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ONICON INCORPORATED

F-5100 Insertion
Thermal Mass Flow Meter
Installation and Operation Guide



SAFETY INFORMATION

This meter was calibrated at the factory before shipment. To ensure correct use of the meter, 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's written permission.
- ONICON 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.
- ONICON 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 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 symbols 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.

TABLE OF CONTENTS

1.0 INTRODUCTION 5
1.1 PURPOSE OF THIS GUIDE 5
1.2 TYPICAL INSERTION THERMAL MASS FLOW METER 5
1.3 STANDARD FEATURES AND SPECIFICATIONS 6
1.4 ADDITIONAL REQUIRED HARDWARE 7
1.5 ADDITIONAL HARDWARE THAT MAY BE REQUIRED 8
1.5.1 Flow Conditioners 8
1.5.2 Additional Remote Mount Cable 8
1.6 WORKING ENVIRONMENT 9
1.7 WARRANTY & SERIAL NUMBER 9

2.0 UNPACKING 10
2.1 CHECKING TO SEE THAT YOU RECEIVED EVERYTHING 10

3.0 INSTALLATION, REMOVAL AND ADJUSTMENT 11
3.1 INSTALLATION SITE SELECTION 11
3.2 MECHANICAL INSTALLATION 13
3.2.1 Installation Kits 13
3.2.2 Directions For Standard Installation (new construction) 14
3.2.3 Directions For Hot Tap Installation (pressurized system) 14
3.3 INSTALLING THE FLOW METER 15
3.3.1 Determining the Insertion Depth, Inserting the Meter and Tightening the Compression Fitting 15
3.4 REMOVING THE FLOW METER 18
3.5 ELECTRICAL INSTALLATION 19
3.5.1 Analog Output 19
3.5.2 Pulse Output 19
3.5.3 Integral Mount Wiring 20
3.5.4 Using the Pulse Isolator Module 21
3.5.5 Remote Mount Wiring 22

4.0 START-UP & COMMISSIONING FOR ONICON INSERTION THERMAL MASS FLOW METERS 23
4.1 DISPLAY 23
4.2 POWERING THE METER 23
4.3 HELPFUL HINTS FOR START-UP & COMMISSIONING 23
4.4 START-UP & COMMISSIONING 24
4.5 START-UP & COMMISSIONING WORKSHEET 25

5.0 TROUBLESHOOTING GUIDE 26

APPENDIX

A-1 REMOTE MOUNT MECHANICAL HARDWARE

A-2 USE OF THE INSERTION DEPTH GAGE

A-3 - A-5 ZERO FLOW CALIBRATION TEST

A-6 CONDITIONS OF SALE

SECTION 1.0: INTRODUCTION

We, at ONICON Incorporated, would like to thank you for purchasing our quality American made F-5100 Series Thermal Mass Flow Meter. As our valued customer, our commitment to you is to provide fast reliable service, while continuing to offer you quality products to meet your growing flow measurement needs.

1.1 PURPOSE OF THIS GUIDE

We have written this guide to provide the persons responsible for the installation, operation and maintenance of your flow meter with the product specific information they will need. This is NOT an electrical or plumbing trade manual.

WARNING

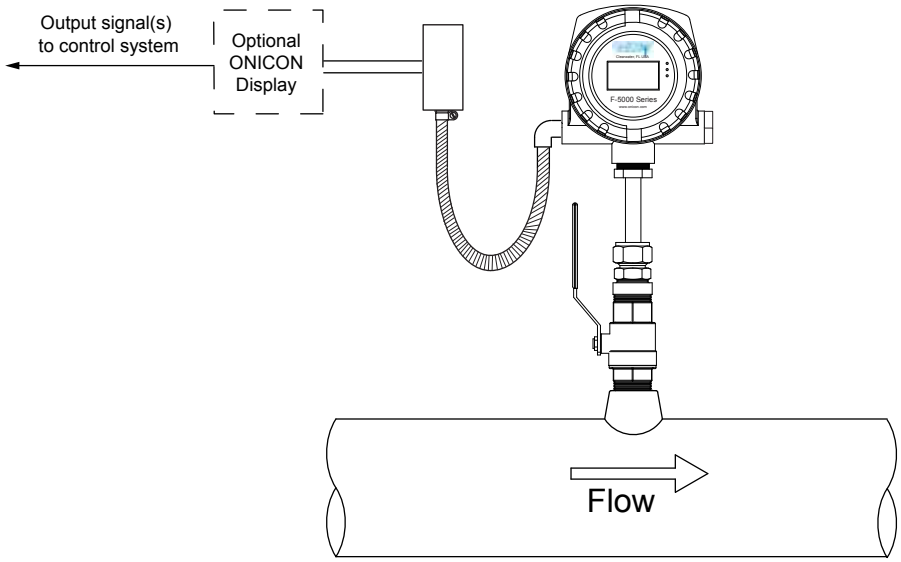
Please do not permit persons to install, operate or maintain this equipment unless they have a complete knowledge of their trade skills and are competent to work on combustible gas and/or high pressure compressed air systems, according to their individual trades. Death or permanent injury may result from accidents with these systems.

This guide is the basic reference tool for all ONICON F-5100 Thermal Mass Flow Meters.
If you have not purchased all of the options, there will be references in this manual which are not applicable to your meter(s).

1.2 TYPICAL INSERTION THERMAL MASS FLOW METER

Each ONICON thermal mass meter has a single pair of encapsulated platinum sensors that are in direct contact with the gas. The sensors consist of highly stable reference-grade platinum windings. One sensor is self-heated and serves as the flow sensor. The other acts as a reference sensor, and measures the gas temperature. Our proprietary sensor circuitry maintains a constant temperature differential between the flow sensor and the reference sensor.

As gas flows by the heated sensor (flow sensor), the molecules of flowing gas carry heat away and the sensor cools. The sensor circuitry continuously compensates for this cooling effect and maintains a constant temperature differential between the two sensors. The energy required to maintain this temperature differential is directly proportional to the mass flow. There is no need for additional temperature or pressure compensation.



1.3 STANDARD FEATURES AND SPECIFICATIONS

CALIBRATION

Every ONICON thermal mass flow meter is wet calibrated in a flow laboratory against standards that are directly traceable to N.I.S.T. A certificate of calibration accompanies every meter. Each meter is calibrated for use with a specific gas.

Standard Reference Conditions for Natural Gas:
- Fluid: Methane
- Fluid Temperature: 60°F
- Fluid Pressure: 29.92" Hg (14.70 PSIA)

Standard Reference Conditions for Air:
- Fluid: Air
- Fluid Temperature: 70° F
- Fluid Pressure: 29.92" Hg (14.70 PSIA)

Contact ONICON for reference conditions for other fluid types.

ACCURACY

Natural Gas
- ± 1.0% of reading from 500 – 7000 SFPM
- ± 2.0 % of reading from 100 – 500 SFPM

Compressed Air & other high velocity calibrations
- ± 1.0 % of reading + 0.5% of scale over a 100:1 turndown

OVERALL FLOW RANGE

5 to 35,000 SFPM

SENSING METHOD

Thermal mass flow utilizing hybrid analog/digital sensing circuitry, no moving parts

INPUT POWER

Standard: 24 VDC ±10%, 100 mA maximum current
Optional: 90-265 VAC, 50/60 Hz
Optional: 12 VDC ±10%, 200 mA maximum current

FLUID TEMPERATURE RANGE

Standard: -40° to 200° F
Optional: 200° to 300° F
Optional: 300° to 450° F
Optional: 450° to 700° F

AMBIENT TEMPERATURE RANGE

-5° to 150° F

MAXIMUM OPERATING PRESSURE

Standard: 500 PSI
Optional: 1,000 PSI

MATERIALS OF CONSTRUCTION

Wetted metal components - 316L stainless steel
Sensor head - Platinum windings encapsulated in 316L stainless steel
Electronics enclosure - Powder coat painted cast aluminum
Remote mount enclosure - Cast aluminum

ENCLOSURE RATING

Weathertight, NEMA 4 (All versions)

APPROVALS

Integral and remote mount (24 VDC only) Class 1, Division 2, Groups B, C, & D,
(ATEX: Ex nA IIC T4X)

ELECTRICAL CONNECTIONS

Enclosed terminal blocks, cable access through two ½" NPT conduit fittings

PROGRAMMING / MEMORY

Factory programmed for specific application.

Non-volatile memory retains all program parameters and totalized values in the event of power loss.

OUTPUT SIGNAL(S)

Analog output: 4-20 mA
Scalable pulse output: Active 24 VDC pulse, 500ms duration

DISPLAY

Graphic OLED display indicates:
Bar graph indicating percentage of full scale flow
Flow rate: 7 digits
Flow total: 9 digits (Total rolls over to zero when maximum count is exceeded)
Fluid temperature: 3 digits
mWatts of energy used to heat flow sensor: 4 digits
Engineering units for rate and total

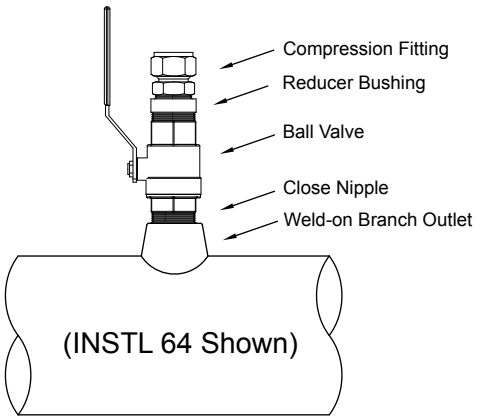
1.4 ADDITIONAL REQUIRED HARDWARE

All ONICON insertion thermal mass meters can be installed and removed via a ¾" or larger full port ball valve without disrupting flow. The terms "Standard" and "Hot Tap" refer to the installation method only.

Standard Installation: Occurs during new construction or scheduled shutdown. Once kit is installed, the flow meter can be installed or removed without disrupting flow.

Hot Tap Installation: For applications which require the access hole in the pipe to be drilled through the valve using a wet tap drilling machine while the piping system is pressurized.

NOTE: Installation hardware materials vary based on pipe material, pipe size, the maximum operating pressure and the maximum operating temperature.



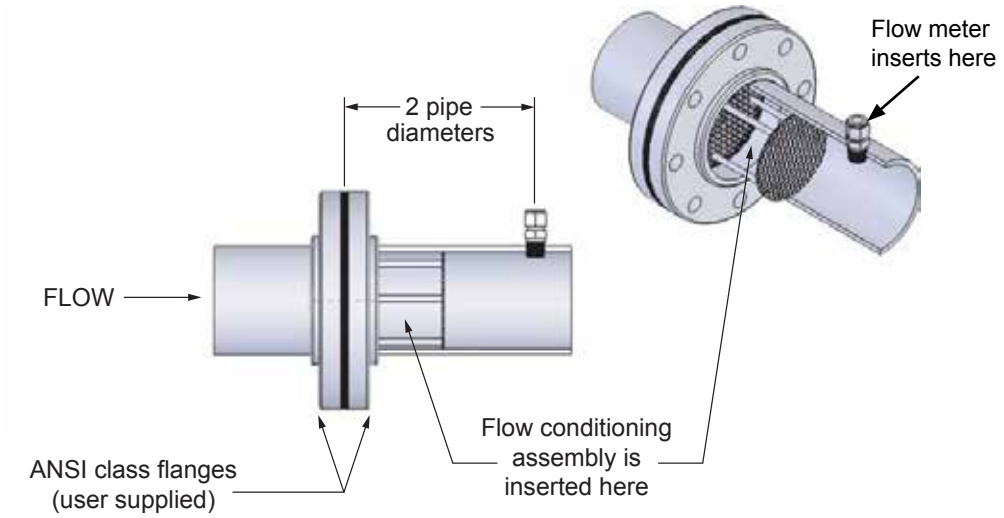
Contact ONICON when installation hardware is required for different pipe materials or when higher pressure or temperature ratings are required.

