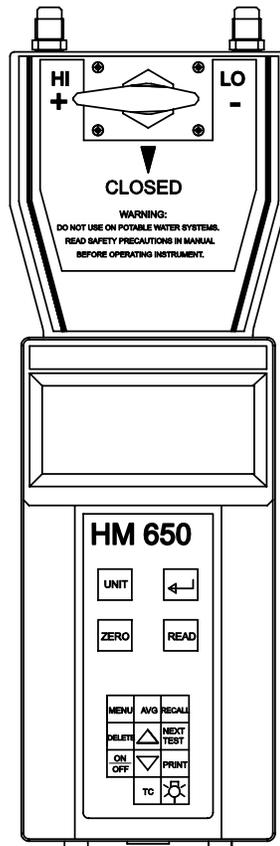


OWNER'S MANUAL

HM 650 Hydronic Manometer



ALNOR[®]

TSI Incorporated

WARRANTY

LIMITATION OF WARRANTY AND LIABILITY.

Seller warrants that this product, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for a period of twenty-four (24) months, or the length of time specified in operator's manual, from the date of shipment to the customer. This limited warranty is subject to the following exclusions:

- a. Batteries and certain other components when indicated in specifications are warranted for a period of 90 days from the date of shipment to the customer.
- b. With respect to any repair services rendered, Seller warrants that the parts repaired or replaced will be free from defects in workmanship and material, under normal use, for a period of 90 days from the date of shipment to the customer.
- c. Seller does not provide any warranty on finished goods manufactured by others. Only the original manufacturer's warranty applies.
- d. Unless specifically authorized in a separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, any goods which are incorporated into other products or equipment by the Buyer. All goods returned under warranty shall be at the Buyer's risk of loss, Seller's factory prepaid, and will be returned at Seller's risk of loss, Buyer's factory prepaid.

The foregoing is IN LIEU OF all other warranties and is subject to the conditions and LIMITATIONS stated herein. NO OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE.

THE EXCLUSIVE REMEDY OF THE USER OR PURCHASER, AND THE LIMIT OF THE LIABILITY OF SELLER FOR ANY AND ALL LOSSES, INJURIES, OR DAMAGES IN CONNECTION WITH THIS PRODUCT (INCLUDING CLAIMS BASED ON CONTRACT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT, OR OTHERWISE) SHALL BE THE RETURN OF THE PRODUCT TO THE FACTORY OR DESIGNATED LOCATION AND THE REFUND OF THE PURCHASE PRICE, OR, AT THE OPTION OF SELLER, THE REPAIR OR REPLACEMENT OF THE PRODUCT. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES. SELLER SHALL NOT BE RESPONSIBLE FOR INSTALLATION, DISMANTLING, REASSEMBLY OR REINSTALLATION COSTS OR CHARGES. NO ACTION, REGARDLESS OF FORM, MAY BE BROUGHT AGAINST THE SELLER MORE THAN ONE YEAR AFTER THE CAUSE OF ACTION HAS ACCRUED.

The purchaser and all users are deemed to have accepted the terms of this LIMITATION OF WARRANTY AND LIABILITY, which contains the complete and exclusive limited warranty of Seller. This LIMITATION OF WARRANTY AND LIABILITY may not be amended or modified nor may any of its terms be waived except by a writing signed by an authorized representative of Seller

Service Policy

Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call Customer Service at (800) 424-7427 (USA) and (1) 651-490-2811 (International).

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SECTION 1

Introduction

HM 650 Kit Contents

The HM 650 Kit (p/n 632-650-001) includes the following items:

- HM 650 Hydronic Manometer
- Two (2) Hoses
- Four (4) C size Alkaline Batteries
- Velcro® Hanging Strap
- Two (2) Sets of Test Adapters
- AC Adapter/Battery Eliminator
- Owner's Manual
- Calibration Data Sheet
- Warranty Card

General Description

The HM 650 Hydronic Manometer is an easy-to-use instrument designed to measure differential or gauge fluid pressure of non-potable water in hydronic systems and air pressure in high-pressure air systems. It measures pressures from 0 to 300 psi and displays results on a large LCD. Measurements can also be stored in memory for later downloading to a printer or personal computer.

The HM 650's key features include:

- Measures gauge and differential pressure.
- User-selectable units of measure:
English: psi, feet H₂O, inches H₂O, inches Hg;
Metric: kPa, meters H₂O, mm H₂O, mm Hg, Bar.
- Manual or Time Log measurements.
- User-selectable Time Constant (Manual mode).
- User-selectable sampling interval and number of samples (Time Log mode).
- Stores up to 999 measurements.
- RS 232 output.
- Automatic power shutoff.

Theory of Operation

The HM 650 Hydronic Manometer utilizes a sensitive pressure transducer in a bridge circuit to measure gauge and differential pressure.

The pressure transducer detects differences in pressure between the two sides of the bridge circuit and generates a corresponding electrical signal. This electrical signal is converted into a pressure measurement by the instrument's built-in microprocessor and displayed on the digital readout in the selected unit of measure.

When making gauge pressure measurements, this circuit measures the pressure difference between the high-pressure line and atmospheric pressure. In differential pressure readings, the pressure difference between the high-pressure line and the low-pressure line is measured.

®Velcro is a registered trademark of Velcro Industries B.V.

Safety

 **WARNING**

- The HM 650 is intended for use on hydronic heating and cooling systems only. Never use the instrument on potable water systems or other systems which may be used to convey fluids or air for human or animal consumption.
- Never use the HM 650 to measure the pressure of volatile, flammable, or otherwise hazardous fluids or gases. The instrument is not designed to be intrinsically safe nor is it intended for use with caustic or corrosive chemicals.
- Never use the HM 650 on steam or temperatures greater than 100°C (212°F) water.
- Always observe proper safety precautions and wear the appropriate personal protective equipment when working on high-pressure systems. Ruptured or leaking lines pose a potential risk of serious personal injury.
- Always be certain the HM 650's High- and Low-pressure lines are properly connected prior to taking pressure measurements. Leaking or spraying connections pose a potential risk of serious personal injury.
- Use caution as you release the water or air pressure when disconnecting the instrument to lessen the risk of water spray and personal injury.
- Exercise appropriate caution when using the HM 650 near electrical devices. Water spray when bleeding or disconnecting the High- and Low-pressure lines poses a potential risk of severe personal injury and/or damage to equipment.
- Never connect the HM 650 to systems which exceed the instrument's maximum pressure specification (300 PSI; 2068 kPa).
- Always thoroughly drain and dry the HM 650's hoses and internal piping after use. This will help prevent accidental spills as well as the growth of hazardous microorganisms.

