"L"** indicates temperature is low (out of range).

```
LIN              -198.8c
Gm 0             GO PROVE
```
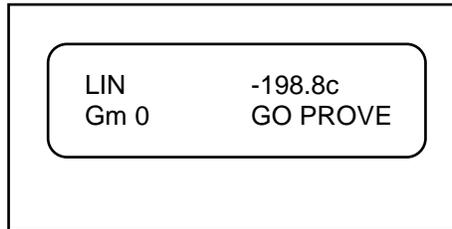
NOTE: The temperature correction factor **(TCF)** may be viewed by pressing & holding the **"ENTER"** key.

```
LIN           No T/C
TCF:  1
```

```
LIN   -198.8c
TCF: 1.012512
```
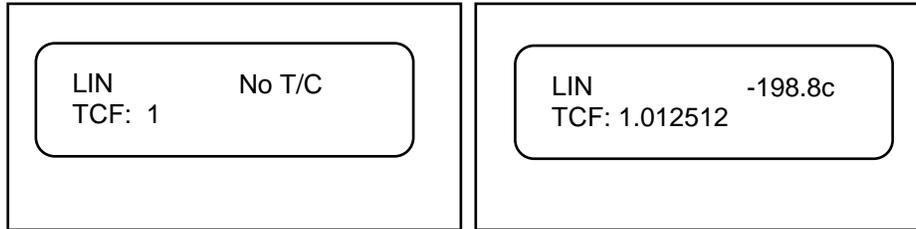
Turn the trailer totalizer "On". Start trailer product pump. Observing the TPS1500 display, once the flow rate and temperature are stable, note the trailer totalizer reading as the **START/STOP** switch is pressed & released.  This starts the prover run.  Continue to pump another 500 gallons according to the trailer totalizer.

As the prover progresses, check the prover flow rate display (Gm).  With 1 1/2" prover system, pump off rate should be at a normal 100 gallons per minute (Gm) and 180 gallons per minute (Gm) for a 2" system.

```
LIN   -198.8c
Gm 100   Tt 125
```
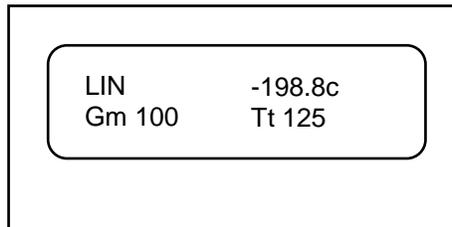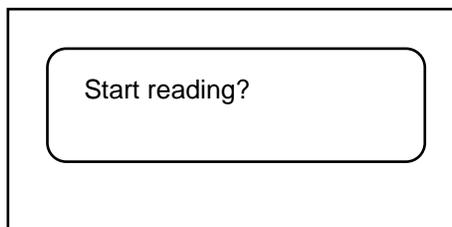
After pumping at least 500 gallons or equivalent according to the trailer totalizer, depress and release the **START/STOP** switch.  Note the trailer totalizer reading.  The prover will display:

NOTE: The **"Tt"** will display
the actual TOTAL for the prover run.

```
Press any key
Gm 100           Tt 500
```
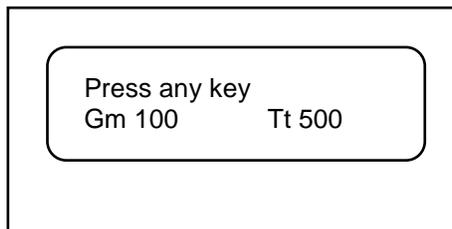
Press any key. Enter data as prompted by the display:

```
Start reading?
```

Enter the trailer totalizer reading noted at the start of the prover. Press **"ENTER"** key.

```
┌─────────────────────────────┐
│   ╭─────────────────────╮   │
│   │                     │   │
│   │  End reading?       │   │
│   │                     │   │
│   ╰─────────────────────╯   │
│                             │
└─────────────────────────────┘
```