Part #	Kit Description	Items Included with Kit
INSTL64	Installation kit for 1" and larger welded carbon steel pipe Maximum operating pressure, 50 PSIG Maximum operating temperature, 200°F	¾" full port bronze ball valve ¾" galvanized close nipple ¾" to ½" brass reducer bushing ¾" carbon steel weld-on branch outlet ½" stainless steel compression fitting with PTFE ferrules
INSTL69	Stainless steel installation kit for 1" and larger welded carbon steel pipe Maximum operating pressure, 50 PSIG Maximum operating temperature, 200°F	¾" full port SS ball valve ¾" SS close nipple ¾" to ½" SS reducer bushing ¾" carbon steel weld-on branch outlet ½" stainless steel compression fitting with PTFE ferrules
INSTL70	Installation kit for 1" and larger welded carbon steel pipe Maximum operating pressure, 500 PSIG Maximum operating temperature, 140°F	¾" full port bronze ball valve ¾" galvanized close nipple (Qty 2) ¾" carbon steel weld-on branch outlet ¾" stainless steel weldment with steel cable and retaining collars ½" stainless steel compression fitting with PTFE ferrules
INSTL91	Insertion meter compression fitting w/o installation hardware, 125psig/140° F max	½" stainless steel compression fitting with PTFE ferrules
INSTL82	Stainless steel installation kit for 1" and larger welded stainless steel pipe Maximum operating pressure, 500 PSIG Maximum operating temperature, 140° F	¾" full port SS ball valve ¾" SS close nipple (Qty 2) ¾" stainless steel weld-on branch outlet ¾" stainless steel weldment with steel cable and retaining collars ½" stainless steel compression fitting with PTFE ferrules

1.5 ADDITIONAL HARDWARE THAT MAY BE REQUIRED

1.5.1 Flow Conditioners

Flow conditioners may be required when an insufficient straight run of pipe is available upstream of the proposed meter location. ONICON provides flow conditioners as an optional accessory.



ONICON flow conditioners are designed to be installed between two flanges (provided by installer) that are located a specific distance upstream of the flow meter. The use of flow conditioners significantly reduces the upstream straight pipe length requirement for flow meter. See page 12 for straight run requirements. The size of the flow conditioner must match the pipe size. Contact ONICON for Schedule 80 flow conditioners.

Part #	Description
17381	1” Flow Conditioner, Sch40
17382	1¼” Flow Conditioner, Sch 40
17383	1½” Flow Conditioner, Sch40
17384	2” Flow Conditioner, Sch40
17385	2½” Flow Conditioner, Sch40
17386	3” Flow Conditioner, Sch40
17387	4” Flow Conditioner, Sch 40
17388	6” Flow Conditioner, Sch40
17389	8” Flow Conditioner, Sch40

1.5.2 Additional Remote Mount Cable

ONICON remote mount meters are provided with 25 ft of cable. Additional cable lengths of up to 1000 ft may be added without affecting the calibration of the meter.

Part #	Description
17350	25 ft of additional mount remote cable
17351	50 ft of additional remote mount cable
17352	100 ft of additional remote mount cable

1.6 WORKING ENVIRONMENT

F-5000 series meters are designed for installation and use in typical industrial environments that are free of corrosive liquids and fumes, direct liquid exposure, heavy condensation, temperature extremes and vibrations. Do not install the meter in direct sunlight.

The operating ambient air temperature range is -5° to 150° F.

The electrical power should be relatively clean, free of high frequency noise, large voltage transients, and protected from power surges and brown outs.

1.7 WARRANTY & SERIAL NUMBER



IMPORTANT NOTE

ONICON F-5000 series flow meters are individually calibrated. Remote mount electronics enclosures and sensors must share the same serial number and must be installed together as a system. Mixing components from different meters will result in significant errors in calibration.

Warranty

ONICON provides a 2-year warranty for this product. Certain exclusions apply. Please refer to Appendix A-6, ONICON's Conditions of Sale for details.

Serial Number

The serial number of your F-5100 series flow meter is located on the nameplate attached to the top of the enclosure. This serial number will also be located on the remote sensor for remote mount meters.

SECTION 2.0: UNPACKING

ONICON Insertion Thermal Mass Flow Meters are packed and shipped in individual cartons. An optional installation hardware kit, if ordered, will be packaged with each meter. All other installation hardware and peripheral devices, including flow conditioners, will be packaged and shipped separately.

Please open all packages with care to prevent damage to their contents. Carefully inspect each item for signs of damage in transit. The flow meter stem should be straight and free of blemishes or abrasions.

All ONICON products are shipped insured unless the customer specifically requests otherwise. Please notify the shipping company and ONICON immediately if any items are damaged in transit. Save all packing material for inspection by the shipper.

2.1 CHECKING THAT YOU RECEIVED EVERYTHING

Standard Documentation

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

- Installation and Operation Guide
- Flow Meter Calibration Certificate
- Product Data Sheet
- Scaled Pulse Isolator Module

Please notify the ONICON customer service department if any of these documents are missing.

Product

- F-5100 Insertion Thermal Mass Flow Meter
- Optional Installation Hardware Kit, if ordered

SECTION 3.0: INSTALLATION, REMOVAL AND ADJUSTMENT

WARNING

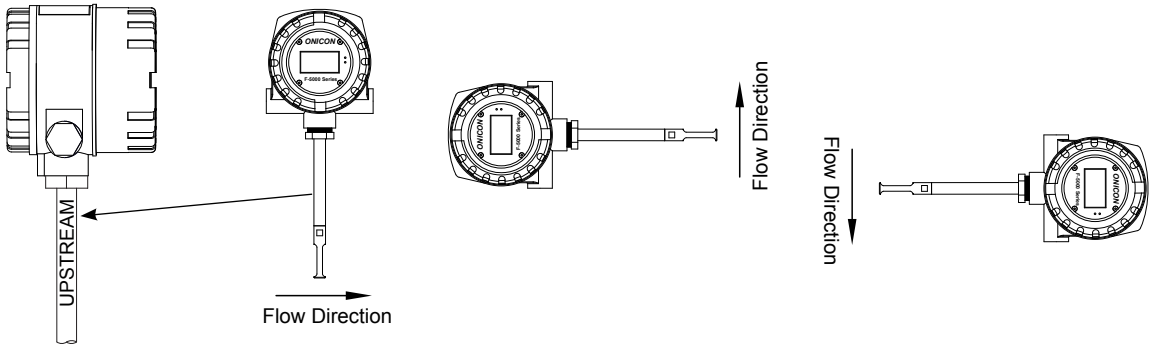
Insertion flow meters may be installed in pipes which are under high pressure or pipes filled with combustible gases. Accidents with these systems can cause serious injury or death. Only persons experienced with high pressure and/or combustible gas distribution systems and fluid metering should attempt to install, adjust, or remove the flow meter. Please read all instructions carefully before attempting to install, remove or service a flow meter.

ONICON will be happy to assist with technical recommendations and to provide guidance by phone or e-mail. On-site field engineering, installation and service are also available at an additional cost.

3.1 INSTALLATION SITE SELECTION

Install the flow meter where it will be accessible for personnel to perform necessary periodic maintenance. The clearance required for installation is typically 30-36" from the pipe wall to the nearest obstruction above the valve assembly. This clearance dimension will increase with larger diameter pipes. Refer to Section 1.6 WORKING ENVIRONMENT for additional considerations.

ONICON insertion style flow meters must also be correctly oriented in the pipe with respect to the direction of flow and the UPSTREAM mark on the stem. On meters with an integrally mounted display, this will affect the orientation of the display.



The drawings above illustrate the relationship between the integral display, the flow direction and the orientation of the meter when installed in the pipe. Contact ONICON for assistance if this relationship does not allow for viewing the display.

GENERAL PRACTICES:

1. For best results, install the flow meter in a straight run of pipe, free of bends, tees, valves, transitions and obstructions.

2. Straight run requirements vary based on the nature of the upstream obstruction. See the table on page 13 for guidelines in determining upstream straight run requirements. Depending upon specific location details, more or less straight run may be required to produce a satisfactory flow profile.

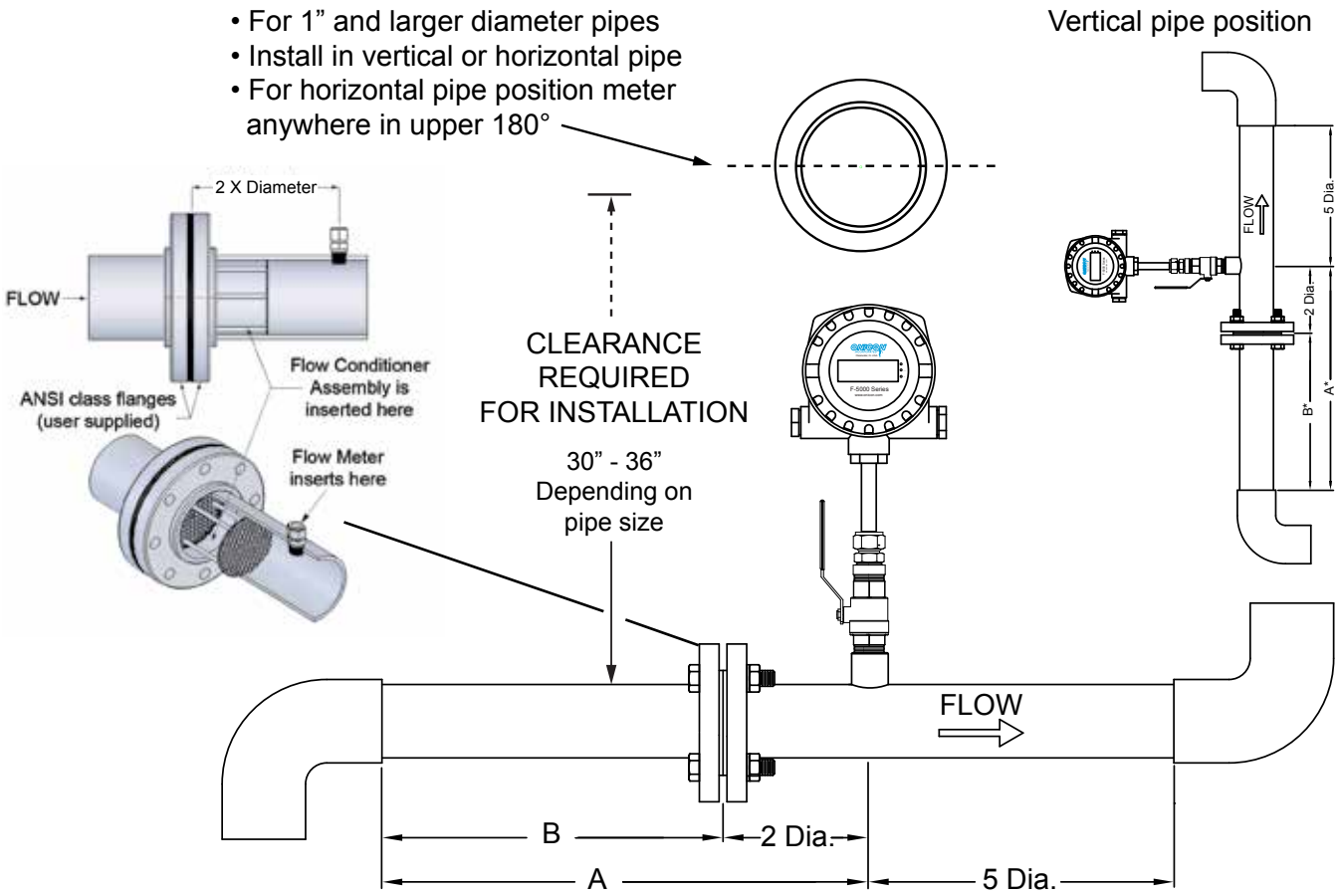
3. If there is insufficient straight run, allow 80% of the run upstream and 20% of the run downstream. If the total length of straight run is less than 75% of the recommended distance, performance may seriously degrade, and consideration should be given to installing a flow conditioner.

