Hydronic Manometers

Hydronic Manometer

Model HM680

Owner's Manual

TSI® | ALNOR®

LIMITATION OF WARRANTY AND LIABILITY

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CONTENTS

About This Manual

This manual explains how to set up, operate and maintain the Alnor® HM680 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. In addition to the different typeface, displayed messages appear in quotes.

Technical Assistance—Help!

For technical assistance or questions about the instrument or this manual, or if the HM680 Hydronic Manometer needs repair or recalibration, call Technical Support at (651) 490-2811 or (800) 874-2811.

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Chapter 1. Safety

Safety Warnings

Carefully read each of the following safety warnings prior to using the HM680 Hydronic Manometer.

- ***Never*** use the HM680 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 HM680 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 HM680 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 high temperature systems. Ruptured or leaking lines pose a potential risk of serious personal injury.
- When using the HM680 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 HM680 Hydronic Manometer from a pressurized system. Water or air discharged under pressure poses a potential risk of serious personal injury.
- Exercise caution in using the HM680 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 HM680 Hydronic Manometer hoses and internal piping after each use. This will help in limiting the potential for growth of hazardous microorganisms.

C A U T I O N

Only use TSI P/N 2182003, the AC adapter supplied with the instrument, when powering the HM670/680 Hydronic Manometer externally. Do **not** connect the AC adapter or car adapter provided with the battery charger or any other AC adapter to the HM670/680. Using any other power cable or power supply may cause damage to the device and void the warranty.

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Chapter 2. Introduction

The HM680 Hydronic Manometer is an easy-to-use instrument designed for the accurate measurement of pressure and calculation of flow 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
- Direct calculation and display of Low-side gauge pressure
- Direct calculation and display of flow
- Automatic density corrected readings
- Data logging with calculated statistics
- Output port for downloading stored data to a computer
- User-selectable units of measure
- User-selectable time constant
- Easy-to-read, dot matrix LCD with backlight
- Power supplied 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
- 4-inch temperature probe

Instrument Description

The HM680 Hydronic Manometer includes a meter, 6-inch temperature probe, 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) ¼" Flare male × ¼" NPT male fittings, AC adapter, (4) NiMH batteries, external battery charger, neck strap, owner's manual, and NIST traceable certificate.

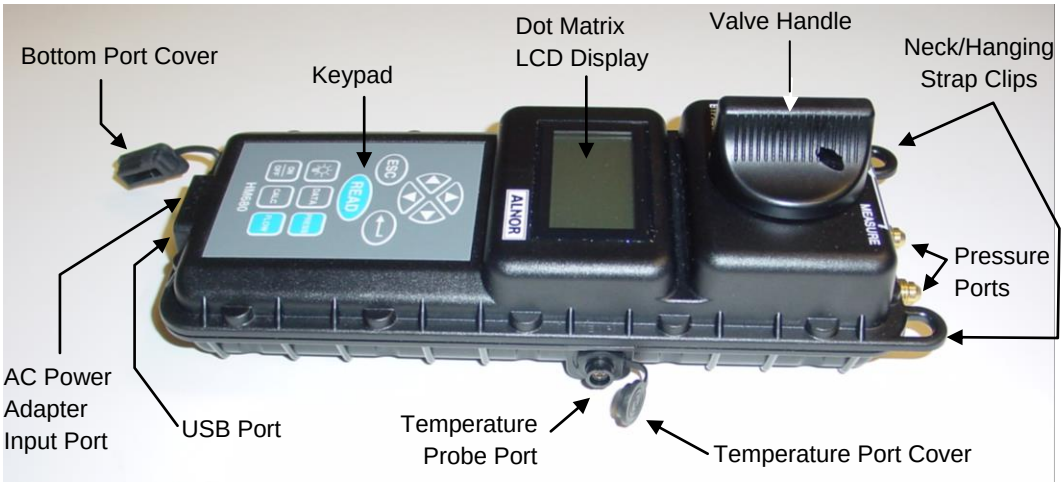


Figure 1: HM680 Meter Description

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 standard and optional components for the HM680 Hydronic Manometer.

Table 1: Standard Components

Item	Part No.
4 in. (15 cm) long, 0.125 in. (3.175 mm) dia. Temperature probe	801291
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	1980518
Pocket screw driver	3012054
115V external battery charger with 4 NIMH AA batteries (USA only)	801093

Table 2: Optional Components

Item	Part No.
Accessory fittings kit (USA only)	HMFIT

Please complete the registration card included with this product and mail it promptly. Registration of the product allows us notify you of product updates. If you prefer, you may register your HM680 through our website at www.tsi.com.

Chapter 3. Getting Started

Keypad

Each key and its function is described below.

▲▼
The ▲and ▼keys are used to navigate through menus or to select an item to change. When entering text, these keys change the highlighted letter/number.

◄►
The ◄ and ► keys are used to change the selected item. When entering text, these keys are used to index the cursor to the desired location.

ESC
The **ESC** key is used to return to the previous screen or to cancel an operation without saving changes made to displayed information.

↵
The **ENTER** key is used to select a menu item, or to accept changes made within a menu item and return to the previous screen. From either the Pressure or Flow Measurement screens, pressing the **ENTER** key accesses the Main Menu.

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


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.*

DATA
Pressing the **DATA** key from either the Pressure or Flow Measurement screens provides access to the Data Logging Menu.

PRESS
Pressing the **PRESS** key from the Flow Measurement screen provides access to the Pressure Measurement screen.

ON/OFF
Press the **ON/OFF** key to turn the HM680 Hydronic Manometer on or off.

CALC
Pressing the **CALC** key from either the Pressure or Flow Measurement screens provides access to the Calculations Menu.

FLOW
Pressing the **FLOW** key from the Pressure Measurement screen provides access to the Flow Measurement screen.

