TIENet™ 360 LaserFlow™ Velocity Sensor

Installation and Operation Guide

TELEDYNE ISCO
Everywhereyoulook™

Part #69-4363-043

Revision A, March 2013

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If the problem persists, call or e-mail the Teledyne Isco Technical Service Department for assistance. Simple difficulties can often be diagnosed over the phone.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by the Customer Service Department, including the use of the **Return Authorization Number** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

Contact Information

Customer Service

Phone: (800) 228-4373 (USA, Canada, Mexico)

(402) 464-0231 (Outside North America)

Fax: (402) 465-3022

Email: IscoCSR@teledyne.com

Technical Support

Phone: Toll Free (866) 298-6174 (Samplers and Flow Meters)

Toll Free (800) 775-2965 (Syringe Pumps and Liquid Chromatography)

Email: IscoService@teledyne.com

Return equipment to: 4700 Superior Street, Lincoln, NE 68504-1398

Other Correspondence

Mail to: P.O. Box 82531, Lincoln, NE 68501-2531

Email: IscoInfo@teledyne.com

Revised September 2012

General Warnings

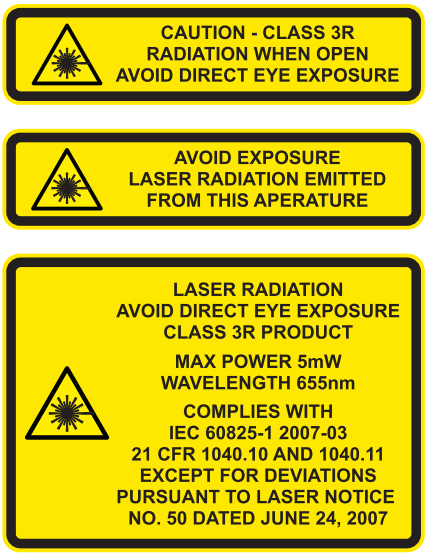
⚠ WARNING

Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Wavelength: 655 nm

Maximum Power: 5 mW

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed of the following general warnings:



⚠ WARNING

Avoid hazardous practices! If you use this instrument in any way not specified in this manual, the protection provided by the instrument may be impaired.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

⚠ CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

⚠ WARNING

Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

⚠ DANGER

DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.

Hazard Symbols

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
Advertencias y Precauciones	
	Esta señal le advierte sobre la importancia de las instrucciones del manual que acompañan a este producto.
	Esta señal alerta sobre la presencia de alto voltaje en el interior del producto.

