

Hydronic Manometer

Model HM670

Owner's Manual



LIMITATION OF WARRANTY AND LIABILITY

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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 (651) 490-2811 or (800) 874-2811.

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About This Manual

This manual explains how to set up, operate and maintain the Alnor[®] HM670 Hydronic Manometer. Read it thoroughly before using the instrument.

Formatting and Typography

- Step-by-step instructions are numbered in boldface type: **1, 2, 3**, etc., set flush-left against the margin.
- References to keys on the manometer and the instrument's displayed readout are represented by a typeface called Arial.

Technical Assistance—Help!

For technical assistance or questions about the instrument of this manual, or if the HM670 Hydronic Manometer needs repair or recalibration, call Technical Support at (651) 490-2811 or (800) 874-2811.

Chapter 1. Safety

Safety Warnings

Carefully read each of the following safety warnings prior to using the HM670 Hydronic Manometer:

- ❑ *Never* use the HM670 Hydronic Manometer or accessories on potable water systems or other systems which may be used to convey fluids for human or animal consumption.
- ❑ *Never* use the HM670 Hydronic Manometer to measure the pressure of volatile, flammable, or otherwise hazardous fluids or gasses. The instrument is not designed to be intrinsically safe, nor is it designed for use with caustic or corrosive chemicals.
- ❑ *Never* connect the HM670 Hydronic Manometer or accessories to systems which exceed the instrument's maximum pressure specification (300 psi; 2068 kPa).
- ❑ Observe proper safety precautions and wear appropriate personal protective equipment, including gloves and eyewear, when working on high pressure or temperature systems. Ruptured or leaking lines pose a potential risk of serious personal injury.
- ❑ When using the HM670 Hydronic Manometer, verify all hose connections are secure prior to taking pressure measurements. Loose connections may result in the discharge of pressurized water or air, posing a potential risk of serious personal injury.
- ❑ Exercise caution when disconnecting the HM670 Hydronic Manometer from a pressurized system. Water or air discharged under pressure poses the potential risk of serious personal injury.
- ❑ Exercise caution in using the HM670 Hydronic Manometer near electrical equipment. Water spray associated with purging or disconnecting hoses presents a potential risk of damage to such equipment.
- ❑ Thoroughly drain and dry the HM670 Hydronic Manometer hoses and internal piping after each use. This will help in limiting the potential for growth of hazardous microorganisms.

Chapter 2. Introduction

The HM670 Hydronic Manometer is an easy-to-use instrument designed for the accurate measurement of pressure in non-potable water and air systems. Features of the manometer include the following:

- ❑ Single-function keys for ease of use
- ❑ Simultaneous measurement and display of High-side gauge and Differential pressure
- ❑ Calculation and display of Low-side gauge pressure
- ❑ User-selectable units of measure
- ❑ User-selectable time constant
- ❑ Easy to read dot matrix LCD with backlight
- ❑ Power input via AC adapter or batteries (alkaline or rechargeable NiMH)
- ❑ Internal NiMH battery charging
- ❑ Automatic power shutoff
- ❑ Splash-proof case
- ❑ Rugged carrying case for storage of meter, hoses, accessories, tools, and paperwork

Instrument Description

The HM670 Hydronic Manometer includes a meter, hard carrying case, (2) 6-foot (1.8 m) hoses with shut-off valves, (2) P/T gauge adapter probes, (2) B&G readout probes, (2) 1/4" Flare male × 1/4" NPT male fittings, AC adapter, (4) NiMH batteries, neck strap, owner's manual, and NIST traceable certificate.

An accessory temperature probe is available as an optional tool for the HM670 Hydronic Manometer. The 1/8" diameter, stainless steel sheathed immersion probe is designed for measurement of water line temperatures.