Powering the Instrument

The HM680 Hydronic Manometer is equipped to be powered either by four (4) AA-size batteries (alkaline or rechargeable NiMH) or the AC adapter.

Using the AC Adapter

The AC adapter allows the HM680 Hydronic Manometer to be powered from a standard AC wall outlet. When using the AC adapter, the 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.*

C A U T I O N

Only use TSI P/N 2182003, the AC adapter supplied with the instrument, when powering the HM670/680 Hydronic Manometer externally. Do **not** connect the AC adapter or car adapter provided with the battery charger or any other AC adapter to the HM670/680. Using any other power cable or power supply may cause damage to the device and void the warranty.

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 assist 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).

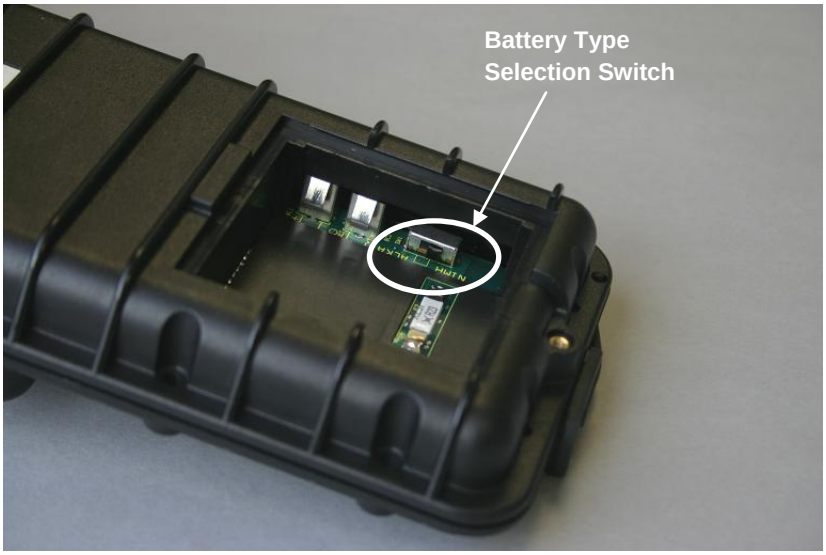


Figure 2: Location of Battery-Type Selection Switch

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 twelve (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.

Instrument Start-up

Upon turning the HM680 Hydronic Manometer on, the meter will engage in a brief self-check while displaying the serial number, model number, and revision of the instrument being used. In completing the self-check, the user is given the option to zero the gauge pressure sensor prior to proceeding to the Pressure Measurement Screen.

Zeroing the Manometer

The HM680 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 HM680 gauge pressure sensor should be zeroed prior to taking readings on each new system. When not in the instrument start-up sequence, the gauge pressure sensor is zeroed as follows:

1. Enter the Main Menu.
2. Select **Zero Gauge Pressure**.
3. Follow the on-screen instruction to complete the gauge pressure sensor zeroing process.

***Notes**: Zeroing the gauge pressure sensor requires the user to disconnect the High pressure (red) hose; as such it is often most convenient to zero the gauge pressure sensor as part of the start-up sequence (i.e,. before hoses have been connected).*

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 and calculated flow (**Flow**) values, the HM680 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:** Zeroing of the differential pressure sensor is unaffected by pressures applied to the meter during zeroing. This feature allows for successful zeroing of the differential pressure sensor while maintaining connections to the system under test.*

*Zeroing of the differential pressure sensor is initiated any time the valve handle has been turned to the **BYPASS** position while in the Pressure or Flow Measurement screens. 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 while in the Pressure or Flow Measurement screens. 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 previously, 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**) and resulting calculated flow (**Flow**) will be negative.*

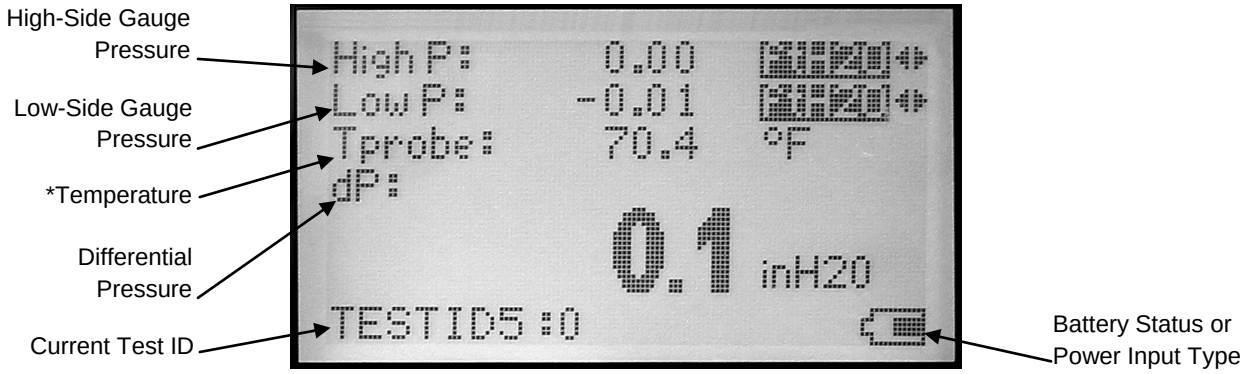
Making Pressure Measurements

The HM680 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. While in the Pressure Measurement screen, the manometer makes and displays continuous pressure measurements, and allows for discrete data storage to the memory.

Accessing the Pressure Measurement Screen

The Pressure Measurement screen is accessed by pressing the **PRESS** key from the Flow Measurement screen, or by pressing the **ESC** key from any of the primary menus (Main Menu, Data Logging Menu, and Calculations Menu) when that menu was accessed from the Pressure Measurement screen.

Pressure Measurement Screen



*Shown with the accessory temperature probe attached.

