

# FSM-3 Series SuperMag

Insertion Electromagnetic Flow Meter  
Installation and Operation Guide



## SAFETY INFORMATION

The FSM-3 Series SuperMag Insertion Electromagnetic Flow Meter was calibrated at the factory before shipment. To ensure correct use of the system, please read this manual thoroughly.

Regarding this manual:

- This manual should be passed on to the end user.
- Before use, read this manual thoroughly to comprehend its contents.
- The contents of this manual may be changed without prior notice.
- All rights reserved. No part of this manual may be reproduced in any form without ONICON Incorporated's written permission.
- ONICON Incorporated makes no warranty of any kind with regard to this material, including, but not limited to, implied warranties of merchantability and suitability for a particular purpose.
- All reasonable effort has been made to ensure the accuracy of the contents of this manual. However, if any errors are found, please inform ONICON Incorporated.
- ONICON Incorporated assumes no responsibilities for this product except as stated in the warranty.
- If the customer or any third party is harmed by the use of this product, ONICON Incorporated assumes no responsibility for any such harm owing to any defects in the product which were not predictable, or for any indirect damages.

### SAFETY PRECAUTIONS:

The following general safety precautions must be observed during all phases of installation, operation, service, and repair of this product. Failure to comply with these precautions or with specific WARNINGS given elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. ONICON Incorporated assumes no liability for the customer's failure to comply with these requirements. If this product is used in a manner not specified in this manual, the protection provided by this product may be impaired.

The following messages are used in this manual:

### **WARNING**

***Messages identified as "WARNING" contain information regarding the personal safety of individuals involved in the installation, operation or service of this product.***

### **CAUTION**

***Messages identified as "CAUTION" contain information regarding potential damage to the product or other ancillary products.***

### **IMPORTANT NOTE**

***Messages identified as "IMPORTANT NOTE" contain information critical to the proper operation of the product.***

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## SECTION 1.0 GENERAL INFORMATION

We at ONICON Incorporated would like to thank you for purchasing our quality American made FSM-3 Series SuperMag Insertion Electromagnetic Flow Meter. As our valued customer, our commitment to you is to provide fast reliable service while continuing to offer quality products to meet your growing flow measurement needs.

### 1.1 PURPOSE OF THIS MANUAL

We have written this guide to provide the persons responsible for the installation, operation and maintenance of the flow meter with the most specific equipment information required. This is NOT an electrical or plumbing trade manual. This guide is the basic reference tool for all ONICON FSM-3 Series SuperMag Insertion Electromagnetic Flow Meters.

### 1.2 ELECTROMAGNETIC FLOW METER

Faraday's Law of electromagnetic induction states that a voltage will be induced in a conductor when it passes through a magnetic field, and that the induced voltage will be directly proportional to the velocity of the conductor.

ONICON's FSM-3 Series Flow Meters generate pulsating magnetic fields that are used to induce a voltage into the conductive fluid flowing through the pipe. Electrodes located on the flow meter sensor head measure the induced voltage.



1.3 STANDARD FEATURES AND SPECIFICATIONS\*

<b>FSM-3 SERIES TRANSMITTER</b>		
PERFORMANCE	ACCURACY	±1.0% of reading from 1 to 20 ft/s ±0.5% of reading at the calibrated velocity ±0.01 ft/s at flow rates less than 1 ft/s
INPUT POWER	24 VAC	40 VA @ 20 to 28 VAC
	24 VDC	50 W @ 24 VDC ± 10%
I/O SIGNALS	One (1) Isolated AO, 4-20 mA or 0-10 VDC One (1) Frequency One (1) Pulse	
ELECTRONICS ENCLOSURE	Cast aluminum NEMA 4 enclosure with display, integral mount	
	DISPLAY	2.88" STN monochrome screen with back light, 128x64 dot matrix
	AMBIENT CONDITIONS	-20°F to 150°F
PROGRAMMING	Menu driven via four (4) programming keys	
ELECTRICAL CONNECTIONS	INPUT POWER	Pluggable terminal block, for use with 18 - 24 Ga. wire
	I/O	Pluggable terminal block, for use with 20 - 26 Ga. wire
<b>FSM-3 SERIES FIXED INSERTION FLOW SENSOR</b>		
PERFORMANCE	SENSING METHOD	Single monolithic coil extending across entire pipe diameter
	OPERATION	Pulsed DC coil with enhanced DSP
OPERATING CONDITIONS	FLUID TEMPERATURE RANGE	15°F to 250°F
	FLUID PRESSURE RANGE	0 to 400 psi
	MINIMUM CONDUCTIVITY	25 µS/cm
	PRESSURE DROP	<0.5 psi in 6" line at 12 ft/s, decreasing with increasing pipe size
CONSTRUCTION MATERIALS	FLOW TUBE	Delrin / PSU
	STEM ASSEMBLY	316/316L SS
	ELECTRODES	316/316L SS
	SEALS	EPDM
	HOT TAP ADAPTER	316/316L SS
PROCESS CONNECTION	1" NPT	
APPROVALS	NSF/ANSI 61 NSF/ANSI 372	

\* SPECIFICATIONS subject to change without notice.

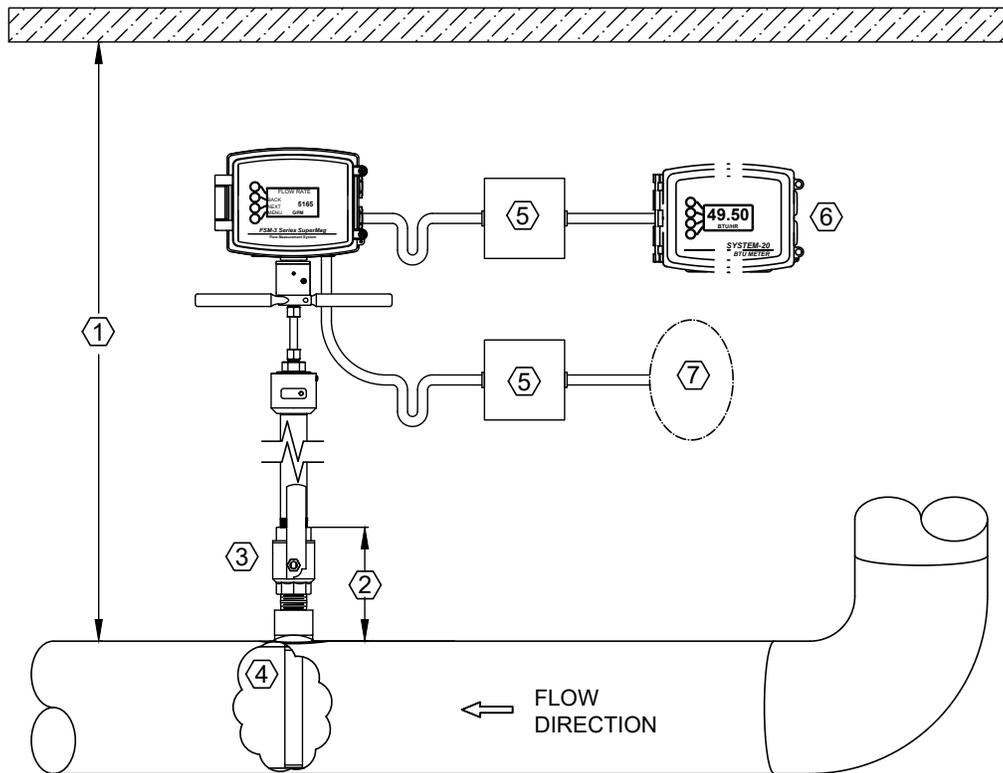
**1.4 MODEL NUMBERING SYSTEM**

**Meter Model Number Coding = FSM-3ABCC-DEFG-HHI-JKL**

<p><b>A = Flow Meter Configuration</b>                  B = Base Flow Meter Model</p> <p><b>B = Meter Type</b>                  F = Insertion, Fixed pipe size</p> <p><b>CC = Meter Style/Size</b>                  06 = 6" Fixed insertion                  08 = 8" Fixed insertion                  10 = 10" Fixed insertion                  12 = 12" Fixed insertion</p> <p><b>DE = Output Configuration</b>                  10 = One (1) active analog output,                  one (1) freq. output &amp; one (1)                  pulse output for totalization</p>	<p><b>F = Enclosure</b>                  1 = Integral NEMA 4 enclosure, with display</p> <p><b>G = Input power</b>                  1 = 24 V AC/DC (24 VAC typical)</p> <p><b>HH = Pipe Size Range/Meter Length</b>                  FA = 6" pipe, 40" meter length                  FB = 8" pipe, 44" meter length                  FC = 10" pipe, 48" meter length                  FD = 12" pipe, 52" meter length</p> <p><b>I = Wiring Connection</b>                  2 = Integral mount, terminal block</p> <p><b>JKL = Mechanical Configuration</b>                  131 = SS stem, SS process connection, Delrin/ NSF                  141 = SS stem, SS process connection, PSU/ HT</p>
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Flow Meter Operating Range		
Model Number	Nominal Pipe Size (in)	Flow Rate Range (GPM) (0.1 to 20 ft/s)
FSM-3BF-06	6	9.0-1800
FSM-3BF-08	8	15.6-3120
FSM-3BF-10	10	24.6-4920
FSM-3BF-12	12	35.3-7060

## 1.5 TYPICAL INSTALLATION



1. Prior to locating the flow meter installation kit, review the Overhead Clearance and Installation Details diagram in Section 3.1.1.
2. Review Section 3 regarding the Maximum Isolation valve stack height when using an existing or separately procured installation kit.
3. The FSM-3 Series insertion type meters can be installed and removed via a 1" or larger full port ball valve without system shutdown. The terms "Dry Tap" and "Hot Tap" refer to the installation method of the isolation valve kit only. Review Section 3.1 regarding the Maximum Isolation valve stack height when using an existing or separately procured installation kit.

### Dry Tap Installation Hardware

For new construction or scheduled shut down, the installation kit is installed into a dry, or un-filled system.

### Hot Tap Installation Hardware

For installations which require the access hole in the pipe to be drilled through the isolation valve, via a hot tap drilling machine, while the hydronic system is full and pressurized.

4. A 1" minimum diameter access hole is required for flow meter installation.
5. Provide enough slack in the flexible conduit connections, between the flow meter transmitter enclosure and field junction boxes, allowing for flow meter installation and removal.
6. Flow meter output signals are provided directly from the transmitter for connection to the BAS and ONICON peripheral equipment (optional SYS-20 BTU Meter shown). Refer to Section 3.5 for wiring information.
7. Refer to the specifications table (1.3) for input power requirements. 24 VAC input power is typical.

### IMPORTANT NOTE

**Installation hardware materials vary greatly based on pipe material, pipe size and dry tap vs. hot tap versions. Refer to the section on installation hardware (3.1.2), or the ONICON website for more information about kit selection.**

## SECTION 2.0 UNPACKING

The FSM-3 Series insertion flow meter will be shipped in a single package. The flow meter transmitter and installation tools will be located inside this package, but separate from the flow meter sensor assembly. Please open the package with caution to avoid damaging their contents. If any item is damaged upon receipt, notify the shipping company immediately and alert the ONICON customer service department. Most products are shipped insured unless the customer specifically requests otherwise.

The FSM-3 Series flow meter consists of a flow sensor and transmitter. The transmitter has been pre-configured for a specific flow sensor and must be matched together in the field at time of installation. The serial numbers on the transmitter and flow sensor are matched. Refer to the following images in the next sections for the location of the serial number tags.

### 2.1 CHECKING THAT YOU HAVE RECEIVED EVERYTHING

#### 2.1.1 Documentation

Enclosed with each meter is a comprehensive documentation package that includes the following items:

- Installation and Operation Guide
- Flow Meter Certificate of Calibration

Please notify ONICON if either of these documents is missing.