SECTION 2

Instrument Overview

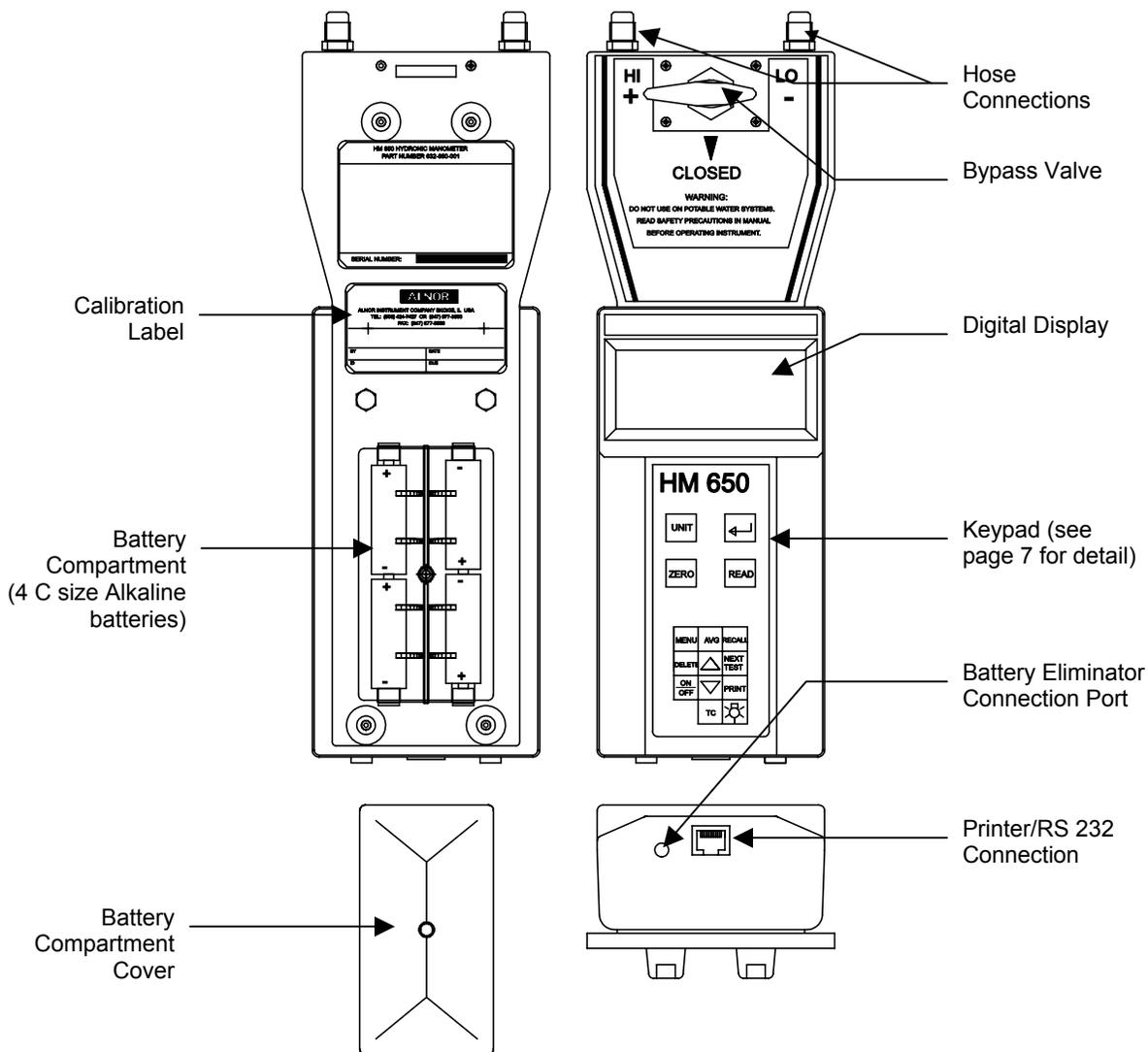


Figure 1

Digital Display

The HM 650 displays all pertinent operating and measurement information on a seven (7) segment liquid crystal display (LCD). Measurement information is displayed to 4 digits with a floating decimal point. The display may be backlit by pressing the ☼ key at the lower right of the keypad.

Main Operational Display

When the HM 650 is first turned “on,” the following information will appear on the digital display:

- Baud Rate (kbs)
- Battery Life (%)
- Log Remaining (%)
- Ready (rdY)

SECTION 3

Instrument Setup

Battery Installation

The HM 650 requires four (4) C size batteries for operation. An appropriate number of non-rechargeable alkaline batteries are shipped with the unit and are installed as follows:

1. Remove the cover from the battery compartment located on the back of the instrument. It is held in place with a single captivated thumbscrew.
2. Install the four C size batteries in the holder, making sure to orient the positive (+) and negative (-) ends as indicated by the markings within the battery compartment.
3. Replace the battery compartment cover.

Rechargeable Batteries

The HM 650 may also be operated using four (4) C size rechargeable nickel cadmium batteries.

A kit containing a battery charger and rechargeable NiCd batteries is available from TSI. Please refer to the instructions that come with the kit for battery charging information.

➔ **IMPORTANT:** *Batteries must be removed for recharging.*



**DO NOT ATTEMPT TO
RECHARGE ALKALINE BATTERIES**

AC Line Power

The HM 650 may also be operated using standard AC current. A Battery Eliminator is supplied for this purpose.

To operate on AC power, plug the Battery Eliminator into a grounded electrical outlet and then insert the DC power cable into the port on the bottom of the HM 650.

Connecting the High- and Low-pressure Hoses

Connect the straight female connector on the High-pressure (red) hose to the male fitting on the top left of the instrument. This fitting is marked with a plus (+) sign.

Connect the straight female connector on the Low-pressure (blue) hose to the male fitting on the top right of the instrument. This fitting is marked with a minus (-) sign.