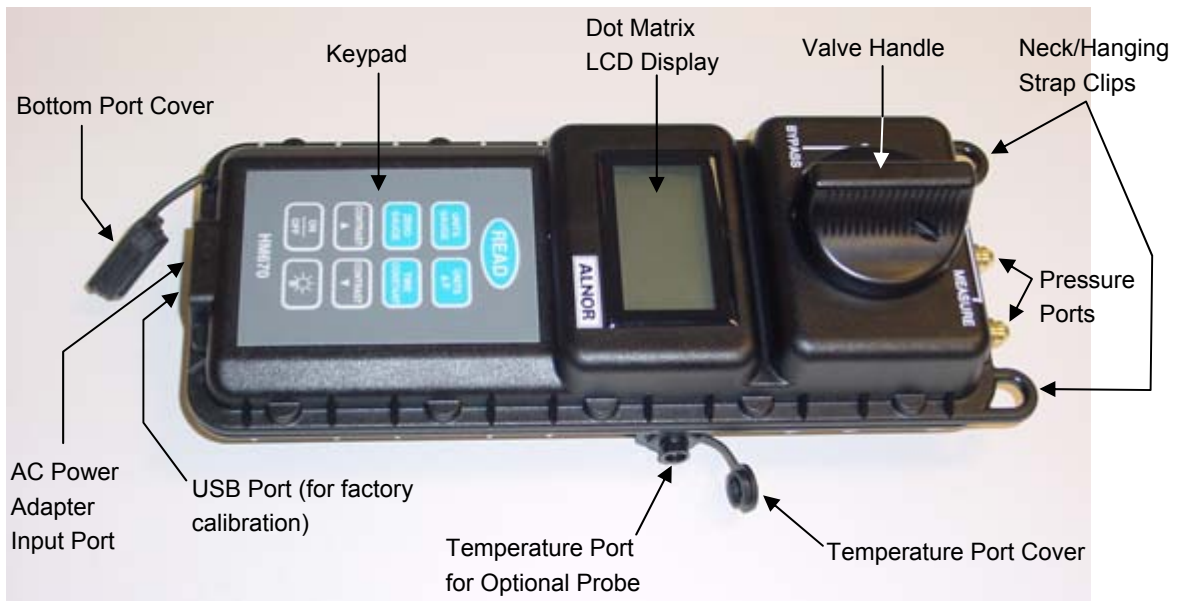


Figure 1: HM670 Meter Description

Unpacking

As you unpack the instrument and accessories, check the components against your packing list. If any parts are missing or damaged, notify Alnor immediately. Tables 1 and 2 list available standard and optional components for the HM670 Hydronic Manometer.

Table 1: Standard Components

Item	Part No.
Carrying case	1319409
Red hose assembly with shut-off valve	632650035
Blue hose assembly with shut-off valve	632650034
P/T gauge adapter probes (2)	632360004
B&G readout probes (2)	632360010
AC adapter	2182003
AA-size NiMH battery, four required	1208048
Battery holder	1801206
Neck strap	2913011
Owner's manual	1980517
Pocket screw driver	3012054

Table 2: Optional Components

Item	Part No.
6 in. (15 cm), 0.125" (3.175 mm) diameter Temperature Probe	801291
12 in. (30 cm), 0.125" (3.175 mm) diameter Temperature Probe	801292
Accessory fittings kit (U.S.A.)	HMFIT

Please complete the registration card included with this product and mail it promptly. The card allows us to inform you of product updates. If you prefer, you may register through our website at www.alnor.com.

Chapter 3. Instrument Operation

Keypad

Each key and its function is described below.

READ

Pressing the **READ** key initiates taking a time-averaged reading based on the current setting of the time constant (**TC**). Upon taking the reading, the values are displayed on-screen for a period of ten (10) seconds or until the **READ** key has been pressed again.

UNITS GAUGE

Pressing the **UNITS GAUGE** key allows for toggling through the available units for gauge pressure measurements (**High P** and **Low P**). The available units of measurement are: psi, inH₂O, ftH₂O, inHg, kPa, mH₂O, mmHg, and bar.

UNITS ΔP

Pressing the **UNITS ΔP** key allows for toggling through the available units for differential pressure measurements (**dP**). The available units of measurement are: psi, inH₂O, ftH₂O, inHg, kPa, mH₂O, mmHg, and bar.