Figure 3: Pressure Measurement Screen

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:

Low P = High P - dP

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

Continuous Measurements

The HM680 Hydronic Manometer makes and displays continuous pressure measurements whenever the manometer is in the Pressure Measurement or Flow Measurement screen, 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.

Making Flow Measurements

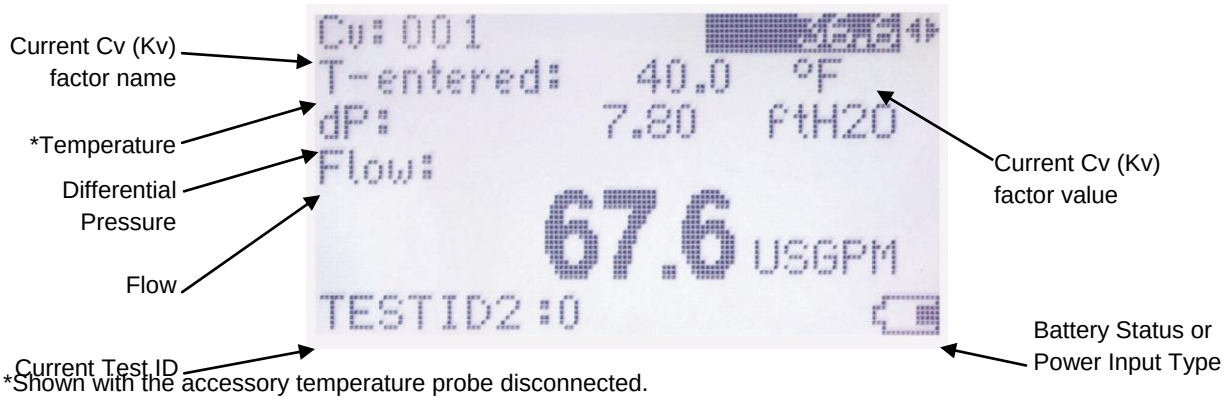
The HM680 Hydronic Manometer allows for continuous calculation and display of flow. While in the Flow Measurement screen, the manometer makes and displays continuous pressure measurements, calculates and displays continuous flow readings, and allows for discrete data storage to the memory.

Note: *The **Cv (Kv)** value of the measured valve must be known in order to obtain meaningful flow readings.*

Accessing the Flow Measurement Screen

The Flow Measurement screen is accessed by pressing the **FLOW** key from the Pressure Measurement screen, or by pressing the **ESC** key from any of the primary menus (Main Menu, Data Logging Menu, and Calculations Menu) when that menu was accessed from the Flow Measurement screen.

Flow Measurement Screen



*Shown with the accessory temperature probe disconnected.

Figure 4: Flow Measurement Screen

Flow
The flow reading is indicated as **Flow** on the manometer display. It represents a calculated value determined from the measured Differential pressure and user entered values for the valve flow coefficient (**Cv** or **Kv**) and fluid specific gravity.

Cv/Kv
The valve flow coefficient is indicated as **Cv (Kv)** on the manometer display. The **Cv (Kv)** value may be edited within the Flow Measurement screen by using the ▲ and ▼ keys to highlight the current setting, and the ◄ and ► keys to change its value.

Notes: *The **Cv (Kv)** value of the measured valve must be known in order to obtain meaningful flow readings.*

*100 different **Cv (Kv)** names and values can be stored in the instrument (Reference Chapter 4).*

Making Temperature Measurements

The HM680 Hydronic Manometer accessory temperature probe is a 1/8” diameter, stainless steel sheathed immersion probe designed for measurement of water line temperatures. When using the accessory temperature probe, the HM680 Hydronic Manometer is equipped to make and display continuous temperature measurements in both the Pressure and Flow Measurement screens.

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.*

Setting Units of Measure

The units of measure for gauge pressure, differential pressure, flow, and temperature are adjusted within either the Pressure or Flow Measurement screens by using the ▲ and ▼ keys to select the unit to change, and the ◄ and ► keys to adjust to the desired unit setting. Available unit settings are as follows:

Gauge Pressure: psi, inH_2O, ftH_2O, inHg, kPa, mH_2O, mmHg, and bar

Differential Pressure: psi, inH_2O, ftH_2O, inHg, kPa, mH_2O, mmHg, and bar

Flow: USGPM, UKGPM, m^3/h, l/s, l/m

Temperature: °F or °C

Storing Discrete Measurements

Taking a discrete measurement allows for measurement, display, and storage of a single time-averaged reading taken over the sampling period as defined by the current time constant setting. Discrete measurement values are stored to the memory (current Test ID) and displayed on-screen for a period of ten (10) seconds or until the **READ** key has been pressed again.

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

Note: *Discrete measurements stored from the Pressure Measurement screen will not contain flow data.*

Disconnecting the Manometer from the Test Points

Caution should be exercised when disconnecting the HM680 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. Main Menu

The Main Menu is accessed by pressing the **ENTER** key from either the Pressure or Flow Measurement screens.

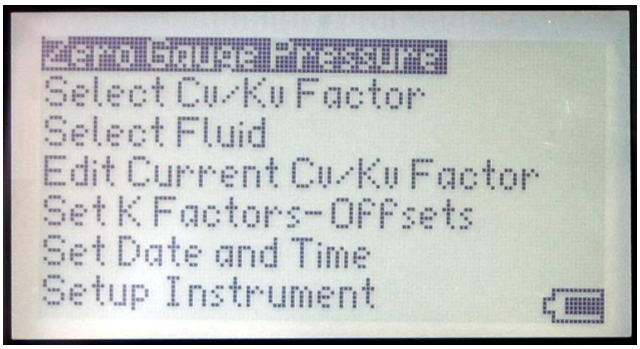


Figure 5: Main Menu

Zero Gauge Pressure

This Main Menu option allows for zeroing the manometer's gauge pressure sensor.