IMPORTANT NOTICE

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.

The flow meter must be properly installed with respect to the direction of flow. Installing the meter with the UPSTREAM label facing downstream will result in significant errors in the flow measurement.

In addition to the information provided above and on the previous page, the following diagram and table should be used as a guide to the proper location for installing the meter.



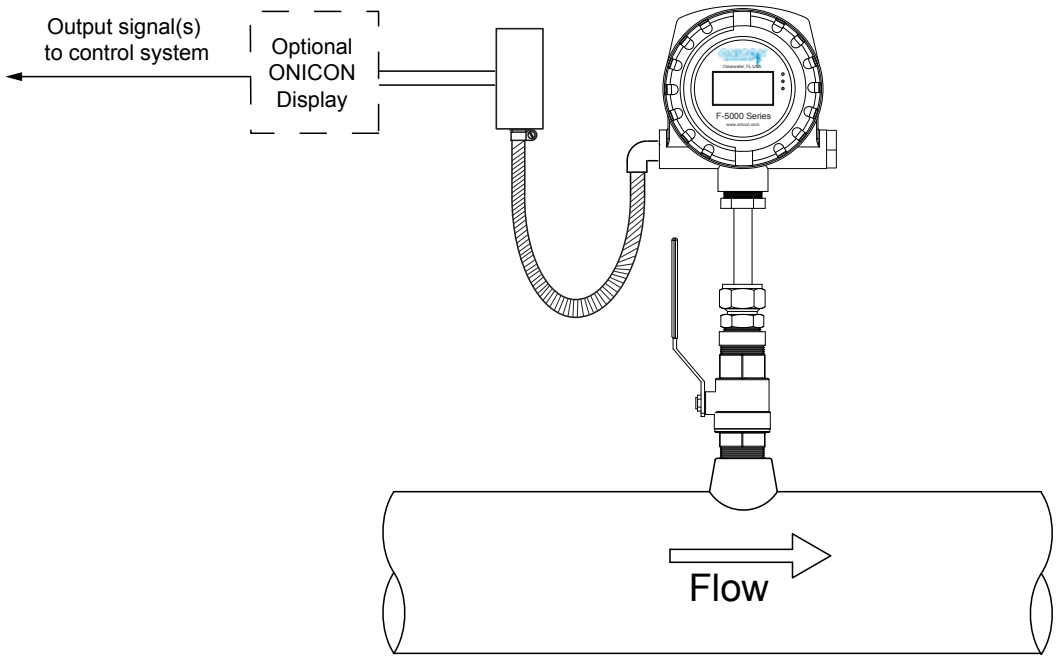
Upstream obstruction	Minimum straight run required upstream of meter location	
	(A) Without Flow Conditioner	(B) Upstream of Flow Conditioner
Single bend preceded by ≥ 9 diameters of straight pipe	15 Diameters	3 Diameters
Pipe size reduction in straight pipe run	15 Diameters	3 Diameters
Multiple bends in plane with < 9 diameters of straight pipe between them	20 Diameters	9 Diameters
Pipe size expansion in straight pipe run	20 Diameters	10 Diameters
Tees	30 Diameters	10 Diameters
Multiple bends out of plane	30 Diameters	9 Diameters
Modulating or regulating valve	40 Diameters	10 Diameters
Diaphram or roots type utility meter	40 Diameters	10 Diameters

How to Determine the Available Straight Pipe Diameters:

For each application, locate the longest straight, unobstructed section of pipe (no bends, tees, valves, other insertion probes, size transitions).The longest straight pipe run in inches divided by nominal pipe size in inches equals "diameters of straight pipe."

3.2 MECHANICAL INSTALLATION

ONICON Insertion Thermal Mass Flow Meters are designed to allow for insertion and removal, when necessary, without interrupting flow in the pipe. To take advantage of this feature, the flow meter must be installed through an isolation valve. The installation must allow for sufficient overhead clearance to fully extract the meter, and a full 5/8" 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 and at least ¾" in actual internal diameter.



CAUTION

ONICON insertion style flow meters must be installed through a valve assembly. Failure to do so negates the ability to remove the meter without disrupting flow. It will also result in an excessive amount of stem protruding from the pipe. Excessive stem lengths unnecessarily expose the meter to incidental damage.

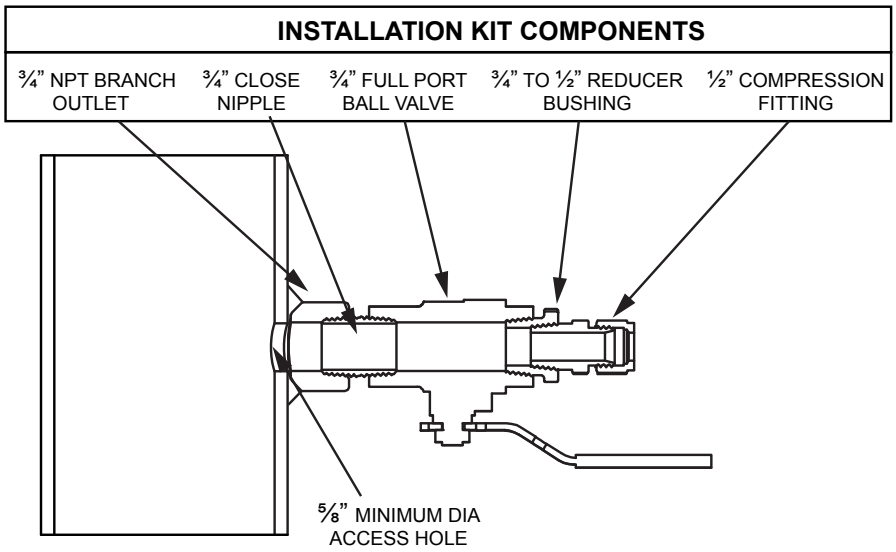
3.2.1 Installation Kits

ONICON offers installation hardware kits for commonly used pipe materials. The kits are specifically designed for ONICON flow meters, and their use is strongly recommended. The installation instructions contained in this manual assume that the pipe material is welded steel. Contact ONICON for assistance, if necessary, if the installation involves a different pipe material.

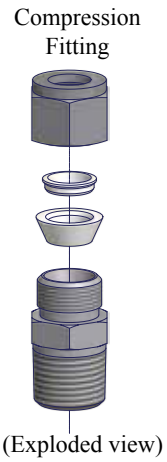
ONICON offers different types of kits based on the maximum operating pressure and the maximum fluid temperature. This information is detailed in section 1.4 of this manual. Contact ONICON for assistance before installing the kit if it does not meet the pressure or temperature requirements of your application.

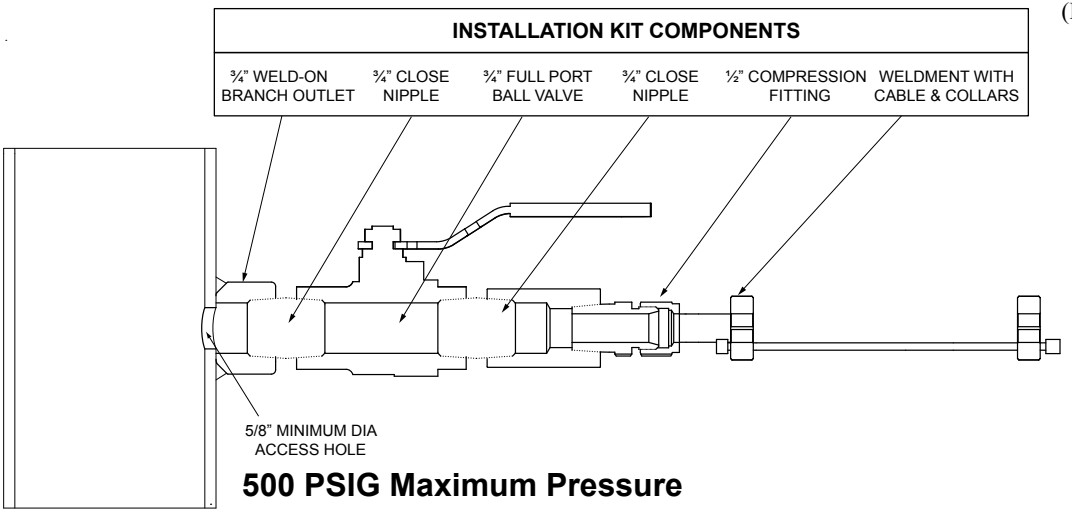
IMPORTANT NOTICE

This manual includes detailed installation instructions for welded steel pipe Contact ONICON if installation hardware instructions are needed for other pipe materials.



50 PSIG Maximum Pressure





500 PSIG Maximum Pressure

3.2.2 Directions For Standard Installation (During New Construction)

1. Identify an appropriate location for the flow meter.
2. Weld the branch outlet onto the pipe.
3. Drill a 5/8 inch (minimum) access hole, centered in the branch outlet.
4. Install the close nipple, ball valve, reducer bushing (or close nipple and weldment) and compression fitting as shown above; use a paste type thread sealant or Teflon® tape as needed.
5. Flush and pressurize the system.

3.2.3 Directions For Hot Tap Installation (A Pressurized System)

1. Identify an appropriate location for the flow meter.
2. Weld the branch outlet onto the pipe.
3. Install the close nipple and ball valve as shown below; use a paste type thread sealant or use Teflon® tape.
4. Use a hot tap drilling machine to create the 5/8" access hole.
5. Remove the drill and clear all debris from the valve.
6. Install the reducer bushing and compression fitting (or weldment and compression fitting) using paste type thread sealant or Teflon tape as needed.

3.3 INSTALLING THE FLOW METER

WARNING

SYSTEM MAY BE UNDER HIGH PRESSURE. When inserting, removing or adjusting the meter position, be sure to hold the enclosure firmly by hand before SLOWLY loosening the compression fitting. Failure to do this will allow the pressure to suddenly and rapidly force the meter from the pipe causing serious injury. The hand effort required to hold the meter will be 0.2 times the pipe pressure.

WARNING

Remove all sources of ignition (i.e. open flame, welding equipment, a lit cigarette, etc.) from the area prior to installing, removing or adjusting the flow meter when working with combustible gases.

Begin by calculating the effort that will be required to hold the meter. Establish adequate footing for this task, taking extra care when working from a ladder or platform. Use the following formula:

E=0.2 x P Where: E = effort in pounds
P = system pressure in pounds per square inch

Example: In a 50 PSI system, 10 pounds of force is required to insert the meter into the pipe.