#### 2.1.2 Calibration Information

## FLOW METER CERTIFICATE OF CALIBRATION

CALIBRATION & CONFIGURATION DATA for FSM-3 SERIES LARGE PIPE INSERTION FLOW METER  
FSM-3BF10-1011-FC2



**METER SPECIFICATION**

Serial Number: 001043454  
 Pipe Size: 10"  
 Analog #1 Signals: 4-20mA and 0-10V  
 Full Scale Accuracy: ±1% of reading from 1 ft/s to 20 ft/s  
 Low Flow Accuracy: ±0.01 ft/s below 1ft/s

**CALIBRATION DATA**

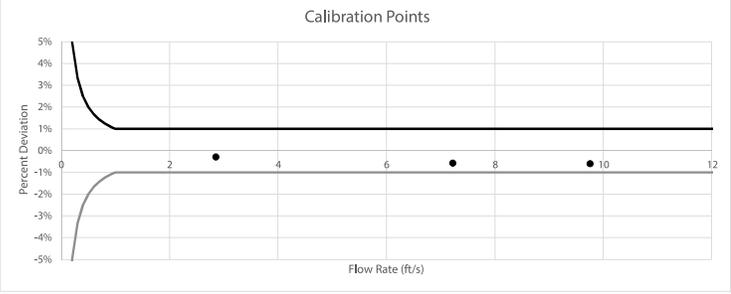
Test #	Time (sec)	Velocity (ft/s)	Reference Flow Rate (gal/min)	Measured Flow Rate (gal/min)	Deviation %
1	180	2.85	553.3	554.9	-0.29%
2	180	7.23	1401.6	1409.7	-0.57%
3	180	9.76	1892.9	1904.3	-0.60%

**FACTORY CONFIGURATION DATA**

Meter Tag: FWB-1  
 Liquid Type: Water  
 Pipe Type: 10" Carbon Steel Schedule 40  
 Full Scale Flow Range: 0-2500gpm  
 Digital Config #1: Volume  
 Digital Config #2: Alarm  
 Digital Config #3: None  
 Digital Pulse Width: 500ms  
 Digital Output Scale Factor: 1000 GALLONS per pulse  
 Meter Factor: 10 PPG

**VERSION**

Firmware Version: 00.01.71  
 Boot: 02.00.03



ONICON Incorporated certifies that this flow meter was calibrated against standards accurate to 0.1% and traceable to the National Institute of Standards and Technology (N.I.S.T.).

Programmed By: **M. Upham**  
 Programmed Date: **7/29/2019**

Calibrated By: **H. Beck**  
 Calibrated Date: **7/25/2019**

ONICON Incorporated, 11451 Belcher Road South, Largo, FL 33773 • USA • Tel +1 (727)447-6140 • Fax (727)442-5699 • www.onicon.com

### 2.1.3 Flow Meter

The flow meter was carefully packed prior to shipment. Before installation, inspect thoroughly for physical damage.

- Inspect the meter stem for bends or other damage. The stem forms the seal against liquid leakage as it slides through an O-ring inside the hot tap adapter. Deep scratches may compromise the seal and cause leakage.
- Make sure that the threads on the meter hot tap adapter have not been damaged.
- Confirm that serial and model numbers on the meter and calibration certificate match the information on the tag attached to the meter.



### 2.1.4 Required Tools

#### Provided with the meter:

- 3/16" T handle Allen (hex) wrench
- Conduit lock nut wrench
- Insertion assist handles

#### Customer supplied:

- 1/8" hex wrench
- 5/8" open end wrench
- 7/64" hex wrench
- 12" adjustable crescent wrench (or 1" open end wrench)
- Flat head screwdriver
- Isopropyl alcohol
- Phillips head screwdriver
- Pipe tape or thread sealant
- Pipe wrench

#### **IMPORTANT NOTE**

***The included tool list may be subject to change without notice.***

**2.2 ADDITIONAL EQUIPMENT**

If installation hardware or grounding rings were purchased for the flow meter through ONICON, they will arrive in a box separate from the meter.

**2.2.1 Installation Hardware**

The installation hardware provided for each flow meter is dependent on the pipe material, pipe size and installation method, dry tap or hot (wet) tap. Refer to the installation detail provided with the installation kit for additional information.

**2.2.2 Grounding Rings**

Grounding rings may be required when meters are installed in non-metallic or lined pipes. Placing the rings between the flanges, before and after the meter, will eliminate the electrical noise that interferes with its proper operation. Refer to Section 3.5.4 for additional information regarding the use of grounding rings.

**2.2.3 Peripheral Equipment**

BTU meters or display modules ordered with an FSM-3 Series Flow Meter will be packaged in a separate carton, pre-programmed for use together as a complete system. Meters that have been configured for operation together will be documented on their respective Calibration / Configuration sheets.



## BTU METER CERTIFICATE OF CALIBRATION

<p><b><u>METER INFORMATION</u></b>                  Meter Tag: BTU 30th Floor                  BTU Meter Model: SYS-10-1110-0101                  Serial No: 001008430                  Attached Flow Meter Model:                  Serial No: <span style="border: 1px solid red; display: inline-block; width: 150px; height: 15px;"></span></p> <p><b><u>SPECIFIED INSTALLATION &amp; OPERATING PARAMETERS</u></b>                  Pipe Information: 2 Inch Inline Copper                  Design Maximum Flow Rate: 125.0 GPM                  Design Supply Temperature: MODE 1: 93°F                  Design Return Temperature: MODE 1: 82°F                  Fluid: Water                  Fluid Specific Heat: 1.000 BTU/lb°F                  Fluid Density: 62.14 lb/ft³</p>	<p><b><u>CALIBRATION DATA</u></b>                  Firmware Version: DDB3.4                  Communications Protocol: BACnet-MS/TP                  Device Network Address: 090                  Display Units &amp; Multipliers:                  Energy Total: BTU x 10K      Energy Rate: BTU/HR x 1K                  Flow Total: GALLONS x 10      Flow Rate: GPM x 1                  Temperature: °F                  Damping: 5                  Pulse Duration: 500 ms                  Supply Temperature Slope: 9.984      Offset: -0.070                  Return Temperature Slope: 10.011      Offset: 0.040                  Flow Diagnostic Test Output (60 Hz): NA</p> <p><b><u>OUTPUT SIGNAL SCALING</u></b>                  Energy Total(s): 1 Pulse = BTU x 10K                  Flow Rate: NA                  Energy Rate: NA                  Supply T: NA                  Return T: NA                  Delta T: NA</p>
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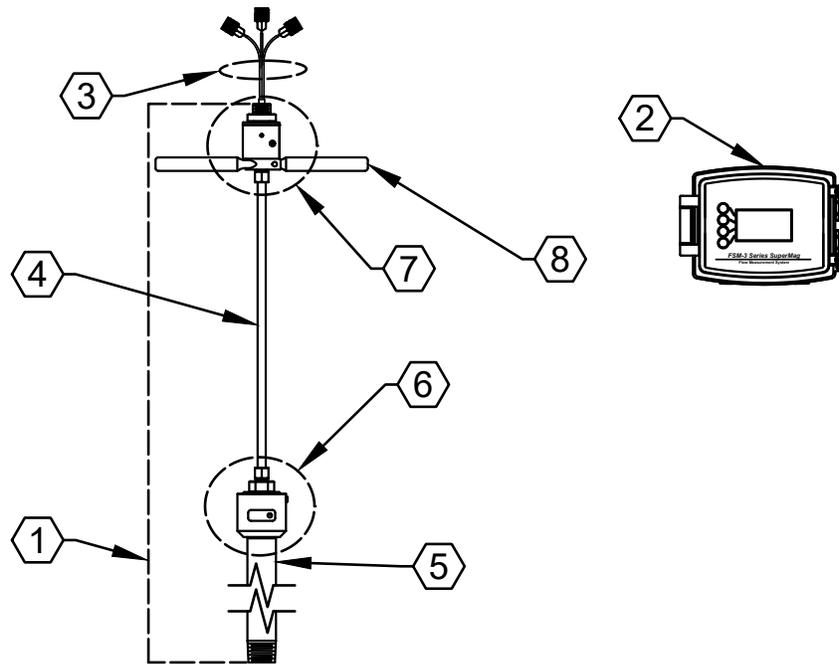
Calibrated By: Curtis R. McElhattan      Date: 06/07/2018

ONICON Incorporated certifies that the flow and temperature sensors provided with this Btu meter have been individually calibrated using application specific data provided above; using standards directly traceable to the U.S. National Institute of Standards and Technology.

11451 Belcher Road South, Largo, Florida 33773 Tel (727) 447-6140 Fax (727) 442-5699



## 2.3 FLOW METER DESCRIPTION AND DETAILS



### 1. Flow Sensor Assembly

Also referred to as the flow meter body. The flow sensor itself is the white dimpled section that retracts into the adapter.

### 2. Flow Meter Transmitter Electronics Enclosure

Added after the flow sensor assembly has been installed in the pipe.

### 3. Electrode And Coil Wires

Pre-connected Terminal Blocks

### 4. Flow Sensor Stem

### 5. Hot Tap Adapter Fitting

Allows the flow sensor to be inserted and removed from the piping system while pressurized and provides the force required to hold the flow sensor inside the pipe.

### 6. (Hot Tap Adapter) Preload Housing

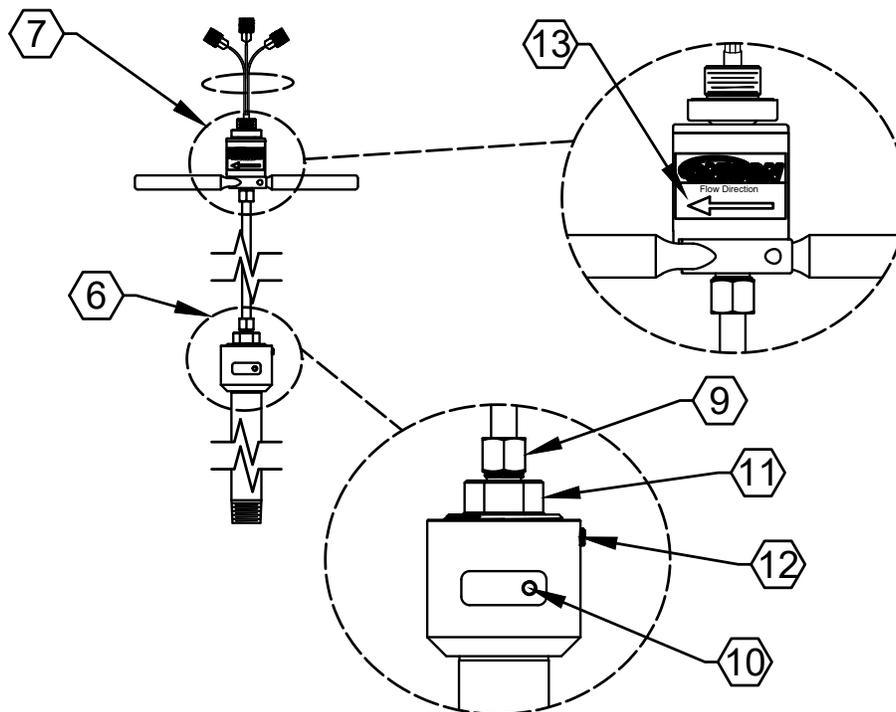
Integral to the hot tap adapter fitting and contains the components that apply the holding force to the flow sensor.

### 7. Enclosure Mount Assembly

### 8. Insertion Assist and Alignment Handles

These handles are used to provide leverage during flow sensor installation and provide a means to align the flow meter correctly along the pipe.

