

SCOPE OF MANUAL

This manual contains information concerning the installation, operation and maintenance of the Model 7000 Transit-Time Ultrasonic Portable flowmeter. To ensure proper performance of the meter, the instructions given in this manual should be thoroughly understood and followed.

Keep the manual in a readily accessible location for future reference.

Changes and additions to the original edition of this manual will be covered by a "CHANGE NOTICE" supplied with the manual. The change notice will explain any changes made to the product described in this manual.

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To avoid damage in transit, Eastech Badger products are shipped to the customer in special shipping containers. Upon receipt of the product, perform the following unpacking and inspection procedures:

NOTE: If damage to the shipping container is evident upon receipt, request the carrier to be present when the product is unpacked.

a. Carefully open the shipping container following any instructions that may be marked on the box. Remove all cushioning material surrounding the product and carefully lift the product from the container.

Retain the container and all packing material for possible use in reshipment or storage.

b. Visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the customer.

Specifications

Electronics

Microprocessor based: Advanced single chip microcomputer with 8K bytes of ROM, 512 bytes of EEPROM and 512 Bytes of RAM.

Linearity: +/- 0.5%
Repeatability: 0.25%
Accuracy: Typically, +/- 1% of actual flow*
Temperature Rating: 32 to 130 degrees F
Humidity Rating: 5 to 95% relative
Outputs: Digital to data logger
4-20 mA flow output

Power Requirements: Internal rechargeable battery with 117 VAC internal charger, 117/230 VAC, 50/60 Hz, or external 12 VDC.

*Accuracy statement is predicted on velocities above 1 FPS, meter location in piping run with proper straight runs for establishment of predictable velocity profile, proper installation of sensors and accurate pipe dimensions. For velocities below 1 FPS, the accuracy is +/- 0.02 FPS.

Sensors:

Temperature Rating: -30 to 190 degrees F
Sensor Materials: Ultem/Stainless Steel,
Electroless (autocatalytic)
nickel plated carbon steel
Sensor Cable: 12' Coax w/BNC connectors

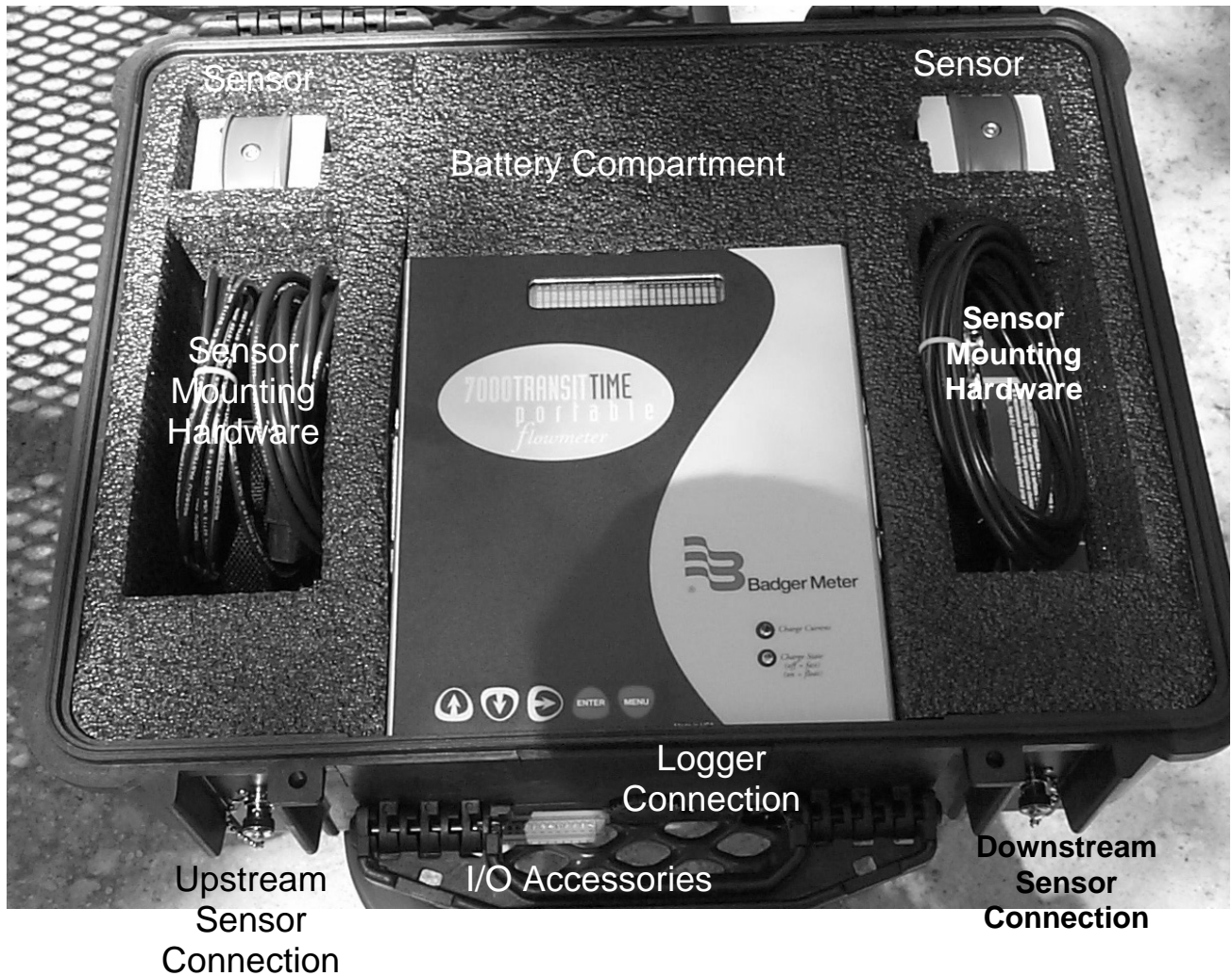
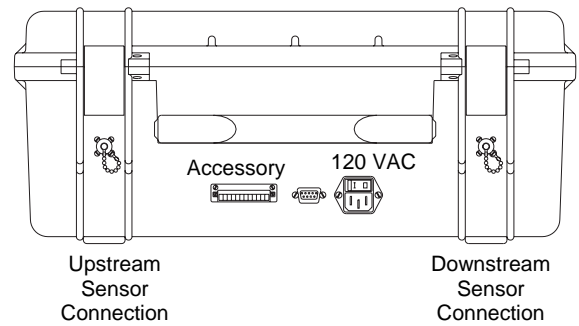
Data Logging Module:

Records flow
RS232C port for computer communications
Logging Interval: (2) Selectable logging intervals - from 1 to 255 minute intervals
Memory Capacity: 128K RAM
90 days at 5 minute logging intervals
Program/Download: Direct with laptop computer using the FLARS™ for Windows™ software package
Stored Information: Site/Equipment Description
Site ID number
Logger serial number
Time and date
Logged measurements
External Inputs: External 4-20 mA input to separate logging channel
Alarm/Event (pulse or contact) input

Model 7000 Electronic Enclosure

The Model 7000 transit-time velocity electronics, data logger and battery charger are card cage mounted for durability and housed in a Pelican watertight, crushproof case. In addition to the electronics card cage, the case also houses the rechargeable battery, two sensors with 25' of cable, all sensor mounting hardware, and the power cord. The enclosure dimensions are 20" long, 17" wide and 8.4" deep. Total weight including case, battery, electronics, sensors and sensor mounting hardware is 34 lbs.

All connections are located on the front of the case including the up stream and downstream sensors, AC power cord connection, On-Off switch, logger port for downloading data to a laptop computer, and the I/O accessories. The I/O accessories terminal includes a pulse input, 4-20 mADC input to analog channel 1 of the data logger, 4-20 mADC flow/velocity output, and an external 12 VDC input.



WIRING CONNECTIONS

AC Power Supply Connections. The AC power cord plugs into the front of the case and provides operational power as well as charges the rechargeable battery. The On-Off switch is located above the power cord connection.

Battery Charge. When AC power is applied, the internal battery is charging. Two LED's are located in the lower right side of the meter panel. The top LED is red and is always "ON" but intensity is proportional to charge current. The bottom LED is green and is "OFF" in fast-charge state, and "ON" in float-charge state.

Fuses. Both the internal power supply and the external 12 VDC input are fused with 1 Amp fuses.