Select Cv/Kv Factor

This Main Menu option allows for selecting any of the 100 user-programmed valve flow coefficients (**Cv** or **Kv**) stored within the instrument. The most recent selected **Cv (Kv)** factor will be the default when entering the Flow Measurement screen.

Select Fluid

This Main Menu option allows for setting the fluid type (**Water** or **Other**) of the system being measured. Defining the fluid type is necessary in order for the manometer to account for the fluid's specific gravity when calculating flow.

Water

In selecting **Water**, the instrument will automatically determine the specific gravity based upon the measured temperature of the fluid (**Tprobe**).

Note: *If the accessory temperature probe is not connected, the user will have the option of manually entering the fluid temperature (**T-entered**).*

Other

In selecting **Other**, the manometer will prompt the user to enter the fluid's specific gravity.

Note: *When **Other** is selected as the fluid type, the entered value for specific gravity will not be compensated with changes in temperature.*

Edit Current Cv/Kv Factor

This Main Menu option allows for editing the type (**Cv** or **Kv**), name (up to 9 characters), and value of the current selected **Cv (Kv)** factor.

Set K Factors-Offsets

This Main Menu option allows for defining a K-factor (multiplier) or offset to adjust the baseline factory calibration curve for the differential pressure sensor, gauge pressure sensor, or accessory temperature probe.

dP K Factor

A K factor for differential pressure measurements is selectable from 0.800 to 1.200. The default is 1.000.

Gauge K Factor

A K factor for gauge pressure measurements is selectable from 0.800 to 1.200. The default is 1.000.

Temperature Offset

An offset value for temperature probe measurements is selectable between ± 5.4 °F (± 3.0 °C).

Set Date and Time

This Main Menu option allows for adjustment and setting of the instrument real-time clock.

Setup Instrument

This Main Menu option allows for defining the following parameters:

Decimal

This setting adjusts the format of the delimiter in both displayed and stored data. The available decimal settings are **PERIOD** and **COMMA**.

Contrast

This setting adjusts the contrast of the manometer display.

Beeper

This setting adjusts whether or not keypad presses are accompanied by an audible beep. The available beeper settings are **ON** and **OFF**.

Time Constant

This setting adjusts the current value of the time constant. The available settings for the time constant are: 1, 5, 10, 20, and 30 seconds.

Notes: *The time constant is the sampling period over which the manometer averages 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.

Auto Off

This setting adjusts whether or not the instruments automatic shut-off feature is enabled. The automatic shut-off feature helps to extend battery life by turning off the instrument if the keypad has been inactive for a period of thirty (30) minutes. The available settings for the Auto-Off feature are **ON** and **OFF**.

Note: *The automatic shut-off feature is disabled whenever data logging is active.*

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Chapter 5. Data Logging Menu

The Data Logging Menu is accessed by pressing the **DATA** key from either the Pressure or Flow Measurement screens.

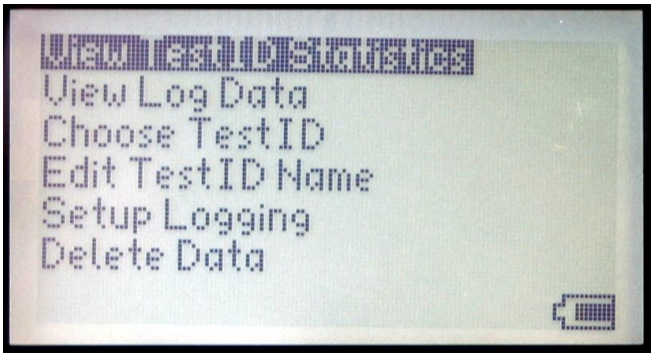

Figure 6: Data Logging Menu

View Test ID Statistics

This Data Logging Menu option allows for viewing statistical data for all samples stored to the current Test ID. The ◄ and ► keys are used to toggle between the available statistics as follows:

AVG
The average of all values stored in that TEST ID.

MIN
The lowest value stored in that TEST ID.

MAX
The highest value stored in that TEST ID.

SUM
The sum of all values stored in that TEST ID.

Note: ***SUM*** *is only presented for flow readings.*

View Log Data

This Data Logging Menu option allows for viewing the data for each sample stored to the current Test ID. The ◄ and ► keys are used to toggle between the individual data samples. The ▲ and ▼ keys are available to scroll up and down to see the entire contents of stored data for a particular sample.

Choose Test ID

This Data Logging Menu option allows for selecting any of the 100 available Test IDs within the instrument. All new data stored will be saved to the most recently selected Test ID.

Edit Test ID Name

This Data Logging Menu option allows for editing the name (up to 10 characters) of the current selected Test ID.

Setup Logging

This Data Logging Menu option allows for setting the parameters, and initiating, continuous unattended data logging.

Interval
The interval defines the frequency period with which the manometer will log readings. The available settings for the logging interval are: 5, 10, 20, 30 seconds; 1, 2, 5, 10, 15, 20, 30 minutes; and 1 hour.

Note: *The logging interval must be set at a time period that is greater than or equal to the current setting of the time constant.*

Samples
This defines the total number of readings to be stored as part of the continuous unattended data logging.

Note: *The instrument can store a maximum of 1000 different samples. These samples can be distributed over one or all of the available Test IDs.*

Delete Data

This Data Logging Menu option allows for deleting discrete samples, an entire Test ID, or all data stored to the instrument.

Note: *Deleted data cannot be retrieved.*

Delete a Sample

This option allows for deleting discrete samples within the current Test ID. The ◄ and ► keys are used to toggle between the individual data samples.

Note: *Test ID statistics will automatically be re-calculated upon deletion of an individual stored sample.*

Delete a Test ID

This option allows for deleting all samples within the current Test ID, as well as restoring its factory set default name.