➔ **CAUTION:** *The High- and Low-pressure hoses should be disconnected and drained whenever the instrument is not in use. See page 15.*

Bleeding Entrained Air

All entrained air must be bled from the High- and Low-pressure hoses prior to zeroing the instrument or taking a pressure measurement. Entrained air is bled as follows:

1. Turn the valves on the High- and Low-pressure hoses to the closed position.
2. Turn the bypass valve to the closed position.
3. If you have not already done so, attach the appropriate connectors to the ends of the High- and Low-pressure hoses.
- ➔ **NOTE:** *Place Teflon[®] tape or an equivalent sealant on the pipe threads as required.*
4. Connect the High-pressure hose to the high-pressure line.
5. Place the open end of the Low-pressure hose in a suitable receptacle or near a suitable drain.
6. Turn the valves on the High- and Low-pressure hoses to the open position.
7. Slowly open the bypass valve and allow the liquid flow to displace the entrained air.
8. Once the liquid is flowing steadily from the Low-pressure hose, close the valve on the High-pressure hose.
9. Close the bypass valve.
10. Close the valve on the Low-pressure hose.

[®]Teflon is a registered trademark of DuPont.

- If you are taking a differential pressure reading, connect the Low-pressure hose to the low-pressure line. If you are taking a gauge pressure reading, leave the Low-pressure hose open to atmosphere.

You are now ready to zero the instrument and begin taking measurements.

Zeroing the Instrument

For optimum accuracy, the HM 650 should be zeroed prior to beginning a pressure measurement. The zeroing procedure is performed as follows:

- Connect and bleed all hoses as outlined above.
- Turn the HM 650 “on” by pressing the On/Off key.
- Verify that the valve on the High-pressure hose is closed.
- Open the bypass valve.
- Open the valve on the Low-pressure hose.
- Wait a few moments to allow the pressure in the hoses to stabilize and then press the Zero key.
- Press the Read key. The instrument will begin counting down toward its first reading. Once this countdown is complete, either 0 or 0 with a flashing minus sign (-) should appear on the display.

➔ **NOTE:** *The length of the countdown sequence depends on the Operational mode and Time Constant or Log Interval selected. The longer the Time Constant or Log Interval, the longer the wait for the zero reading. If the instrument is set up for either Continuous or Time Log operation, pressing the Read key after the zero reading is displayed will stop the measurement process.*

- If the minus sign (-) is on continuously, verify that the hose and bypass valves are in the proper positions and repeat steps 6 and 7 above. If the zero problem still persists, the hose lines, fittings, or filters may be clogged or the pressure transducer faulty. See Section 7 Troubleshooting for more information.

You are now ready to begin measurements.

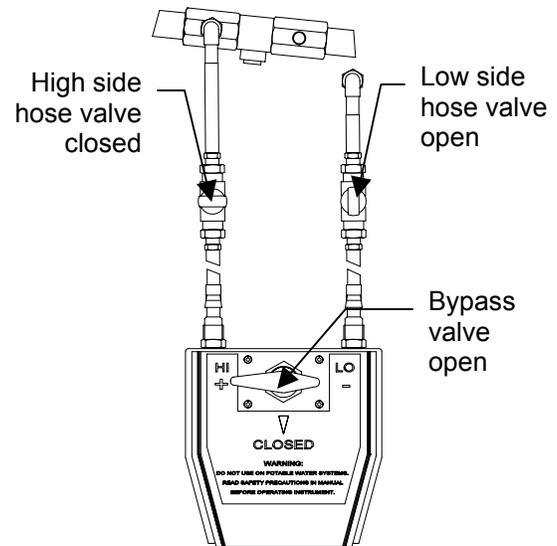


Figure 2
Valve Positions — Gauge Pressure “Zero”

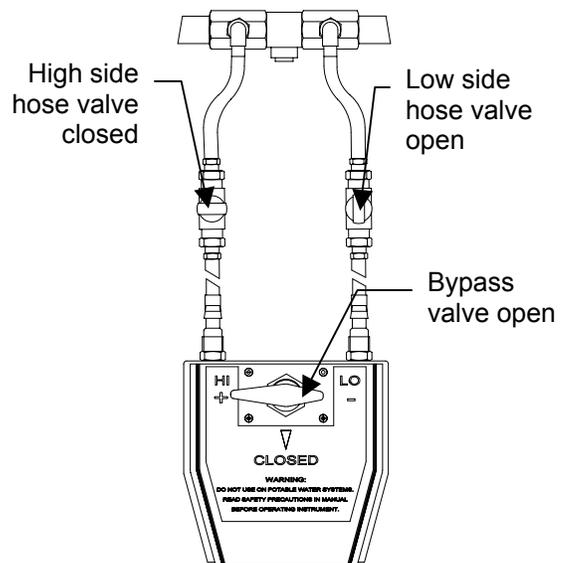


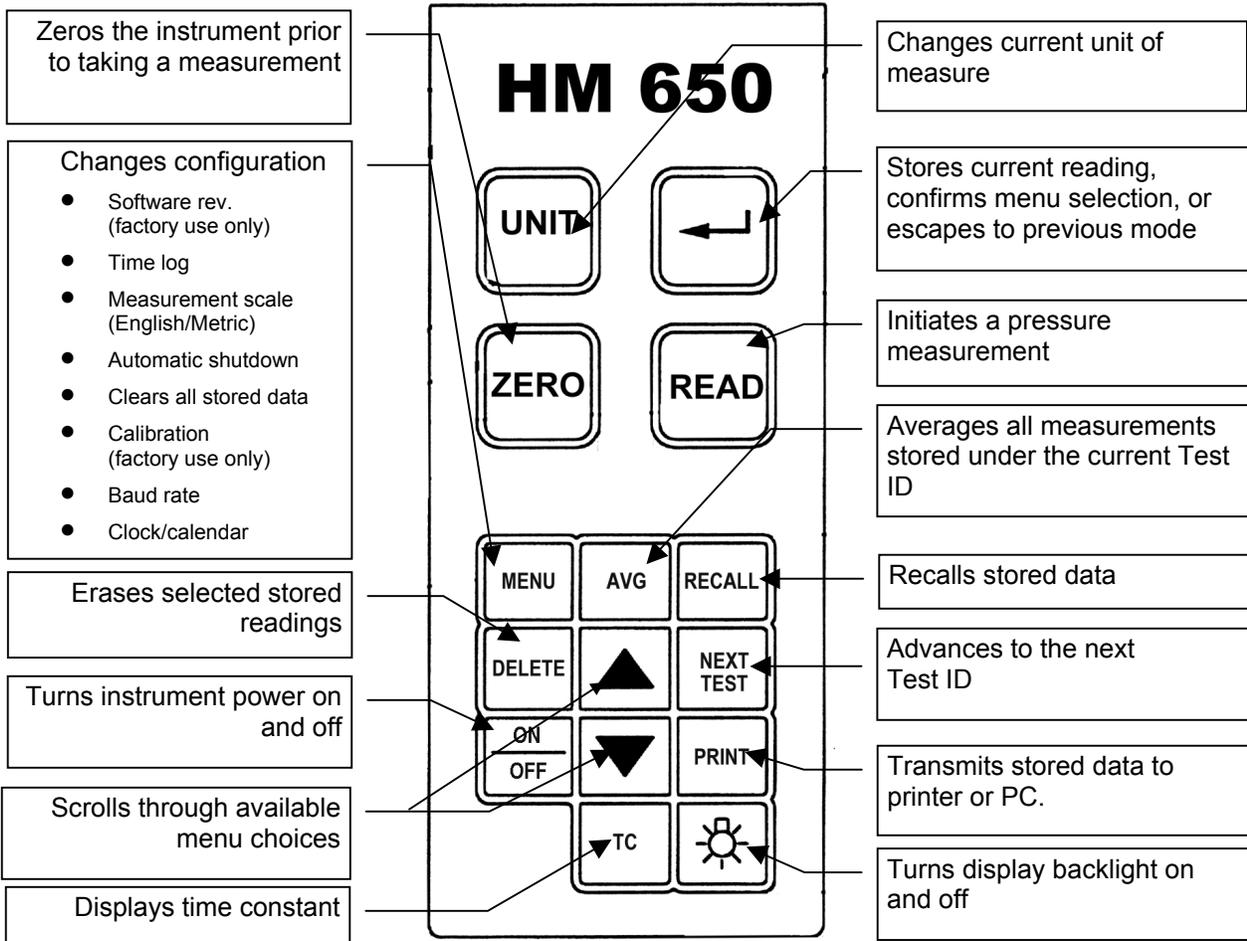
Figure 3
Valve Positions — Differential Pressure “Zero”