Accessory Terminal Strip. Terminal connector 1 and 2 is for a pulse input to the data logger. Terminal connector 3 and 4 is the 4-20 mA input to analog channel 1 of the data logger with terminal 3 positive and 4 negative. Terminal 5 and 6 is the 4-20 mA flow output with terminal 5 positive and terminal 6 negative. Terminals 7-10 is for laptop communication directly to the flowmeter for special programming. This is covered in the programming section of the manual. When not used for special programming, a jumper is placed between terminals 9 and 10 for logger operation. Terminals 11 and 12 are for a 12 VDC external input with terminal 11 positive and terminal 12 negative. When used, the external 12 volt source will automatically be connected in parallel to the internal rechargeable battery.

Data Logger Connection. The 9 pin data logger connector provides the interface between the built-in data

logger and a laptop computer running Eastech Badger FLARS™.

4-20 mA Flow Output. The maximum load resistance for the 4-20 mA flow output is 1000 ohms and requires a separate external power supply to drive the 4-20 mA output. The size of the external DC supply will depend on the load resistance the 4-20 mA is driving. It requires 8 vDC to power the 4-20 mA circuitry. The equation to determine the required voltage for a load is:

$$V = (R * .02) + 8$$

where:

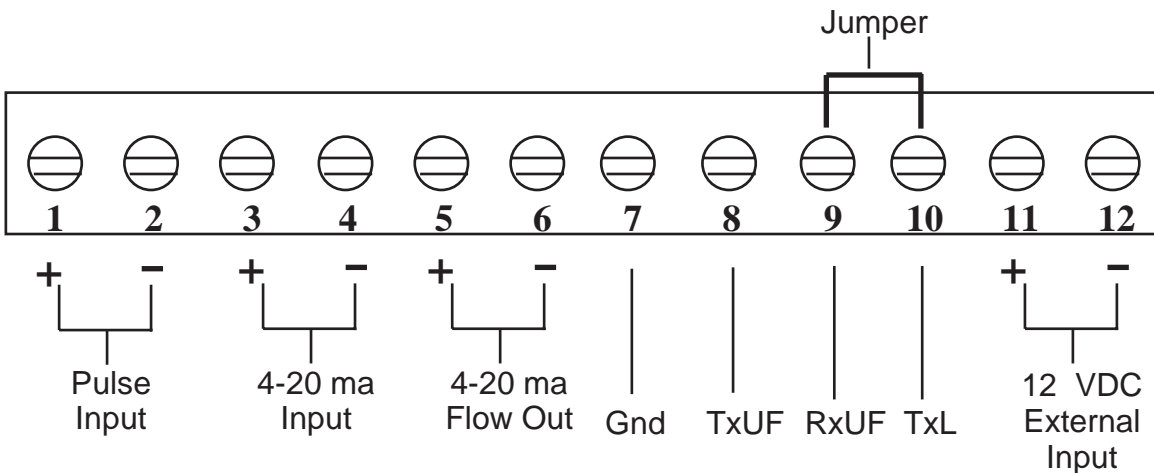
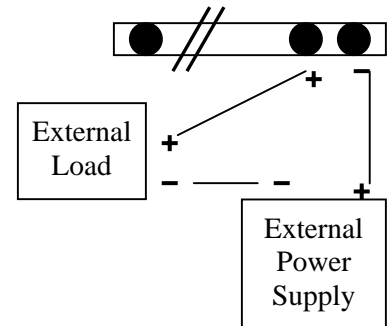
$$V = \text{Power supply in VDC}$$

$$R = \text{Resistance of load in ohms}$$

For example, if the device connected to the 4-20 mA output has a resistance of 250 ohms, then the required power supply is 13 VDC.

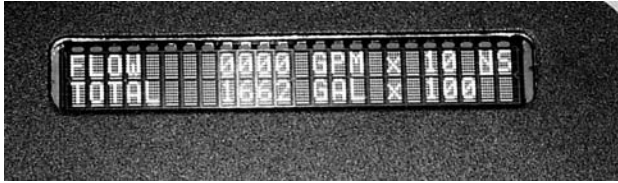
$$V = (250 * .02) + 8$$

$$V = 13 \text{ VDC.}$$



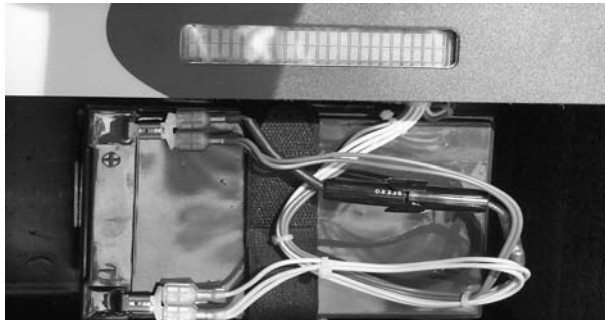
Display

The 2 line display is a vacuum fluorescent display. In order to conserve battery energy, it has an automatic shutoff after 5 minutes that turns the display off. To turn the display back on, press any key.



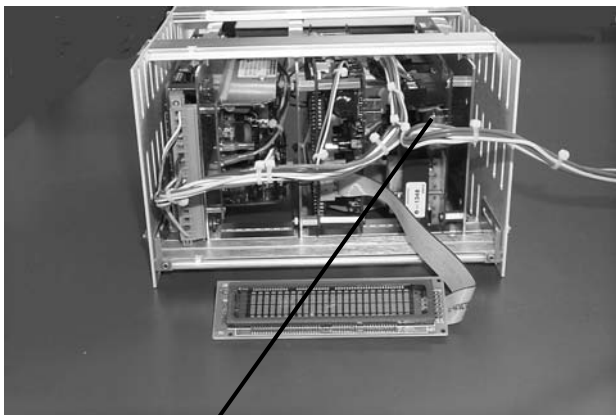
Battery

The battery is a 12 Volt DC, 12 Amp/Hour sealed rechargeable battery designed to operate the unit for up to 24 hours. Once discharged, a full charge takes between 6 to 8 hours.



Card Cage

The circuit boards are card cage mounted for protection underneath the main panel.



Main Power Fuse

The 1 amp main power fuse is located on the power supply.

Frequency (Two Different Models of 7000 Portables)

There are two models of the portable 7000: The Model 7000-12 transmits at a frequency of 1280 KHz and the Model 7000-6 transmits at a frequency of 640 KHz. The sensors are also available in either 1280 KHz or 640 KHz and must be the same frequency as the transmitter.

The 7000-12 (1280 KHz) is recommended for unlined pipe applications from 2" up to 54". For 2" pipes, a special sensor is required and the unit must be programmed with a laptop computer and AP45 software. The 7000-12 is also recommended for thin wall, brass and copper pipe with wall thickness less than 1/8" using the ST52 degree sensors.

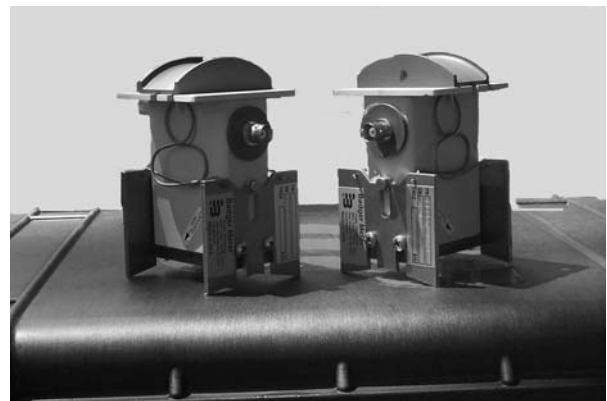
The 640 KHz Model 7000-6 is recommended for pipes 4" to 54", both lined and unlined.

Sensors

The Model 7000 uses ST30 or ST52 sensors with a Ultem lens. These sensors can be used on pipes with temperatures up to 190° F. They can be used on pipes with temperatures up to 300° F, but only for one hour or less.

The ST30 sensors are standard and used with most pipes from 4" up to 54".

The ST52 sensors are designed for thin wall pipes with 1/8" or less wall thickness and copper or brass pipes.