Note: When using the accessory temperature probe, the unit of measurement for temperature (°F or °C) is driven by the selected unit of measurement for differential pressure:

- Differential pressure in psi, inH₂O, ftH₂O, or inHg → temperature in °F
- Differential pressure in kPa, mH₂O, mmHg, or bar → temperature in °C

ZERO GAUGE

Pressing the **ZERO GAUGE** key initiates zeroing of the gauge pressure sensor.

*Note: Proper zeroing of the gauge pressure sensor is achieved with the High pressure (+) port open to atmosphere and the valve handle in the **MEASURE** position.*

TIME CONSTANT

Pressing the **TIME CONSTANT** key allows for toggling through the available settings for the time constant (**TC**) as follows: 1, 5, 10, 20, and 30 seconds. The current setting of the time constant is indicated on the display.

Notes: The time constant is the sampling period over which the manometer averages pressure measurements. Example: with the time constant equal to ten (10) seconds, the displayed reading represents the average of measurements taken over the previous ten (10) seconds.

Increasing the time constant will serve to improve measurement stability, particularly when measuring systems with fluctuating pressures.

CONTRAST ▲

Press the **CONTRAST ▲** key to increase the display contrast.

CONTRAST ▼

Press the **CONTRAST ▼** key to decrease the display contrast.

ON/OFF

Press the **ON/OFF** key to turn the HM670 Hydronic Manometer on or off.



Press the **BACKLIGHT** key to turn the display's backlighting on or off.

Note: Backlighting has a significant impact on battery life. Use backlighting only when working in areas where you cannot read the display with existing light.

Measurement Screen

*Shown with the accessory temperature probe attached

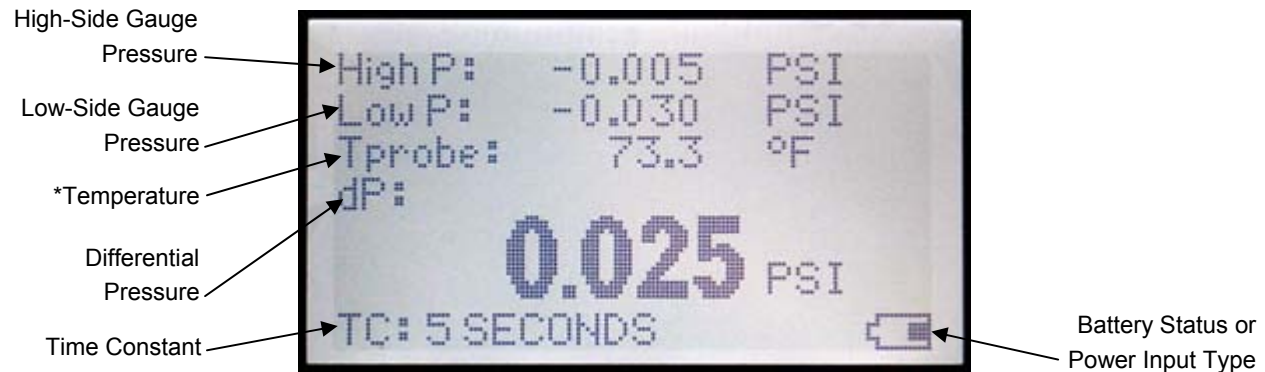


Figure 2: Pressure Screen

Powering the Instrument

The HM670 Hydronic Manometer can be powered by four (4) AA-size batteries (alkaline or rechargeable NiMH) or the AC adapter.

Using the AC Adapter

The AC adapter allows the HM670 Hydronic Manometer to be powered from a standard AC wall outlet. When using the AC adapter, alkaline batteries (if installed) will be bypassed. The AC adapter also charges the NiMH type batteries (if installed) in the unit.

Note: With the battery-type selection switch set to NiMH, the manometer will initiate charging the batteries whenever the AC adapter is connected.