SECTION 4

Getting Started

Keypad Overview

Figure 4



Taking a High Side Gauge Pressure Reading

➔ **NOTE:** For optimum measurement accuracy, the end of the Low side hose should be level with the end of the High side hose when taking a reading.

1. Connect and bleed all hoses as described in Instrument Setup.
2. Turn the HM 650 “on” by pressing the On/Off key.
3. Verify that the valve on the High-pressure hose is closed.
4. Open the bypass valve.
5. Open the valve on the Low-pressure hose.
6. Zero the instrument.
7. Close the bypass valve.
8. Open the valve on the High-pressure hose.
9. Press the Read key. The gauge pressure reading will appear on the instrument’s display.

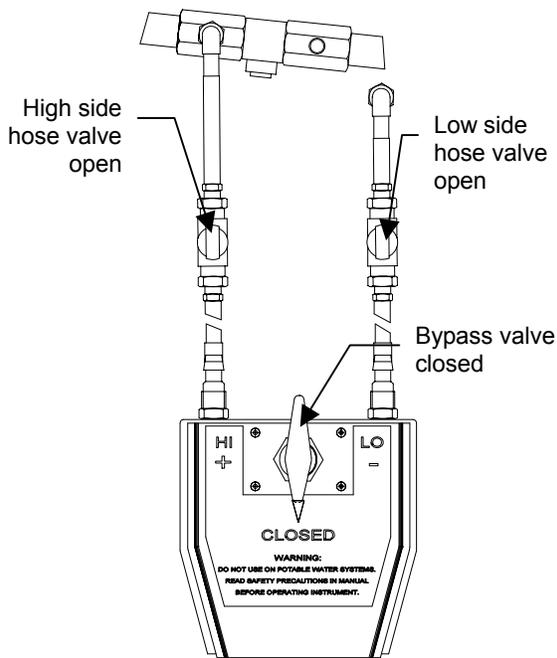


Figure 5
Valve Positions — Gauge Pressure “Read”

Taking a Differential Pressure Reading

1. Connect and bleed all hoses as described in Instrument Setup.
2. Turn the HM 650 “on” by pressing the On/Off key.
3. Verify that the valve on the High-pressure hose is closed.
4. Open the bypass valve.
5. Open the valve on the Low-pressure hose.
6. Wait a few moments to allow the pressure in the hoses to stabilize and then press the Zero key.
7. Close the bypass valve.
8. Open the valve on the High-pressure hose.
9. Press the Read key. The differential pressure reading will appear on the instrument’s display.

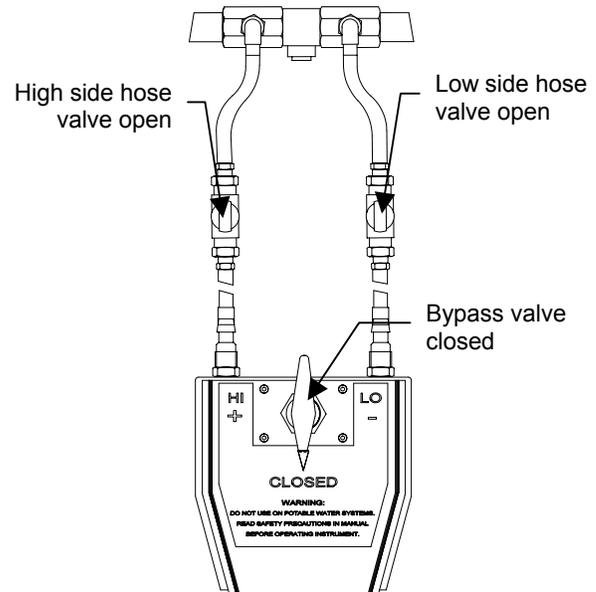


Figure 6
Valve Positions — Differential Pressure “Read”

Calculating the Low Side Gauge Pressure

1. Take High Side Gauge Pressure and Differential Pressure readings as outlined above.
2. Subtract the Differential Pressure value from the High Side Gauge Pressure value. The result is the Low Side Gauge Pressure.

Changing the Unit of Measure

The HM 650 is capable of displaying, storing, and printing pressure readings in a variety of English and metric units of measure.

English (**EnG**) or Metric (**Si**) units are selected via the Menu key.

Once English or Metric is selected and the display returned to the Main Run display, the unit of measure is selected by pressing the Unit key until the desired unit of measure is displayed.

Selecting the Measurement Type

The HM 650 may be configured for either Time Log or Manual measurements.

When Time Log is selected (Time Log set to “On”), the instrument will take a pre-determined number of measurements at the selected time intervals.