Delete All Log Data

This option allows for deleting all samples stored to the instrument, as well as restoring the factory set default names to each of the Test IDs.

Chapter 6. Calculations Menu

The HM680 Hydronic Manometer is capable of performing a variety of calculations useful in evaluating hydronic system performance. The Calculations Menu is accessed by pressing the **CALC** key from either the Pressure or Flow Measurement screens.

Figure 7: Calculations Menu

Brake Power

This Calculations Menu option allows for determination of pump brake power.

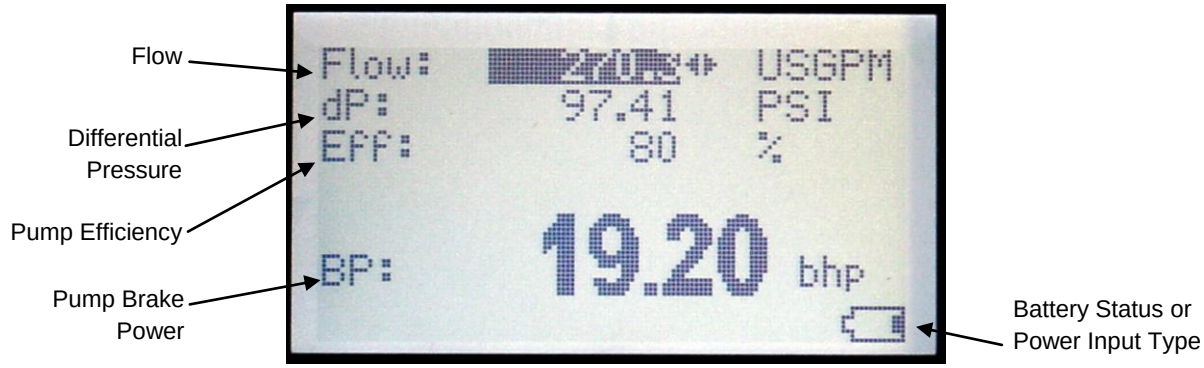

Figure 8: Brake Power Screen

Inputs

The following inputs are necessary for calculating brake power. Use the ▲ and ▼ keys to select the parameter to be updated, and the ◄ and ► keys to change the value of the highlighted field. Units for the inputs are driven by what was last set in the Pressure and Flow Measurement screens.

Flow

The pump flow rate.

dP

The pressure drop measured across the pump.

Note: *The pressure drop across the pump can be entered as a real-time measurement. With the value for differential pressure highlighted, press the **READ** key. The field will begin updating with measured values of differential pressure. Press the **READ** key again to discontinue real-time updates.*

Eff
The pump efficiency (as a percent).

Notes: *The pump efficiency should be provided by the manufacturer.*

If the pump efficiency is not known, allowing for an efficiency factor of 70 % is a good rule-of-thumb.

Output
The calculated pump brake power (**BP**) will automatically update as the input parameters are changed. Using the ▲ and ▼ keys to scroll, and the ◄ and ► keys to change the selected field, the unit of measure for brake power may be adjusted. Available units for brake power are: bhp, W, and kW.

Heat Flow

This Calculations Menu option allows for determination of heat flow.

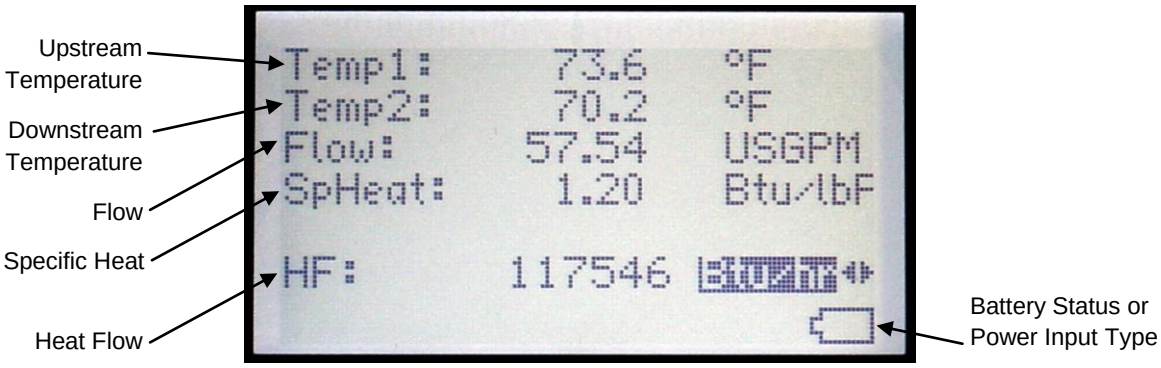

Figure 9: Heat Flow Screen

Inputs
The following inputs are necessary for calculating heat flow. Use the ▲ and ▼ keys to select the parameter to be updated, and the ◄ and ► keys to change the value of the highlighted field. Units for the inputs are driven by what was last set in the Pressure and Flow Measurement screens (with the exception of specific heat).

Temp1
The upstream fluid temperature of the device being measured.

Note: *The upstream temperature can be entered as a real-time measurement if the accessory temperature probe is connected. With the value for the upstream temperature highlighted, press the **READ** key. The field will begin updating with measured values of temperature. Press the **READ** key again to discontinue real-time updates.*

Temp2
The downstream fluid temperature of the device being measured.

Note: *The downstream temperature can be entered as a real-time measurement if the accessory temperature probe is connected. With the value for the downstream temperature highlighted, press the **READ** key. The field will begin updating with measured values of temperature. Press the **READ** key again to discontinue real-time updates.*

Flow
The flow rate through the device.

Note: *The flow rate through the device can be entered as a real-time measurement. With the value for flow highlighted, press the **READ** key. The field will begin updating with calculated values of flow. Press the **READ** key again to discontinue real-time updates.*

SpHeat
The specific heat of the system fluid.