## 2.3 FLOW METER DESCRIPTION AND DETAILS (CONTINUED)

**9. Stem Locking Collet Nut**

Provides the final stem locking required to complete the flow meter installation. (Requires  $\frac{5}{8}$ " Open End wrench)

**10. Stem Locking Collar**

Holds the stem against the preload assembly, which is required to maintain the proper force pressing the flow sensor against the bottom of the pipe. (Requires  $\frac{3}{16}$ " Allen (hex) wrench)

**11. Preload Compression Fitting**

Sets the correct spring tension in the preload assembly. (Requires 1" Open End or Crescent wrench)

**12. Preload Set Screw**

Keeps the preload fitting in place after flow meter installation. (Requires a  $\frac{1}{8}$ " Allen (hex) wrench)

**13. Flow Direction Arrow**

## SECTION 3.0 FLOW METER INSTALLATION

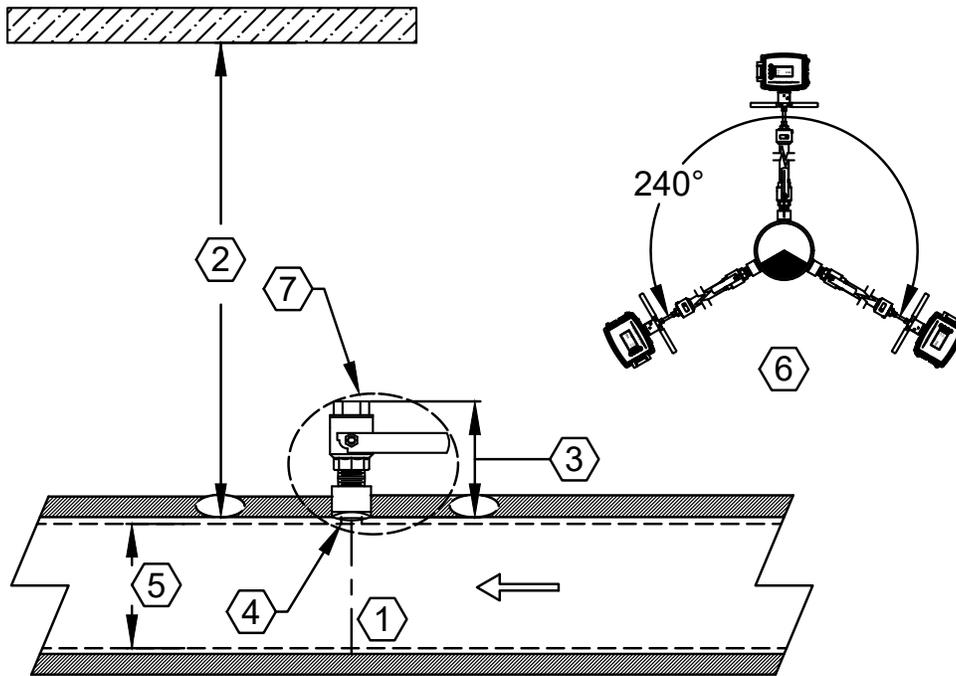
### **CAUTION**

*Insertion flow meters may be installed in pipes which are under high pressure. Accidents with these systems can cause serious injury or death. Only persons experienced with high pressure systems and related knowledge in the heating, cooling and fluid metering fields should attempt to install, adjust or remove the flow meter. Please read all instructions before attempting to insert or remove the flow meter.*

### **3.1 FLOW METER SITE SELECTION GENERAL GUIDELINES**

Install the flow meter where it will be accessible for personnel to perform necessary periodic maintenance. The environment should be free of corrosive liquids / fumes, temperature extremes and heavy vibration.

3.1.1 Overhead Clearance and Installation Details



General Information Installation Requirements			
Model Number	Nominal Pipe Size (in)	Minimum Overhead Clearance (in)	Maximum Overhead Clearance (in)
FSM-3BF-06	6	40	46
FSM-3BF-08	8	44	50
FSM-3BF-10	10	48	54
FSM-3BF-12	12	52	58

**TABLE 1.0**

1. Mount the installation kit per the recommendations in Section 3.1.4, table 2 regarding straight pipe run requirements.
2. Confirm there is sufficient overhead clearance for installation and removal of the flow meter. The clearance required from the top of the pipe to the nearest obstruction is listed in Table 1.0. The flow sensor installation is performed with the transmitter electronics enclosure removed. Refer to IOM Section 3.2, Flow Meter Installation, for additional information.
3. Confirm the isolation valve stack height is 7" or less. The measurement must be made from the top of the pipe, NOT the insulation, to the top of the isolation valve.
4. Confirm the access hole into the pipe is at least 1" in diameter, minimum.

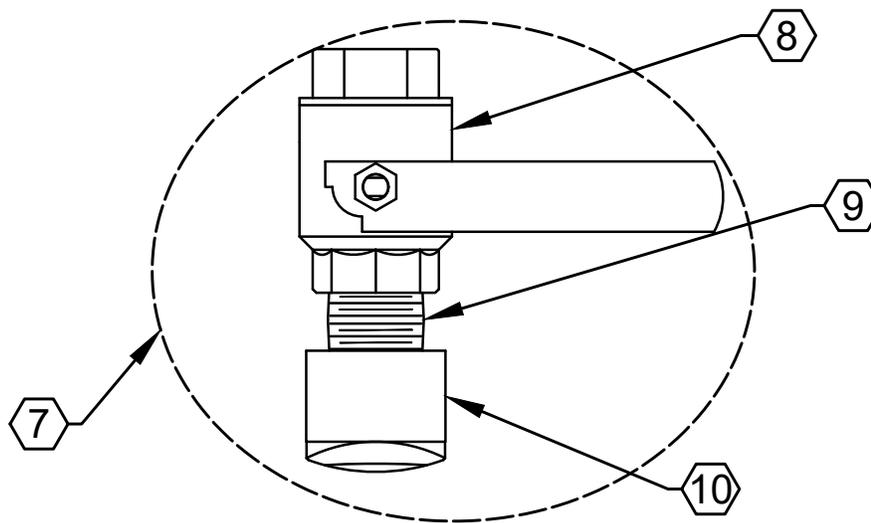
**CAUTION: The access hole diameter must be confirmed prior to beginning the installation process. Attempting to install the flow meter through a hole less than 1" in diameter will cause damage to the meter and potentially lodge the flow sensor assembly in the piping system, preventing its removal.**

5. Confirm the actual pipe diameter prior to beginning the installation of the flow meter.
6. Locate the installation kit in upper 240 deg. section of a horizontal piping run. This will prevent debris from collecting in the valve assembly, which could keep it from operating.
7. Typical installation kit (additional information provided on the following page).

### 3.1.2 Hardware Installation

ONICON offers a wide range of installation hardware kits for commonly used pipe materials. The kits are specifically designed for ONICON flow meters, and their use is recommended. The use of ONICON installation hardware kits accomplishes two important objectives. First, it ensures that the proper hardware is used. Second, it simplifies order processing by standardizing the dimensions of the installation hardware. ONICON must have an accurate measurement of the overall height of the installation hardware as measured from the outside wall of the pipe to the top of the valve in order to determine the correct stem length when assembling the meter in our factory. ONICON documents refer to this dimension as the stack height.

7. Typical installation kit detail for steel piping systems is shown. Refer to the installation kit instructions provided with your kit. The installation kit must be installed correctly per the manufacturer's written instructions.



ONICON installation hardware kits consist of three separate component parts:

8. Full port isolation valve, 1" minimum required for dry tap installations. 1.25" full port isolation valve minimum required for hot tap installations.
9. Threaded close nipple, 1" NPT minimum.
10. Welded branch outlet, 1" NPT minimum, typical for steel piping system installation.

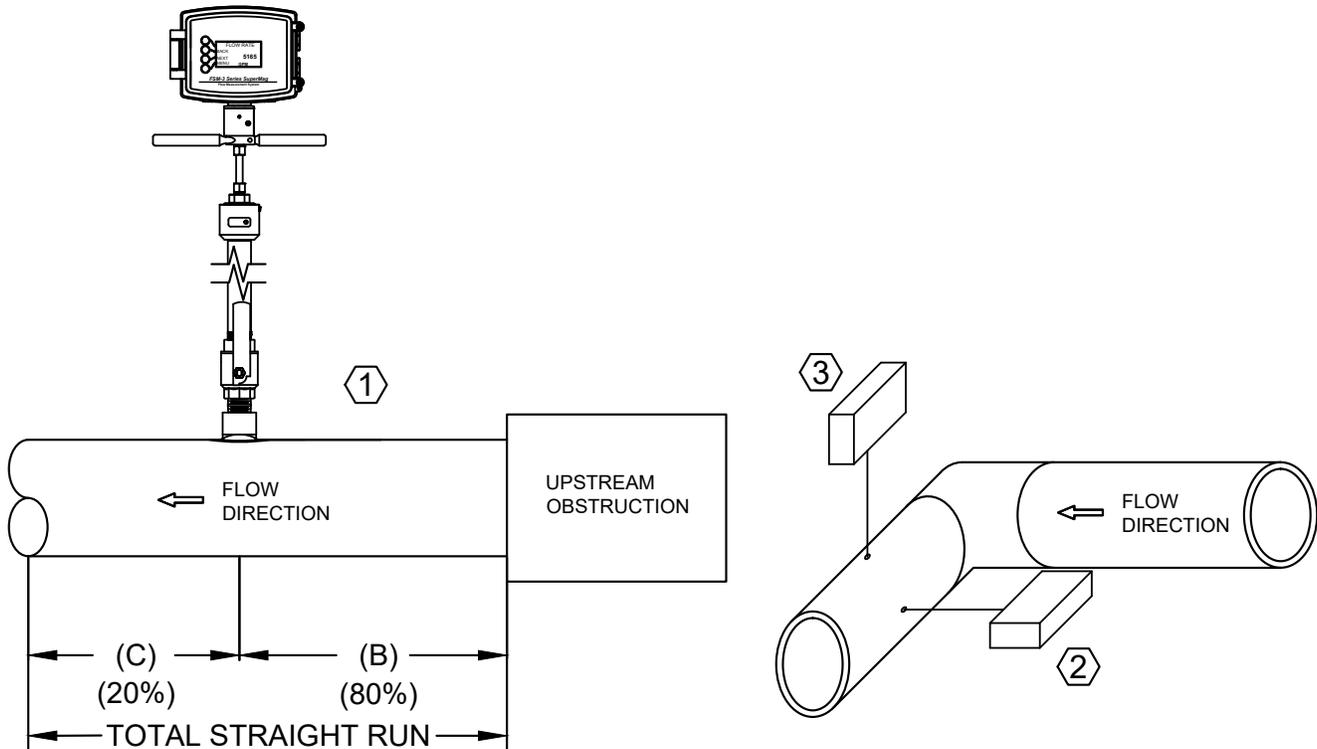
### 3.1.3 Customer Supplied Installation Hardware

There are occasions where circumstances require that the customer provide the installation hardware or that the flow meter be installed through existing hardware. In these cases, it is important to confirm that the installation hardware is suitable for use with the flow meter provided by ONICON before it is installed.

The installation must allow for sufficient overhead clearance (3.1.1) to fully extract the meter and must not be too tall where the meter cannot reach the appropriate depth. A full 1" opening in the pipe wall is required to clear the sensor head and allow for insertion. Make sure that your valves and fittings are full port, at least 1" in actual internal diameter, and that the overall stack height (from the top of the ball valve to the top of the pipe) does not exceed 7.0".

### 3.1.4 Flow Meter Installation Straight Run Requirements

The following diagrams should be used as a guide regarding the location for installing the meter.



1. Install the flow meter in a section of pipe with the longest un-obstructed straight run available. If the published straight run recommendations cannot be met, locate the flow meter with 80% of the available straight run upstream.
2. Flow meter installed In Plane with upstream elbow.
3. Flow meter installed Out Of Plane with upstream elbow.