WARNING

Do not attempt to insert the meter into a pipe pressurized to greater than 200 PSIG. For pipes pressurized above 200 PSIG isolate flow and relieve pressure in the pipe before attempting to install the meter.

3.3.1 Determining the Insertion Depth, Inserting the Meter and Tightening the Compression Fitting

WARNING

The following instructions assume that the pipe is pressurized. Whenever the ball valve is open; a firm grip must be maintained on the meter at all times until the insertion depth is set and the compression fitting is properly tightened.

The insertion depth is based on the inside diameter of the pipe into which the meter is installed. When the meter is properly installed, the flow sensor is positioned in the center of the pipe.

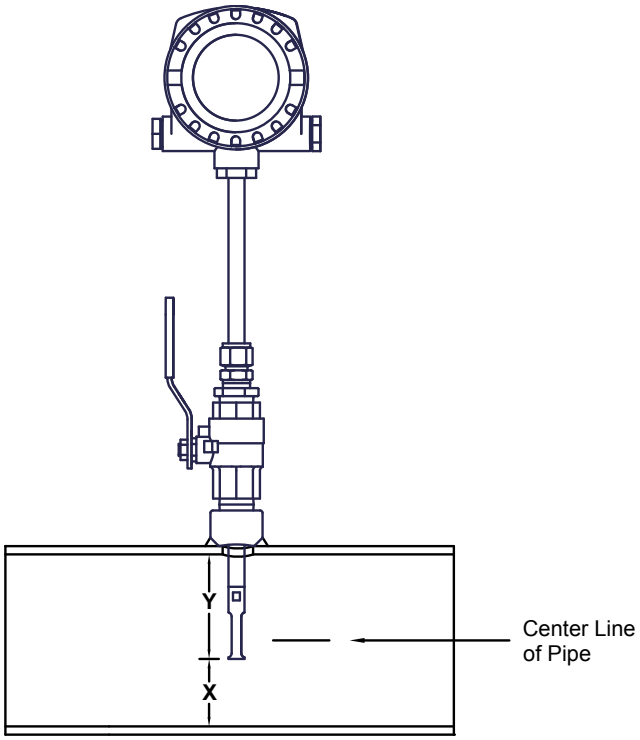
For meters installed in pipes with a nominal diameter ≤ 6 inches, the reference point for the insertion depth measurement is the inside wall of the pipe directly opposite from the insertion point. For meters installed in pipes with a nominal diameter > 6 inches, a depth gage is provided. See Appendix A-2 for instructions on the use of the insertion depth gage.

Determining the Insertion Depth

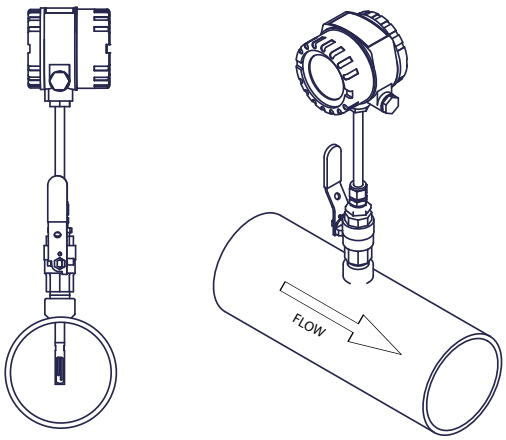
The dimension used to set the insertion depth is the “X” dimension. This dimension is printed on the laminated tag attached to the meter and can be found in the tables below.

Schedule 40 Pipe				
Nominal Diameter	O.D.	I.D.	X	Y
1”	1.315	1.049	Bottom	N/A
1.25”	1.660	1.380	Bottom	N/A
1.5”	1.900	1.610	0.20”	1.56”
2”	2.375	2.067	0.40”	1.82”
2.5”	2.875	2.469	0.60”	2.07”
3”	3.500	3.068	0.90”	2.38”
4”	4.500	4.026	1.40”	2.86”
6”	6.625	6.065	2.40”	3.95”

Schedule 80 Pipe				
Nominal Diameter	O.D.	I.D.	X	Y
1”	1.315	0.957	Bottom	N/A
1.25”	1.660	1.278	Bottom	N/A
1.5”	1.900	1.500	0.15”	1.56”
2”	2.375	1.939	0.35”	1.82”
2.5”	2.875	2.323	0.55”	2.07”
3”	3.500	2.900	0.80”	2.38”
4”	4.500	3.826	1.30”	2.86”
6”	6.625	5.761	2.25”	3.95”



Inserting the Meter



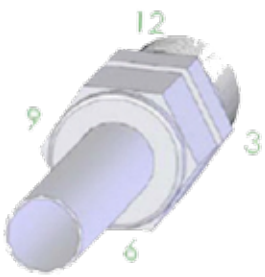
1. Insert the flow meter stem into the compression fitting.
2. Open the ball valve and carefully insert the flow meter until the end of the stem just contacts the opposite wall of the pipe.
3. Mark the position of the stem where it exits the top of the compression fitting.
4. Withdraw the stem “X” distance as measured from the top of the compression fitting. At the same time position the electronics enclosure parallel to the pipe in the correct orientation relative to the flow direction as shown. This will position the sensor with its axis in line with the flow and in the correct direction.

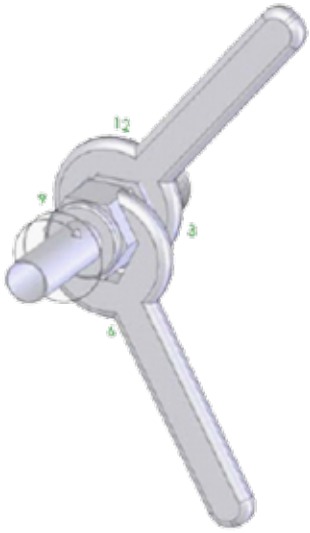
CAUTION

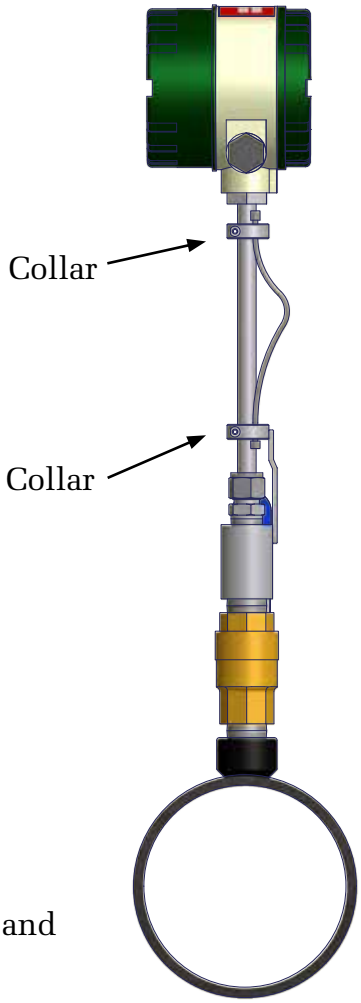
The compression fitting must be tightened as described in the following procedure. Failure to do will likely result in fluid leaks and/or permanent damage to the flow meter stem.

Tightening the Compression Fitting

1. Insert the meter as described above.
2. Tighten the nut until the stem will not turn by hand or move axially in the fitting.
3. Mark the nut at the 6 o'clock position.
4. While holding the fitting body steady, tighten the nut one and one quarter (1¼) turns to the 9 o'clock position.







For high pressure kits, position upper collar as shown and then tighten both collars to complete the installation.

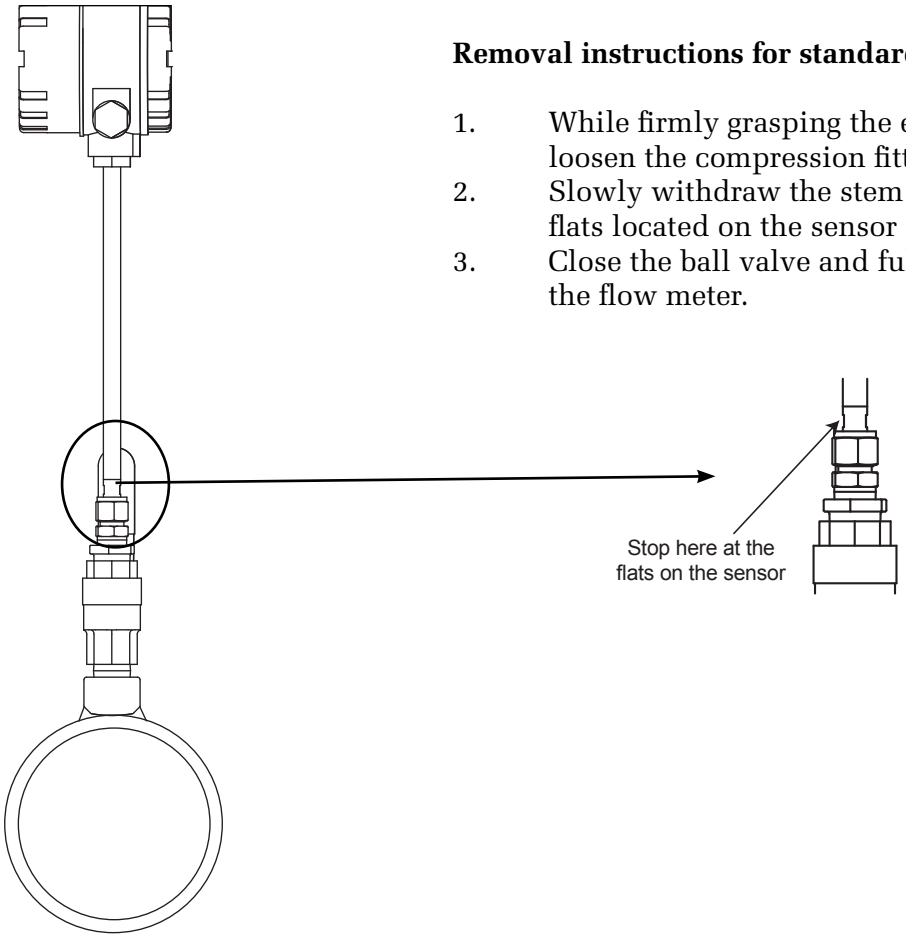
3.4 REMOVING THE FLOW METER

WARNING

SYSTEM MAY BE UNDER HIGH PRESSURE. When removing the flow meter, be sure to grasp the electronics enclosure firmly by hand before slowly loosening the compression fitting. Failure to do this will allow the pressure in the pipe to suddenly and rapidly force the meter from the pipe causing serious injury. The hand effort required to hold the meter will be 0.2 times the pipe pressure.

WARNING

Do not attempt to remove the meter from a pipe pressurized to greater than 200 PSIG. For pipes pressurized above 200 PSIG isolate flow and relieve pressure in the pipe before attempting to remove the meter.



Removal instructions for standard meter installations.

1. While firmly grasping the enclosure, loosen the compression fitting.
2. Slowly withdraw the stem until the flats located on the sensor are exposed.
3. Close the ball valve and fully withdraw the flow meter.

Removal instructions for meter installed with safety cable and retaining collars.

1. Confirm that upper retaining collar is installed at the top of the flow meter stem. If it is not reposition the collar as shown in the drawing on the preceding page. Make certain this collar is tightly connected to the stem.
2. Loosen the lower retaining collar.
3. While firmly grasping the enclosure, loosen the compression fitting.
4. Slowly withdraw the stem until safety cable is taut.
5. Close the ball valve, loosen the upper retaining collar and remove the flow meter.