TIENet™ 360 LaserFlow™ Velocity Sensor

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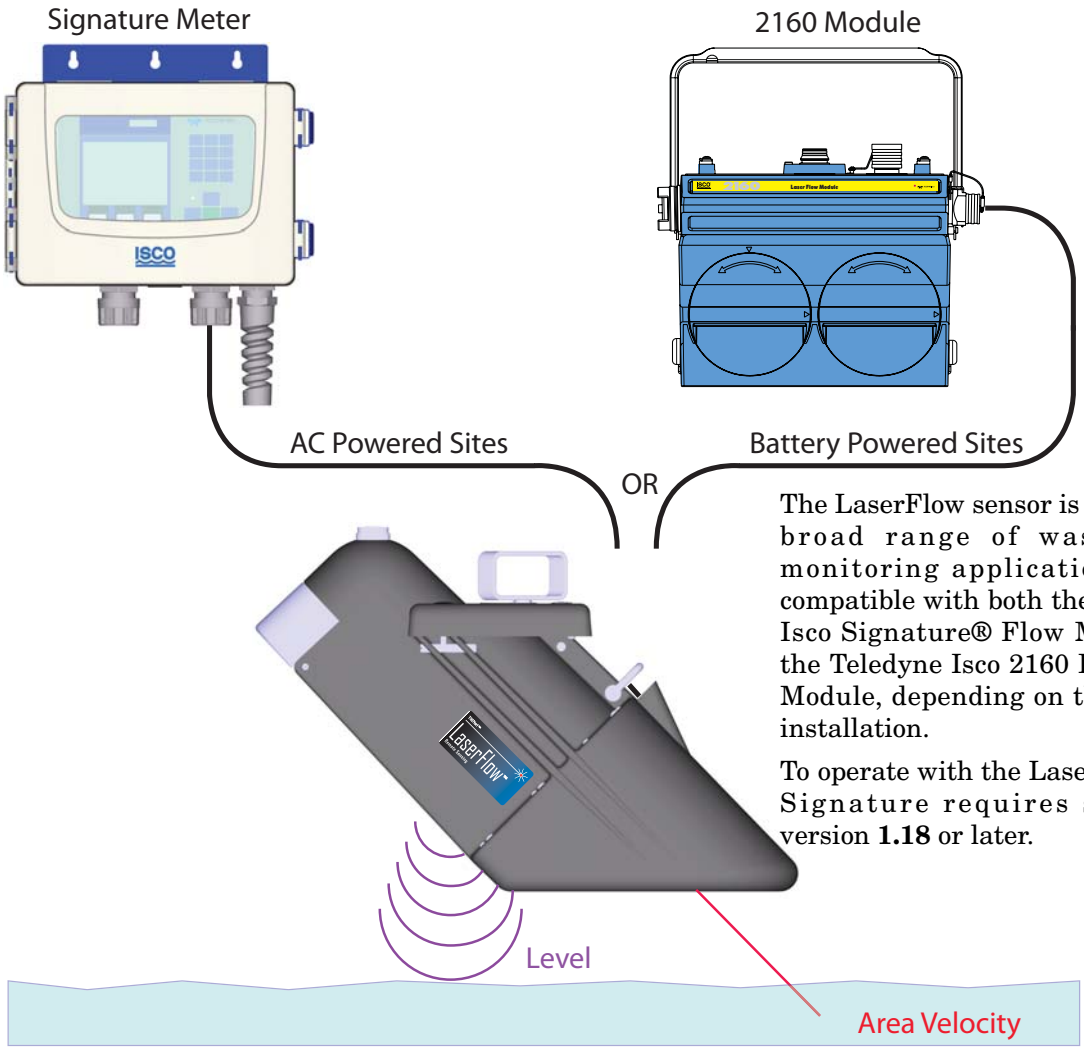
TIENet™ 360 LaserFlow™ Velocity Sensor

Section 1 Introduction

1.1 Description

The TIENet 360 LaserFlow sensor is an Area Velocity flow measurement device that remotely measures flow in open channels with non-contact Laser Doppler Velocity Sensing and non-contact Ultrasonic Level Sensing technologies. The sensor uses advanced technology to measure velocity with a laser beam at single or multiple points below the surface of the wastewater stream.



The LaserFlow sensor is ideal for a broad range of wastewater monitoring applications. It is compatible with both the Teledyne Isco Signature® Flow Meter and the Teledyne Isco 2160 LaserFlow Module, depending on the type of installation.

To operate with the LaserFlow, the Signature requires software version **1.18** or later.

Figure 1-1 Basic LaserFlow system (showing both AC and battery-powered options)

1.2 Design

The LaserFlow sensor consists of a housing with two measurement technologies working together.

1.2.1 Measurement Technology

The **laser velocimeter** has a laser diode that serves as both transmitter and receiver of a laser light beam. The Doppler-shifted signal frequency is used to determine flow stream velocity.

The **ultrasonic level transducer** determines the stream's level by emitting an ultrasonic pulse and measuring the time it takes for the echo to return from the stream's surface. The transducer is both pulse transmitter and echo receiver.

1.2.2 Cabling

The LaserFlow sensor is available with a 5m, 10m, 15m, or 23m cable. For greater distances, external connection via conduit, and connection of additional TIENet devices, the TIENet Expansion Box is available. Bulk TIENet cable may also be used for greater distances.