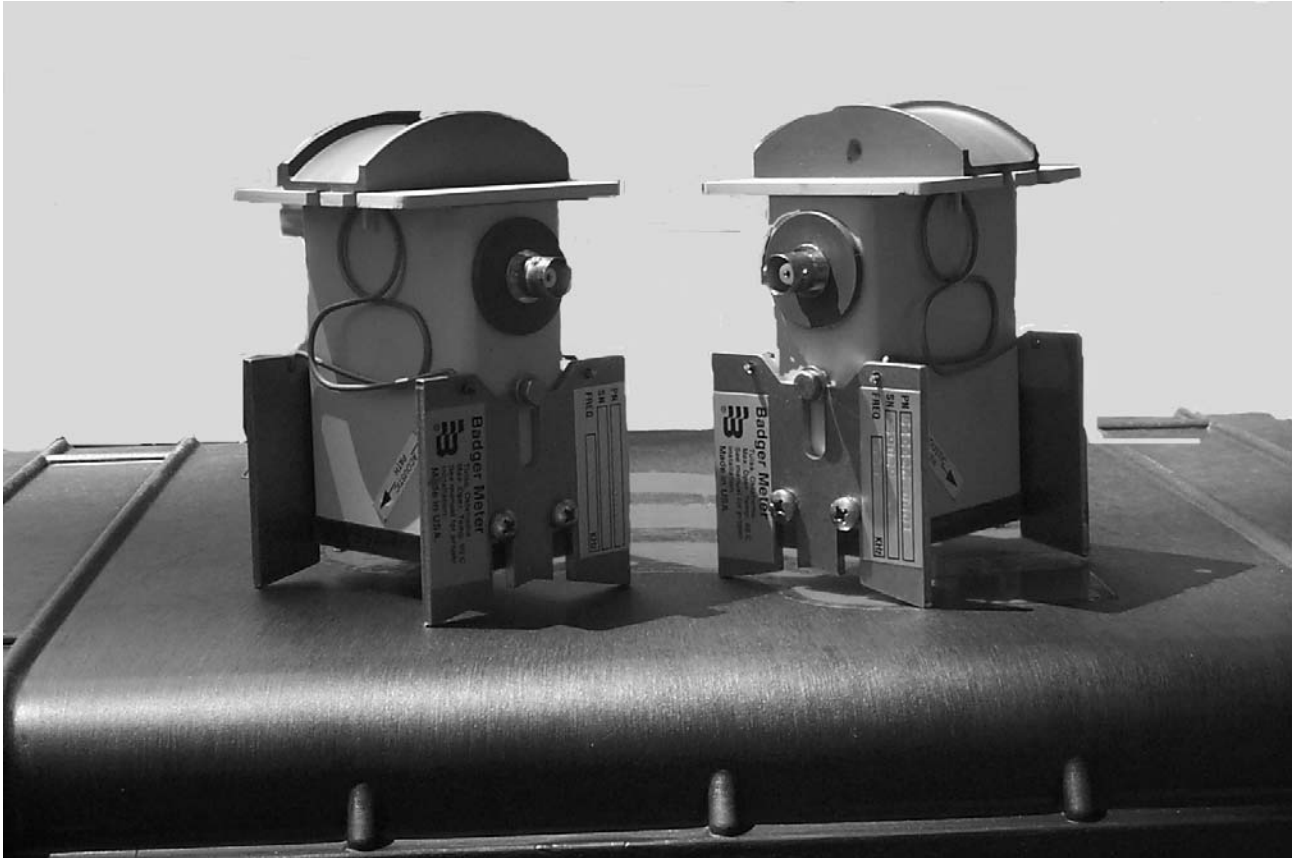


Pipe Preparation

Some pipes, particularly older cast iron and ductile iron pipes have a very rough surface. In order to achieve the best possible signal from the sensors, it may be necessary to clean or grind a smooth surface on the pipe where the sensors are to be mounted. The pipe surface should be smooth but still maintain the radial surface of the pipe.

Sensor Installation of Strap-On Sensors

The strap-on sensors for the portable 7000 are designed for external mounting on pipes made of material, such as steel or plastics, that will support ultrasonic signal transmissions. The sensors are constructed of electroless (autocatalytic) nickel plated carbon steel materials with stainless steel side brackets, accessories, and Ultem lenses. They are designed for ease of installation.



It is important that the sensors are installed correctly on the pipe to ensure good accuracy. The sensors may be mounted on horizontal or vertical pipe runs. **If the pipe is horizontal, the sensors must be located on the sides and not on the top and/or bottom of the pipe. For vertical pipe runs, the flow should be flowing upward in the pipe.**

It is important that there be as much upstream straight run as possible so there will be a well developed velocity profile at the point of measurement. There should be 3 pipe diameters of downstream straight run after the point of measurement.

The sensor may be mounted on the pipe in two different configurations: A "V" mounting configuration and a "Z" mounting configuration. The "V" configuration places both sensors on the same side of the pipe and offset upstream and downstream by the sensor separation called out in the setup program View Menu.

The "Z" configuration locates each sensor 180° apart on opposite sides of the pipe and offset upstream and downstream by the sensor separation called out in the setup program View Menu.

Sensor mounting is accomplished using the supplied web straps. Sensor grease is applied to the bottom of each sensor prior to mounting.

Sensor Mounting

V Configuration

Program the flow meter for the application and record the sensor separation from the View setup parameters in the setup menus.

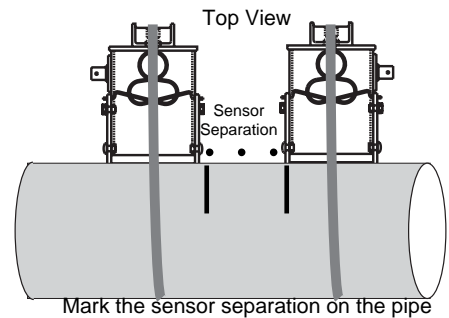
Determine the approximate sensor location on the pipe. Mark the sensor separation on the pipe with the correct sensor separation between the marks.

Loop the mounting web straps around the pipe and through the sprocket slots in the ratchet brackets. Leave the straps loose with the ratchet away from the sensor. Place a bead of sensor grease on one of the Ultem sensor lenses and place the left edge of the sensor on the right hand mark with the BNC connection facing out or on the right side of the sensor. Slide the sensor strap over the sensor and "ratchet" the strap snug.

Place a bead of sensor grease on the other Ultem sensor lens and place the right edge of the sensor on the left hand mark with the BNC connection facing out or on the left side of the sensor. Slide the sensor strap over the sensor and "ratchet" the strap snug.

Push each sensor tight against the pipe and ratchet the straps down tight. Watch that the strap doesn't pull the sensor upward on the pipe.

Connect the sensor cables to the sensors. Connect the cable from the upstream sensor to the upstream connector on the electronics case. Connect the downstream sensor cable to the downstream connector on the electronics case.



Z Configuration

Program the flowmeter for the application and record the sensor separation from the View setup parameters in the setup menus.

Unhook the web strap from the ratchet. Wrap the strap around the pipe. Pull the strap straight and mark or hold the point of overlap on the strap. Remove the strap and fold the end of the strap over to the mark. Pull tight and mark the end of the fold. Place the strap back on the pipe and mark the end of the strap on the pipe. Then mark the "fold" mark on the pipe. This should place the two marks 180° around the pipe from each other or on opposite sides of the pipe.

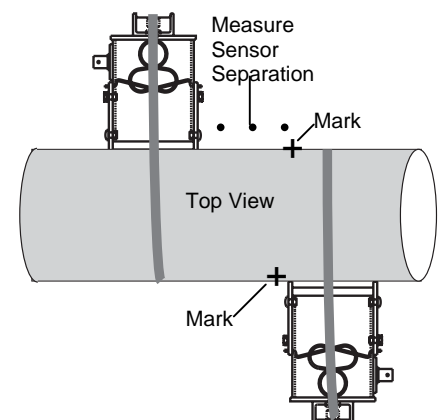
Loop the mounting web straps around the pipe and through the sprocket slots in the ratchet brackets. Leave the straps loose with the ratchet away from the sensor. Place a bead of sensor grease on one of the Ultem sensor lenses and place the left edge of the sensor on the right hand mark with the BNC connection facing out or on the right side of the sensor. Slide the sensor strap over the sensor and "ratchet" the strap snug.

Measure the sensor separation from the mark on the other side of the pipe and place a second (sensor placement) mark.

Place a bead of sensor grease on the other Ultem sensor lens and place the inside edge (opposite the BNC connector) on the mark with the BNC connection facing out. Slide the sensor strap over the sensor and "ratchet" the strap snug.