When Manual is selected (Time Log set to “Off”), each sample must be individually initiated.

Changing the Time Constant

The default Time Constant is a five second measurement period during which the instrument takes five 1-second measurements and then displays the average reading. The Time Constant may be changed via the TC key.

Storing Measurements

When the HM 650 is in the Manual mode, the most recent measurement is stored by pressing the Enter (↵) key. When the instrument is in the Time Log mode, measurements are stored automatically.

Recalling Stored Measurements

Stored measurements may be displayed by pressing the Recall key. The arrow keys (▲▼) are used to scroll through the available Test IDs and then the stored values. The Enter key (↵) is pressed to select the Test ID of interest.

➔ **NOTE:** *Data must be stored before it can be recalled. If pressing the Enter (↵) key when a Test ID is displayed does not have any effect, there are not any stored values associated with that Test ID.*

Displaying Measurement Averages

Press the AVG key to display the average of all the stored readings for the selected Test ID.

Printing Stored Measurements

Pressing the Print key sends all stored data for the selected Test ID to a connected printer or PC via the RS 232 serial port.

Disabling the Automatic Shutoff

The HM 650 is factory configured to automatically shut itself “off” if there has not been any keypad activity for ten (10) minutes. The automatic shutoff may be disabled by pressing the Menu key until “**AUt**” appears in the upper left of the digital display. The word “**OFF**” or “**On**” will also appear in much larger letters on the display. Use the arrow (▲▼) keys to toggle between the two choices.

➔ **NOTE:** *The automatic shutoff option is not functional when the HM 650 is in the Time Log mode.*

SECTION 5

Detailed Operation

Selecting the Measurement Scale

The HM 650 Hydronic Manometer can be configured to measure and display pressure readings in either English (**EnG**) or metric (**Si**) units. The measurement scale is selected as follows:

1. Turn the instrument “on” by pressing the On/Off key.
2. Press the Menu key until **Unt** and the letters **EnG** or **Si** appear on the display.
3. Press either the ▲ or ▼ arrow key to toggle the display between the **EnG** and **Si** selections.
4. When the desired measurement scale is displayed, press the Enter (↵) key to return to the main operational display or press the Menu key to advance to the next Main menu selection until the main operational display appears.

Selecting the Unit of Measure

Several different units of measure are available under each measurement scale. The available units of measure are:

English (EnG)

- Psi
- inches H₂O
- feet H₂O
- inches Hg.

Metric (Si)

- kPa
- mm H₂O
- meters H₂O
- mm Hg
- Bar

The unit of measure within a given measurement scale is selected by pressing the Unit key until the desired unit of measure appears on the display.

➔ **NOTE:** *Different units of measure appear in different locations on the main operational display.*

Setting the Time Constant

The HM 650 is factory programmed to take five 1-second pressure measurements and then display the average of those five readings. The number of 1-second readings that will be averaged and then displayed is field-selected via the TC key. The available choices are Continuous (**COnT**), 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, and 30 seconds.

The Time Constant is changed as follows:

1. Press the TC key. The present Time Constant (**tC**) setting will appear on the display.
2. Press the ▲ or ▼ arrow keys to scroll through the available choices.
3. When the desired Time Constant is displayed, press the Enter (↵) key.

➔ **NOTE:** *The TC key can only be used to set the Time Constant when the HM 650 is in the Manual or Continuous mode.*

Operational Mode

The HM 650 can be configured for either Manual, Continuous, or Time Log operation.

Manual Mode

When Manual is selected, each measurement must be individually initiated by pressing the Read key. Manual operation is useful for taking a single measurement or a short series of measurements.

Manual operation is selected as follows:

1. Press the Menu key until the words **Set**, **LOG**, and either **OFF** or **On** appear on the display.
2. If “**On**” is displayed, press the ▼ arrow key to toggle the display to “**OFF**.”
3. Press the Enter (↵) key. The main measurement display will appear.

➔ **NOTE:** *The Time Constant in the Manual mode may be changed using the TC key.*

➔ **NOTE:** *When **COnT** is selected, sampling continues until manually stopped by pressing the Read key.*

Continuous Mode

When the HM 650 is operating in the Continuous mode, the instrument takes a continuous series of 1-second measurements. In this mode, the display is updated every five seconds with the average of the previous five 1-second measurements.

To select the Continuous mode, set the Time Constant to **COnT** and press the Read key. Measurements will be taken continuously until the Read key is pressed a second time.

Time Log Mode

The Time Log mode is designed for unattended operation. When this mode is selected, the instrument will perform a pre-determined number of measurements and then automatically stop.

The Time Log mode is useful for monitoring the pressure drop across a valve, pump, etc. over an extended period of time. In this mode, you select how often a measurement is taken (every 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, and 30 seconds and 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, and 60 minutes) and the total number of measurements to take (Continuous or 1 to 999).

Time Log operation is selected as follows:

1. Press the Menu key until the words **Set, LOG**, and either **OFF** or **On** appear on the display.
 2. If "**OFF**" is displayed, press the **▲** arrow key to toggle the display to "**On**."
 3. Press the Enter (**↵**) key; the words "**tnE**," and "**LOG**" will appear on the display along with the current log interval. The log interval is the time between samples.
 4. Press the **▲** or **▼** arrow keys to scroll through the available log intervals.
- ➔ **NOTE:** *Pressing and holding the **▲** or **▼** arrow keys will make the available choices scroll faster.*
5. When the desired log interval is displayed, press the Enter (**↵**) key. The words "**COUNT**" and "**LOG**" will appear on the display. This allows the user to set the number of measurements that will be taken.
- ➔ **NOTE:** *When **COnT** is selected, sampling continues until manually stopped by pressing the Read key. When a value from 1 to 999 is selected, sampling will automatically stop when the selected number of measurements have been made or when measurements are manually stopped by pressing the Read key.*
6. Press the **▲** or **▼** arrow keys to scroll through the available choices.
 7. When the desired value is displayed, press the Enter (**↵**) key.

8. The words **Prt** and either **ON** or **OFF** will appear on the display. This allows you to turn the HM 650's real-time printing function on or off. Press the **▲** or **▼** arrow keys to toggle between the two choices and then press the Enter (**↵**) key.

➔ **NOTE:** *Real-time printing is not allowed if the log interval is less than five seconds.*

9. Press the Read key to begin logging. While logging is in progress, the display will update every five seconds. The time remaining until the next measurement, in either minutes or seconds, will also be displayed.