1.3 Operation

The **laser velocimeter** uses a laser beam to generate a source frequency light, which is focused at points below the surface of the flow stream. The light is scattered back to the laser. The returned light is frequency shifted due to the Doppler effect and the motion of the flow. The lens that focused the laser light below the surface of the flow stream now focuses the returned light back into the laser. The source light and shifted light frequencies are mixed to determine a Doppler shift, which is then used to calculate flow stream velocity.

The LaserFlow is able to move the laser beam transverse to the flow in order to obtain readings at multiple points in the flow, with automatic compensation to maintain precise focus at all times.

The **ultrasonic level transducer** emits multiple ultrasonic pulses per second. Between pulses, the transducer switches from transmitter to receiver. When the transducer receives the echo from the water's surface, the sound energy is converted into an electrical signal. The signal is then amplified and processed by the flow meter into an "echo-received" signal. The time between the transmitted pulse and the echo-received signal is proportional to the distance between the transducer and the liquid surface, which is then translated into a level reading. Because the speed of the pulse through the air varies with temperature, compensation is built-in. A temperature sensor inside the LaserFlow measures ambient temperature. The microprocessor program automatically compensates for speed-of-sound changes caused by air-temperature changes.

The LaserFlow operates with no deadband from the measurement point for both level and velocity measurement.

1.4 Optional Submerged Functionality

During submerged conditions, flow measurement continues without interruption with the optional TIENet 350 AV sensor, which combines continuous wave Doppler to measure area velocity with a differential pressure transducer to measure level.

The 350 AV sensor is factory-installed on the bottom of the LaserFlow sensor, and is also available as a kit for installation in an existing system. Refer to Section 5.7 for kit installation instructions.