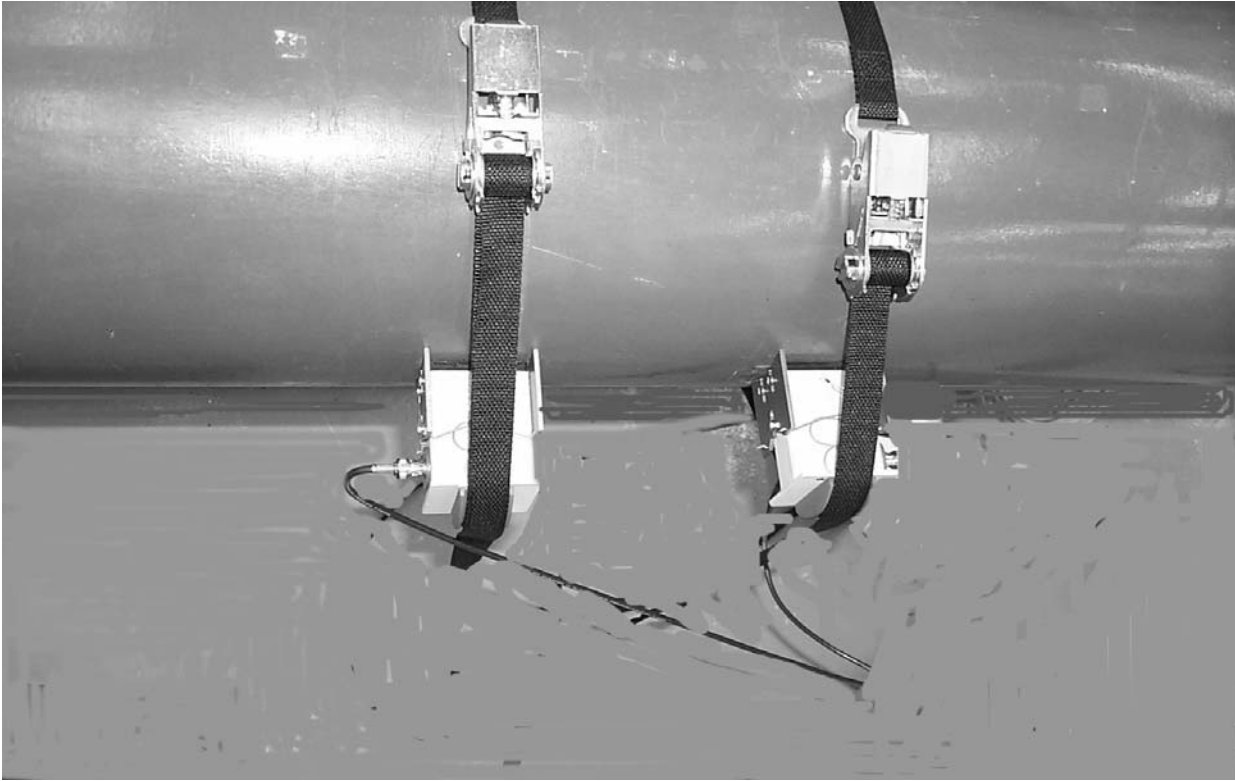
Push each sensor tight against the pipe and ratchet the straps down tight. Watch that the strap doesn't pull the sensor upward on the pipe.

NOTE: The "Acoustic Path" arrows on each sensor should be "facing" each other.

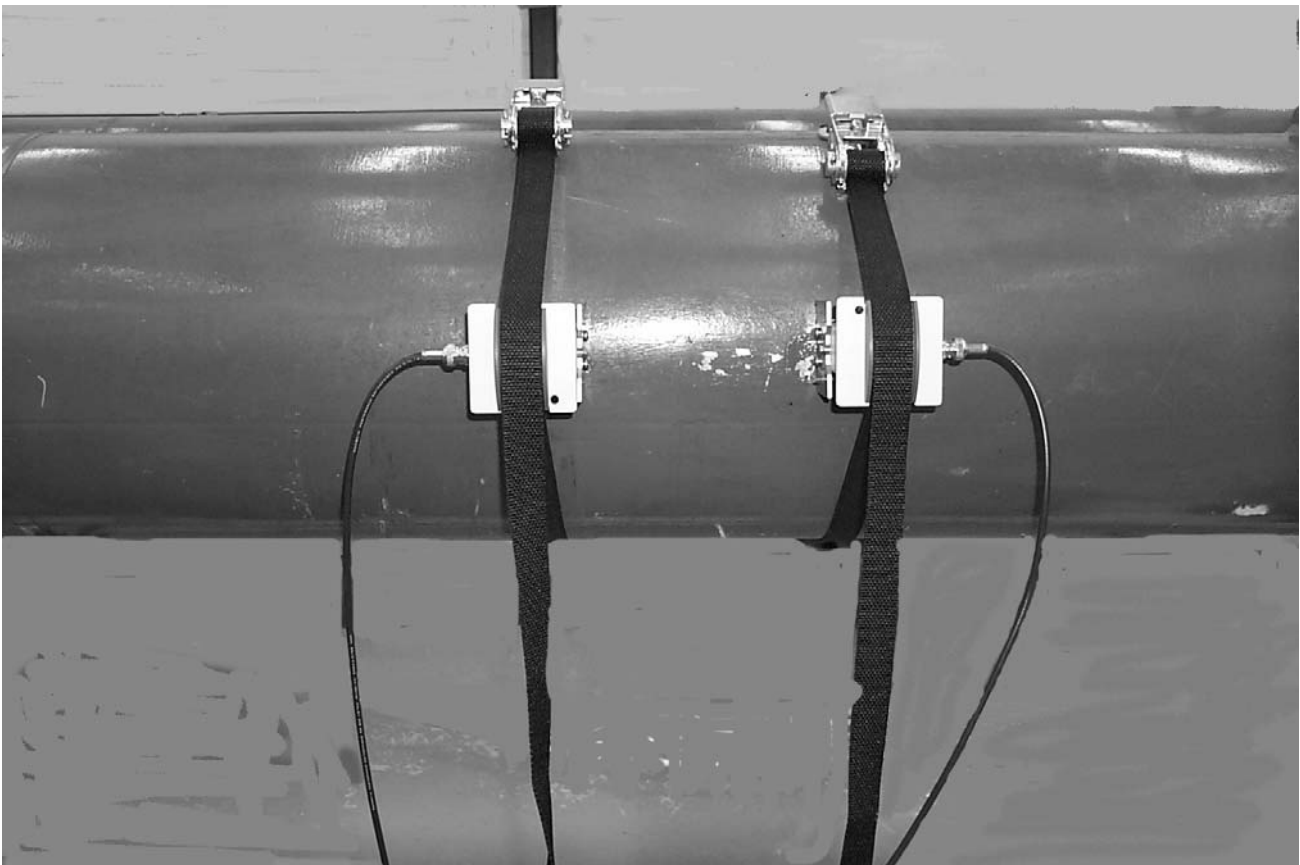


Connect the sensor cables to the sensors. Connect the cable from the upstream sensor to the upstream connector on the electronics case. Connect the downstream sensor cable to the downstream connector on the electronics case.

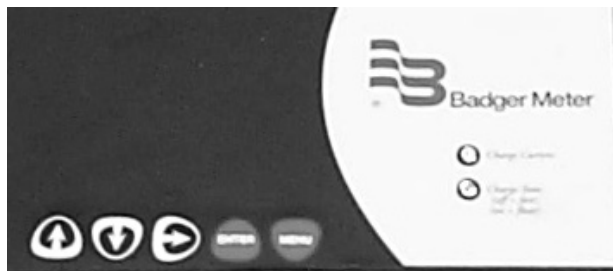
Web Strap Ratchet



Typical "V" Configuration Mounting



OPERATION



General Description

The Model 7000 is a Portable Ultrasonic Transit-Time Flowmeter designed to measure fluid flow in full pipes from 4" to 54" in diameter. The meter operates on 117 VAC or an internal rechargeable 12 VDC battery. The meter is equipped with a 2-line, 24 character per line vacuum fluorescent display, 4-20 mA DC signal output, 12 VDC external input and a built-in data logger with external 4-20 mA input and pulse input.

The Model 7000 is microprocessor based and provides a number of menu functions via keypads on the front panel which allows the user to program, modify or interrogate meter operations to suit the user's needs. These keys are the UP arrow, DOWN arrow, RIGHT arrow, MENU and ENTER.

The MENU key allows access to the Status Mode, Calibration Mode or Setup Mode of the meter. It can also be used to return to normal operation any time you are in the Status, Calibration, or Setup Mode. If you press the MENU key while in the Calibration Mode, the processor will store any changes made up to that point, but will retain the previous programming after that point and return to the normal operating screen. In the Setup mode, you have to complete all of the menu changes and then "recalculate" the setup parameters for any setup changes to take place.

The ENTER key is used to store any data changes that are made in the Calibration Mode and to step through the screens of the Status, Calibration or Setup Modes. The ENTER key must be pressed to store the change made. Pressing the MENU key before the ENTER key will not store the change.

The UP, DOWN, and RIGHT arrow keys are used for selecting or making changes in the various screens of the meter in the Status, Calibration, or Setup Mode.

To prevent unauthorized entry into the Calibration Mode of the meter there is a Security screen that requires the correct security code to be entered in order to gain access. The security code when shipped from the factory is 0000.