Assigning the Test ID

This function allows you to assign a Test ID to an individual test or group of tests for later recall and reporting. It is intended to provide you with the means to clearly associate test results with specific equipment, zones, systems, etc.

The first Test ID is automatically assigned by the HM 650 and always start with 1. As few as 1 or as many as 999 measurements may be stored under a single Test ID.

Manual Mode

Press the Next Test key prior to initiating the measurement(s) you wish to store under that Test ID number.

Time Log Mode

The Test ID increments automatically at the end of the test cycle. No operator interaction is required.

Taking a Pressure Measurement

Once all operational criteria for the HM 650 has been selected and/or programmed, you are ready to begin taking pressure measurements. Either gauge or differential pressure measurements may be performed.

High Side Gauge Pressure Readings

See Figures 2 and 5.

➔ **NOTE:** *For optimum measurement accuracy, the end of the Low side hose should be level with the end of the High side hose when taking a reading.*

1. Connect and bleed all hoses as described in Instrument Setup.
2. Turn the HM 650 "on" by pressing the On/Off key.

3. Verify that the valve on the High-pressure hose is closed and the bypass valve is open.
4. Open the valve on the Low-pressure hose.
5. Zero the instrument.
6. Close the bypass valve.
7. Open the valve on the High-pressure hose.
8. Press the Read key. The gauge pressure reading will appear on the digital display.
9. To store the reading, press the Enter (↵) key.

➔ **NOTE** *It may take as long as thirty (30) seconds for the gauge pressure reading to appear, depending on the Time Constant.*

➔ **IMPORTANT:** *For optimum accuracy, the HM 650 should be re-zeroed when making subsequent measurements at different locations.*

Differential Pressure Readings

See Figures 3 and 6.

1. Connect and bleed all hoses as described in Instrument Setup.
2. Verify that the valves on both the High- and Low-pressure hoses are closed.
3. Turn the HM 650 “on” by pressing the On/Off key.
4. Open the bypass valve.
5. Zero the instrument.
6. Close the bypass valve.
7. Open the valves on both the High- and Low-pressure hoses.
8. Press the Read key. The differential pressure reading will appear on the instrument’s display.
9. To store the reading, press the Enter (↵) key.

➔ **NOTE** *It may take as long as thirty (30) seconds for the differential pressure reading to appear, depending on the Time Constant selected.*

➔ **IMPORTANT:** *For optimum accuracy, the HM 650 should be re-zeroed when making subsequent measurements at different locations.*

Low Side Gauge Pressure Readings

Low side gauge pressure readings are taken in the same manner as high side gauge pressure readings except that the high-pressure hose is connected to the low-pressure side.

The low side gauge pressure can also be calculated by simply subtracting the differential pressure reading from the high side gauge pressure reading.

Over-Pressure Readings

Should the pressure measurement exceed the measuring range of the instrument, four dashes (----) will appear on the digital display.

➔ **CAUTION:** *An over-pressure condition can seriously damage the instrument. Immediately close the High- and Low side hose valves and disconnect the instrument. Once disconnected, open hose valves to relieve pressure.*

Storing Measurement Readings

Manual or Continuous Mode

Once a measurement has been completed, the reading may be stored in the HM 650’s memory by pressing the Enter (↵) key.

➔ **IMPORTANT:** *If you do not store the results of a measurement before either (1) beginning a subsequent measurement or (2) turning power to the instrument “off,” that result will be lost.*

Time Log Mode

When the instrument is being operated in the Time Log mode, measurements are stored automatically.

Displaying Stored Results

The HM 650 allows you to display test results in either of two formats: the average of stored readings for the current Test ID or detailed information for any/all stored Test IDs.

Current Test ID, Count, and Average

In the Manual or Continuous mode, a variety of information is available by pressing the AVG key.

- Current Test ID
- Count (the number of stored samples within the current Test ID)
- Average (the average measured value of all stored samples within the current Test ID)

Press the AVG key to scroll through these three informational displays. Pressing the AVG key when the Average is displayed returns you to the main measurement display (rdY).

Detailed Measurement Information

Detailed information on all stored test results is displayed as follows:

1. Press the Recall key. “TEST ID” and a Test ID number will appear on the display.
2. Press the arrow keys (▲▼) to scroll through the list of stored Test ID numbers.
3. Press the Enter (↵) key to select the displayed Test ID. All measurement information for that test ID will appear.

➔ **NOTE:** *Data must be stored before it can be recalled. If pressing the Enter (↵) key when a Test ID is displayed does not have any effect, there are no stored values associated with that Test ID.*

4. Press the arrow keys (▲▼) to scroll through the stored measurement information. This data will be displayed one item at a time, in the following order:
 - Average pressure measurement
 - Number of samples (count)
 - Minimum pressure measurement
 - Maximum pressure measurement
 - Sample number and value in first to last order
5. Press the Enter (↵) key to return to the main measurement display.

Deleting Stored Results

Individual Readings

The HM 650 allows you to erase individual readings when in the Recall mode. Readings are deleted as follows:

1. Recall the information stored under the desired Test ID as outlined above.
2. When the sample number and value you wish to delete is displayed, press the Delete key.
3. Additional readings that were stored under this Test ID may be deleted by repeating the above steps.

➔ **NOTE:** *When you delete an individual measurement, all measurements that followed it will be re-numbered. For example, if Test ID 4 contained 10 samples (numbered 1 through 10) and you delete reading number 5, samples 6 through 10 will automatically be re-numbered 5 through 9).*

All Readings

1. Press the Menu key until the words “CLR” and “no” appear on the display.
2. Press the ▲ arrow key until “YES” is displayed.
3. Press the Enter (↵) key. All stored readings will be deleted.

Printing Stored Results

➔ **IMPORTANT:** *Be sure that the HM 650 and printer baud settings are the same before attempting to print stored results.*

Stored test results can be sent to an attached serial printer (optional, see Replacement Parts and Accessories). You may print results for either an individual Test ID or all Test IDs.

Individual Test ID

1. Press the Recall key.
 2. Press the arrows keys (▲▼) until the Test ID you want to print is displayed.
 3. Press the Enter (↵) key twice.
- ➔ **NOTE:** *These first three steps are not necessary if you are printing the results associated with the current Test ID.*
4. Press the Print key; **CUrr** will be displayed.
 5. Press the Enter (↵) key to send the results to the attached printer.