Notes: *The unit of measure for specific heat is driven by that selected for heat flow as follows:*

- *Heat flow in Btu/hr → specific heat in Btu/lb·°F*
- *Heat flow in W or kW → specific heat in kJ/kg·°C*

The default specific heat is that of water: 1.00 Btu/lb·°F (4.19 kJ/kg·°C)

Output
The calculated heat flow (**HF**) will automatically update as the input parameters are changed. Using the ▲ and ▼ keys to scroll, and the ◄ and ► keys to change the selected field, the unit of measure for heat flow may be adjusted. Available units for heat flow are: Btu/hr, W, and kW.

Cv/Kv

This Calculations Menu option allows for determination of a valve flow coefficient (**Cv** or **Kv**).

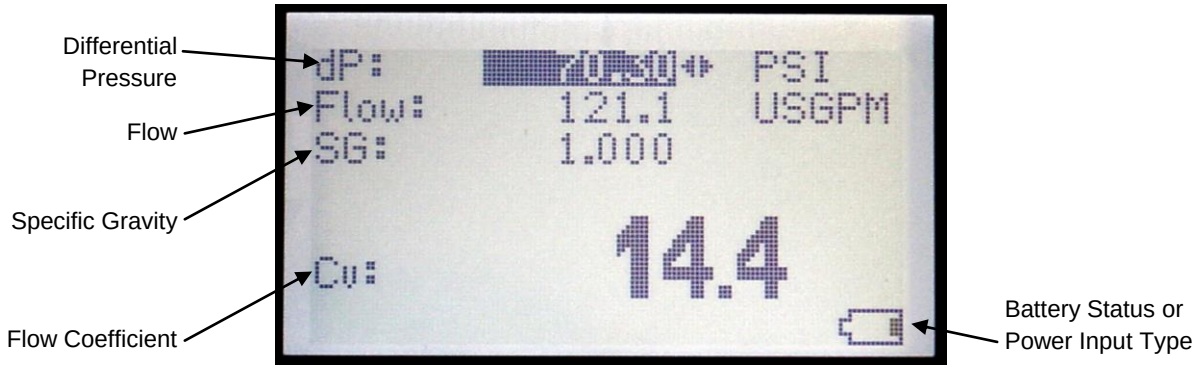

Figure 10: Cv/Kv Screen

Inputs
The following inputs are necessary for calculating the flow coefficient. Use the ▲ and ▼ keys to select the parameter to be updated, and the ◄ and ► keys to change the value of the highlighted field. Units for the inputs are driven by what was last set in the Pressure and Flow Measurement screens.

dP
The pressure drop across the valve.

Flow
The flow rate through the valve.

SG
The specific gravity of the system fluid.

Output
The calculated valve flow coefficient (**Cv** or **Kv**) will automatically update as the input parameters are changed.

Note: *Whether a **Cv** or **Kv** value is being calculated is dependent on the type (**Cv** or **Kv**) set for the current selected valve flow coefficient (Reference Chapter 4).*

Pump Law Impeller Diameter

This Calculations Menu option allows for determination of required pump impeller size. The calculation is based upon the following affinity law: Flow varies directly as the change in impeller diameter.

Figure 11: Pump Law Impeller Diameter Screen

Inputs
The following inputs are necessary for calculating the required impeller diameter. Use the ▲ and ▼ keys to select the parameter to be updated, and the ◄ and ► keys to change the value of the highlighted field. Units for the inputs are driven by what was last set in the Pressure and Flow Measurement screens (with the exception of impeller diameter).

Flow1
The actual system flow rate.

Diam1
The actual pump impeller diameter.

Flow2
The desired system flow rate.

Output
The calculated required impeller diameter (**Diam2**) to achieve the desired flow will automatically update as the input parameters are changed. Using the ▲ and ▼ keys to scroll, and the ◄ and ► keys to change the selected field, the unit of measure for impeller diameter may be adjusted. Available units for impeller diameter are: in, and mm.

Pump Law Delta P

This Calculations Menu option allows for determination of required pump pressure drop. The calculation is based upon the following affinity law: Pump pressure drop varies as the square of flow.

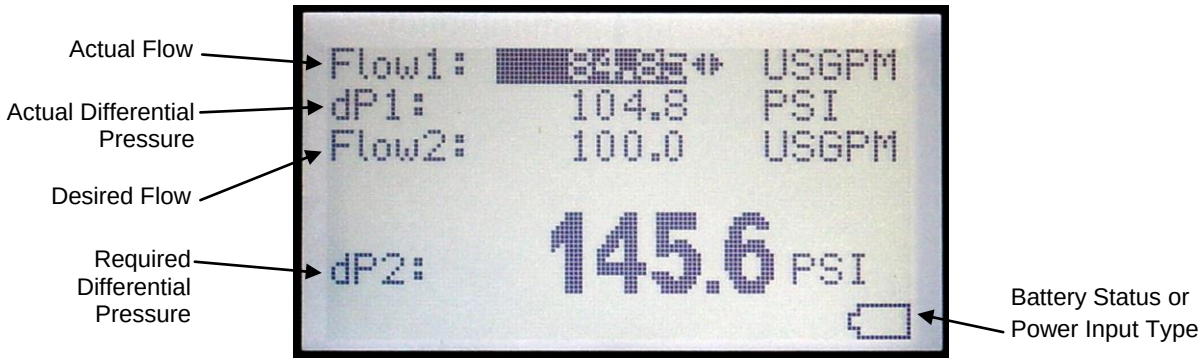

Figure 12: Pump Law Delta P Screen

Inputs
The following inputs are necessary for calculating the required pump pressure drop. Use the ▲ and ▼ keys to select the parameter to be updated, and the ◄ and ► keys to change the value of the highlighted field. Units for the inputs are driven by what was last set in the Pressure and Flow Measurement screens.