When the unit is turned on, the display will show the normal operating screen, typically flow and total or velocity. The meter will then begin to indicate the flow rate if an OK is displayed in the right corner of the top line as shown below.

FLOW	3480	GPM	X	10	OK
TOTAL	458932	GAL	X	1000	

If the meter is programmed for bi-directional flow, there will be the letter "F" or "R" that follows the FLOW word and the letter "F" or "R" at the right end of the total line that will indicate the direction of the flow. "F" indicates forward flow and "R" reverse flow. The screen below shows this feature.

FLOW	3480	GPM	X	10	OK
TOTAL	458932	GAL	X	1000	F

There are two totalizer registers in the meter. One for forward flow and the other for reverse flow. While in the normal operating screen, the UP or DOWN arrow keys can be used to view the totalizer that is not displayed.

The following pages in this Section cover the Status, Calibration and Setup Mode menus. They will be listed in the order of the sequence of screens.

The MENU key can be used to exit from any function in the Status, Calibration or Setup Modes and go directly back to the normal operating screen. **The DOWN arrow key can be used to step backwards in the main function screens of the Status or Calibration modes, but not the Setup mode. arrow key can be used to step backwards in the main function screens of the Status or Calibration modes, but not the setup mode.**

Status Mode

The Status Mode allows the user to determine the operational status of the Model 7000 as well as perform a self diagnostic and a flow simulation. Normal meter operation will still be performed while in the Status Mode except when in the flow simulation function.

To enter into the Status Mode from the normal operating screen, press the MENU key and the following screen will appear:

SELECT	UP=CALIBRATE
DOWN=STATUS	RIGHT=SETUP

This screen allows entry into the Status, Calibration or Setup menu modes. Press the Down ARROW KEY TO ENTER INTO THE Status Menus, and the following screen will appear:

Measurement Data
Press UP to Activate

This screen allows entry into the measurement data of the meter. This is normally used in troubleshooting to detect signal strength and error codes.

Press the UP arrow key and the following screen will appear:

ZOF = 0000 NOR = BE38
DEL = A9C2 T12 = 02C4

This screen of the measurement data gives the values of the captured zero offset (ZOF), the normalized flow rate (NOR), the phase shift (DEL) and the signal crossing time (T12). These will be discussed in more detail in the Troubleshooting Section of this manual.

Press the ENTER key and the following screen will appear:

ERR = 0000 AGC = 25024F
SIG: ■ ■ ■ ■ ■ ■ ■ ■

This screen shows the error codes and the AGC (automatic gain control) value on the first line and the signal strength indication on the second line.

The various error codes are listed in the Troubleshooting Section of this manual.

The first two hexadecimal digits of the AGC value indicate the relative strength of the received signal from the upstream sensor with a value of 9F for a minimum signal and 10 the maximum signal. The second two hexadecimal digits of the AGC value indicate the relative strength of the received signal from the downstream sensor with a value of 9F for a minimum signal and 10 for the maximum signal.

You may switch between the two screens by pressing the UP arrow key.

Press the ENTER key and the following screen will appear:

Self Test
Press UP to Activate

This screen allows entry into the self test diagnostics routine. Press the UP arrow key and the following screen will appear:

SELF TEST
TRANSMIT: <<PASSED>>

The self diagnostics first tests the transmitter section of the electronics. A brief message will be displayed indicating that testing is in process and then a PASSED or FAILED message

will appear. The self test automatically steps through each test segment.

The following screen will appear next:

SELF TEST
RECEIVER: <<PASSED>>

Again a brief message will be displayed indicating that testing is in process and then a PASSED or FAILED message will appear. This test checks that the receiver section of the electronics is functioning properly. The self test then checks for the presence of a signal. If a received signal is present and within the timing limits, the self test will step to the EEPROM test. If there is no signal, this will be indicated on the display. If there is a signal arriving at a time shorter than expected, then 'T12 Short' will be displayed. If there is a signal arriving at a time longer than expected, then 'T12 Long' will be displayed.

The following screen will appear next:

SELF TEST
EEPROM: <<PASSED>>

This screen indicates that the EEPROM of the microprocessor is being tested. After a few seconds the "TESTING" message will change to either "PASSED" or "FAILED". The following screen will appear:

SELF TEST
* * * * * COMPLETED * * * * *

This screen indicates that the self test function of the Status Mode is completed. The following screen will appear:

Flow Simulation
Press UP to Activate

This screen allows entry into the flow simulation function. This function can be used to simulate the flow or velocity from zero to full scale. It will drive the 4-20 mADC output to the simulated flow value.

When in this function the normal flow measurement of the meter is discontinued. No totalization of flow will take place, but any totalization in Flow Simulation will record on the normal totalizer.

Press the UP arrow key and the following screen will appear:

FLOW 0000 GPM X 10 SM
Badger Meter Inc

This screen is the flow simulation screen. In the top, right corner of the display are the letters SM. These letters

are to prevent confusion with the normal flow screen. **The meter will stay in this mode until the MENU key is pressed.**

To adjust the flow simulation to a specific flow rate, use the RIGHT arrow key to move the cursor under the digit to be adjusted and use the UP or DOWN arrow keys to adjust the digit to the desired value. For example, if you wanted to simulate a flow rate of 2500 GPM, move the cursor under the second digit from the left with the RIGHT arrow key and press the UP arrow key twice for a value of two (2). Then move the cursor under the third digit from the left with the RIGHT arrow key and press the UP arrow key five times for a value of five (5). The display will now show 0250 which is 2500 GPM with the X10 multiplier.

To exit from flow simulation, press the MENU key. The screen will return to the normal operating screen.

To exit from any screen and go back directly to the normal operating screen press the MENU key.

This completes the Status Mode operation instructions.

Calibration Mode

The Calibration Mode allows the user to calibrate and adjust various functions related to the operation of the Model 7000. A brief description of each follows:

4-20 mA Calibration – Adjusts the zero and span of the 4-20 mA output.

Meter Rescale – Changes the full scale range of the meter.

Meter Factor – Adjusts meter factor for field calibration.

Zero Offset – Performs zero offset capture at no flow condition.

Totalizer – Enables or disables totalizer or clears totalizer.

Response Time – adjusts the response time of the meter.

Failure Mode – Selects the default display and 4-20 mA output of meter when loss of signal occurs.

Security ID – Changes the security code.

Calibration Mode Programming Screens

FLOW	0000	GPM	X	10	SM
TOTAL	480	GAL	X	1000	

To enter into the Calibration Mode, press the MENU key while the display is in the normal operating screen. The following screen will appear:

SELECT	UP=CALIBRATION
DOWN=STATUS	RIGHT=SETUP

Press the UP key and the following screen will appear:

SECURITY ID
Input 4 Digit ID 0000

This screen is the Security screen which requires the correct 4 digit number to allow entry into the Calibration Mode of the Model 7000. To change the value of each digit, move the line under the digit to be changed with the RIGHT arrow key and then use the UP or DOWN arrow keys to change the value of the digit. When the 4 digit number is correct, press the ENTER key. If the number is incorrect, the meter will go back to the normal operating screen. If the number is correct the following screen will appear:

4-20 mA Calibration
Press UP to Activate

This screen allows entry into the Calibration screens for the 4-20 mA DC current output.

Press the UP arrow key and the following screen will appear:

4-20 mA Calibration
ZERO WORD = XXXX

This screen allows adjustment of the zero output to 4-20 mA. The 4-20 mA output can be monitored on terminals 5 and 6 of the accessory terminal block on the front of the case. Terminal 5 is positive and terminal 6 is negative. Use the RIGHT arrow key to position the cursor under the digit to be adjusted. Fine adjustment is made on the far right digit with the adjustment becoming more coarse with each digit to the left. Use the UP or DOWN arrow keys to adjust for the correct output. The display Zero Word is for reference only. Press the ENTER key to store the value. The following screen will appear:

4-20 mA Calibration
SPAN WORD = XXXX

This screen allows adjustment of span to 20 mA. The 4-20 mA output can be monitored on terminals 5 and 6 of the accessory terminal block on the front of the case. Terminal 5 is positive and terminal 6 is negative. Use the

RIGHT arrow key to position the cursor under the digit to be adjusted. Fine adjustment is made on the far right digit with the adjustment becoming more coarse with each digit to the left. Use the UP or DOWN arrow keys to adjust from the correct output. The display Span Word is for reference only. Press the ENTER key to store the value. The following screen will then appear:

Meter Rescale
Press UP to Activate

This screen allows entry into the meter rescale screen which increases or decreases the full scale of the meter. Press the UP arrow key and the following screen will appear:

Meter Rescale
Full Scale 0900 x 10

The full scale value shown on this screen is the present full scale flow rate or velocity of the meter. To change the full scale of the meter, use the RIGHT arrow key to move the cursor under the digit to be adjusted and use the UP or DOWN arrow keys to adjust the digit to the desired value. For example, if you wanted to change the full scale from 9000 to 10000, move the cursor under the first digit from the left with the RIGHT arrow key and press the UP arrow key once for a value of one (1). Then move the cursor under the second digit from the left with the RIGHT arrow key and press the DOWN arrow key nine times for a value of zero (0). The display will now show 1000 which is 10000 with the X10 multiplier.