All Test IDs

1. Press the Print key.
 2. Press the arrows keys (▲▼) until **ALL** is displayed.
 3. Press the Enter (↵) key to send the results to the attached printer.
- ➔ **NOTE:** *If a printer is not attached when you press the Print key, the display will appear to “lock.” Press the Print key a second time to return to the main measurement mode (rdY).*

Sample Printouts

Log Status = On

```
TEST_ID #7

LOG STATUS:ON
LOG INTERVAL:1 MIN
START DATE: 3/14/99
STOP DATE: 3/14/99

AVG: 71.93
CNT: 10
MIN: 71.50
MAX: 72.36

1 71.53 PSI 19:23:34
2 71.86 PSI 19:24:34
3 72.07 PSI 19:25:34
4 72.04 PSI 19:26:34
5 72.00 PSI 19:27:34
6 71.79 PSI 19:28:34
7 72.36 PSI 19:29:34
8 72.22 PSI 19:30:34
9 71.50 PSI 19:31:34
10 71.89 PSI 19:32:34

Name: _____
```

Log Status = Off

```
TEST_ID #1

LOG STATUS:OFF
LOG INTERVAL:NONE
START DATE: 3/15/99
STOP DATE: 3/15/99

AVG: 19.99
CNT: 4
MIN: 12.99
MAX: 24.33

1 24.33 FT H2O 7:57:10
2 18.41 FT H2O 7:57:59
3 12.99 FT H2O 7:58:11
4 24.24 FT H2O 7:58:51

Name: _____
```

Download Results to a Computer

Contact Technical Support for more information.

Enabling/Disabling Automatic Power Shutoff

When in the Manual mode, the HM 650 is designed to automatically shut itself off if there has not been any keypad activity for ten (10) minutes. This function is internally disabled when the instrument is in the automatic operating mode.

To enable/disable the automatic power shutoff feature, proceed as follows:

1. Press the Menu key until the words “**AUT**” and “**OFF**” or “**On**” appear on the display.
2. Press the ▲ or ▼ arrow key to toggle the display to the desired selection (**On** = enabled; **OFF** = disabled).
3. Press the Enter (↵) key.

Setting the Internal Clock/Calendar

The HM 650 incorporates an internal 24-hour clock and calendar. This time/date information will appear on printed and transmitted results. The clock/calendar is set as follows:

1. Press the Menu key until “**CI**” appears on the digital display along with the present time setting. Press the Enter (↵) key.
2. The minutes (**min**) setting should now be displayed. Change the displayed reading using the ▲ or ▼ arrow keys. When the desired reading is displayed, press the Enter (↵) key.
3. The display will advance to the hour (**Hr**) reading (24-hour clock). Again, use the ▲ or ▼ arrow keys to change the displayed reading and then press the Enter (↵) key.
4. Proceed as above with the day (**dAY** — 1 to 31), month (**th** — 1 to 12), and year (**Yr** — 00 to 99) settings.

Setting the HM 650's Baud Rate

This function allows you to set the speed at which stored data is downloaded to a computer system. Baud rates from 1200 to 19,200 may be selected. The baud rate is set as follows:

1. Press the Menu key until the word **Baud** and the present setting appear on the display.
 2. Press the ▲ or ▼ arrow keys to scroll through the available choices.
- **NOTE:** Baud rates are displayed as 1.2, 2.4, 4.8, 9.6, and 19.2 x 1000)

Press the Enter (↵) key. The main measurement display will appear.

Setting the Printer's Baud Rate

The baud rate on the Alnor MicroPrinter 8522 printer is set via a series of DIP switches on the side of the unit. The following chart shows the settings used to select various baud rates:

BAUD RATE	1	2	3	4	5	6
1200 bps	ON	ON	OFF	ON	OFF	OFF
2400 bps	ON	ON	OFF	OFF	ON	ON
4800 bps	ON	ON	OFF	OFF	ON	OFF
9600 bps	ON	ON	OFF	OFF	OFF	ON
19200 bps	ON	ON	OFF	OFF	OFF	OFF

Disconnecting Hoses After a Pressure Measurement

To minimize the amount of “spillage” once measurements at a given station have been completed, the High- and Low-pressure hoses should be disconnected as follows:

1. Close the bypass valve.
2. Close the valves on the High- and Low-pressure hoses.
3. Disconnect the High-pressure hose from the high-pressure line. Be prepared for a small amount of spillage from the short section of hose between the hose valve and the high-pressure line.
4. Disconnect the Low-pressure hose from the low-pressure line (differential pressure readings only). Be prepared for a small amount of spillage from the short section of hose between the hose valve and the low-pressure line.

➔ **NOTE:** *If you will be making subsequent measurements at another location/system containing the same or a very similar fluid, it is not necessary to drain or disconnect the hoses from the HM 650 at this time. The liquid remaining in the longer sections of the hose will minimize the amount of air which must be bled prior to making the subsequent measurements.*

SECTION 6

Routine Maintenance

Your HM 650 Hydronic Manometer is designed to require an absolute minimum of maintenance. As with any precision electronic device, however, proper care, maintenance, and handling will further ensure its accurate and reliable operation.

Recommended Routine Maintenance Schedule

Description	Frequency
Drain fluid from High- and Low-pressure hoses	Daily*
Drain fluid from bypass valve	Daily*
Clean housing	Daily*
Clean in-line filters	Daily or as required
Replacing/recharging the batteries	As required
Check calibration	Annually

* Perform whenever the instrument is being transported, stored, or will be out of service for more than a few hours.

Draining the Hoses

Trapped fluid should be drained from the High- and Low-pressure hoses whenever the instrument is being stored after use. Fluid should not be allowed to remain in these hoses overnight.

➔ **CAUTION:** *Water left in lines may freeze if stored at low ambient temperatures and damage the pressure sensor.*

1. Disconnect the High- and Low-pressure hoses from the bypass valve.
2. Open the valve on each hose.
3. Connect the end of each hose to a suitable high-pressure air source and blow the entrained liquid from the hose.

Draining the Bypass Valve

Trapped fluid should be drained from the bypass valve whenever the instrument is being stored after use. Fluid should not be allowed to remain in this valve overnight.

1. Remove the High- and Low-pressure hoses from the instrument.
2. Hold the HM 650 with the bypass valve fittings facing down.
3. Open the bypass valve and allow liquid to drain.