3.5 ELECTRICAL INSTALLATION

The electrical installation of this product must comply with all federal, state and local building codes. Connect and re-verify all output signal and safety earth wiring connections prior to connecting power.

All connections must be made through the (2) ½' NPT cable glands located on the enclosure. To access the terminal wiring connections, remove the rear cover from the enclosure.



CAUTION

Cable glands shipped with the meter are for shipping purposes only. Remove and replace with approved glands when installing the meter.



WARNING

If the meter is being installed in a Class 1 hazardous location, the installation must comply with all appropriate electrical codes.



WARNING

The meter must be connected to a protective earth wire at the transmitter and at the sensor for remote mount meters as per electrical codes.

3.5.1 Analog Output

The F-5100 is provided with a single 4-20 mA output for instantaneous rate. This output is electrically isolated from earth, but shares common with the scaled pulse output and, on DC versions of the meter, with input power.

The output is programmed at the factory. Refer to the attached laminated tag or the certificate of calibration for information regarding the programmed full scale flow. Contact ONICON for assistance if the full scale flow rate requires reprogramming.

3.5.2 Pulse Output

The F-5100 is provided with a single scaled pulse output for totalizing . This is an active pulse output with a nominal pulse amplitude of 24 VDC (12 VDC for 12 V versions of the meter). In all versions, the pulse duration is 500ms.

This DC pulse output is electrically isolated from earth, but shares common with the analog output and, on DC versions of the meter, with input power. This output is programmed at the factory. Refer to the attached laminated tag or the certificate of calibration for information regarding the programmed pulse value.

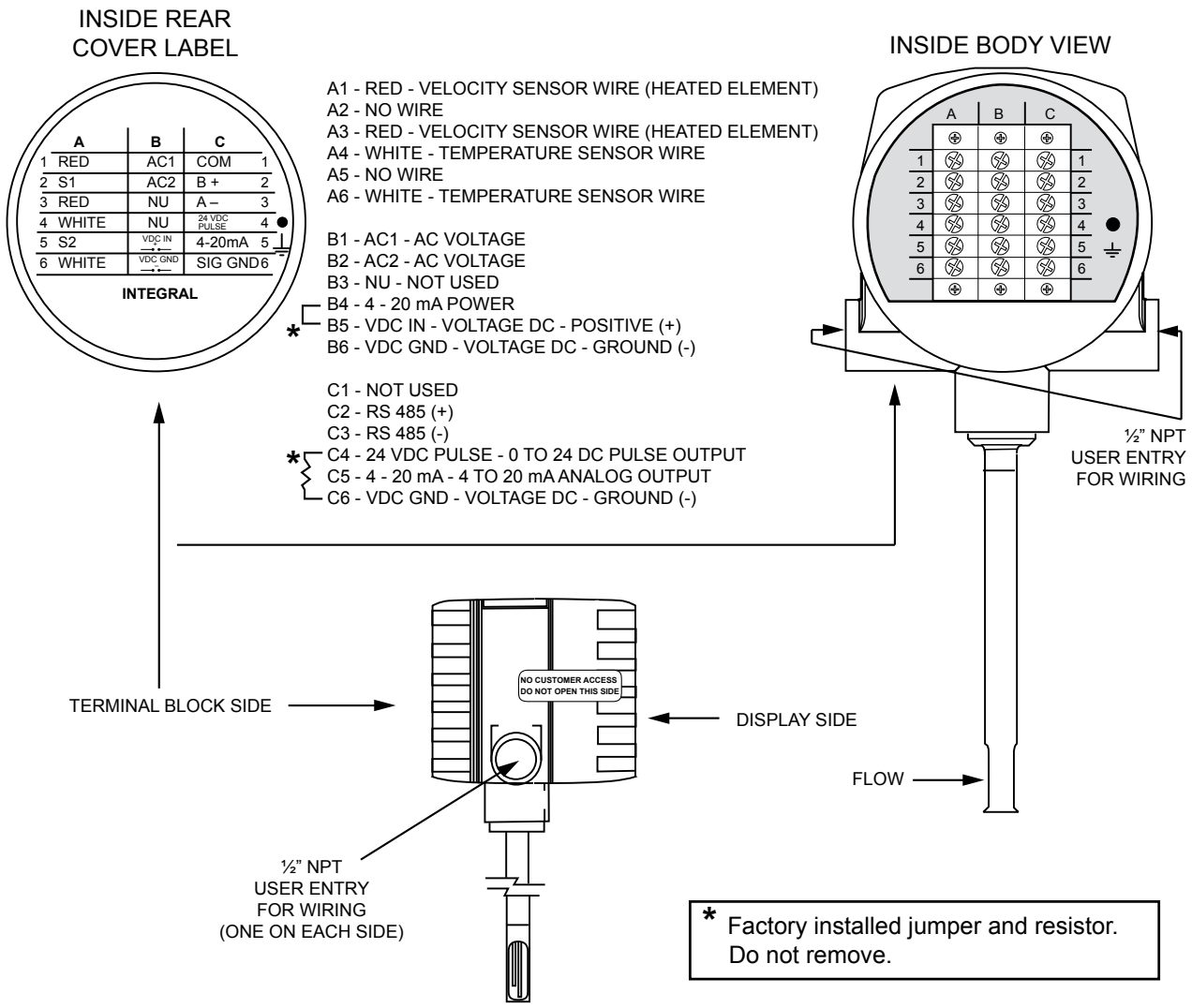
Contact ONICON for assistance if the scaled pulse output requires reprogramming.

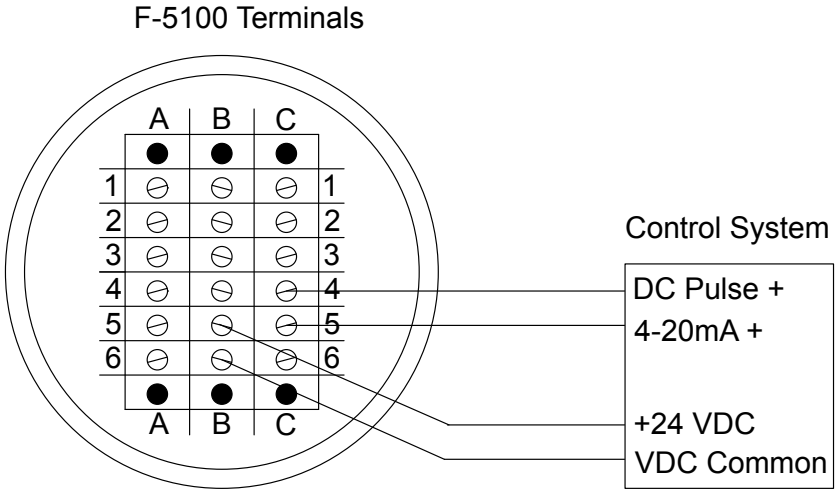


IMPORTANT NOTICE

The nominal pulse output voltage from this meter is 24 VDC. A pulse isolator module has been provided with this meter that will convert this active pulse into an isolated dry contact output. Refer to section 3.5.4 Using the Pulse Isolator Module for details.