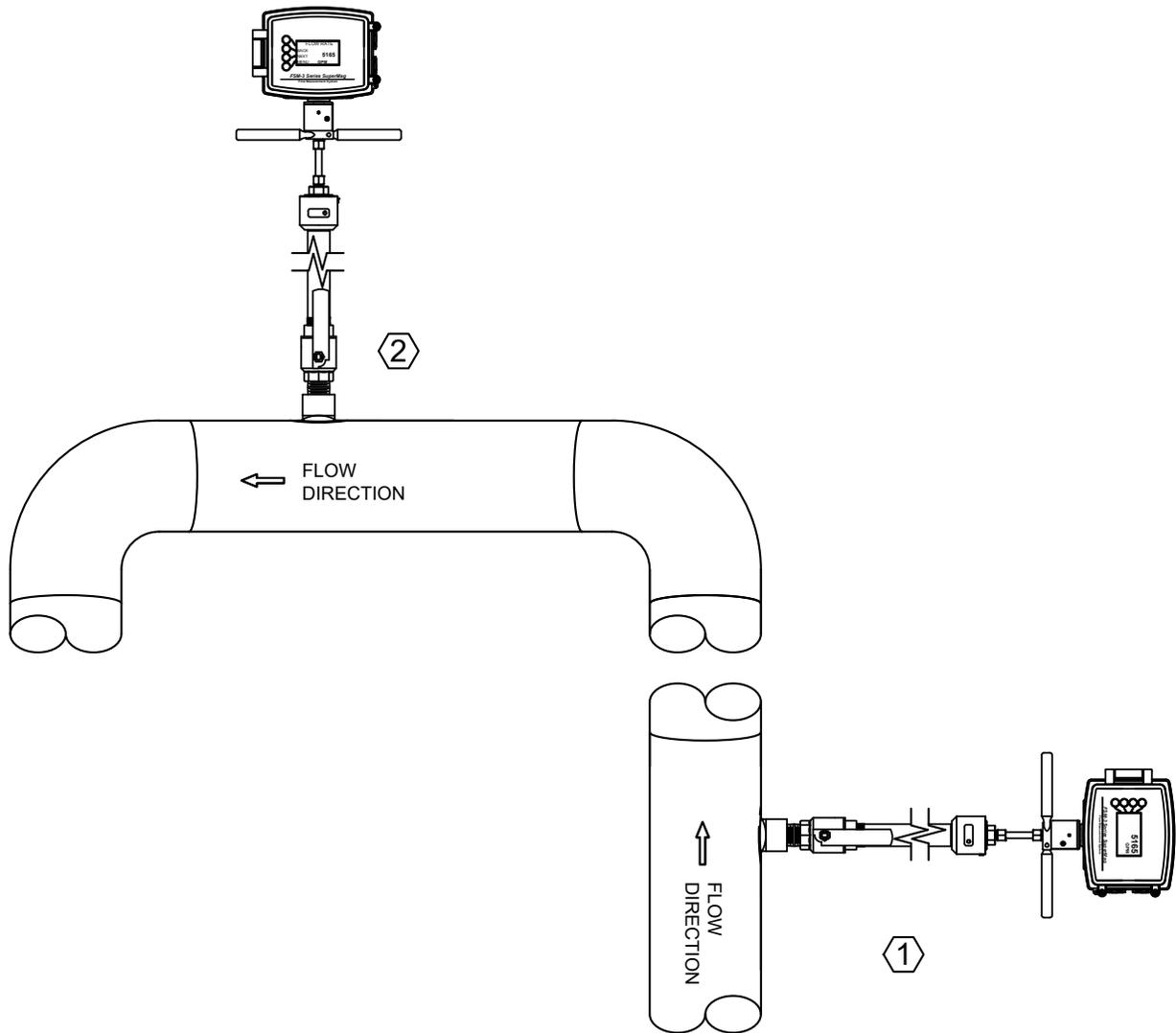
Straight Run Requirements			
Upstream Obstruction	Orientation	Upstream Diameters (B)	Downstream Diameters (C)
Single Elbow	In Plane	8	2
Single Elbow	Out of Plane	6	2
Butterfly Valve (Fully Opened)	In Plane	5	2
Butterfly Valve (Fully Opened)	Out of Plane	4	2
Single Pipe Size Reduction	Any	3	2

TABLE 2.0

**IMPORTANT NOTE**

**Always use the maximum available straight run. When more than the minimum required straight run is available, place the meter such that the excess straight run is upstream of the meter location.**

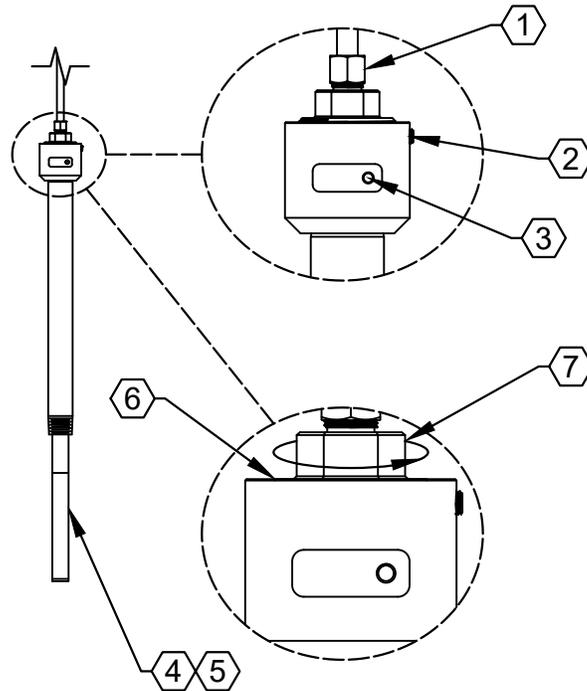
### 3.1.5 Flow Meter Installation - Orientation



1. Installation of the FSM-3 flow meter in vertical pipes is acceptable. Flow in the upward direction is recommended in non-pressurized (open loop) systems.
2. Avoid locating the flow meter at the highest point where air can be trapped in a horizontal piping system.

## 3.2 FLOW METER INSTALLATION PROCEDURE

### 3.2.1 Flow Sensor Installation Instructions



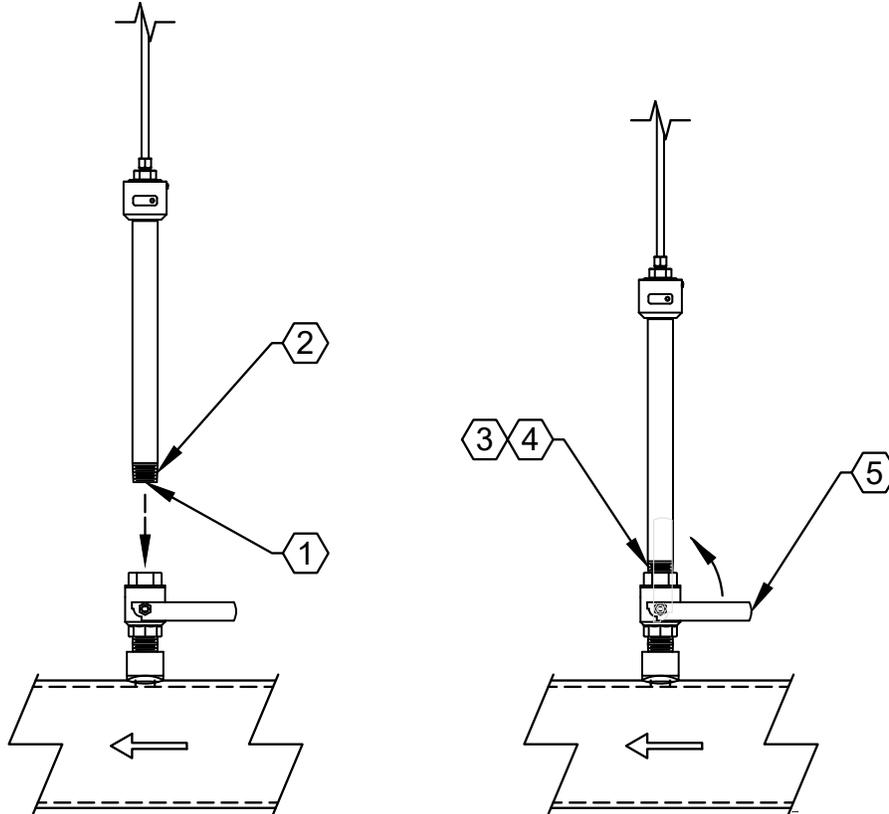
1. Use a  $\frac{5}{8}$ " open end wrench to loosen the stem locking collet nut.
2. Use a  $\frac{3}{16}$ " Allen (hex) wrench to loosen the preload fitting set screw.
3. Confirm the stem locking collar is loose and floats freely in the hot tap adapter preload housing. Use the  $\frac{5}{16}$ " hex T handle Allen (hex) wrench provided.
4. Slide the flow sensor down and out of the hot tap adapter fitting. The flow sensor should slide easily, if it does not repeat steps 1 through 3.

#### **CAUTION**

***If the flow sensor does not slide easily out of the hot tap adapter, confirm the flow meter stem (Item 4 in Flow Meter Description on page 11) is not bent before proceeding.***

5. Inspect the flow sensor and confirm it is free of any dirt, debris, oils or other chemicals. If required, clean with isopropyl alcohol.
6. With the flow sensor fully extended, use a 1" open end or crescent wrench to tighten the preload fitting completely. When tightened correctly, the preload fitting should be flush with the hot tap adapter preload housing.
7. **IMPORTANT:** Back the preload fitting out of the preload housing by turning the preload fitting counterclockwise  $1\frac{1}{4}$  turns. This will set the appropriate preload compression when the flow meter is installed in the piping system.

## 3.2.1 Flow Sensor Installation Instructions (Continued)



1. Fully retract the flow sensor into the hot tap adapter fitting.
2. Apply thread sealant to the 1" NPT hot tap adapter threads. Confirm the sealant is appropriate for use with Stainless Steel. If using thread sealing tape, confirm that no tape extends beyond the end of the hot tap adapter.
3. Begin threading the hot tap adapter fitting into the fully closed isolation valve by hand.
4. Use a small pipe wrench to complete the installation of the hot tap adapter fitting into the isolation valve.

**CAUTION**

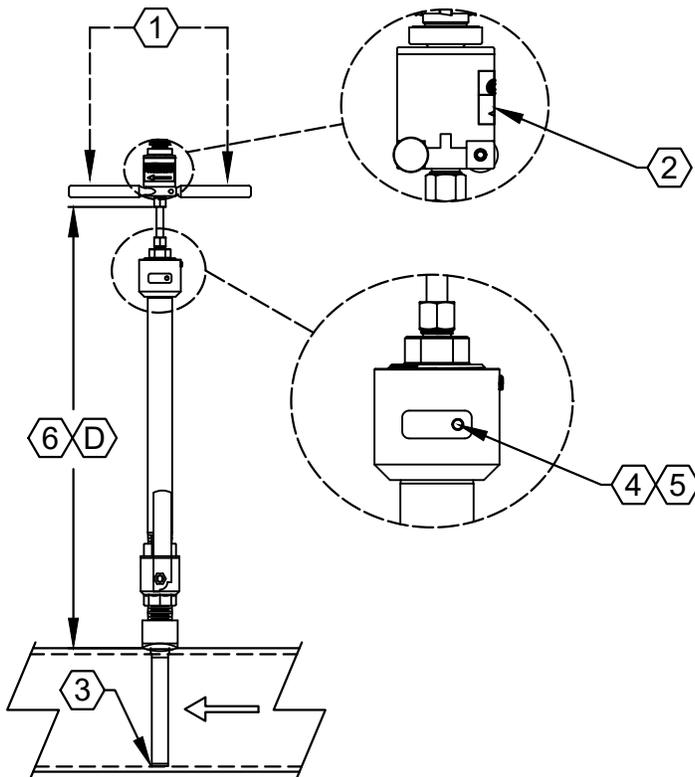
**Do NOT overtighten, apply only the minimum amount of torque required to establish a seal.**

**WARNING**

**Overtightening the hot tap adapter in the isolation valve may deform the fitting, creating an interference fit with the flow sensor assembly.**

5. Slowly open the isolation valve and confirm there are no leaks before proceeding. Repeat step 4 as required to eliminate any leaks.

3.2.1 Flow Sensor Installation Instructions (Continued)



Insertion Dimensions		
Model Number	Nominal Pipe Size (in)	Dimension (D) (in)
FSM-3BF-06	6.0	24
FSM-3BF-08	8.0	26
FSM-3BF-10	10.0	28
FSM-3BF-12	12.0	30

**TABLE 3.0**

1. Once the hot tap adapter has been installed into the isolation valve, confirm the isolation valve has been opened completely before inserting the flow sensor into the pipe. The insertion assist handles are used to provide even and steady pressure to the flow sensor during installation.

**IMPORTANT NOTE**

*The force required to insert the flow sensor into the pipe is equal to 10% of the system pressure (Example: 0.1 x 60 psig = 6 lb force). Make sure you have adequate support before inserting the flow sensor.*

**CAUTION**

*The flow sensor should travel smoothly through the hot tap adapter, isolation valve and pipe. If any resistance is met other than the system force, stop inserting the flow sensor and prepare to remove it for inspection.*

2. Use the insertion handles to align the flow sensor with the pipe. The flow direction arrow will indicate the downstream orientation of the flow sensor.
3. Continue to apply and maintain the downward force on the insertion handles, even after the flow sensor "foot" has contacted the far side of the pipe.
4. While holding the flow sensor in place, use the 5/16" T handle Allen (hex) wrench to tighten the stem locking collar.

**CAUTION**

*Do NOT overtighten the stem locking collar, apply only enough torque to provide a clamp on the flow sensor stem.*

5. Once the stem locking collar has been tightened, the downward force on the flow sensor can be removed and the locking collar will keep the flow sensor in place.
6. Confirm the flow sensor is fully inserted by measuring the distance from the top of the pipe (not the insulation) to the enclosure fitting nut. Refer to table 3.0 for dimension D, which is based on the flow meter size.