Installing the Batteries

To install/replace the batteries:

1. Turn the manometer off and locate the battery cover on the back of the unit.
2. Loosen the screw on the battery compartment cover and lift to remove.

3. Remove the battery holder. Tapping the backside of the meter against your hand may help in removing the battery holder.
4. Remove the old batteries and replace with fresh batteries (alkaline or rechargeable NiMH). Ensure that the batteries are correctly oriented within the battery holder.
5. Set the battery-type selection switch to indicate the type of batteries to be used (alkaline or rechargeable NiMH).

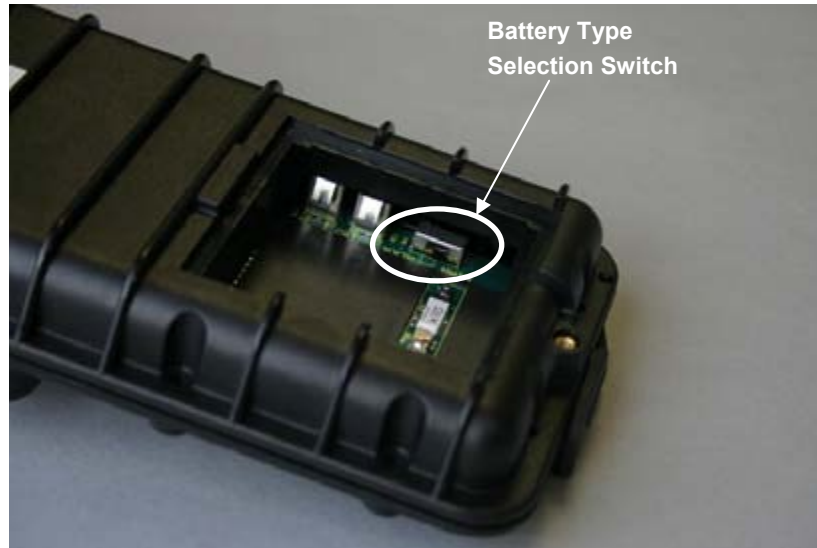


Figure 3: Location of Battery-Type Selection Switch

6. Reinstall the battery holder. Ensure the battery holder orientation is such that its terminals make contact with the spring contacts within the battery compartment.
7. Replace the battery compartment cover.

Notes: *The NiMH batteries included with the instrument may require recharging prior to first use.*

Fully charged batteries should enable the instrument to operate for a period of at least 12 hours.

Setting the battery-type selection switch properly will prevent unwanted charging of non-rechargeable alkaline batteries and provide charging of NiMH batteries when the AC adapter is connected.

A battery charge life remaining indicator is shown on the display whenever the manometer is powered by batteries, and turned on.

When using NiMH batteries, the indicator of battery charge life remaining will not be accurate due to their inherent non-linear voltage drop with power use.

Due to the danger of battery leakage, remove batteries from the battery compartment prior to storage.

Never mix battery types.

For maximum battery life, ensure backlight is “off” when not needed.

Zeroing the Manometer

The HM670 Hydronic Manometer is equipped with both a gauge and differential pressure sensor, allowing for simultaneous measurement and display of High-side gauge and Differential pressure. The gauge and differential pressure sensors are zeroed independently of one another.

Zeroing the Gauge Pressure Sensor

To ensure the most accurate gauge pressure (**High P**) measurements, the HM670 gauge pressure sensor should be zeroed prior to taking readings on each new system. The gauge pressure sensor is zeroed as follows:

1. Disconnect the High pressure (red) hose from the manometer such that the High pressure (+) port is open to atmosphere.
2. Turn the valve handle on the manometer to the **MEASURE** position.
3. Press the **ZERO GAUGE** key.
4. Allow the manometer to stand undisturbed for five (5) seconds until the zero gauge pressure sensor function has completed.

Note: The zero offset of the gauge pressure sensor is sensitive to temperature changes. If moving the manometer between areas of extreme temperature difference, it is best to allow the meter to settle to the new temperature prior to zeroing.