3.5.3 Integral Mount Wiring

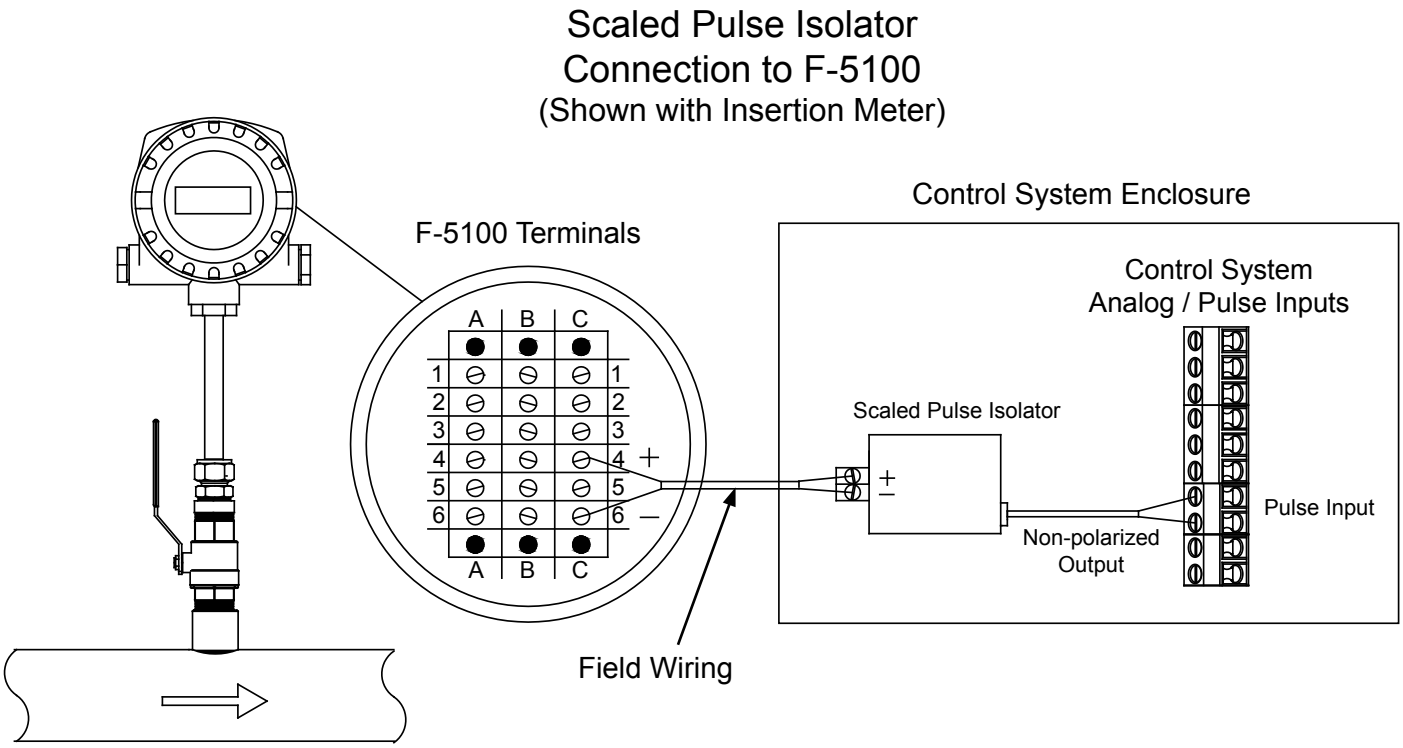




IMPORTANT NOTICE

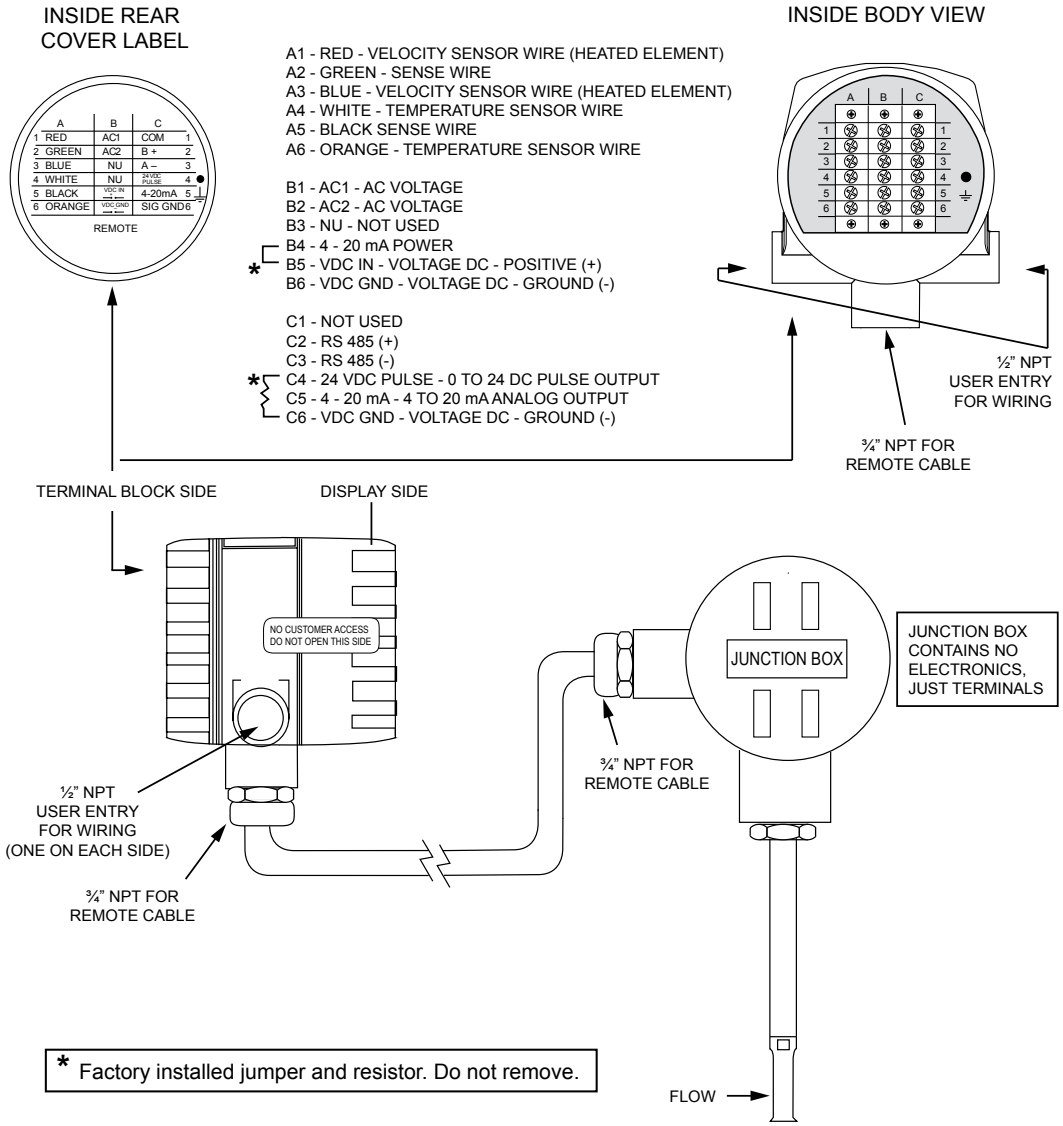
The nominal pulse output voltage from this meter is 24 VDC. A pulse isolator module has been provided with this meter that will convert this active pulse into an isolated dry contact output. Refer to section 3.5.4 Using the Pulse Isolator Module for details.

3.5.4 Using the Pulse Isolator Module

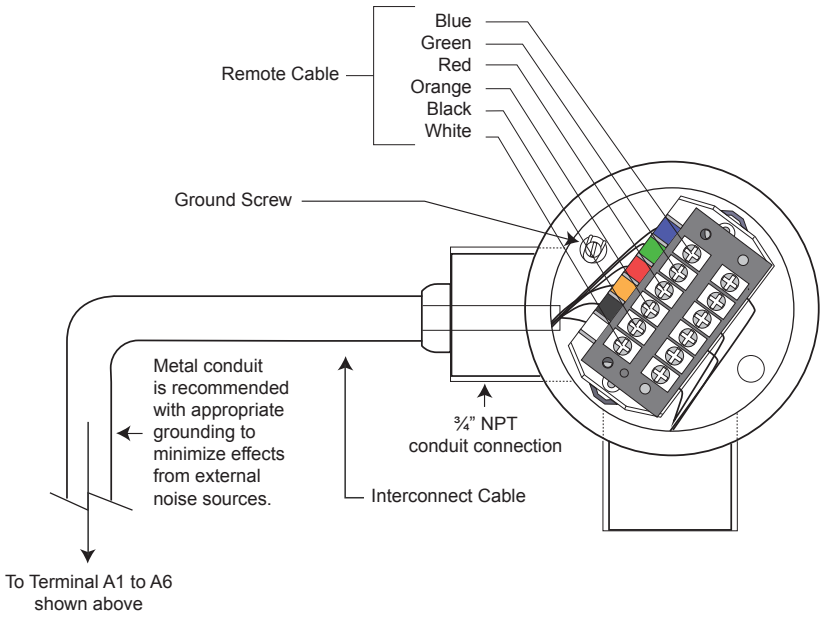


The Pluse Isolator Module is designed to be mounted inside the control system enclosure. It converts to active DC pulse output from the flow meter into an isolated dry contact closure output. Using the pulse isolator does not change the pulse rate or duration.

3.5.5 Remote Mount Wiring



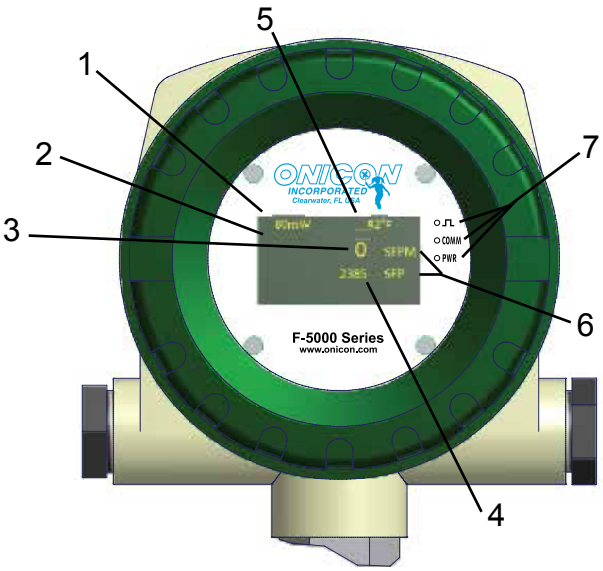
Remote Sensor Wiring Detail



SECTION 4.0: START-UP & COMMISSIONING FOR ONICON INSERTION THERMAL MASS FLOW METERS

4.1 DISPLAY

The F-5100 flow meter features a bright easy-to-read graphic LED display that displays alphanumeric and graphical data.



This display is provided with a screen saver function that extends the life of the display. The display will revert to the normal display mode whenever the proximity sensor detects movement directly in front of the meter.

Displayed Information:

1. Energy reading used to validate calibration
2. Graphical indication of percentage of full scale flow rate
3. Flow rate
4. Flow total
5. Fluid temperature
6. Engineering units associated with flow rate and total
7. LED's for Power, Serial Communications, and Pulse Output

4.2 POWERING THE METER

Upon initial power up, the meter will indicate ONICON F-5000 Series along with the current firmware version and the serial number. Two additional messages will be displayed and then the meter will advance to the normal run mode screen. If the meter is installed in a pipe with flow, the meter will begin displaying flow and temperature data. After one minute of no movement, the screen saver message will appear.

4.3 HELPFUL HINTS FOR START-UP & COMMISSIONING

A step-by-step procedure and companion worksheet are located on the next two pages. Please read all installation instructions carefully before proceeding with start-up and commissioning.

Please read these helpful hints before proceeding with the start-up and commissioning procedure on the next page.

1. ONICON flow meters are individually calibrated for a particular application. Be sure to verify the pipe size and location.
2. When measuring analog output signals, remember that current (mA) must be measured in series, while voltage is measured in parallel. If the 4-20 mA signal is already connected to a control system, you must break the connection and measure the signal in series.
3. Do not attempt to rotate the electronics enclosure on the stem.
4. Never connect power to analog or pulse output signal wires. Standard ONICON F-5100 Flow Meters are not configured from the factory as "loop powered" devices.

4.4 START-UP & COMMISSIONING

Please read the entire procedure before proceeding. A worksheet for checking off the following steps and recording measured values is located on the next page.

1.	Confirm flow meter location. Confirm adequate straight pipe run to achieve desired results.	Is the meter located in the correct location as required by the plans? Compare the actual straight pipe upstream and downstream of the meter location to recommended distances identified in this manual. If straight pipe run is very short, consult ONICON PRIOR to installing the meter to discuss the possibility of using a flow conditioner.
2.	Confirm pipe size.	Confirm that the meter is tagged for the pipe size in which it is installed. When in doubt, measure the circumference of the pipe. Pipe O.D. = (circumference / 3.14) – (insulation thickness x 2).
3.	Confirm insertion depth and orientation.	Refer to the information in section 3.3.1 of this manual to ensure that the meter is inserted to the correct depth. Also confirm that the electronics enclosure is parallel with the pipe and properly oriented with respect to the direction of flow.
4.	Confirm control system programming.	Confirm that the control system input point is properly configured for the analog range and/or scale factor identified on the calibration tag & certificate.
5.	Confirm connection to correct ONICON display	Confirm that the flow meter serial number matches the ONICON display (when ordered together).
6.	Verify wiring before connecting power.	Prior to connecting the power, verify that the wiring is correct as shown in this manual and/or on additional wiring diagrams provided with the ONICON display. If in doubt, contact ONICON for assistance before proceeding further.
7.	Confirm correct supply voltage.	Verify that the supply voltage matches the voltage listed on the meter tag.
8.	Connect power.	Wait approximately 45 seconds after power-on before proceeding further.
The following steps require flow in the pipe. Flow signal readings should be taken while holding the flow rate constant, if possible. Otherwise, take the various output readings as quickly as possible.		
9.	Measure and record analog and pulse outputs. Current Output: Scaled Output:	Refer to flow meter wiring diagram to locate the correct output terminals. Use the following formula to calculate the flow rate from the analog signal measurement: SCFM = $\frac{\text{(measured current in mA - 4)}}{16}$ X Full Scale Flow Rate Each 24VDC pulse = unit volume identified as “Scale Factor” (measure and record time interval between pulses)
10.	Compare output signals to each other and to the flow rate displayed by the control system.	Compare the flow rate calculated in step 9 to the flow rate indicated by the control system. Confirm that the control system is registering scaled output pulses as they occur. Refer to troubleshooting guide when readings are inconsistent.

4.5 START-UP & COMMISSIONING WORKSHEET

Please read all installation instructions carefully prior to proceeding with these steps. Use the following worksheet for checking off the commissioning steps and recording measured values.

STEP	TEST/MEASUREMENT	S/N:	S/N:	S/N:	S/N:
1.	Meter location:				
2.	Confirm pipe size:				
3.	Insertion depth and orientation:				
4.	Control system programming:				
5.	Match display serial number (S/N) if ordered:				
6.	Signal connections verified:				
7.	Supply voltage verified:				
8.	Connect power:				
The following steps require flow in the pipe. Flow signal readings should be taken while holding the flow rate constant, if possible. Otherwise, take the various output readings as quickly as possilbe.					
9.	Analog or pulse output(s) 4 - 20 mA signal: Scaled output interval: Calculated flow rate:	_____mA _____ _____SCFM	_____mA _____ _____SCFM	_____mA _____ _____SCFM	_____mA _____ _____SCFM
10.	Flow rate displayed by control system:	_____SCFM	_____SCFM	_____SCFM	_____SCFM

SECTION 5.0: TROUBLESHOOTING GUIDE

NOTE: Also refer to the START-UP AND COMMISSIONING GUIDE located on page 24.