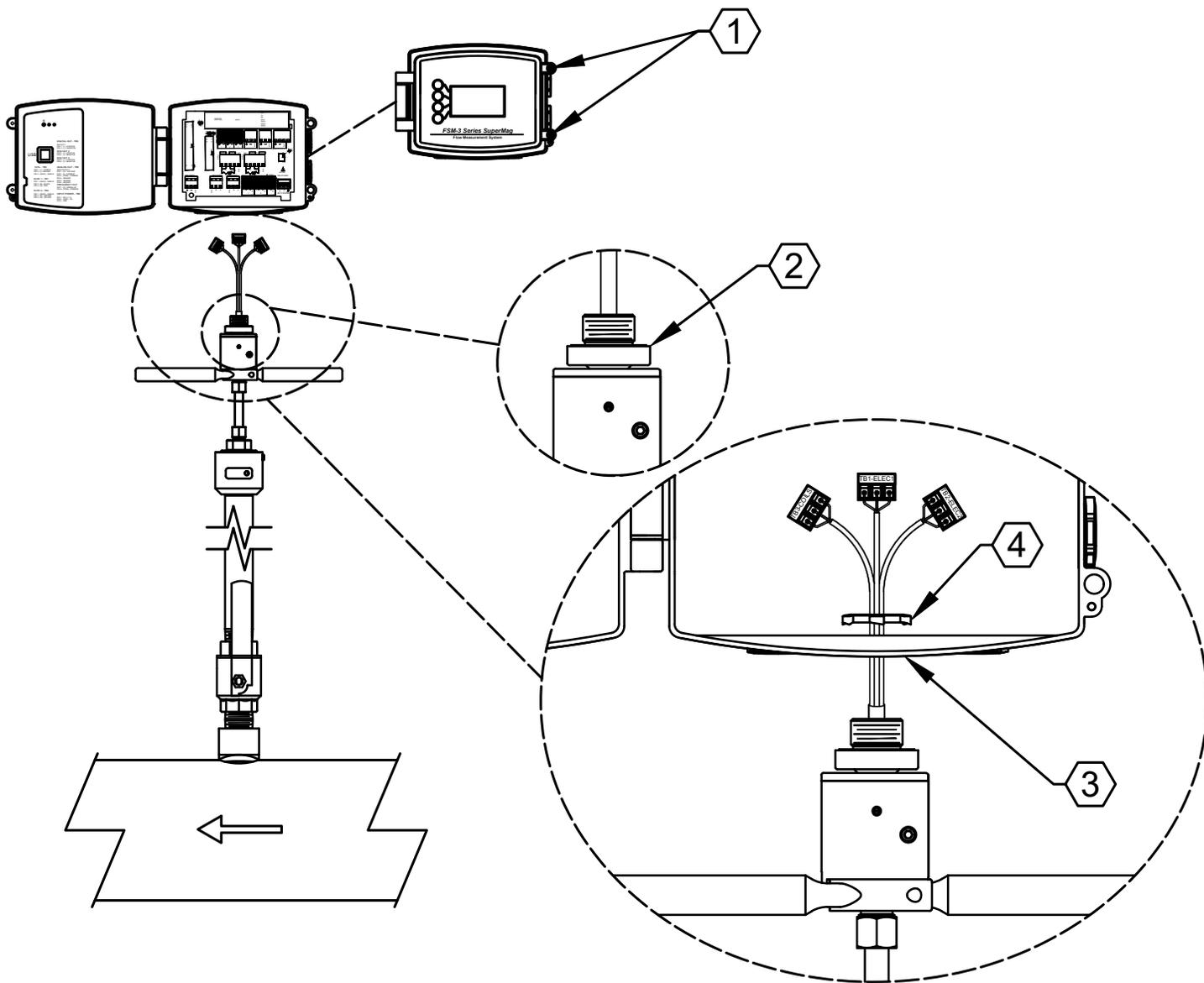
**IMPORTANT NOTE**

*If the flow sensor is not installed to the proper depth, repeat steps 3 and 4.*

**WARNING**

*Failing to fully insert the flow sensor in the pipe may result in damage to the flow sensor.*

3.2.2 Transmitter Installation Instructions



1. Open the transmitter enclosure by loosening the two (2) captive screws.

**IMPORTANT NOTE**

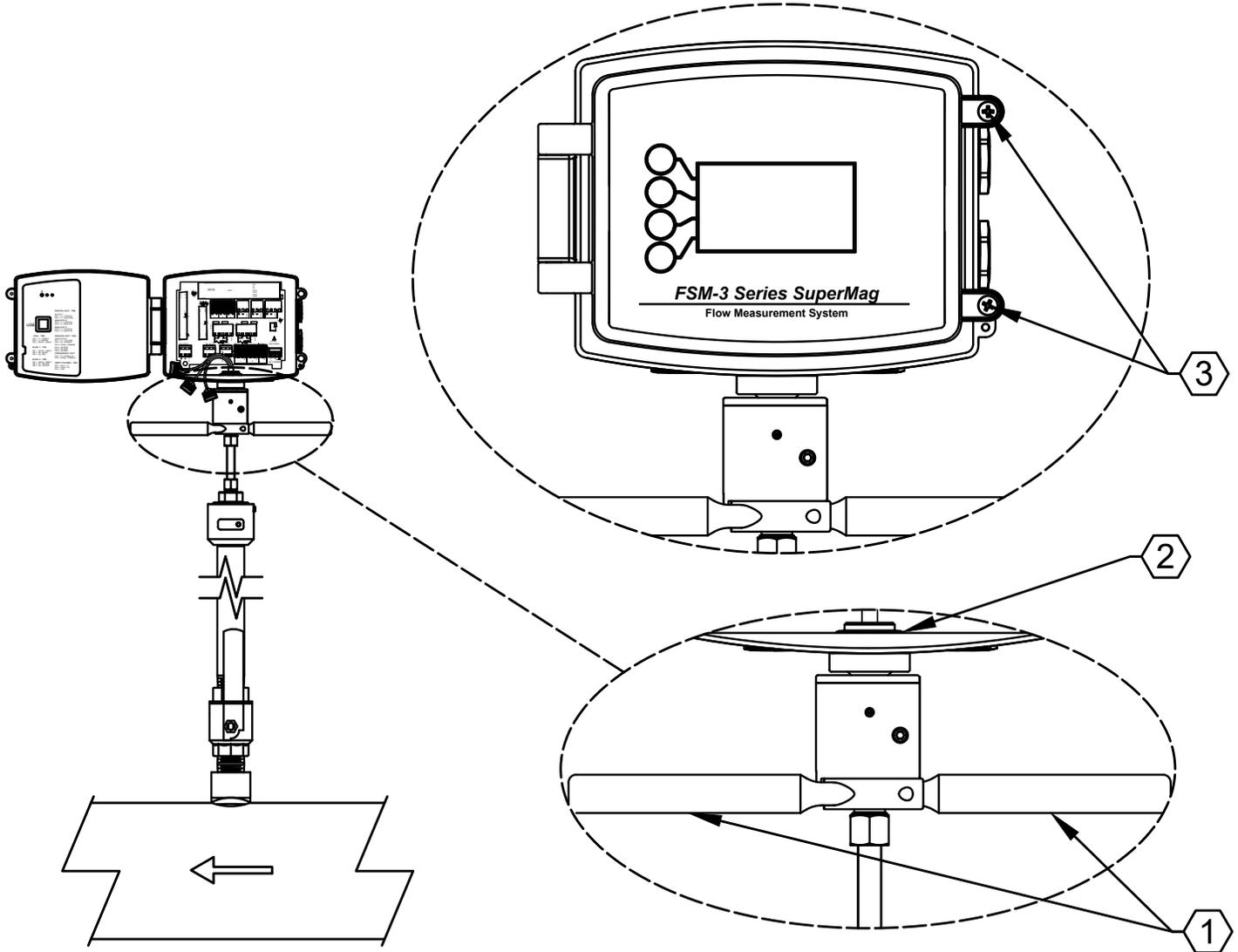
**Locate the 1/2" conduit lock nut provided in the pouch attached to the flow meter.**

- 2. Verify the sealing o-ring is properly seated in the enclosure mount fitting o-ring groove.
- 3. Carefully align the transmitter enclosure's center conduit hole over the flow sensor box fitting and coil / electrode wires. Carefully lower the transmitter enclosure onto the fitting, routing the wire pigtail and terminal blocks into the enclosure.
- 4. Carefully route the 1/2" conduit lock nut over the coil wire and electrode wire terminal blocks one at a time.

**CAUTION**

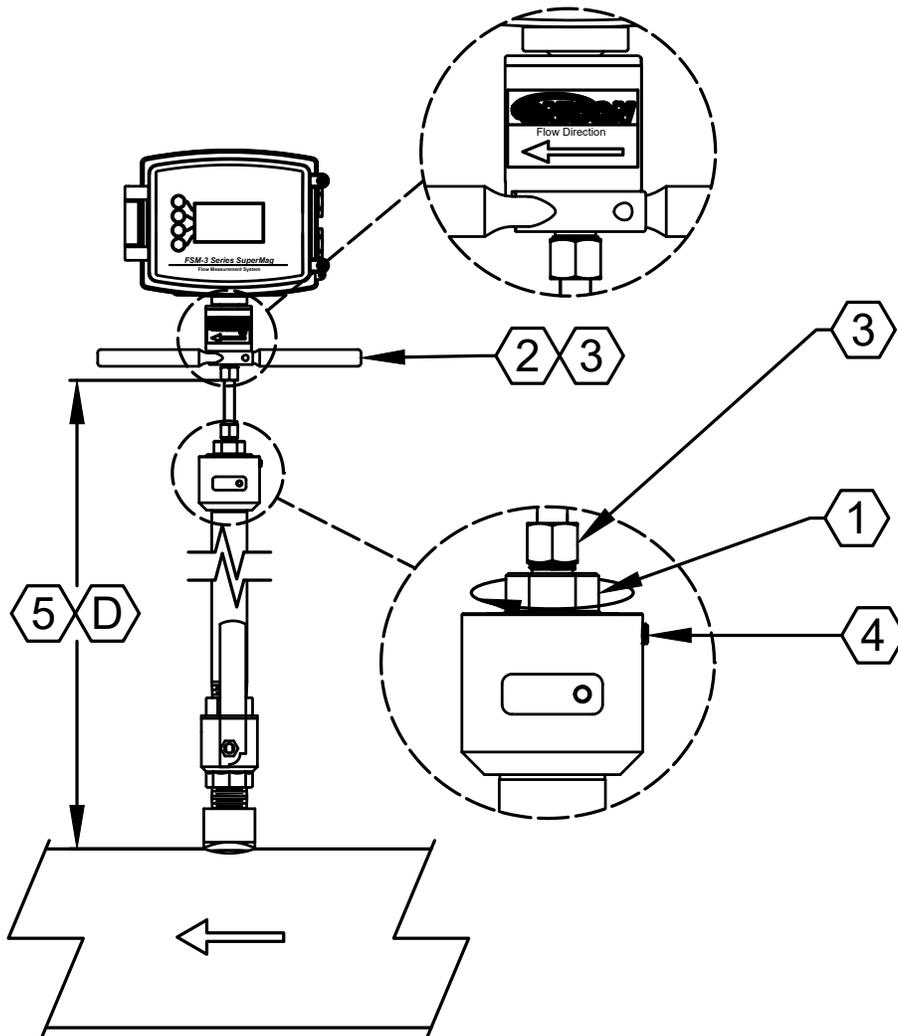
**The terminal blocks are prewired at the factory. If the individual coil or electrode wires are removed from the terminal blocks during installation, refer to the wiring detail for the correct terminal locations.**

3.2.2 Transmitter Installation Instructions (Continued)



1. Align the transmitter enclosure into the proper orientation regarding the conduit connections and operator viewing position. Use the insertion assist handles to maintain the flow sensor orientation in the pipe during this process.
2. Use the conduit lock nut wrench provided to tighten the 1/2" conduit locking nut. Use the insertion assist handles to hold the flow meter in the correct orientation while securing the transmitter in place.
3. Carefully place the coil and electrode wires inside the transmitter enclosure before closing the cover and re-tightening the screws before proceeding with the flow meter installation.

## 3.2.2 Transmitter Installation Instructions (Continued)



1. Use a 1" open end or crescent wrench to tighten the preload fitting. The preload fitting will be flush with the hot tap adapter preload housing when complete, approximately 1.25 turns clockwise.
2. Use the insertion handles to maintain the correct flow meter orientation while tightening the preload fitting.