Flow1
The actual system flow rate.

dP1
The actual pump pressure drop.

Flow2
The desired system flow rate.

Output
The calculated required pump pressure drop (**dP2**) to achieve the desired flow will automatically update as the input parameters are changed. The units for pump pressure drop are driven by what was last set in the Pressure and Flow Measurement screens.

Pump Law Brake Power

This Calculations Menu option allows for determination of required pump brake power. The calculation is based upon the following affinity law: Pump brake power varies as the cube of flow.

Figure 13: Pump Law Brake Power Screen

Inputs
The following inputs are necessary for calculating the required pump brake power. Use the ▲ and ▼ keys to select the parameter to be updated, and the ◄ and ► keys to change the value of the highlighted field. Units for the inputs are driven by what was last set in the Pressure and Flow Measurement screens (with the exception of brake power).

Flow1
The actual system flow rate.

BP1
The actual pump brake power.

Flow2
The desired system flow rate.

Output

The calculated required pump brake power (**BP2**) to achieve the desired flow will automatically update as the input parameters are changed. Using the ▲ and ▼ keys to scroll, and the ◄ and ► keys to change the selected field, the unit of measure for pump brake power may be adjusted. Available units for pump brake power are: bhp, W and kW.

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Chapter 7. Maintenance and Troubleshooting

The HM680 Hydronic Manometer has been designed to provide long-term field use with minimum required maintenance. As with any precision electronic device, proper care, maintenance, and handling will ensure its accurate and reliable operation.

Routine Maintenance

The following guidelines should be followed whenever storing the HM680 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 HM680 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 HM680 Hydronic Manometer without the pressure snubbers installed in the hose assemblies or sensor damage will occur.

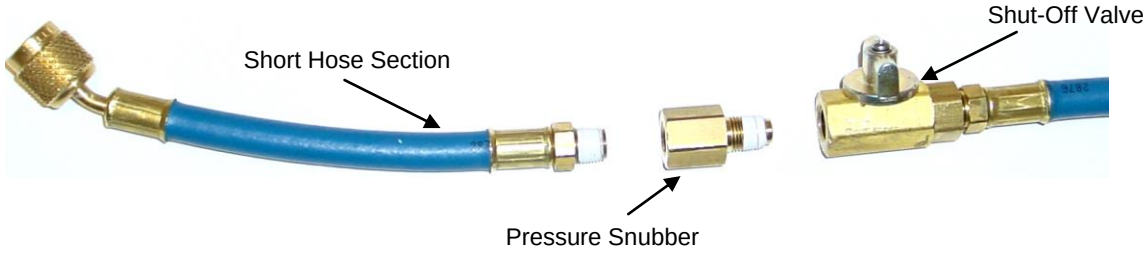

Figure 14: Inline Filter Assembly

Cleaning the In-line Pressure Snubbers

The HM680 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 with the second hose.

Cleaning the Instrument Housing

The HM680 Hydronic Manometer may be cleaned using a soft, damp, clean cloth.

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

Battery Charging

The HM680 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 twelve (12) hours.

The manometer is fully operational while charging batteries.

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

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

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 terminate early.

Calibration

TSI recommends that the HM680 Hydronic Manometer receive an annual calibration. TSI will 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.tsi.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.

Chapter 8. USB Downloading to a Computer

The HM680 Hydronic Manometer allows for downloading of stored data to a computer by using the included Windows®-based CompuDat™–USB downloading program and USB interface cable.

Installing the USB Software

Successful installation of the CompuDat™–USB downloading software is completed as follows:

1. Insert the CompuDat™–USB Software CD into the computer CD drive.

2. Allow the Autorun program to initiate the installation.

Note: *If the program fails to start automatically, run the file setup.exe located on the CD.*

3. Follow the on-screen instruction to properly install the program.

Notes: *You must have administrative rights on the computer in order to successfully install the included USB downloading software.*

You will need to restart the computer (as prompted) upon completing the installation prior to first running the USB downloading program.

Connecting the Manometer to the Computer

The HM680 Hydronic Manometer is connected to the computer using the provided USB interface cable. The meter must be powered on in order to properly establish communication.

First Time Connection

The *first* time the meter is connected to the computer, you will be prompted to complete the following New Hardware installation.

Note: *The screens shown here are from a Windows® XP installation. Windows® Vista® screens will differ.*

(continued on next page)