REPORTED PROBLEM	POSSIBLE SOLUTIONS
No signal	• Verify that the meter is properly inserted into the pipe. • Verify that the electronics enclosure is parallel with the pipe. • Verify supply voltage. • Verify correct wiring to control system (see wiring diagram). • Verify that there is flow in the pipe. • Please contact ONICON for further assistance.
Reading is too high or low	• Verify pipe size. Contact ONICON if pipe size is different from that shown on the meter tag. • Verify that the meter is properly inserted into the pipe. • Verify that the electronics enclosure is parallel with the pipe. • Verify correct wiring to control system (see wiring diagram). • Confirm that the control system is programmed for correct flow range or pulse scale factor. • Verify that the meter cable shield is connected to earth at the control system. Lack of proper shielding can lead to excessive noise that can affect the flow reading. • Verify that the meter is connected to earth. • Check for ground loop or offset voltage: Disconnect analog signal input from control system and measure analog output directly from the flow meter. Reconnect signal input to control system and measure the analog signal again. Any difference between these readings indicates a potential ground loop or offset voltage. • Sensor may be contaminated. Remove sensor from pipe and wipe off or clean with mild detergent and water. • Meter is being used to measure flow of a different gas or gas mix than the meter was specified and calibrated for. • Please contact ONICON for further assistance.
Erratic readings	• Confirm that the meter is connected to earth and all cabling is properly shielded. • Please contact ONICON for further assistance.

APPENDIX

A-1 REMOTE MOUNT MECHANICAL HARDWARE

A-2 USE OF THE INSERTION DEPTH GAGE

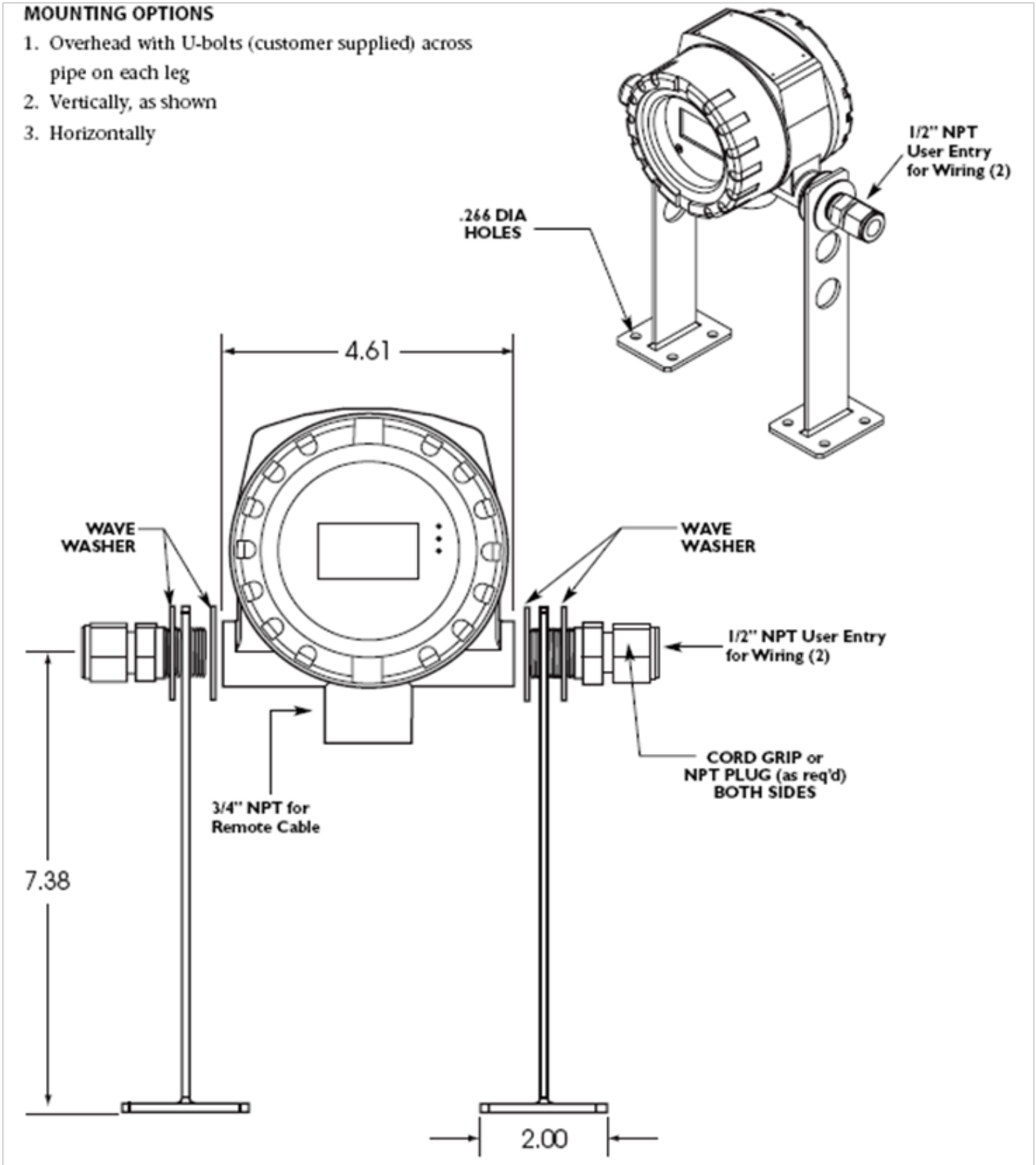
A-3/A-5 ZERO FLOW CALIBRATION TEST

A-6 CONDITIONS OF SALE

REMOTE MOUNT MECHANICAL HARDWARE

MOUNTING OPTIONS

1. Overhead with U-bolts (customer supplied) across pipe on each leg
2. Vertically, as shown
3. Horizontally

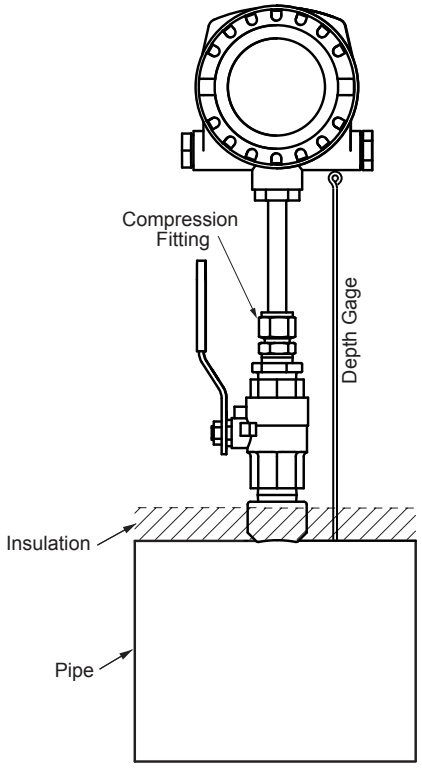


SETTING INSERTION DEPTH WITH GAGE

WARNING

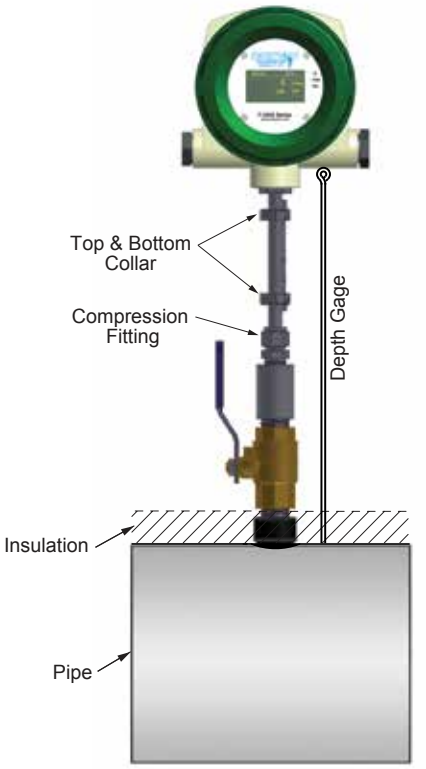
SYSTEM MAY BE UNDER HIGH PRESSURE. When inserting, removing or adjusting the meter position, be sure to hold the enclosure firmly by hand before SLOWLY loosening the compression fitting. Failure to do this will allow the pressure to suddenly and rapidly force the meter from the pipe causing serious injury. The hand effort required to hold the meter will be 0.2 times the pipe pressure.

LOW PRESSURE



1) Pierce insulation (if present) until gage tip touches pipe.
2) Insert flow meter until bottom of electronics case touches top of depth gage.
3) Confirm upstream mark is aligned with flow and hand tighten compression fitting. Refer to instructions below to tighten fitting.

HIGH PRESSURE



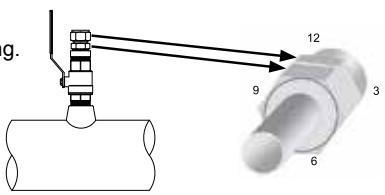
1) Pierce insulation (if present) until gage tip touches pipe.
2) Insert flow meter until bottom of electronics case touches top of depth gage.
3) Confirm upstream mark is aligned with flow and hand tighten compression fitting. Refer to tightening instructions below.
4) Once the compression fitting is tight, position top and bottom locking collars as shown. Tighten both to complete installation.

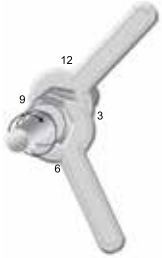
CAUTION

The compression fitting must be tightened as described in the following procedure. Failure to do will likely result in fluid leaks and/or permanent damage to the flow meter stem.

TIGHTENING THE COMPRESSION FITTING

1) Insert the meter as described above.
2) Tighten the nut until the stem will not turn by hand or move axially in the fitting.
3) Mark the nut at the 6 o'clock position.
4) While holding the fitting body steady, tighten the nut one and one quarter (1¼) turns to the 9 o'clock position.





ZERO FLOW CALIBRATION TEST

The zero flow calibration test provides a simple, yet effective, method for periodic field validation of the factory calibration. Prior to shipment to the customer, each ONICON F-5000 series flow meter undergoes a multipoint calibration. In this process, signal levels are recorded at a series of known velocities over the specified operating range. The last data point taken in this process is taken at zero flow (zero velocity). The value recorded at zero flow is part of the calibration record provided with the meter and is stamped on the meter nameplate. By utilizing the mW output displayed by the meter, it is possible to duplicate the factory no flow condition (zero velocity) test in the field.

Successfully duplicating this test provides field validation of the current calibration. A successful zero flow test confirms that the flow sensor circuitry operating characteristics have not changed and validates that the zero velocity data point has not shifted or drifted. It also verifies that the sensor assembly is clean and undamaged and does not require visual inspection. It essentially provides a means to validate that the meter is operating properly and can be used as part of a quality assurance/ preventative maintenance program or in lieu of scheduled annual factory calibrations.



IMPORTANT NOTE

The original factory zero flow calibration was performed with a vertically oriented meter installed through a valve located on the top of a horizontal test pipe. If the meter is installed in a different orientation the output at zero flow will be slightly different.

Depending on the orientation, meters inserted horizontally into a pipe may increase the reading by as much as 5-6 mW.

There are 3 ways to validate the meter's zero flow calibration.