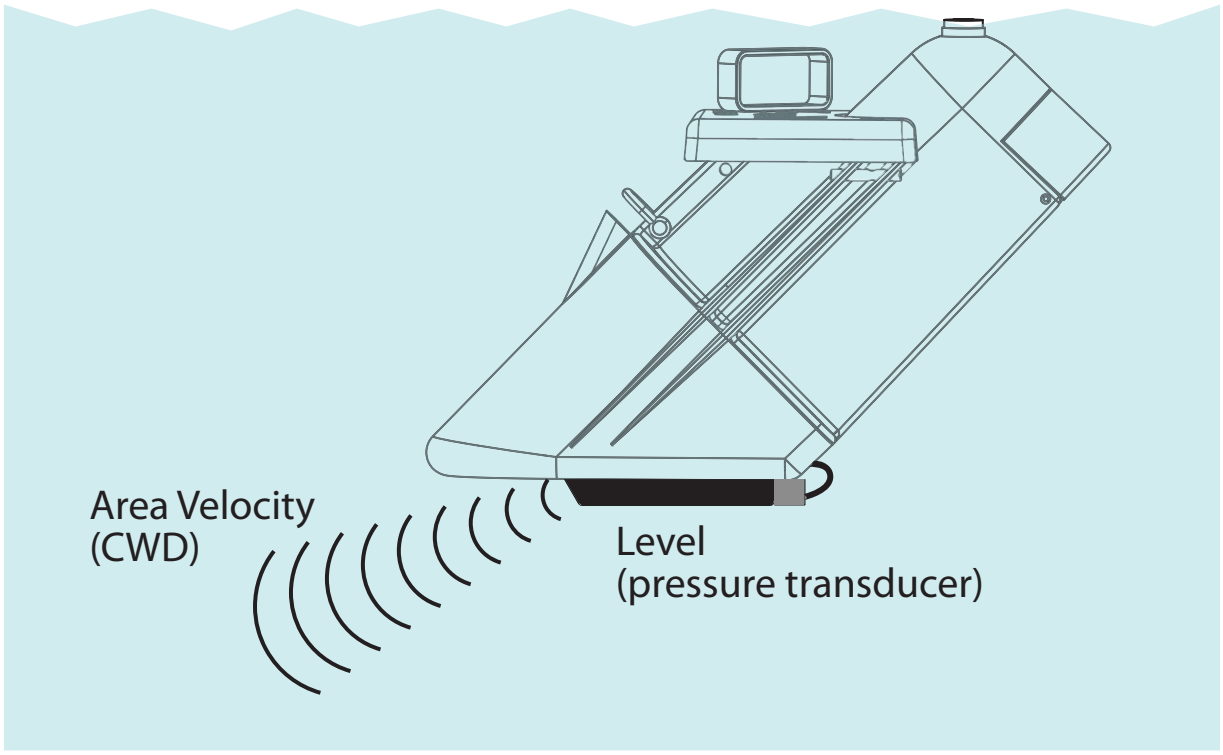


Figure 1-2 Optional submerged functionality

1.5 Technical Specifications

Table 1-1 provides technical specifications for the LaserFlow.

Table 1-1 LaserFlow Sensor Specifications[a]

Size (HxWxD)	38.01 x 26.21 x 56.7 cm	14.96 x 10.3 x 22.32 in
Cable Lengths	5, 10, 15, or 23 m	16.4, 32.8, 49.2, or 75.5 ft
Weight (Sensor, 10m) Sensor w/ 350 AV Sensor	8.7 kg 9 kg	19.2 lbs 20 lbs
Materials	Conductive Carbon Filled ABS Plastic, SST, Conductive Kynar®[b], Anodized Aluminum, UV Rated PVC	
Enclosure (self-certified)	IP68 (Submerged @ 2 m depth for 72 hrs)	
Certifications	CE EN61326; FDA CDRH 21CFR1040; IEC 60825-1	
Laser Class	Class 3R	
Laser Wavelength	655 nm	
Laser Exit Angle	45° ±3°	
Power (from connected flow meter/module)	Input voltage range: 8 to 26VDC; 12VDC Nominal	
Electrical Connections	Signature Flow Meter 2160 LaserFlow Module	Screw Terminal TIENet Plug
Temperature Range	Operating: Storage:	0 to 60 °C -40 to 60 °C 32 to 140 °F -40 to 140 °F
Flow Accuracy	±5% of Reading (Typical under normal flow conditions)	
Velocity Measurement		
Technology	Non-Contact, Subsurface Laser Doppler Velocity (patent pending)	
Measurement Range	-4.6 to + 4.6 m/sec	-15 to +15 ft/sec
Number of velocity readings per measurement	1 to 15 (selectable measurement points)	
Time required for one velocity measurement	1 to 15 minutes (depending on number of measurement points selected)	
Maximum distance: liquid surface to bottom of sensor	3m (10 ft)	
Direction	Selectable Bi-Directional Measurement[c]	
Minimum Velocity	0.25m/s	0.8 ft/s
Deadband	Zero deadband from bottom of sensor	
Accuracy	±0.5% of reading ±0.03 m/s (0.1 ft/s)	
Level Measurement		
Technology	Non-Contact Ultrasonic Signal	
Measurement Range	0 to 3 m (0 to 10 ft) from measurement point	
Accuracy @ 22 °C	±0.006m (0.02 ft) at ≤ 1ft level change; ±0.012m (0.04 ft) at > 1ft level change	
Ultrasonic Temperature Coefficient	± 0.0002 x D (m) per degree C (± 0.00011 x D (ft) per degree F)	
Ultrasonic Beam Angle	10°	(5° from center line)
Ultrasonic Signal	50KHz	
Deadband	Zero deadband from bottom of sensor	

a. All specifications are subject to change without notice.
b. Kynar® is a registered trademark of Arkema, Inc.
c. Turbidity > 20 NTU. Distance < 48 inches.

1.6 Accessories

Accessories used in sensor installation are briefly described below. Refer to the next section for ordering information.