➔ **NOTE:** *The HM 650 should be stored with the bypass valve in the Open position.*

Cleaning the Inline Hose Filters

The HM 650 is equipped with inline filters just upstream of the hose valves. These filters should be flushed periodically (daily cleaning is recommended) with relatively clean water as follows:

1. Disconnect the hose from the HM 650 and connect the straight end (farthest from the hose valve) to the water source. Place the opposite end of the hose in a drain or suitable receptacle.
2. Open the hose valve and allow the water to flush through the hose.
3. Connect the end of the hose to a suitable high-pressure air source and blow any entrained water from the hose.
4. Repeat for the other hose.

Cleaning the Instrument Housing

Moisture, grime and fluids should be wiped off the instrument housing using a soft, damp, clean cloth.

Care should be taken to prevent water or other liquids from entering the instrument or battery compartment. Solvents or abrasive cleansers should never be used to clean the instrument housing, keypad, or display.

Calibration

It is recommended that your HM 650 Hydronic Manometer be returned to the factory once a year for a calibration check. When returning the instrument for calibration, be sure to first drain all fluids from the bypass valve and then pack it carefully for shipment.

Complete instructions for returning your instrument can be found on page 19.

Replacing/Recharging the Batteries

The batteries in your HM 650 should be replaced/recharged as required. Under normal use, standard alkaline batteries will provide approximately 50 hours of continuous operation.

SECTION 7

Troubleshooting

Symptom	Possible Cause	Corrective Action
No pressure reading.	Hoses valves closed during measurement. Bypass valve open during measurement. High- and low side hose connections reversed. Clogged hose line or fitting. Clogged inline filter(s). Faulty pressure transducer.	Open hose valves. Close bypass valve. Connect hoses correctly. Clear obstruction. Clean line filter(s). Return to TSI for service.
Incorrect gauge pressure reading.	Instrument not zeroed correctly. Hose valve closed during measurement. Clogged hose line or fitting. Clogged inline filter(s). Open end of low side hose not level with high side connection. Instrument out of calibration. Faulty pressure transducer.	Zero the instrument before measurement. Open hose valves. Clear obstruction. Clean inline filter(s). Position low side hose correctly. Return to TSI for calibration. Return to TSI for service.
Incorrect differential pressure reading.	Instrument not zeroed correctly. Hose valve(s) closed during measurement. Bypass valve open during measurement. Clogged hose line or fitting. Clogged inline filter(s). Open end of low side hose not level with high side connection. Instrument out of calibration. Faulty pressure transducer.	Zero the instrument before measurement. Open hose valve(s). Close bypass valve. Clear obstruction. Clean inline filter(s). Position low side hose correctly. Return to TSI for calibration. Return to TSI for service.
Instrument can't be zeroed.	Clogged hose lines or fittings. Clogged inline filter(s). Faulty pressure transducer.	Clear obstruction. Clean inline filter(s). Return to TSI for service.
Instrument won't power up.	Dead or missing batteries. Instrument malfunction.	Replace or recharge. Return to TSI for service.
Display indicates over-pressure reading (----).	Measured pressure exceeds the instrument's measurement range specifications (300 psi; 2068 kPa).	Immediately close hose valves and disconnect instrument. Once disconnected, open hose valves to relieve pressure.

SECTION 8

Service Information

Replacement Parts and Accessories

Description	Part Number
MicroPrinter 8522, 120V.....	638-852-200
MicroPrinter 8522, 230V.....	638-852-210
Power Supply, 120VAC/7.2 VDC.....	459-009-015
Power Supply, 230VAC/7.2VDC.....	459-009-016
Hose Kit, one each red hose and blue hose with valves.....	632-650-500
Extension Hose Kit, one each 6 ft. red hose and blue hose without valves ...	632-650-525
Velcro® Cinching Strap, 1 x 36 inch	370-650-005
Filter Kit, Pkg. of two Filter Discs and O-Rings.....	632-650-750
Accessory Fittings Kit	632-650-005
Carrying Case	346-650-005
B & G Readout Probe	360-650-010
P/T Gauge Adapter, 1/8 inch dia., 1.5L..	360-650-004
HM 650 Owner's Manual.....	116-159-650

Service and Repair

Please return your Product Registration Card immediately. This allows us to send you service reminders, special offers, and important information about your instrument.

Before returning your instrument for calibration or repair, please call Customer Service. The Service Department will provide you with the cost of service or calibration, a Return Material Authorization (RMA) number, and shipping instructions.

Please have the following information available when you call:

- Owner's Name, address and phone number
- Billing address (if different and applicable)
- Instrument Name or Model Number
- Serial Number
- Date of Purchase
- Where Purchased

We recommend that you keep a log of the calibration, service, and repair history for your instrument.

Returning Your Instrument

Send the instrument prepaid.

Securely package your instrument in a strong container surrounded by at least two inches (5 cm) of suitable, shock-absorbing material.

Include a Purchase Order showing the instrument model number, cost of service and/or calibration, and the RMA number.

Mark the outside of the shipping container with the RMA number. This will expedite the processing of your instrument when we receive it.

Damage in Transit

All orders are carefully packed for shipment. On receipt, if the shipping container appears to have been damaged during shipment, the instrument should be thoroughly inspected. The delivering carrier's papers should be signed noting the apparent damage. **DO NOT DISCARD THE BOX.**

If the instrument itself has been damaged, a claim should be promptly filed against the carrier by the customer. The selling agent will assist the customer by supplying all pertinent shipping information. However, the claim must be filed by the insured.

If the instrument is damaged beyond use, a new order should be placed while awaiting reimbursement from the carrier for the damaged instrument.

If necessary, call Customer Service directly for assistance.

HM 650 HYDRONIC MANOMETER

Specifications

Range:	0 to 8303 inches H ₂ O; 0 to 300 psi; 0 to 2068 kPa; 0 to 210.9 meters H ₂ O.	Operating Temperature:	-10° to 60°C (14° to 140°F).
Resolution:	1 inch H ₂ O; 0.05 psi; 0.25 kPa.	Media Temperature:	0° to 100°C (32° to 212°F).
Accuracy:	±(2% reading plus two times the resolution) throughout operating temperature range.	Storage Temperature:	-10° to 60°C (14° to 140°F).
Pressure Limits:	Burst pressures of 400 psi (2758 kPa) on either port.	Power Source:	Four C size 1.5V alkaline batteries (optional Nickel Cadmium) or line current with Battery Eliminator.
		Battery Life:	Minimum 50 hours continuous use.
		Dimensions:	6.99 x 10.2 x 31.8 cm (2¾ x 4 x 12½ inches).
		Weight:	1.36 kg (3 pounds) with batteries installed.



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