There is a maximum and minimum full scale limit. When the full scale value reaches either limit, the digits will stop changing.

Remember: Changing the full scale of the meter will cause the 4-20 mADC output to change to reflect the new full scale value.

Press the ENTER key to store the value. The following screen will appear:

Meter Factor
Press UP to Activate

This screen allows the user to calibrate the Model 7000 to reproduce actual flow conditions. The user can modify the meter factor for calibration of the meter to a known standard.

Press the UP arrow key and the following screen will appear:

Meter Factor
Meter Factor = 1.000

The user can modify the meter factor from a value of 0.800 to 1.200. The meter factor is the relation between the indicated flow rate of the meter and the actual flow rate as proven by calibration tanks or other means. If, for example, the meter was installed on a pipe and due to uncertainty in the pipe dimensions, the meter was determined to be indicating a flow rate 5.6% higher than the actual flow, the flow meter is indicating 1.056 times the true value. The initial meter factor will be 1.000 as set at the factory.

To correct for the 5.6% high error, the meter factor must be changed to 0.947 (1/1.056). To change the meter factor, press the RIGHT arrow key to move the cursor under the first digit to the right of the decimal point and press the DOWN arrow key to change the value to 9. Press the RIGHT arrow key to move the cursor under the second digit to the right of the decimal point and press the UP arrow key to change the value to 4. Press the RIGHT arrow key to move the cursor under the third digit to the right of the decimal point and press the UP arrow key to change the value to 7. Pressing the MENU or ENTER key will store the new value.

After pressing the ENTER key the following screen will appear:

Zero Offset
Press UP to Activate

This screen allows the user to capture and correct for zero offsets that may be present in the metering system. It is intended to be used for periodic maintenance to correct for small zero drifts.

THE FLOW IN THE PIPE MUST BE ZERO TO USE THIS FUNCTION. IF FLOW EXISTS IN THE PIPE, USE OF THIS FUNCTION WILL CREATE LARGE ERRORS IN THE METER. Therefore, the user must prepare for use of this function. Appropriate valving must be done to ensure that no flow exists; allow at least 10 minutes for the fluid motion to settle out. To start the Zero Offset function press the UP arrow key and the following screen will appear:

Zero Offset
STAT : Evaluating >

The Zero Offset function is now activated and the display will indicate that it is evaluating for any offsets in the system. After a period of approximately 20 seconds, the screen will display: 'ERROR: Failed' or 'CAPTURED: Press UP to Sav'.

If an error is indicated, it means that the measured offset was greater than expected under normal conditions. The

pipe needs to be rechecked to verify that there is no flow. Press the ENTER key to step out of the error screen. The display will step to the Totalizer Function screen. If you desire to try the zero offset function again, press the DOWN arrow key and the display will step back to the zero offset screen. Repeat the above procedure.

If the screen indicates that an offset is captured, press the UP arrow key to store this value. After the UP arrow is pressed the following screen will appear:

Totalizer
Press UP to Activate

This screen allows the totalizer to be enabled, disabled, or reset to zero. Press the UP arrow key and the following screen will appear:

Totalizer
Enabled

This screen allows the totalizer to be enabled or disabled. If the totalizer is enabled, the totalizer will be displayed on the second line of the normal operating screen with its appropriate multiplier and units of measurement. If the totalizer is disabled then the second line of the normal operating screen will have Badger Meter, Inc. displayed. Use the UP or DOWN arrow keys to make your selection and press the ENTER key.

If you selected DISABLED, the next screen displayed will be the Response Time function. If the meter is programmed for bi-directional flow, the next screen will show:

Differential Totalizer
Enabled

The differential totalizer will display the difference between the forward flow totalizer and the reverse flow totalizer. The differential totalizer will be indicated by the letter "D" on the totalizer line. If the forward totalized flow is greater than the reverse totalized flow, then a "+" sign will appear in front of the "D". If the reverse flow totalizer is greater than the forward flow totalizer, a "-" sign will appear in front of the "D". **Note:** during normal operation from the normal operating screen, pressing the UP arrow key will advance to the Forward and Reverse Totalizers.

Press the ENTER key and the next screen to appear is the totalizer clear screen.

If you selected ENABLED the following screen will appear:

Totalizer Clear
Press UP to Activate

This screen allows the user to clear the value in the totalizer registers of the forward and reverse totalizers if applicable.

Press the UP arrow and the following screen will appear:

Response Time
Press UP to Activate

This screen allows setting of the response time of the meter to changes in the flow rate. Press the UP arrow key and the following screen will appear:

Response Time
Response Const: 007

This screen sets the response time of the meter. The selections are from 1 to 14. The response time for each of the selections is: 1 = 2 seconds; 2 = 4 seconds; 3 = 8 seconds; 4 = 16 seconds; 5 = 32 seconds; 6 = 64 seconds; 7 = 128 seconds, etc. Use the UP or DOWN arrow keys to change to the desired response time. Press the ENTER key to save. The following screen will appear:

Failure Mode
Press UP to Activate

This screen allows setting of the default output of the meter and the display in the event there is a loss of signal. There are three available selections: Zero, Full Scale or Hold Last Reading. The selection of zero will drive the meter output to 4 mA and the display to zero. The selection of full scale will drive the meter output to 20 mA and the display to full scale. The selection of hold last will retain the last flow value on the display and the output, before the loss of signal.

Press the UP arrow key and the following screen will appear:

Failure Mode
FAIL TO: ZERO

This screen allows selection of the failure mode to zero, full scale, or hold last reading. Use the UP or DOWN arrow key to make the desired selection. Press the ENTER key to store the selection. The following screen will appear:

Security ID
Press UP to Activate

This screen allows entry into the Security Identification where the security code may be changed. Press the UP arrow key and the following screen will appear:

SECURITY ID
Input 4 Digit ID 0000

This screen will show the present security code in the meter. To change the security code move the cursor with the RIGHT arrow key under the digit to be changed. Use the UP or DOWN arrow keys to change the value. The value can be 1 through 9 and A through F. After the new code has been entered, press the ENTER key to store the new values. The display will then return to the normal operating screen.

NOTE: At any time after a change has been entered in the Calibration Mode, the MENU key can be pressed and the display will return to the normal operating screen. Also the DOWN arrow key can be used to step backwards through the main function screens of the Calibration Mode.

This completes the Calibration Section.

Setup Mode

The Setup Mode allows the user to program the meter to the specific application. A brief description of each follows.

Meter Display Type – Select English or Metric units of measure.

Type of Fluid – Select water (includes wastewater) or Other. If other, supply the sonic velocity, viscosity, and specific gravity.

Pipe Material – Select the type of pipe the meter is being used on.

Liner Material – Epoxy, Glass, Bitumastic, Rubber, Mortar, None.

Pipe Outer Diameter – Enter the pipe OD.

Pipewall Thickness – Enter the thickness of the pipe wall. (**NOTE:** If there is a liner, do not include the liner in the pipe wall thickness.)

Select Sensor Type – Select standard sensor SO30, ST30 or thin pipe wall sensor SO 52, ST52.

Sensor Frequency – Select transmitting frequency of the meter and sensors. Either 1280 or 640 Kilohertz.

sensor Mounting Configuration – Select either "V" Mounting or "Z" Mounting.

Flow Direction – Select Uni-Directional or Bi-Directional flow measurement.

Meter Configuration – Select to measure and display either velocity, flow, or flow and total flow.

Flow Unit of Measure – Select GPM, CFS, LPS, LPM, LPD, MLD, M3H, BPH, MGD, IGM.

If Totalizer is Enabled – Select Totalizer Units; GAL, MET3, LTRS, BARR, CUFT, ACFT, IGAL, M-GAL

Recalculate the Setup Parameters – Displays the calculated parameters including sensor separation for sensor mounting.

NOTE: Every time you power up the meter, the last calculated parameters will be recalled, but they will not be available for viewing in the View Mode. In order to view the parameters, you must go through the Setup Mode and activate the "recalculate" screen and then the "View" screen.