Zeroing the Differential Pressure Sensor

To ensure the most accurate differential pressure (**dP**) measurements, the HM670 differential pressure sensor should be zeroed prior to taking readings on each new system. The differential pressure sensor is zeroed as follows:

1. Turn the valve handle on the manometer to the **BYPASS** position.
2. Follow the on-screen instruction to complete the differential pressure sensor zeroing process.

*Notes: Any pressures applied to the hoses will not affect the **dP** zeroing function. This feature allows for successful zeroing of the differential pressure sensor while maintaining connections to the system under test.*

*The differential pressure sensor is zeroed any time the valve handle has been turned to the **BYPASS** position with the meter turned on. This feature allows for successful zeroing of the differential pressure sensor while entrained air is being purged from the hoses.*

The zero offset of the differential pressure sensor is sensitive to temperature changes. If moving the manometer between areas with extreme temperature difference, it is best to allow the meter to settle to the new temperature prior to zeroing.

Connecting the Manometer to the Test Points

Attaching the Hoses to the Manometer

1. Connect the straight female flare fitting on the High pressure (red) hose to the male fitting on the top of the manometer marked with a plus (+) sign.

2. Connect the straight female flare fitting on the Low pressure (blue) hose to the male fitting on the top of the manometer marked with a minus (-) sign.

Bleeding the Entrained Air

To ensure the most accurate pressure measurements, all entrained air within the hoses should be purged as follows:

1. Turn the shut-off ball valve on both the High and Low pressure hoses to the closed position.
2. Turn the valve handle on the manometer to the **MEASURE** position.
3. Using an appropriate fitting, connect the open end of the High pressure (red) hose to the test point with the higher line pressure.
4. Attach the appropriate fitting to the open end of the Low pressure (blue) hose.
5. To ensure all the air is bled from the hoses, hold the open end of the Low pressure (blue) hose in an upright position over a suitable receptacle or near a drain.
6. Turn the shut-off ball valve on both the High and Low pressure hoses to the open position.
7. Turn the valve handle on the manometer to the **BYPASS** position to allow the liquid flow to displace the entrained air.

Note: Zeroing of the differential pressure sensor is initiated any time the valve handle has been turned to the **BYPASS** position with the meter turned on. This feature allows for successful zeroing of the differential pressure sensor while entrained air is being purged from the hoses.

8. Once the liquid is flowing steadily from the Low pressure (blue) hose, turn the valve handle on the manometer to the **MEASURE** position.

Note: The time to fully prime the hose with fluid may take up to one minute depending on the line pressure. Higher line pressure will reduce the bleed time.

Attaching the Hoses to the Test Points

1. As indicated above, use an appropriate fitting to connect the open end of the High pressure (red) hose to the test point with the higher line pressure.
2. Using an appropriate fitting, connect the open end of the Low pressure (blue) hose to the test point with the lower line pressure.

Note: If the hoses are connected in the inverse orientation (i.e., High pressure (red) hose to the lower line pressure), the displayed High-side gauge pressure (**High P**) will be less than the Low-side gauge pressure (**Low P**), and the Differential pressure (**dP**) will be negative.

Making Pressure Measurements

The HM670 Hydronic Manometer allows for simultaneous measurement and display of the High-side gauge and Differential pressure. The calculated Low-side gauge pressure is also displayed. The manometer is equipped to make and display either discrete or continuous pressure measurements.

High-Side Gauge Pressure

The High-side gauge pressure measurement is indicated as **High P** on the manometer display.

Low-Side Gauge Pressure

The Low-side gauge pressure reading is indicated as **Low P** on the manometer display. It represents a calculated value determined from the measured High-side gauge and Differential pressure as follows:

$$\text{Low P} = \text{High P} - \text{dP}$$

Differential Pressure

The Differential pressure measurement is indicated as **dP** on the manometer display.

Continuous Pressure Measurements

The HM670 Hydronic Manometer makes and displays continuous pressure measurements whenever the manometer is turned on, with the exception of when the **READ** key is pressed. The displayed readings are averaged measurements taken over the sampling period as defined by the current time constant setting. The display is updated once per second.