Enter the trailer totalizer reading noted at the end of the prover. Press **"ENTER"** key

```
┌─────────────────────────────┐
│   ╭─────────────────────╮   │
│   │  Enter cal type     │   │
│   │  0=CF / 1=KF?       │   │
│   ╰─────────────────────╯   │
│                             │
└─────────────────────────────┘
```

Enter the type of Factor used to calibrate the trailer totalizer.
Press **"0"** if CF (Calibration Factor = 1/K) or press **"1"** if KF (K-Factor direct entry for calibration)
Press **"ENTER"** key

```
┌───────────────────────────┐   ┌───────────────────────────┐
│  ╭─────────────────────╮  │   │  ╭─────────────────────╮  │
│  │                     │  │   │  │                     │  │
│  │  Enter CF?          │  │   │  │  Enter KF?          │  │
│  │                     │  │   │  │                     │  │
│  ╰─────────────────────╯  │   │  ╰─────────────────────╯  │
│                           │   │                           │
└───────────────────────────┘   └───────────────────────────┘
```

Enter the CF from the trailer totalizer.   Enter the KF from the trailer totalizer.
 Press **"ENTER"**   Press **"ENTER"**

```
┌───────────────────────────┐   ┌───────────────────────────┐
│  ╭─────────────────────╮  │   │  ╭─────────────────────╮  │
│  │  Set new CF:        │  │   │  │  Set new KF:        │  │
│  │  XXXX               │  │   │  │  XXXX               │  │
│  ╰─────────────────────╯  │   │  ╰─────────────────────╯  │
│                           │   │                           │
└───────────────────────────┘   └───────────────────────────┘
```

Examples ONLY!

Press **"PRINT"** key

Additional prove tickets may
be printed by pressing the
"PRINT" key.

```
***********************
Calibration information
11:20A  12-Apr-13
Meter  :  44795
Plant  :  815
Tractor :  456
Trailer :  789

LIN      -198.8c
Delivry GPM:  100.
Calib total:  101
Delivry TCF:  1.012512
    -   -   -
Truck start:  0
Truck stop :  100
Truck total:  100
Truck C/K  :  CF
Truck Factr:  .1
    -   -   -
Truck % err:  -.990
Set  new CF:  .1010
```

```
***********************
Calibration information
11:20A  12-Apr-13
Meter  :  44795
Plant  :  815
Tractor :  456
Trailer :  789

LIN      -198.8c
Delivry GPM:  100.
Calib total:  101
Delivry TCF:  1.012512
    -   -   -
Truck start:  0
Truck stop :  100
Truck total:  100
Truck C/K  :  KF
Truck Factr:  1
    -   -   -
Truck % err:  -.990
Set  new KF:  .9901
```

***NOTE: If incorrect data was entered press **"ENTER"** & reinsert prove data. Dial the **"New CF"** or **"New KF"** into the trailer totalizer. Press **"RESET"** key.

```
LIN          -198.8c
Gm 120       GO PROVE
```
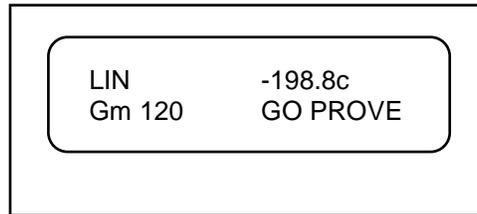
Reprove the trailer.

Compare the prover totalizer reading to the trailer totalizer.

Truck % error should be within specified tolerance.

Repeat as necessary.

Proceed with sealing the trailer meter box.

Affix calibration decal.

Complete documentation. (Work order)

WARNING: Condensation quickly forms inside piping left unattended. This will cause ice to form on the turbine bearings once cryogenic liquid is introduced, preventing rotation and rendering the prover inoperable. End cap the piping run or maintain a flow of nitrogen gas through the prover piping and turbine.
DO NOT USE SHOP AIR.

When all proving has been completed, CLEAN and DRY prover system. Place all components including temperature probe and all cables in proper case for storage.