WARNING

SYSTEM MAY BE UNDER HIGH PRESSURE. When removing the flow meter, be sure to grasp the electronics enclosure firmly by hand before slowly loosening the compression fitting. Failure to do this will allow the pressure in the pipe to suddenly and rapidly force the meter from the pipe causing serious injury. The hand effort required to hold the meter will be 0.2 times the pipe pressure.



WARNING

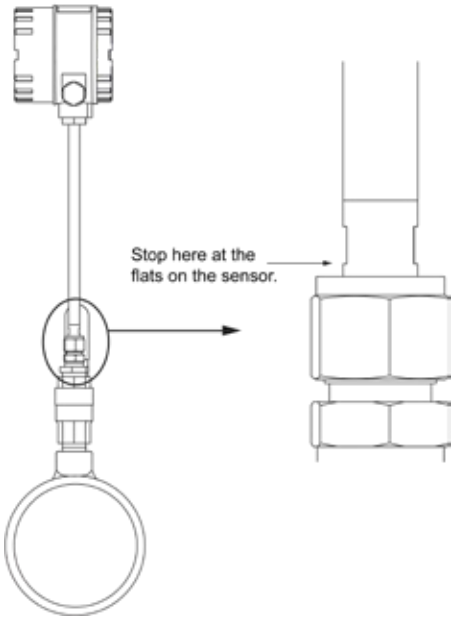
Do not attempt to remove the meter from a pipe pressurized to greater than 250 PSIG. For pipes pressurized above 250 PSIG isolate flow and relieve pressure in the pipe before attempting to remove the meter.

Method 1

1. Close valves in the process supply line to stop all flow in the pipe where the meter is located.
2. Wait up to 2 – 3 minutes to allow the meter reading to stabilize at zero and note the mW reading on the display.
3. Compare the reading to that stamped on the nameplate. The two readings should agree within ± 5mW.

Method 2 (Used when it is not possible to stop flow in the pipe.)

1. While firmly grasping the enclosure, loosen the compression fitting at the top of the ball valve.
2. Slowly withdraw the stem until the bottom of the flats located on the sensor is just exposed.
3. Re-tighten the compression fitting to ½ turn beyond hand tight.
4. Carefully close the ball valve.
5. Wait up to 2 – 3 minutes to allow the meter reading to stabilize at zero and note the mW reading on the display.
6. Compare the reading to that stamped on the nameplate. The two readings should agree within ± 5mW.
7. At the conclusion of the test, re-install the meter as per the instruction manual.



Method 3 (Ambient Pressure Air Calibration Test)

1. While firmly grasping the enclosure, loosen the compression fitting at the top of the ball valve.
2. Slowly withdraw the stem until the flats located on the sensor are exposed.
3. Carefully close the ball valve and fully withdraw the flow meter.
4. Place the flow sensor in to an empty water bottle.
5. Wait up to 2 – 3 minutes to allow the meter reading to stabilize at zero and note the mW reading on the display.
6. Compare the reading to the zero flow air calibration shown on the laminated tag attached to the meter. The two readings should agree within ± 5mW.
7. At the conclusion of the test, re-install the meter as per the instruction manual.

IMPORTANT NOTE

The ambient pressure air calibration test can be used to validate the meter calibration independent of the process fluid. As such, this test can be a useful diagnostic tool.

Interpreting Test Results

Zero flow calibration test readings that are within ± 5mW of the original calibration value indicate that the meter calibration is still valid.

Zero flow calibration test readings that are within ± 10mW of the original calibration value indicate that the meter calibration is still valid, but the test results were likely influenced by external factors. These include any or all of the following:

1. Sensor orientation (installed horizontally).
2. Dirt or debris is coating all or part of the sensor assembly.
3. Process fluid composition different from the fluid used during calibration. (Use ambient air calibration test to confirm.)
4. Residual flow readings during test due to leaking valves or sensor movement. (Repeat test using alternate method.)

Cleaning the Sensor Assembly

Note, in some cases, contamination of the sensor is the only cause of the additional heat transfer during the "no flow" test. Remove the meter, and clean the sensor (use an appropriate non-corrosive solvent to remove the build-up). A soft brush can be used to gently clean the sensing surface, using caution to avoid damaging the sensor elements. Once clean, re-install the meter as per the instruction manual.

Contact ONICON Service for assistance if the mW readings differ by more than ± 10mW.

CLIMATE ACTION RESERVE LANDFILL PROJECT PROTOCOL VER. 4.0 JUNE 29, 2011

ONICON's zero flow calibration test complies with the requirements of section 6.2 for field checking the flow meter for calibration accuracy. Percent drift can be determined by multiplying the mW change from factory value (see 2) by 1.0% (i.e. each mW change equals 1% drift).

The Climate Action Reserve is a national offsets program working to ensure integrity, transparency and financial value in the U.S. carbon market. It does this by establishing regulatory-quality standards for the development, quantification and verification of greenhouse gas (GHG) emissions reduction projects in North America.

CONDITIONS OF SALE

1. ACCEPTANCE: The following Conditions of Sale apply to all sales of ONICON's products. These provisions shall apply even if ONICON fails to object to provisions appearing on, incorporated by, referenced in, or attached to Buyer's purchase order form. Buyer's acceptance of delivery of ONICON's products constitutes its acceptance of these Conditions of Sale.

2. DELIVERY AND TITLE: All product shipments are F.O.B. shipping point and title passes to the Buyer at the time ONICON delivers the merchandise to the carrier. Risk of loss or damage to the product passes to the Buyer at the time ONICON delivers the product to the carrier. The Buyer immediately upon receipt should inspect all shipments, and should there be any evidence of damage or loss in transit, Buyer must file claims or tracers upon carrier. ONICON will assist in tracing shipments upon request.

3. LIMITED WARRANTY: ONICON warrants that for a period of two (2) year following the date of original shipment of an ONICON product: (i) the product will conform to ONICON's standard written specifications applicable to such product in effect on the date of Buyer's order, or as modified by ONICON's quotation or Buyer's purchase order accepted by ONICON, (ii) the product will be free from defects in workmanship, and (iii) that ONICON has title to the product prior to shipment to the Buyer; provided, however, that the warranties provided herein shall be void and may not apply in the event Buyer misuses or damages a product, including, but not limited to, any use by the Buyer of a product for an application other than one of a type approved by ONICON. ONICON's sole liability and Buyer's sole remedy for any breach of the foregoing warranty is for ONICON to repair or replace, at ONICON's option, any defective product that is returned to ONICON during the warranty period. EXCEPT AS MAY BE SPECIFICALLY AGREED BY ONICON IN WRITING IN RELATION TO EACH SALE, NO OTHER WARRANTIES SHALL APPLY, WHETHER EXPRESSED, IMPLIED OR STATUTORY, AND THERE SHALL BE NO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

4. REMEDIES: ONICON's OBLIGATION UNDER THE FOREGOING WARRANTIES IS LIMITED SOLELY TO REPAIR OR REPLACEMENT, AT ONICON's OPTION, OF DEFECTIVE OR NONCONFORMING PRODUCTS. ONICON SHALL NOT BE LIABLE FOR CONSEQUENTIAL, INDIRECT, PUNITIVE, INCIDENTAL, OR SPECIAL DAMAGES WHETHER FOUND ON CONTRACT, TORT OR ANY OTHER THEORY OF LAW. No products shall be returned to ONICON without its prior consent and transportation and insurance costs shall be prepaid. Any repair or replacement of ONICON's products under the foregoing warranty will be at no charge to the Buyer provided such repair is done at the ONICON factory or authorized service center. ONICON products that are repaired or replaced under this warranty will be returned to Buyer via the same method of shipment use to return the product to ONICON. Repair or replacement of ONICON products is conditioned upon ONICON's acknowledgement of any alleged defect or nonconformance during the warranty period and issuance of a Return Authorization number. All product returns must reference the Return Authorization number on the outside of the shipping carton and on any paperwork referencing the return.

5. PRICES AND PAYMENT TERMS: The prices set forth in the most recent quote or acknowledgement as applicable, supersede all previous prices or quotations. All quotations are subject to change or withdrawal without notice except as may be specifically noted on the face of the quotation. The prices shown do not include sales, excise or government charges payable by ONICON to Federal, State, or local authority. Any such tax or charge now or hereafter imposed upon the sale or shipment of the products under this contract will be added to the purchase price. Buyer agrees to reimburse ONICON for such tax or charge or provide ONICON with an acceptable exemption certificate. Payment of invoices will be due 30 days from the date of shipment of the products contained therein. In the event that payment of an invoice is not received by the invoice due date, ONICON will assess a late fee not to exceed 1.5% per month or 18% per year, or the maximum allowableby law whichever is lower.

6. CANCELLATION: Buyer may cancel its order, or any part of it, by sending written notice of cancellation to ONICON and paying a reasonable cancellation fee as determined by ONICON. The reasonable cancellation fee will reflect, among other factors, the expenses already incurred and commitments made by ONICON, sales and administrative costs and profit as determined by ONICON. If Buyer received a reduced price based on the quantity of products ordered, but has not purchased the applicable quantity at the time of cancellation, Buyer will pay the price it would have paid had ONICON's sale price been based on the quantity actually purchased.

7. CHANGES: If Buyer makes any changes in its drawings, designs, or specifications applicable in any contract with ONICON that cause an increase or decrease in the cost of performance of the contract, or if such changes result in rework or obsolescence, an equitable adjustment shall be made to the contract. Such changes are subject to ONICON's prior written consent.

8. EXCUSABLE DELAY: ONICON shall under no circumstance be responsible for failure to fill any order or orders when due to: fires, floods, riots, strikes, freight embargoes or transportation delays, shortage of labor, inability to secure fuel, material supplies, or power at current price or on account of shortages thereof, acts of God or of the public enemy, any existing or future laws or acts of the Federal or State Government (including specifically, but not exclusively, and orders, rules or regulations issued by any official or agency of any such government) affecting the conduct of ONICON's business with which ONICON in its judgment and discretion deems it advisable to comply as a legal or patriotic duty, or due to any cause beyond ONICON's reasonable control.

9. PATENTS: ONICON shall defend all suits or proceedings brought against Buyer or its customers arising from claimed infringements of any patent, trademark, service mark or copyright for any product furnished by ONICON and shall indemnify it against all costs, fees, and damages on the condition Buyer promptly notifies ONICON in writing and provides information and assistance to enable ONICON to conduct the defense, provided that ONICON shall have no such obligation in case of infringement resulting from ONICON's conformance to special requirements of Buyer. If ONICON is not able to settle any such suit or proceeding on acceptable terms, ONICON may, at its option, require return of the infringing product and refund the purchase price to Buyer less a reasonable allowance for depreciation or use.

10. FAIR LABOR STANDARDS ACT: ONICON represents that all products delivered under this contract are furnished in accordance with the applicable provisions of the Fair Labor Standards Act as amended.

11. APPLICABLE LAW: This document and any resulting contract shall be governed by and construed in accordance with the laws of the State of Florida. The courts of the State of Florida and the federal courts located in Florida shall have jurisdiction and venue with respect to litigation to this contract. In the event of litigation, the prevailing party shall be entitled to recover attorney's fees and costs from the non-prevailing party, including appellate attorney's fees.

12. MODIFICATIONS: These Conditions of Sale along with the prices, quantities, delivery schedules and other provisions and instructions in applicable quotations by ONICON or Buyer's purchase orders accepted by ONICON shall constitute the entire agreement between ONICON and Buyer pertaining to any resulting contract. They can be modified only in writing.