Discrete Pressure Measurements

Taking a discrete pressure measurement allows for measurement and display of a single time-averaged reading taken over the sampling period as defined by the current time constant setting. Discrete pressure measurement values are displayed on-screen for a period of 10 seconds or until the **READ** key has been pressed again.

1. Press the **READ** key.
2. Allow the manometer to stand undisturbed until the reading is complete (time of completion dependent on the time constant setting).

Making Temperature Measurements

The accessory temperature probe is an optional tool for the HM670 Hydronic Manometer. The 1/8" diameter, stainless steel sheathed immersion probe is designed for measurement of water line temperatures. When using the accessory temperature probe, the HM670 Hydronic Manometer is equipped to make and display either discrete or continuous temperature measurements.

Connecting the Temperature Probe

Connect the keyed 3-pin plug of the accessory temperature probe to the mating connector located on the right-hand side of the manometer.

Notes: A locking nut is provided on the accessory temperature probe plug to allow for a more secure attachment when connecting to the manometer.

When using the accessory temperature probe, the unit of measurement for temperature (°F or °C) is driven by the selected unit of measurement for differential pressure:

- *Differential pressure in psi, inH₂O, ftH₂O, or inHg → temperature in °F*
- *Differential pressure in kPa, mH₂O, mmHg, or bar → temperature in °C*

Disconnecting the Manometer from the Test Points

Caution should be exercised when disconnecting the HM670 Hydronic Manometer from a pressurized system, as water or air discharged under pressure poses the potential risk of serious personal injury. The following provides a guideline for disconnecting the manometer from the test points once measurements have been completed.

1. Turn the shut-off ball valve on both the High and Low pressure hoses to the closed position.
2. Disconnect the High pressure (red) hose from the higher line pressure test point.
3. Disconnect the Low pressure (blue) hose from the lower line pressure test point.

Note: If additional measurements at another location/system containing the same fluid are to be made, it is not necessary to proceed to step 4 and drain the fluid entrained within the hoses at this time. The fluid remaining within the hoses will help minimize the time necessary to bleed entrained air prior to making subsequent measurements.

4. Place the open end of the Low pressure (blue) hose in a suitable receptacle or near a drain.
5. Turn the valve handle on the manometer to the **BYPASS** position.
6. Turn the shut-off ball valve on the Low pressure (blue) hose to the open position to discharge the pressurized fluid out of the open end of the Low pressure (blue) hose.
7. Elevate the High pressure (red) hose and turn its shut-off ball valve to the open position to allow for draining of the remaining entrained fluid.

Chapter 4. Maintenance and Troubleshooting

The HM670 Hydronic Manometer has been designed to provide long-term field use with minimum required maintenance. As with any precision electronic device, however, proper care, maintenance, and handling will further ensure its accurate and reliable operation.

Routine Maintenance

The following guidelines should be followed whenever storing the HM670 Hydronic Manometer:

Draining the Hoses

Fluid within the High (red) and Low (blue) pressure hoses should be properly drained whenever the instrument is being stored after use.

1. Disconnect the manometer hoses from the test points (*reference Chapter 3*).
2. Disconnect the High (red) and Low (blue) pressure hoses from the manometer.
3. Turn the shut-off ball valve on both the High and Low pressure hoses to the open position.
4. Using a suitable high pressure air source, blow the entrained liquid from both hoses.

Draining the Manometer Valve

Fluid within the manometer valve should be properly drained whenever the instrument is being stored after use.

1. Disconnect the High (red) and Low (blue) pressure hoses from the manometer.
2. Turn the valve handle on the manometer to the **BYPASS** position.
3. Hold the manometer with the pressure ports directed downward to allow liquid to drain from the unit.
4. Turn the valve handle on the manometer to the **MEASURE** position.
5. Hold the manometer with the pressure ports directed downward to allow liquid to drain from the unit.

Note: The HM670 Hydronic Manometer should be stored with the valve handle in the **MEASURE** position.