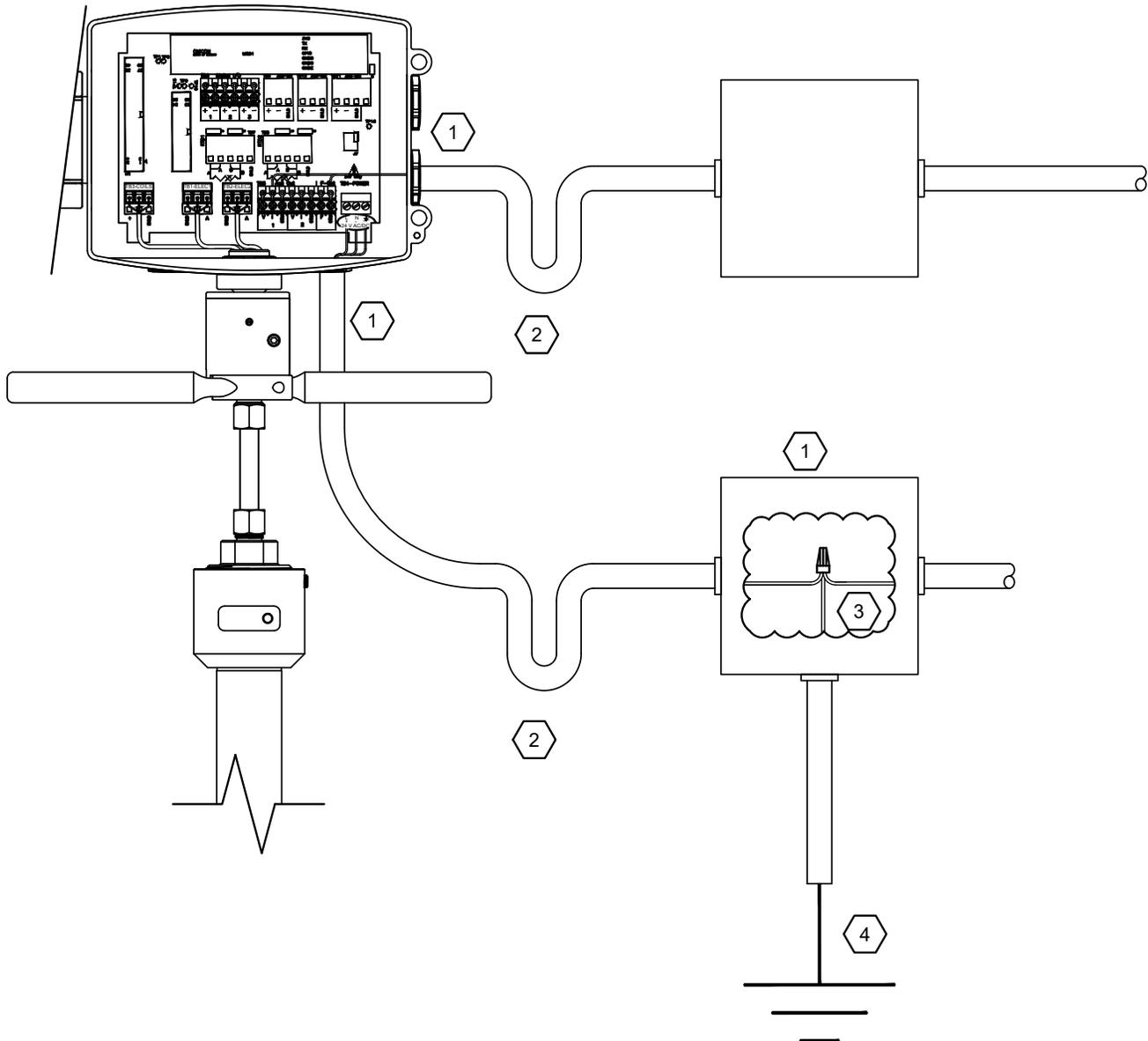
**IMPORTANT NOTE**

***The preload fitting establishes the correct force required to hold the flow sensor against the pipe wall.***

3. Use the insertion assist handles to align the flow direction indicator with the downstream, top-center of the pipe.
4. Use a  $\frac{3}{16}$ " Allen (hex) wrench to tighten the preload fitting set screw.
5. The flow meter has now been completely installed and should be locked in position. As a final check, use a tape measure to confirm that dimension D from table 3.0 on page 20 has not changed.

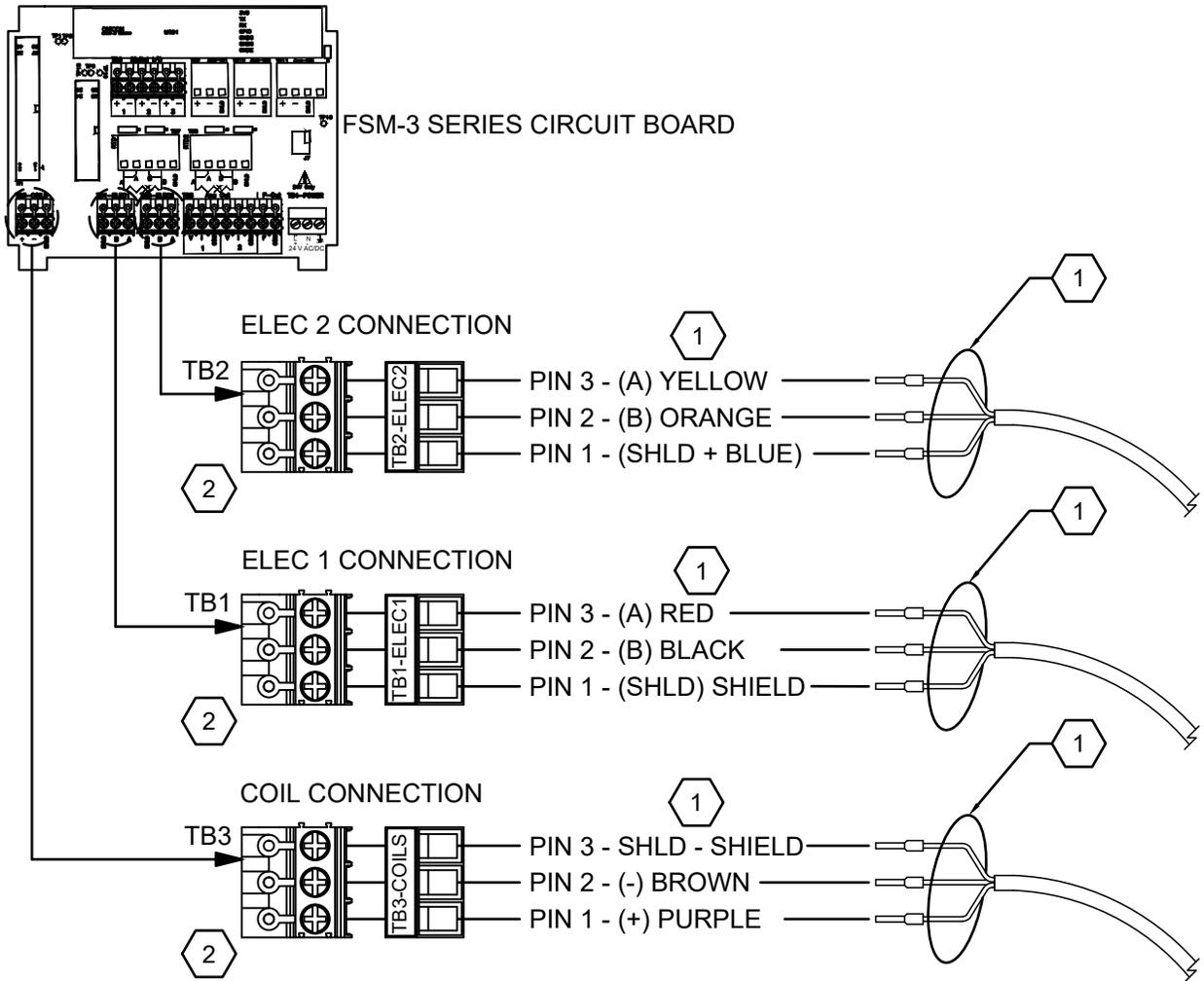
### 3.3 WIRING CONNECTIONS

#### 3.3.1 Signal and Power Wiring Connections



1. Route input power and ground wires through separate conduits and junction boxes from other signal wires.
2. Provide enough slack in the flexible conduit connection between the flow meter enclosure and junction boxes to allow for the installation and removal of the flow meter.
3. Separate the flow meter ground into a protection ground (ground connection terminated at the electrical panel) and signal ground in the junction box, as close to the flow meter as possible.
4. The signal ground must be connected to earth ground for proper flow meter operation and should be kept as short as possible. Terminate the signal ground to the best earth grounding source available. A grounding rod driven into the earth in proximity to the flow meter is best. Avoid ground sources that are shared by other equipment such as VFD's and lighting fixtures.

3.3.2 Flow Meter Coil and Electrode Wiring Connections



**Field Wiring**

1. Identify the pre-connected flow sensor coil and electrode terminal blocks based on label and wire lead colors.
2. Confirm the individual wire ferrules have been seated properly in their respective terminal blocks before repopulating the terminal blocks onto the circuit board.