1.6.1 Ordering Information

Options and accessories can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: 800 228-4373
402 464-0231
FAX: 402 465-3022

E-mail: IscoInfo@teledyne.com

LaserFlow Sensor, 5m Unterminated Cable 60-4364-021
LaserFlow Sensor, 10m Unterminated Cable 60-4364-022
LaserFlow Sensor, 23m Unterminated Cable 60-4364-023
LaserFlow Sensor, 10m Cable w/ TIENet Plug 60-4364-001
LaserFlow Sensor, 15m Cable w/ TIENet Plug 60-4364-015
LaserFlow Sensor, 23m Cable w/ TIENet Plug 60-4364-016

TIENet Expansion Box 60-4307-023

Cord grip fitting, ¾" NPT, for TIENet cable 209-0073-12
Integrated 350 AV Kit for surcharge functionality 60-4354-017
Signature Flow Meter Exterior desiccator
(required for use with 330 and 350 TIENet devices) 60-4354-019
Silica gel desiccant, 1.5-lb container 099-0011-03

> **Note**
> Guidelines for Area Velocity reference line support and networking with the expansion box can be downloaded in the Teledyne Isco application note Signature Flow Meter Expansion Box, available on the company website. Contact the factory for more information.

LaserFlow Instruction Manual 69-4363-043
Signature Flow Meter Instruction Manual 69-4303-070
Signature Bubbler Flow Meter Instruction Manual 69-4333-004

Permanent Wall Mounting Hardware Kit 60-4364-003
Refer to Section 2.5.1 *Wall Mount Installation* for additional information.

Temp Mount Cargo Bar, 48-55" Variable Range 60-4364-032
Temp Mount Cargo Bar, 54-66" Variable Range 60-4364-034
Temp Mount Cargo Bar, 63-84" Variable Range 60-4364-035
Temp Mount Cargo Bar, 83-114" Variable Range 60-4364-036
Temp Mount Hardware Assembly 60-4364-038
Temp Mount Kit, 48-55" Variable Range 62-4364-032
Temp Mount Kit, 54-66" Variable Range 62-4364-034

Temp Mount Kit, 63-84" Variable Range 62-4364-035
Temp Mount Kit, 83-114" Variable Range 62-4364-036
Temp Mount Elbow Pipe for Offset 60-4368-016
Refer to Section 2.6.1 *Temporary Mounting Installation* for additional information.

Sensor retrieval arm for sensor retrieval, replacement, and locking
(Maximum extension of 23 feet) 60-4364-033
ProHanger SST Bracket for suspending equipment in manhole
(Up to 24 inches) 69-2003-599
Air Blast Kit for cleaning laser window, 5 m tubing 60-4364-027
Air Blast Kit for cleaning laser window, 10 m tubing 60-4364-028
Air Blast Kit for cleaning laser window, 15 m tubing 60-4364-029
Air Blast Kit for cleaning laser window, 23 m tubing 60-4364-030
Refer to Section 5.6 *Installing the Optional Air Blast Kit* for additional information.

☑ Note

Teledyne Isco uses FreeRTOS version 5.4.2 in its TIENet devices. In accordance with the FreeRTOS license, FreeRTOS source code is available on request. For more information, visit www.FreeRTOS.org.

1.7 Unpacking Instructions

When the system arrives, inspect the outside packing for any damage. Then carefully inspect the contents for damage. If there is damage, contact the delivery company and Teledyne Isco (or its agent) immediately.

⚠ WARNING

If there is any evidence that any items may have been damaged in shipping, do not attempt to install the unit. Please contact Teledyne Isco (or its agent) for assistance.

When you unpack the system, check the items against the packing list. If any parts are missing, contact the delivery company and Teledyne Isco's Customer Service Department. When you report missing part(s), please indicate them by part number. In addition to the main packing list, there may be other packing lists for various sub-components.

It is recommended that you retain the shipping cartons as they can be used to ship the unit in the event that it is necessary to transport the system. Please complete the registration card and return it to Teledyne Isco.

1.7.1 Protective Window Cap

Leave the protective window cap in place until the sensor is ready to be installed.

Before installation, remove the cap. The sensor will not be able to measure velocity with the cap in place. Retain the cap for use during cleaning, storage, or shipment, to protect the laser window from damage.

⚠ CAUTION

Be sure the protective window cap is installed during cleaning, storage, or shipment.