In-Line Pressure Snubbers

The blue and red hose assemblies include pressure snubbers. The pressure snubbers must be used to prevent damage to the pressure sensors from unexpected water hammering or pressure spikes. Do **not** use the HM670 Hydronic Manometer without the pressure snubbers installed in the hose assemblies or sensor damage will occur.

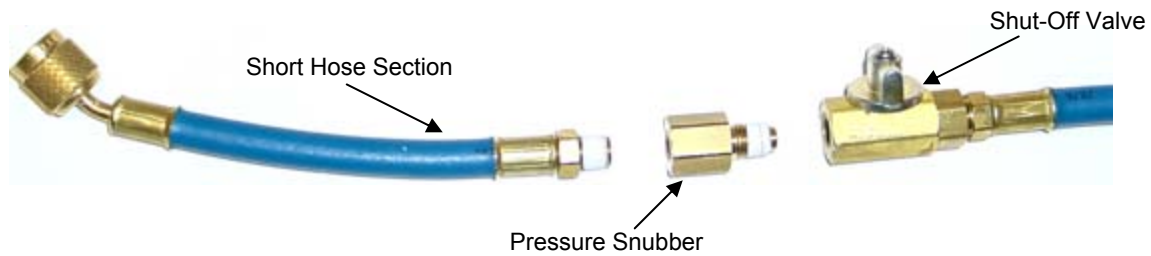


Figure 4: Inline Filter Assembly

Cleaning the In-line Pressure Snubbers

The HM670 Hydronic Manometer is equipped with in-line pressure snubbers upstream of the shut-off ball valve on both the High and Low pressure hoses. These pressure snubbers should be flushed periodically with clean water to minimize potential clogging.

1. Disconnect the hose from the manometer.
2. Turn the shut-off ball valve on the hose to the closed position.
3. Connect the straight female flare fitting (farthest from the hose shut-off valve) on the hose to a suitable water source.
4. Place the open end of the hose in a suitable receptacle or near a drain.
5. Turn the shut-off ball valve on the hose to the open position and allow water to flush through for several minutes.
6. Using a suitable high pressure air source, blow the entrained water from the hose.
7. Repeat for the other hose.

Cleaning the Instrument Housing

The HM670 Hydronic Manometer may be cleaned using a soft, damp, clean cloth.

Note: Solvents or abrasive cleaners should never be used to clean the instrument housing, keypad, or display.

Battery Charging

The HM670 Hydronic Manometer allows for internal charging of AA-size type NiMH (only) batteries. Charging of the batteries is initiated as follows:

1. Turn the manometer off and locate the battery cover on the back of the unit.
2. Loosen the screw on the battery compartment cover and lift to remove.
3. Remove the battery holder. Tapping the backside of the meter against your hand may help in removing the battery holder.
4. Verify the batteries installed are rechargeable type NiMH.
5. Set the battery-type selection switch to NiMH.
6. Reinstall the battery holder. Ensure the battery holder orientation is such that its terminals make contact with the spring contacts within the battery compartment.
7. Replace the battery compartment cover.
8. Plug in the AC adapter.

Notes: Full charge of the batteries is achieved within four (4) hours.

Fully charged batteries should enable the instrument to operate for a period of at least 12 hours.

The manometer remains fully operational while charging batteries.

Never attempt to charge battery types other than AA-size rechargeable NiMH.

Never mix battery types.

NiMH batteries should only be charged at room temperature. Starting with batteries that are too cold or too warm can cause the charge cycle to stop early.

For maximum battery life, ensure the backlight is “off” when not needed.

Calibration


TSI recommends that the HM670 Hydronic Manometer receive an annual calibration. TSI can also verify calibration of the instrument and re-issue a certificate of calibration with traceability to NIST. This “annual checkup” helps to ensure the specified accuracy of the instrument is maintained.

To calibrate the instrument, please ship TSI the complete package that includes the meter and accessory temperature probe. Everything should be packed carefully within the carrying case and then inside a shipping box. The original shipping box is preferred. Prior to shipment, please contact Customer Service for an RMA (Return Materials Authorization) number at (651) 490-2811, (800) 874-2811; or visit the service page on our website at www.alnor.com to complete an RMA# form online.