### 3.3.3 Input Power and I/O Wiring Connections

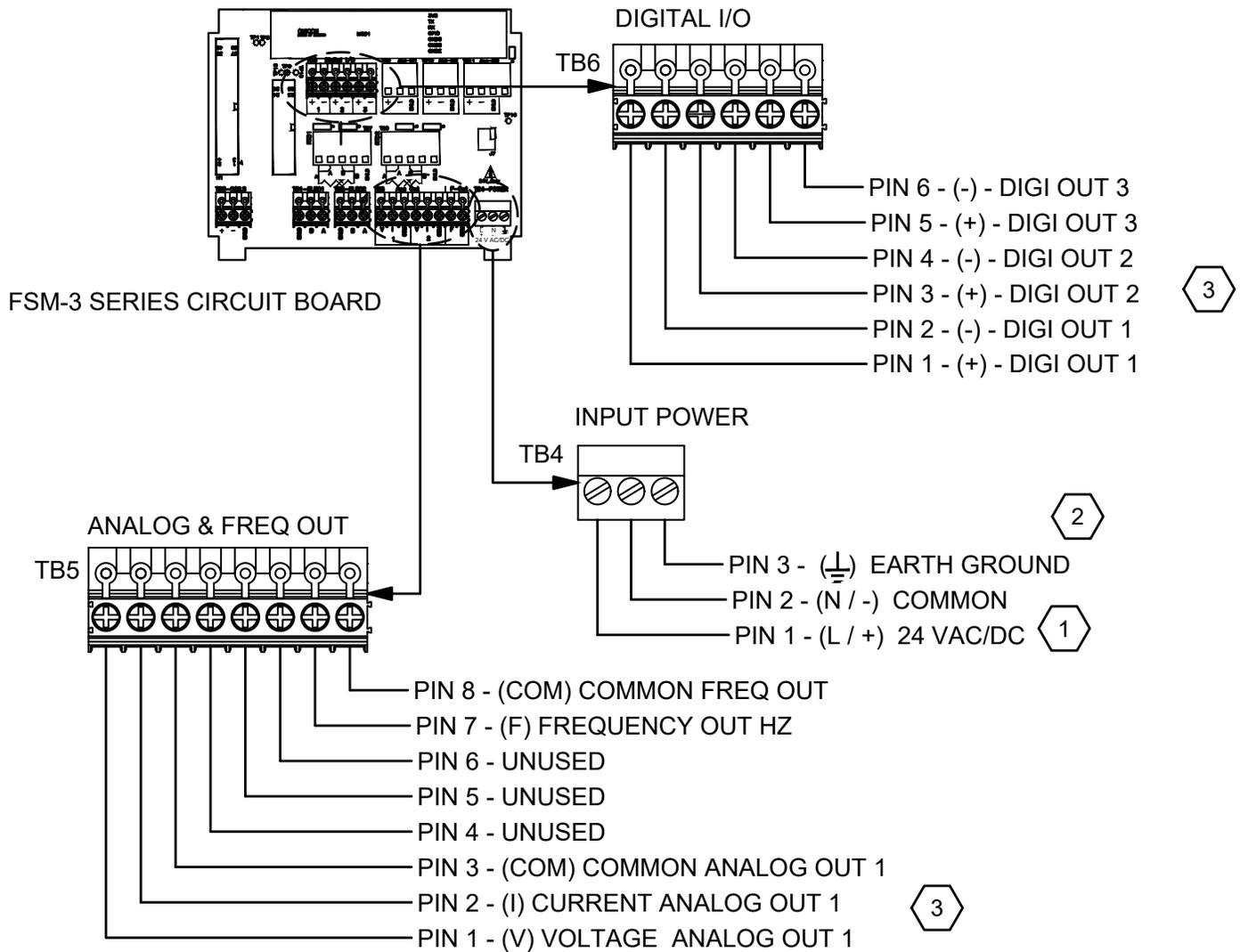
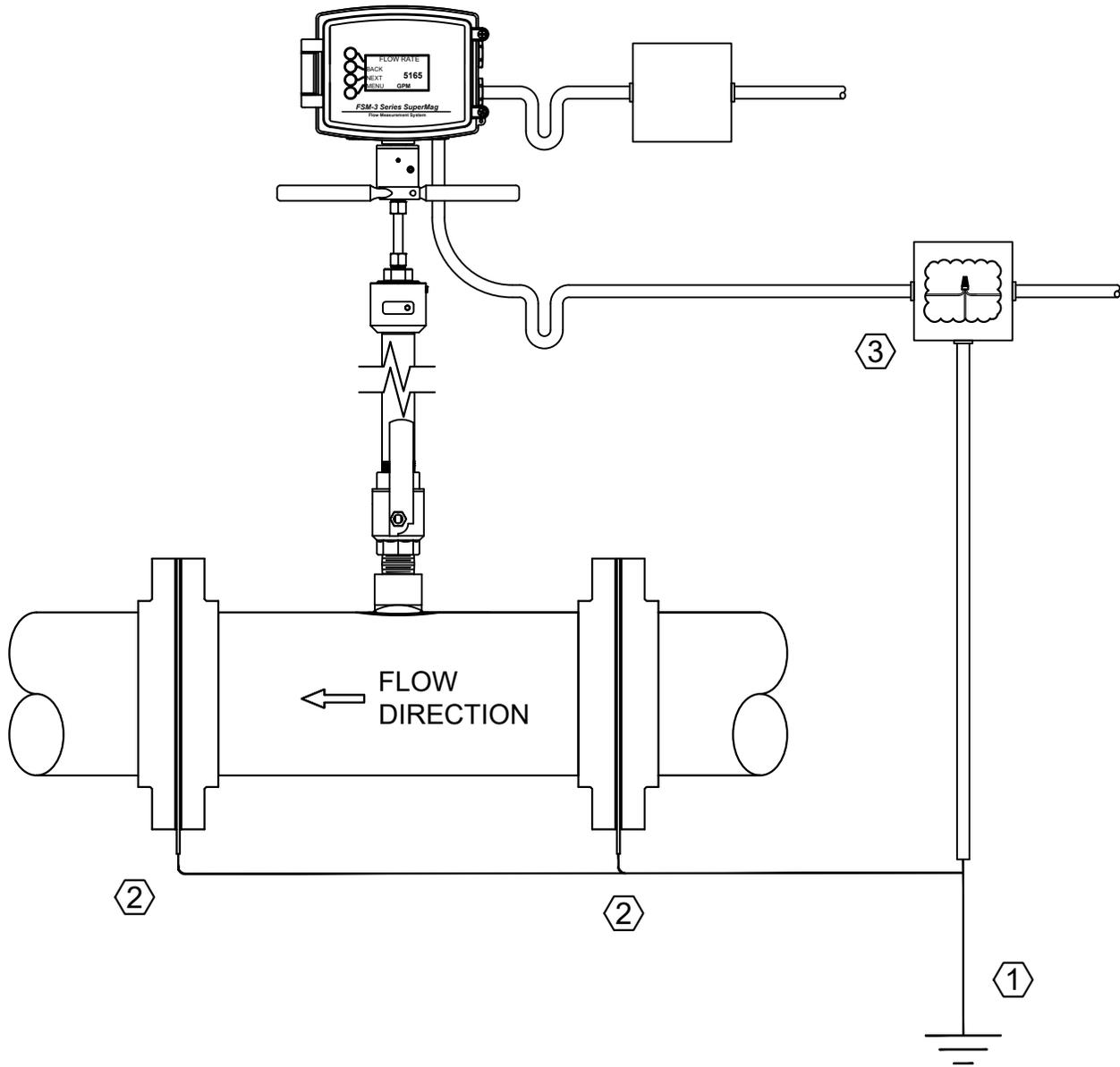


FIGURE 3.5.1.3: AO, DO and Input Power

#### Field Wiring

1. Input power supply should be clean; free of any noise and voltage ripple.
2. Earth ground connection is required and must be kept as short as possible.
3. Outputs can be configured via the front panel user interface.

3.3.4 Field Wiring in Non-Conductive Pipe Applications



**Field Wiring**

1. An earth ground connection is required for proper operation of the flow meter. The earth ground wire run should be kept as short as possible, terminating at the best earth grounding source available.
2. Grounding rings are required for installations in non-metallic pipe. Connect grounding rings together with a dedicated ground wire, terminating at the grounding source.
3. The flow meter earth ground connection should be separated into a protection ground and signal ground wire in the field junction box as shown.

### 3.4 REMOVAL OF THE FLOW METER

Refer to Section 2.3 to identify the components listed in the steps below.

Remove electronics enclosure.

1. Unplug the Coil and Electrode wire terminal blocks from the FSM-3 circuit board.
2. Use the supplied ½" conduit lock nut wrench to remove the conduit lock nut. Do not discard the lock nut.
3. Carefully remove the transmitter enclosure from the threaded mount.

#### **CAUTION**

***Carefully feed the terminal blocks through the transmitter opening one at a time. DO NOT remove individual wires from the terminal blocks.***

Remove the flow sensor

4. Use a 7/64" Allen (hex) wrench to loosen the preload fitting set screw.
5. Use a 5/8" open end wrench to loosen the stem locking collet nut.
6. Use a 1" open end wrench or crescent wrench to loosen the preload fitting.
7. While applying pressure to the insertion assist handle, use the 3/16" T handle Allen (hex) wrench to loosen the stem locking collar.

#### **CAUTION**

***Once the stem locking collar has been loosened, the flow meter will be pushed out of the isolation valve at 0.1 x System Pressure***

#### **WARNING**

***Safety concern. Continue holding the flow sensor assembly while loosening the stem locking collar to avoid potential injury.***

8. Retract the flow meter completely into the hot tap adapter.

#### **CAUTION**

***Ensure that the ball valve is completely open before the sensor head is pulled into the hot tap adapter.***

9. Slowly close the isolation valve.
10. Loosen the hot tap adapter with the pipe wrench and remove meter completely from pipe.

#### **CAUTION**

***Depending on the flow meters installed orientation, a small amount of system fluid may be captured in the hot tap adapter fitting during removal. Be prepared to dispose of this fluid appropriately.***

## SECTION 4.0 START-UP AND COMMISSIONING

### 4.1 COMMISSIONING

The FSM-3 Series flow meter must be commissioned in order to operate correctly. Commissioning is a two step process:

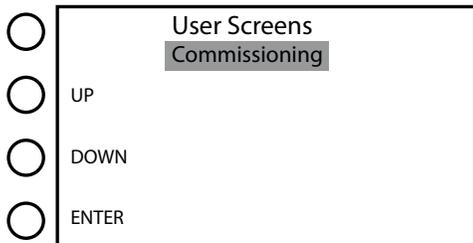
#### Step 1 - Mechanical installation

- Confirm that the flow sensor is properly located in the piping system (Section 3).
- Confirm that the flow sensor is properly oriented with respect to flow direction (Section 3).

#### Step 2 - Review the flow meter program settings.

Both steps must be completed to finish the installation process.

To complete the installation, the meter must be installed in a pipe with flow and power must be applied to the meter. When power is first applied to the meter the display will be illuminated and this start screen will appear. Use the four pushbuttons on the left side of the display to navigate the display pages and change settings.



Press DOWN to position cursor at Commissioning, and ENTER to access to the commissioning menu.

### 4.1.1 Commissioning Following Initial Power-up

The following display pages will appear when the commissioning option is selected. The settings shown below allow the installer to set the date and time, and label the meter.

If the factory pre-programmed engineering units for flow and the pulse and analog output scaling are correct, press SAVE to exit commissioning at the end of this process. Momentarily press NEXT if you need to change the factory pre-programmed settings or you wish to view all of the commissioning mode display pages shown on the following pages.

<input type="radio"/>	EXIT	Set Date
<input type="radio"/>	BACK	YYYY/MM/DD
<input type="radio"/>	NEXT	
<input type="radio"/>	EDIT	

Enter the current date in year, month and day order. Press the edit button to change the date.

<input type="radio"/>	EXIT	Set Time
<input type="radio"/>	BACK	HH:MM:SS
<input type="radio"/>	NEXT	
<input type="radio"/>	EDIT	

Enter the current time in hours, minutes and seconds order. Press the edit button to change the time.

<input type="radio"/>	EXIT	Location Tag
<input type="radio"/>	BACK	Text entry
<input type="radio"/>	NEXT	
<input type="radio"/>	EDIT	

The location tag function allows the user to label the meter. The text will appear on the unique meter data display page in the meter data menu. Press the edit button to change the text.

<input type="radio"/>	EXIT	Protocol
<input type="radio"/>	BACK	None
<input type="radio"/>	NEXT	
<input type="radio"/>	EDIT	

The protocol function is not active on this meter.

<input type="radio"/>	EXIT	Set Meter
<input type="radio"/>		Press Exit for more settings
<input type="radio"/>		SAVE completes install with current settings
<input type="radio"/>		

Press SAVE to complete the commissioning process. Press EXIT if you wish to access the full commissioning menus and edit any settings.

**4.1.2 Full Commissioning Display Pages**

○ EXIT	Fast Commission
○ UP	Application
○ DOWN	User Settings
○ ENTER	Factory Settings
	Finish Commission

The complete access to all user settings are provided through the four menus listed here. A description of each menu is provided on the following pages.

**4.1.2.1 Fast Commission**

○ EXIT	<b>Fast Commission</b>
○ UP	Application
○ DOWN	User Settings
○ ENTER	Factory Settings
	Finish Commission

Fast commission is the initial commissioning process as described in section 4.1.1. It allows the user to set the following parameters.

- Set Date
- Set Time
- Enter Location Tag
- Save and Exit Commissioning

**4.1.2.2 Application**

○ EXIT	Pipe CS 6.00
○ UP	Medium: Water
○ DOWN	Operating Mode: UniDir
○ ENTER	Configuration Menu

Application allows the user to modify the following settings.

**Pipe**

Set pipe material. Options include – CS (carbon steel), CU (copper), SS (stainless steel), CPVC, HDPE, PPR and NA (not available.)

Set nominal pipe size. Options include – 6.00, 8.00, 10.00 and 12.00 inches.

Set pipe schedule. Options vary with pipe material selection.

Set inner diameter adjust. This option allows the user to modify the nominal diameter based on actual measurements.

**IMPORTANT NOTE**

***Do not attempt to adjust the nominal inner diameter unless you measured the inner diameter or calculated it based on actual measurements of the outside diameter and wall thickness of the pipe where the meter is installed.***

**4.1.2.2 Application (Continued)**

○	EXIT	Pipe CS 6.00
○	UP	Medium: Water
○	DOWN	Operating Mode: UniDir
○	ENTER	Configuration Menu

**Medium**

Set liquid type. Options include – water, ethylene glycol and propylene glycol. When selecting glycols, you will be required to enter the glycol percentage (0 – 50%).

**Operating Mode**

Set the meter to operate as a unidirectional or bidirectional flow meter.

**Configuration Menu**

Set the pulse and analog output functions.

Aux IO setup allows the user to set the pulse output time in milliseconds (ms). The user can also set the output function for the 3 pulse outputs. Options include – Volume Total, Alarm And Flow Direction.

Analog output setup allows the user to select the analog output function (Volume Rate or Off), set the voltage range (0-5V or 0-10V) for the voltage output and set the full scale value.

**4.1.2.3 User Settings**

User settings allow the user to modify the following settings.

○	EXIT	Units Menu
○	UP	Date / Time
○	DOWN	Location Tag
○	ENTER	Reset User Totals

**Units Menu**

Set flow units and multiplier. Options include – gpm (gallons/min), l/s (liters/sec), ft<sup>3</sup>/m (ft<sup>3</sup>/min), m<sup>3</sup>/h, (m<sup>3</sup>/hour). Multiplier options include – 1, 10, 100, 1k, 10k, 100k and 1M.