1. Select **Automatic Install** and click **Next**.

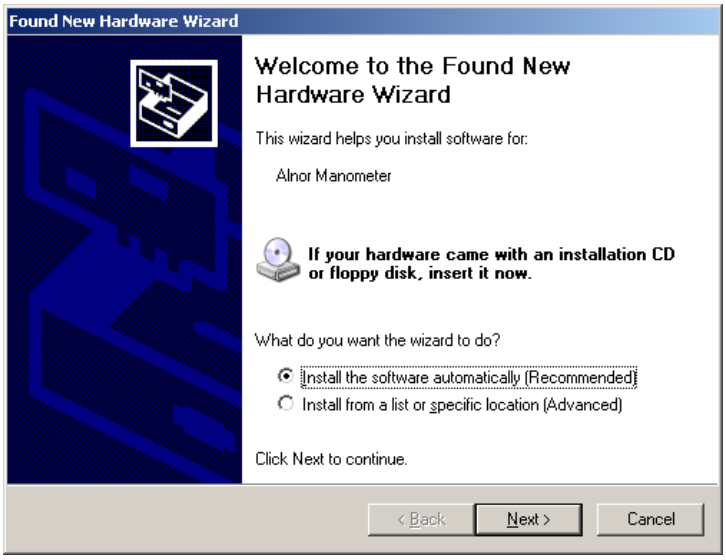

Figure 15: Found New Hardware Wizard

2. Click **Continue Anyway**.

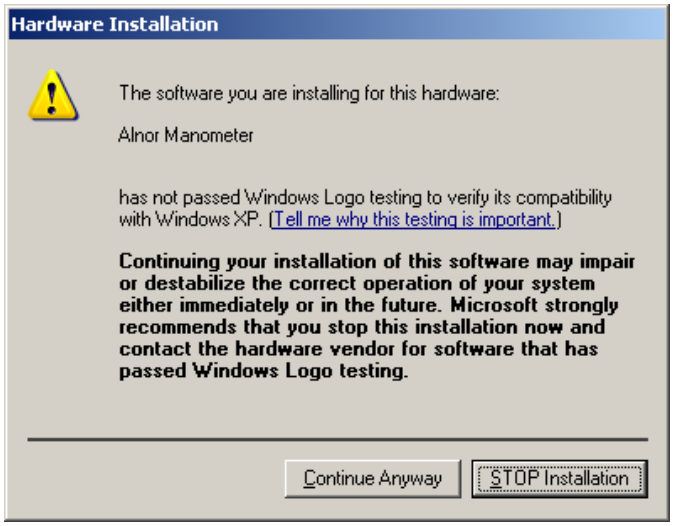

Figure 16: Hardware Installation

3. Click **Finish**.

Figure 17: Completing the Found New Hardware Wizard

Software Interface

With the HM680 meter connected to the computer, the CompuDat™–USB program will launch automatically. All downloadable data stored to the instrument will be presented in a form similar to as follows:

Note: *The CompuDat™-USB program will not launch automatically when run on a Windows® Vista® operating system.*

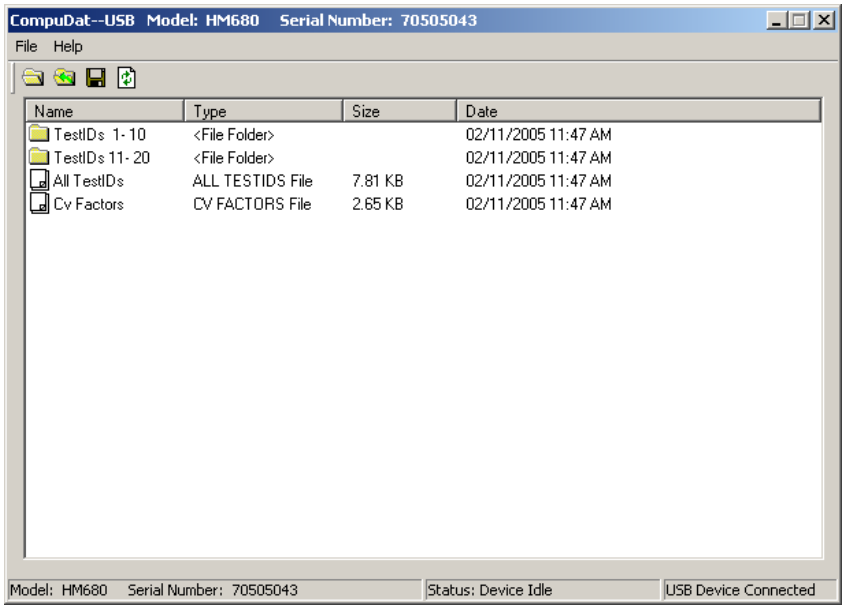

Figure 18: USB Folders and Files

All TestIDs

The All TestIDs file contains all data stored to each of the instrument's 100 available Test IDs.

Cv Factors

The Cv Factors file contains all data associated with the instruments 100 available Cv/Kv valve coefficients.

TestIDs Folder

Each TestIDs folder contains files for each of the Test ID numbers indicated (example: the folder 'TestIDs 1-10' will contain files of stored data for Test ID 1 through Test ID 10). TestIDs folders can be downloaded in their entirety or opened for access to individual Test ID files.

Downloading Data

Downloading stored data is completed as follows:

1. Single-click the desired file/folder to highlight.
2. Click the **Save As** icon in the toolbar.

   Note: *You may also use the **Save As** option in the file pull-down menu.*
3. Choose the filename, file type, and directory to save data to.

   Notes: *Double-clicking or using the **Open** menu option allows for automatically opening the selected file using an appropriate application (i.e., Microsoft® Excel® spreadsheet) upon having saved the file to the computer.*

   TSI recommends that you do not save data files in the C:\Program Files directory when running on a Windows Vista® operating system in a multi-user environment.

Specifications*

Range	
Differential Pressure	-300 to 300 psi (-2068 to 2068 kPa)
Gauge Pressure	-20 to 300 psi (-138 to 2068 kPa) (-40 to 610 in. Hg)
Flow[1]	0 to 9999 USGPM (0 to 631 l/s, 0 to 2271 m^3/h)
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) (0.01 in. Hg)
Flow (best)	0.0001 USGPM (0.00001 l/s)
Temperature	0.1°F (0.1°C)
Accuracy	
Pressure[2]	±1% of reading plus .072 psi (0.5 kPa) (0.15 in. Hg)
Flow	per pressure accuracy + valve deviation
Temperature	±0.5% of reading + 1.2°F (0.7°C)
Units	
Pressure	psi, in. H_2O, ft H_2O, kPa, mm Hg, in. Hg, m H_2O, bar
Flow	USGPM, UKGPM, m^3/h, l/s, l/m
Temperature	degrees F, degrees C
Statistics	min, max, average, sum up to 1000 readings
Data Storage	100 Test IDs, 1000 combined readings, time and date stamped
Logging Interval	user selectable (5 to 3600 seconds)
Averaging Interval	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 Life[3]	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.*

[1]The flow reading is a calculated value determined from the measured Differential pressure, user entered valve flow coefficient (Cv or Kv), and fluid specific gravity.

[2]Accuracy statement applies from 0–250 psi (0–1724 kPa).

[3]The 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.

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