Ship directly to: TSI Incorporated
 ATTN: Customer Service
 500 Cardigan Road
 Shoreview, MN 55126-3996

Troubleshooting

The following table lists the symptoms, possible causes, and recommended solutions for common problems encountered with the instrument. If your symptom is not listed, or if the recommended solutions do not address your problem, please contact the factory.

Symptom	Possible Causes	Corrective Action
No display	Unit not turned on. Low or dead batteries. Dirty battery contacts. AC adapter not connected.	Press On/OFF key. Replace or recharge the batteries. Clean the battery contacts. Plug in AC adapter.
 flashing on display	Low battery charge. Dirty battery contacts.	Replace or recharge the batteries. Clean the battery contacts.
“8888” flashing on display	The indicated measurement is out of range.	The allowable ranges for pressure and temperature measurements are shown on the specifications page.
“-----” on display	The indicated value is invalid.	The allowable ranges for pressure and temperature measurements are shown on the specifications page.

The following table lists error codes which can be displayed should the instrument detect a problem. Should any of these error codes recur repeatedly, the instrument should be returned to the factory for servicing.

Error Code	Possible Causes
RTC CODE:	Problem detected in reading or setting the time and date.
COUNTER CODE:	Problem detected with the counter chip.
LCD CODE:	Problem detected in writing to the display.
ADC7718 CODE:	Problem detected in reading the pressure voltage.
ADC3300 CODE:	Problem detected in reading a non-pressure voltage.
EEPROM A CODE: EEPROM B CODE:	Problem detected in reading from or writing to one of the chips that store calibration data, user settings and logged data.
USB CODE:	Problem detected with the USB chip.
Calibration CODE:	The meter's calibration data has been corrupted.
The Lithium Battery is Low.	Low voltage detected on the on-board lithium battery.

Specifications*

Range

Differential Pressure	0 to 300 psi (0 to 2068 kPa)
Gauge Pressure.....	0 to 300 psi (0 to 2068 kPa)
Operating Temperature	40 to 100°F (4 to 38°C) electronics
Storage Temperature	0 to 140°F (-18 to 60°C)
Temperature Probe**	-40 to 250°F (-40 to 121°C)

Resolution

Pressure (best)	0.001 psi (0.01 kPa)
Temperature**	0.1°F (0.1°C)

Accuracy

Pressure ¹	±1% of reading or .072 psi (0.5 kPa), whichever is greater
Temperature**	±0.5°F (0.3°C) from 32 to 160°F (0 to 71°C); max ±2.0°F (1.2°C) from -40 to 32°F (-40 to 0°C) and from 160 to 250°F (71 to 121°C)

Units

Pressure	psi, in. H ₂ O, ft H ₂ O, kPa, mm Hg, in. Hg, m H ₂ O, bar
Temperature**	degrees F, degrees C

Time Constant user selectable (1 to 30 seconds)

Display..... dot matrix LCD with backlight

Dimensions (meter only)..... 11.1 in. × 4.7 in. × 3.5 in. (28.2 cm × 11.9 cm × 8.8 cm)

Pressure Connection ¼" 37° Flare Fitting, Male

Weight with Batteries..... 2.65 lb. (1.20 kg)

Power Requirements four AA-size cells, alkaline or rechargeable NiMH (included), or AC adapter (included) 7.5 VDC, 1.6 A, regulated

Battery Life² minimum of 12 hours with backlight on
minimum of 18 hours with backlight off

Recharge Time 4 hours (internal charger)

Warranty..... 2 year factory warranty

*Specifications are subject to change without notice.

**Optional accessory

¹Accuracy statement applies from 0–250 psi (0–1724 kPa).

²The minimum battery life stated will occur after the NiMH batteries have been recharged 2-3 times after initial charge.

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Contact your local Alnor Distributor or visit our website www.alnor.com for more detailed specifications.