Set volume units and multiplier. Options include – gallons, liters, ft<sup>3</sup> and m<sup>3</sup>. Multiplier options include – 1, 10, 100, 1k, 10k, 100k and 1M.

Set velocity units. Options include –ft/s (ft/sec) and m/s (m/sec).

**Date/Time**

Use this to change the current date and time settings.

**Location Tag**

Use this to edit the location tag name shown on the meter display.

**Reset User Totals**

This option allows the user to reset the user volume total to zero.

**4.1.2.4 Factory Settings**

○	EXIT	Empty Pipe Setting
○	UP	Low Flow Cutoff Warning Settings
○	DOWN	Damping Menu
○	ENTER	Config Frequency Out

Factory settings allow the user to modify the following settings.

**Empty Pipe Setting**

Set the empty pipe alarm threshold. The value is set as a percentage from 0 to 100% with a default value of 50%. There is also an option to turn off the empty pipe alarm function.

**Low Flow Cutoff**

The low flow cutoff sets the lowest flow velocity the meter will read. Flow rates below this level will be reported as zero flow. The default setting is 0.1 ft/sec. The display will indicate the equivalent flow rate for this velocity based on the pipe size setting.

**Warning Settings**

Warning settings allows the user to adjust the high and low flow warnings and alarm. Alarms and warnings are set as a percentage of the full scale flow rate.

**Damping Menu**

Flow damping allows the user to adjust to apply filtering to the flow signal to smoothen out variations in the flow readings and analog output signal. The damping range is from 1 to 32. The default setting is 4.

**Config Frequency Out**

The config frequency out function sets the frequency value for the full scale flow rate. The range is 0 – 500Hz.

**4.1.2.5 Finish Commission**

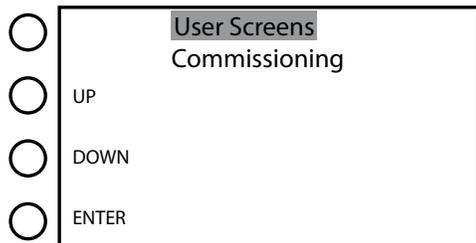
○	EXIT	Set Meter
○		Press Exit for more settings
○		SAVE completes install with current settings
○		

Finish Commission allows the user to complete the commissioning process and begin normal operation.

Press SAVE to complete the current configuration and place the meter in Run Mode.

Press EXIT if you wish to access the full commissioning menus and edit any settings.

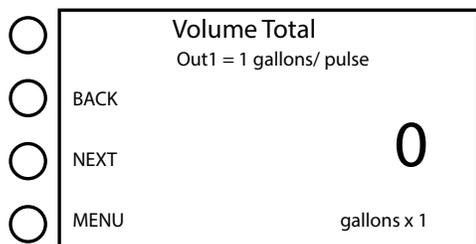
4.2 USER SCREENS



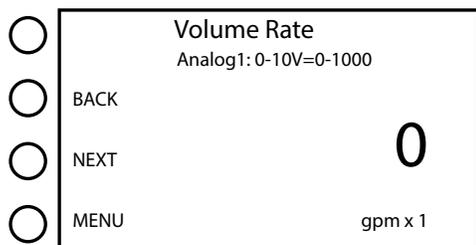
Momentarily press ENTER to access the operating mode (User Screens) display pages shown here. Next, verify that the meter is functional by stepping through the pages and confirming the flow rate and velocity are within expected norms.

When reviewing the displayed data, note the factory programmed engineering units on each display page (e.g. gallons, gpm, ft/s, etc.) and the output scaling information. Note any changes that may need to be made during commissioning.

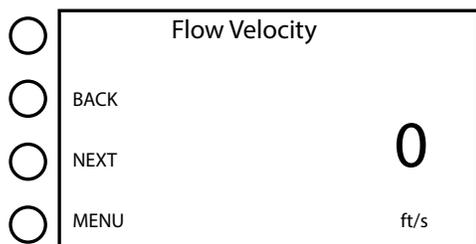
Bidirectional user screens are shown in appendix 1.



**Volume Total** is a non-resettable flow total. It can only be reset when the meter is recalibrated. It will roll over to zero when the maximum total has been accumulated. If one of the three digital outputs have been configured to totalize flow, the output and pulse scaling will be displayed on this page.



**Volume Rate** provides a continuous display of the instantaneous flow rate from the meter. Scaling for the 4-20mA and 0-5V/0-10V analog outputs will also be displayed on this page.



**Flow Velocity** provides a continuous display of instantaneous velocity from the meter.

4.2 USER SCREENS (CONTINUED)

<input type="radio"/>	EXIT	Main
<input type="radio"/>	UP	More Totals
<input type="radio"/>	DOWN	!Alarms / Warnings
<input type="radio"/>	ENTER	Diagnostics
		Meter Data

Momentarily press MENU and the following page will appear.

Use UP, DOWN and ENTER to view the other operating mode display pages shown on the following pages.

Momentarily press EXIT to return to the to the start screen.

4.2.1 More Totals

<input type="radio"/>	EXIT	YTD Volume
<input type="radio"/>	BACK	
<input type="radio"/>	NEXT	0
<input type="radio"/>	MENU	gallons

**YTD Volume** provides a year-to-date flow total. This total will become the previous year total and reset to zero at midnight on December 31st of each year.

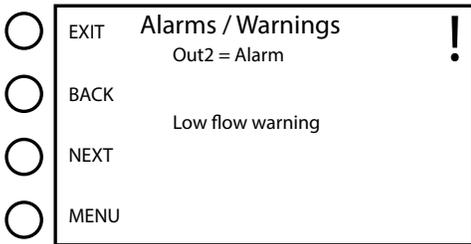
<input type="radio"/>	EXIT	Previous Year Volume
<input type="radio"/>	BACK	
<input type="radio"/>	NEXT	0
<input type="radio"/>	MENU	gallons

**Previous Year Volume** provides the flow total for the previous calendar year. This total will be replaced by the YTD Volume total at midnight on December 31st of each year.

<input type="radio"/>	EXIT	User Volume Total
<input type="radio"/>	BACK	
<input type="radio"/>	NEXT	0
<input type="radio"/>	MENU	gallons

**User Volume Total** is a totalizer that may be reset by the user. This total will be replaced by the YTD Volume total at midnight on December 31st of each year.

4.2.2 Alarms / Warnings



**Alarms / Warnings** provides the user with real time operating information. Warning messages alert the user to potential problems. Warnings are indicated by an exclamation point (!) in the upper right-hand corner of the display.

A flashing exclamation point (!) indicates an active alarm. Alarm messages occur when the meter is operating outside of normal operating conditions. The meter will not report flow when alarms are present. If one of the three digital outputs have been configured as an alarm indicator, it will be displayed on this page

**Warnings**

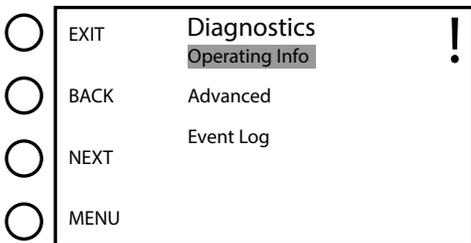
- Low Flow Warning – flow ≤ 10% of full scale
- High Flow Warning – flow ≥ 90% of full scale
- Freq. Low Flow Warning – Frequency ≤ 10% of full scale
- Reverse Flow Warning – Flow direction in pipe reversed

**Alarms**

- Low Flow Alarm – Flow ≤ low flow cutoff
- High Flow Alarm – Flow ≥ high flow limit
- Empty Pipe Alarm – Pipe not full

Please refer to Section 5.0 for more information on alarm and warning messages.

4.2.3 Diagnostics



**Diagnostics** provides the user with general operating information, advanced diagnostic data and an event log.

**Operating Info**

Operating Status – Indicates if the meter is configured for Unidirectional or Bidirectional flow.

Powered Up Since – Provides a date/time stamp for the last time power was applied to the meter.

Last Power Loss – Provides a date/time stamp of the last time power was removed from the meter.

Run Hours – A continuous, non-resettable, run-hour total.

Reset Count – A continuous, non-resettable count of microprocessor resets.

**Advanced**

ADC 1 Counts / Volts – Provides real time internal ADC counts and signal strength data.

System Outputs – Displays the current DAC and frequency output settings.

Empty Pipe – Provides the most recent threshold calculation and the alarm threshold setting.

Meter Calibration – Displays the current offset and scale settings.

Meter Voltage Threshold – Provides the most recent signal level measurement.

**4.2.3 Diagnostics (Continued)**

○ EXIT	Diagnostics	!
	Operating Info	
○ BACK	Advanced	
○ NEXT	Event Log	
○ MENU		

**Event Log**

The event log provides a date/time stamped record of the last 25 events.

Events include:

- Power Up
- Power Loss
- System Reset
- User Total Reset
- Change To Meter Configuration

**4.2.4 Meter Data**

○ EXIT	Main
○ UP	More Totals
○ DOWN	! Alarms / Warnings
	Diagnostics
○ ENTER	Meter Data

**Meter Data** provides the user with following information.

- Unique Meter Data (serial number, etc.)
- Manufacture Date
- Calibration Date
- Pipe Data
- Current Date / Time
- Firmware Versions

## SECTION 5.0 TROUBLESHOOTING

### 5.1 WARNINGS AND ALARMS

<b>Warnings</b>		
Message	Description	Solution
Warn Analog Low Flow	This message occurs when analog output value is at or below programmed threshold	User defined value, if flow rate is correct, this value can be changed via programming.
Warn Analog High Flow	This message occurs when analog output value is at or above programmed threshold	User defined value, if flow rate is correct, this value can be changed via programming.
Warn Freq. Low Flow	This message occurs when frequency output value is at or below programmed threshold	User defined value, if flow rate is correct, this value can be changed via programming
Warn Freq. High Flow	This message occurs when frequency output value is at or above programmed threshold	Field configurable threshold, if flow rate is correct, this value can be changed via programming.
Warn Low Supply Voltage	This message occurs when input power falls below minimum requirements	Check supply power.
Warn Pulse 1 Overrun	This message occurs when volume total scaling is too low	Check volume total units scaling; i.e GAL x 1,10,100.
<b>Alarms</b>		
Message	Description	Solution
Alarm Low Flow	This message occurs when the low flow cutoff of the flow meter is reached	Verify system flow rate is correct. Contact ONICON technical support for further assistance.
Alarm High Flow	This message occurs when the flow rate is over 20 ft/s	Verify system flow rate is correct. Contact ONICON technical support for further assistance.
Alarm Empty Pipe	This message occurs when the pipe is empty.	Verify pipe is empty or if there is entrained air in the system. Contact ONICON technical support for further assistance.
Alarm Reverse Flow	This message occurs when the flow meter sees reverse flow	Verify coil and electrode wiring is correct. Verify the flow meter is not installed backwards.

## 5.2 MECHANICAL INSTALLATION

Installation Troubleshooting		
Symptom	Possible Cause	Solution
Excessive vibration	Insufficient preload	Repeat preloading process as described in Section 3.2.1
Stem locking collet nut and enclosure mounting nut contact each other before flow meter has been fully inserted.	Installation hardware stack height exceeds 7"	Measure valve assembly stack height. If it is too tall, the installation kit will need to be replaced/changed.
	Flow meter is the wrong size for the pipe	Check sizes of meter and pipe. Contact ONICON technical support for further assistance.
Leak from threads at base of hot tap adapter fitting	Insufficient seal on hot tap adapter threads	Tighten hot tap adapter further. If issue persists, uninstall and reapply fresh pipe tape (on the bottom 1/3 of the hot tap adapter threads) then reinstall.
Preload nut won't turn	Preload fitting is already fully screwed down	Attempt to back off the fitting. If it moves freely, it was bottomed out. Resume installation.
System pressure forces flow meter out with stem locking collar tightened	Stem locking collar is not fully tightened	Using the correct hex tool, ensure it is properly engaging the bolt. Back the bolt out a full turn and retighten. Resume installation.
Flow meter will not install	Valve is closed, fully or partially	Check that the valve is open fully. If the stops on the valve are bent or damaged, the valve may over-or-under-rotate.
	Collet nut or preload collar are tightened on the stem.	Check that the locking collet nut and stem locking collar are both loose.
Flow meter starts to insert but stops short	Flow sensor is stuck in hot tap adapter fitting	Try rotating the flow meter (up to 90 degrees) while inserting. If issue persists, contact ONICON technical support for further assistance.