Press Up/Down/Right to Default Parameters – Defaults to a 12" pipe application.

Setup Mode Programming Screens

FLOW	0000	GPM	X	10	OK
TOTAL	480	GAL	X	1000	

To enter the Setup Mode from the normal operating screen, press MENU. The Menu Mode screen appears:

SELECT	UP=CALIBRATE
DOWN=STATUS	RIGHT=SETUP

To enter the Setup Mode, press the RIGHT arrow key and the Meter Display Type appears:

Meter Display Type English Units

Choose English Units or Metric Units by pressing either the UP or DOWN arrow keys.

Press the ENTER key to continue to the next display screen.

Type of Fluid Water

Choose Water or Other by using the UP or DOWN arrow keys. For raw water, wastewater and sewage, select Water. For all other types of fluid, select OTHER. **NOTE:** For Other, you must be able to provide the fluid sonic velocity (for comparison, the sonic velocity of water is 4800 feet per second). You will also need to provide the viscosity of the fluid in CP and the fluid specific gravity. Use the UP, DOWN and RIGHT arrow keys to change the values and then press ENTER after each one.

The display will change to the pipe material screen.

Pipe Material
Stainless Steel

Press the UP or DOWN arrow keys to scroll through the pipe selections: Stainless Steel, carbon Steel, PVC, Cast Iron/Ductile Iron, Asbestos Cement, Copper/Brass. Press ENTER to change to the Liner screen.

Pipe Liner Material
Epoxy

Use the UP or DOWN arrow keys to select the liner: Epoxy Glass, Bitumastic, rubber, Mortar or None. Press ENTER and the thickness screen appears:

Pipe Liner Thickness
0.050 Inches

Use the UP, DOWN, or RIGHT arrow keys to select the correct value. Press the ENTER key to advance to the pipe OD screen.

Pipe Outer Diameter
00.0 Inches

Use the UP, DOWN, or RIGHT arrow keys to select the correct value. Press the ENTER key to advance to the pipe thickness screen.

Pipewall Thickness
0.000 Inches

Use the UP, DOWN, or RIGHT arrow keys to select the correct value. If there is a liner, do not included the liner thickness. Press the ENTER key to advance to the sensor screen.

Select Sensor Type
ST30

Use the UP or DOWN arrow keys to select either SO30 (older strap-on sensors), ST30 (standard Model 7000 sensors), SO52 (older strap-on sensors for thin wall pipes) or ST52 (standard Model 7000 sensors for thin wall pipes with wall thickness of less than 1/8"). **NOTE:** the ST sensors may be used continuously on pipes with fluid temperatures of 180° and in one hour increments to temperatures up to 300°. Press the ENTER key to advance to the frequency screen.

Sensor Frequency
1280 Kilohertz

Use the UP or DOWN arrow keys to select either 1280 Kilohertz or 640 Kilohertz sensors. **Note: The frequency of the sensors must match the frequency of the Model 7000 analog circuit.**

Press the ENTER key to advance to the configuration screen:

Sensor Configuration
V-SHOT

Use the UP or DOWN arrow keys to select either V-SHOT or Z-SHOT sensor mounting configuration. Press the ENTER key to advance to the direction screen.

Flow Direction
Uni-Directional

Use the UP or DOWN arrow keys to select either Uni-Directional or Bi-Directional flow. Press the ENTER key to advance to the meter configuration screen.

Meter Configuration
Velocity

Use the UP or DOWN arrow keys to select Velocity, Flow Rate, or Flow Rate and Total. Press the ENTER key to advance to the flow unit screen.

Note: The flow unit screen does not appear if Velocity is selected. The velocity units will either be Feet Per Second or Meters Per Second depending upon Meter Display Type selected (English or Metric).

Flow Unit of Measure
GPM (Gallons X Minute)

Use the UP or DOWN arrow keys to select the flow unit of measure:

- GPM (Gallons x Minute)
- CFS (Cubic Feet x Sec)
- LPS (Liter x Sec)
- LPM (Liters x Minute)
- LPD (Liters x Day)
- MLD (Million Liters x day)
- M3H (Cubic Meter x Hour)
- BPH (Barrels x Hour)
- MGD (Million Gal x Day)
- IGM (Imperial Gal x Min)

Press the ENTER key to advance to the next screen:

Selected FullScale
0000.000 GPM

Use the UP, DOWN, or RIGHT arrow keys to select the full scale range of the unit.

Press the ENTER key to advance to the next screen.
Note: If you have selected both Flow Rate and Total, the next screen will be the Totalizer Unit screen.

Totalizer Unit
GAL (Gallons)

Use the UP or DOWN arrow keys to select the totalizer units:

- GAL (Gallons)
- MET3 (Cubic Meters)
- LTRS (Liters)
- BARR (Barrels)
- CUFT (Cubic Feet)
- ACFT (Acre Feet)
- IGAL (Imperial Gallons)
- M-GAL (Million Gallons)

Press the ENTER key to advance to the recalculate screen.

NOTE: You must recalculate the setup parameters to save any changes to the setup menus. If you do not want to recalculate the parameters, but simply wish to view the current parameters, press the ENTER key to bypass the recalculate screen.

Press UP to Recalculate
the SETUP parameters

Press UP to recalculate the programmed setup parameters.

The recalculate screen accepts any changes you have made to the application setup screens and recalculates the application setup parameters. After a few seconds, the screen will change to the View Setup Parameters screen.

Press UP to View
the SETUP parameters

Press UP to view the programmed parameters.

Sensor Separation
0.000000

NOTE: Pres the UP arrow to scroll through the other programmed parameters: Maximum Rate, Minimum Rate,

Full Scale Rate and Full Scale Velocity. Then press ENTER to advance to the default screen.

To view all of the programmed and calculated parameters, in the View screen, press the RIGHT, DOWN and UP arrow keys at the same time. Then use the UP arrow key to scroll through all of the programmed and calculated parameters: Sensor Separation, Effective Diameter, Effective Area, Maximum Rate, Minimum Rate, FullScale Rate, FullScale Velocity, Reynolds Number, Fluid Transit Time, System Delay Time, FullScale Phase, K Factor, Crossing Angle Fluid, Crossing Angle Wall, Crossing Angle Liner, site Number, Scale, Delay, Span, T12 Max, T12 Min, Totcon, Display Totalizer Multiplier, Rate Multiplier, Display Max, Display Min, Display Inc., K Display, Rate Units, Tot Units, Direction Flag, and Tot On/Off.

To scroll backwards through the parameters, use the DOWN arrow key.

Press the ENTER key to advance to the default screen.

Press Up/Down/Right to
Default Parameters

This screen programs the setup parameters for a 12 inch carbon steel pipe application.

Press ENTER to return to the beginning of the Setup Mode screens to make additional changes to the setup programmed parameters, or press MENU to return to the normal operating screen.

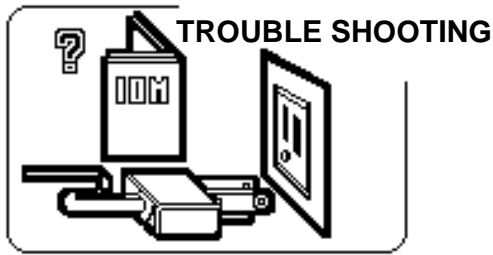
This completes the Setup Mode programming.

AP 45 Programming with Laptop Computer

You can also program the meter with a laptop computer and Eastech Badger AP45 software by removing the jumper between terminals 9 and 10 on the accessory terminal block and connecting the laptop using a special Eastech Badger cable to terminals 7, 8, 9, and 10. **NOTE:** Be sure to reconnect the jumper between terminals 9 and 10 afterwards.

Data Logger Operation

The built-in data logger is connected to the flowmeter via digital channel 1. The external 4-20 mA input on the accessory terminal block is connected to analog channel 1 of the logger and the pulse input is connected to the Totalizing Contact Input of the logger. Refer to the 128 DCM Data Logger Instrument Manual for logger and FLARS™ software instructions.



GENERAL

The Model 7000 is equipped with self test features which allow the user to identify the operational status of the unit and with the help of this section of the IOM manual to determine proper action to be taken. This section details the meaning of the operational codes which appear in the main menu, the meaning of the self test features, and provides a step by step troubleshooting chart for determining the fault and the necessary action.

Operational Codes. The main menu of the Model 7000 indicates flow rate and flow total or velocity. In the upper right hand corner of the display appears an operational code which indicates the operating condition of the meter.

After power on, the operational code will display an OK which indicates the meter is operating properly. The meter may recycle a few times before locking onto a good signal. Should an OK not be displayed, refer to the Troubleshooting Section below.

The following is a list of the operational codes and their meanings:

- OK - Nominal Operation
- NS - No Signal Detected
- XM - Transmit Confirm Failure
- TL - Signal Transit Time Out of Bounds (too long)
- TS - Signal Transit Time Out of Bounds (too short)
- TM - FIFO Error (missing or misaligned timing mark)
- OF - Amplitude Overflow
- UF - Amplitude Underflow
- GE - Gain Error
- CM - Communications Mode Enabled

Measurement Data Screen in Status Mode: The Measurement Data screen of the Status Mode displays several measurement parameters that can be used to determine the operational status of the flowmeter. These screens are intended to help facilitate troubleshooting should a problem exist, especially when communicating with the factory Service Department. The following is an explanation of the data:

- ZOF - Value of the capture zero offset
- NOR - Hexadecimal flow rate in percent of full scale.
- DEL - Hexadecimal measured phase in percent of full scale
- T12 - Hexadecimal measured average transit-time of the signals in microseconds.
- ERR - Error codes.
- AGC - First two hexadecimal digits represent relative signal strength of upstream sensor with 9F being minimum signal strength and 10 being maximum signal strength.

Second two hexadecimal digits represent relative signal strength of downstream sensor with 9F being minimum signal strength and 10 being maximum signal strength.

REPLACEMENT OF PARTS

While the Model 7000 has been designed and built for maximum reliability, there can be instances where replacement of parts may be necessary. In those cases where the troubleshooting procedure calls for replacement of a part, the factory should be contacted for authorization to send in the unit for repair.

The Model 7000 has been designed so that the card cage located under the unit face plate, contains the major electronic hardware and can be easily removed by spreading the foam on each side of the plate and removing the two small bolts on each side. The plate should lift out with the card cage.

The rechargeable battery is replaceable and is located under the foam cover above the display.

TROUBLESHOOTING

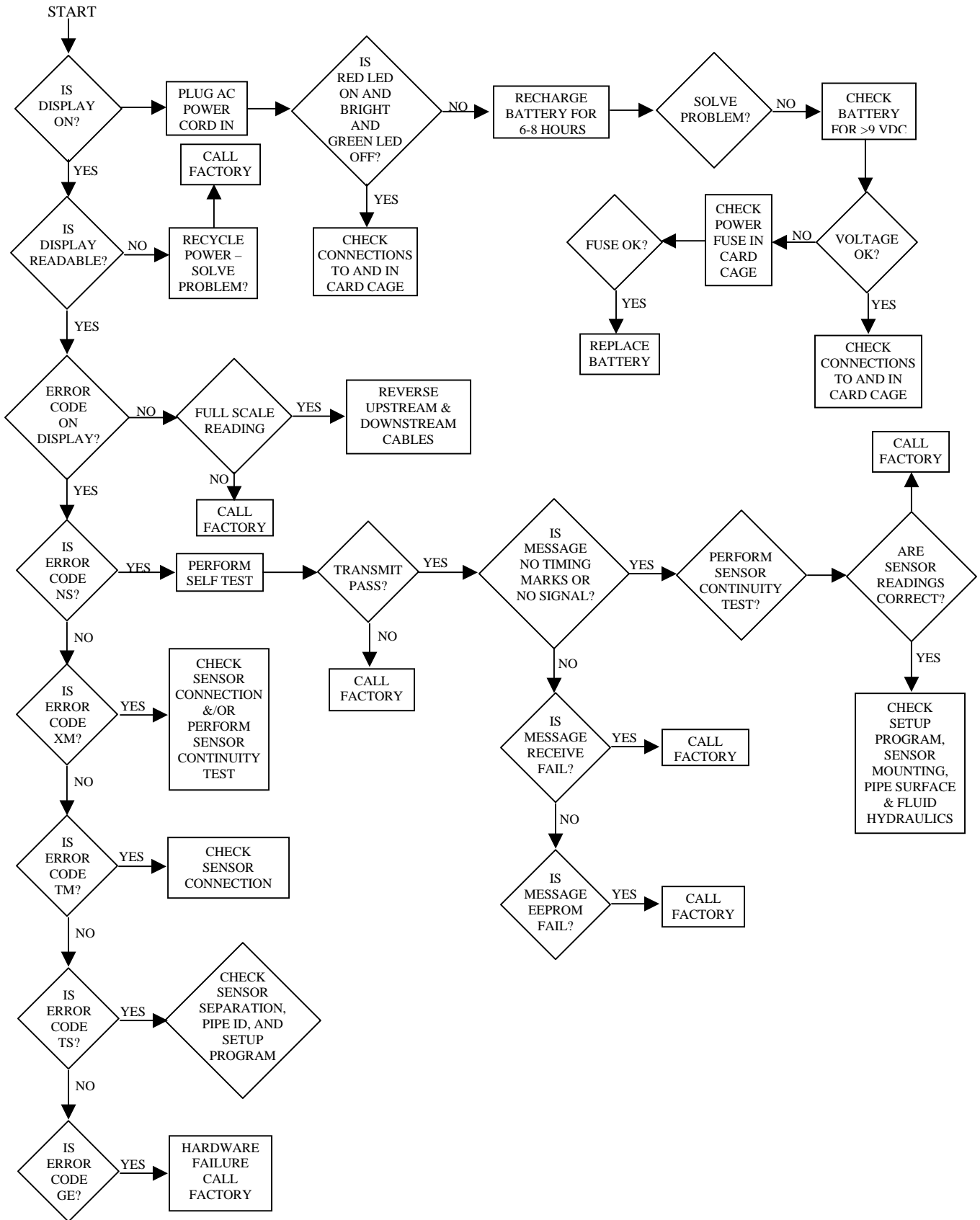
This section may help you in isolating possible causes for problems you may encounter and give suggested corrected actions. In the troubleshooting chart, there will be areas that require certain tests to be performed. The following describes these tests.

Sensor cable connection continuity test. This test will require the use of an ohmmeter. Disconnect the sensor from the case. Connect the test leads of the ohmmeter to the center of the BNC connector and the outside case of the connector. The ohmmeter should read 10,000 ohms \pm 5%.

Battery voltage check. This test requires the use of a DC Voltmeter. Remove the foam above the display. Disconnect one of the battery cables. Connect the test leads of the voltmeter to each of the two battery terminals. The meter should read at least 9 volts DC (13.78 volts DC fully charged).

Self test. The self test feature is menu driven and located in the status mode menus of the flowmeter.

MODEL 7000 TROUBLESHOOTING CHART



PART LIST
Model 7000

PART #	DESCRIPTION	QUANTITY
151945-0001	7000 Power Supply Circuit Board 117 VAC	1
151971-0001	7000 Logic Circuit Board	1
151943-0001	1280 KHz Analog Circuit Board	1
	OR	
151943-0002	640 KHz Analog Circuit Board	1
151935-0004	Data Logger Circuit Board	1
501580-0001	Battery Charger	1
501386-0002	Rechargeable Battery 12 V 12.0 AH	1
544422-0001	Laptop to Logger External Cable	1
501417-0001	AC Power Cord	1
501586-0001	Sensor Web Strap (Ratchet Style)	2
544426-0002	1280 KHz 30° Sensor (ST 30)	2
	OR	
544426-0004	1280 KHz 52° Sensor (ST 52)	2
	OR	
544426-0001	640 KHz 30° Sensor (ST 30)	2
	OR	
544426-0003	640 KHz 52° Sensor (ST 52)	2
500458-0021	Tube Sensor Grease	1
512989-0001	Model 7000 Case	1
160096	Ext 12 VDC Input Fuse (AGC 1, 1/4 x 1-1/4) 1 Amp	1
****	AC Power Fuse in Charger (5 x 20 mm 1 Amp Fast Acting)	1
****Fuse is not stocked. It is a common fuse usually available locally.		

WARRANTY

Eastech Badger warrants meters and parts manufactured by it and supplied hereunder to be free from defects in materials and workmanship for a period of 18 months from date of shipment or 12 months from date of installation, whichever period shall be shorter. If within such period any meters or parts shall be proved to Seller's satisfaction to be defective, such meters or parts shall be repaired or replaced at Seller's option. Seller's obligation hereunder shall be limited to such repair and replacement and shall be conditioned upon Seller's receiving written notice of any alleged defect within 10 days after its discovery and, at Seller's option, return of such meters or parts f.o.b. to Seller's factory. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES WHATSOEVER INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES (EXCEPT OF TITLE) OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Eastech Badger shall not be liable for any defects attributable to acts or omissions of others after shipment, nor any consequential, incidental or contingent damage whatsoever.

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