Figure 1-3 Remove protective window cap before installation

TIENet™ 360 LaserFlow™ Velocity Sensor

Section 2 Preparation and Installation

2.1 Safety

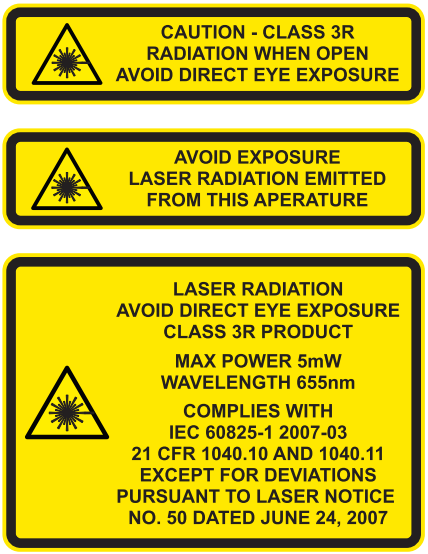
Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood.

2.1.1 Site Conditions

Components are often installed in confined spaces. Some examples of confined spaces include manholes, pipelines, digesters, and storage tanks. These spaces may become hazardous environments that can prove fatal for those unprepared. These spaces are governed by OSHA 1910.146 and require a permit before entering.

⚠ WARNING

The installation and use of this product may subject you to hazardous working conditions that can cause you serious or fatal injuries. Take any necessary precautions before entering a worksite. Install and operate this product in accordance with all applicable safety and health regulations, and local ordinances.



2.2 Sensor Installation Considerations

Measurement accuracy can be affected by a number of site factors that should be taken into consideration when selecting the location for the sensor.

These factors may affect the laser velocity or the ultrasonic level, or both.

If the laser velocimeter or ultrasonic transducer cannot obtain a valid reading at any measurement point, an asterisk (*) will appear next to the displayed reading, indicating there is an error.

2.2.1 Ultrasonic Beam Angle

The ultrasonic level transducer has a 10° beam angle (5° from center line), forming a cone whose apex is the transducer. The transducer can only detect surfaces within this cone.

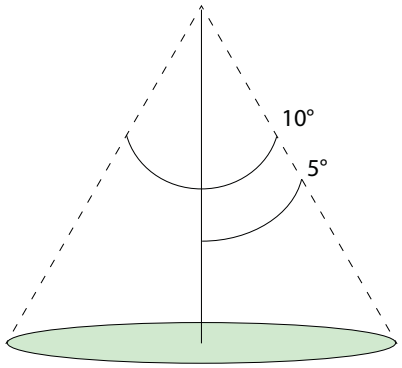


Figure 2-1 Ultrasonic level sensor beam angle

The ultrasonic beam narrows as elevation decreases, which can increase difficulty in detecting the return echo. Narrow channels can result in false echoes and incorrect level readings off the walls and sides of the channel.

The beam widens as elevation increases. If the beam is too wide, the sensor may pick up signals from unwanted surfaces, such as the walls of the channel.

2.2.2 High Water Levels

In most open channel installations where the level may exceed one-half of full pipe, mount the sensor as near as possible to the midpoint between the entrance and exit to measure over the least turbulent flow.

2.2.3 Submersion and Fouling

Fouling by grease or solids can cause the LaserFlow to malfunction. The LaserFlow is sealed, so unless it was exposed to corrosive substances, submersion will not harm it. Upon retrieval, ensure that the surfaces of the laser window and ultrasonic sensor are clean.

Cleaning instructions are provided in Section 5.

2.2.4 Humidity

Conditions of extremely high or low humidity can cause ultrasonic level detection to occur either earlier or later than under normal conditions. A drop in water level, normally compensated for by the sensor's interval-based amplifier, may produce errors in echo detection.

The LaserFlow is designed to minimize the effects of condensation on the laser's window and on the ultrasonic sensor face; however, an optional air blast kit is available to keep the window free of condensation. Refer to Section 5 for details.

2.2.5 Surface

Solids, foam, oil, and turbulence can all absorb or weaken the ultrasonic and laser signals, causing errors in detection. Foam or oil on the surface of the stream can also produce false level readings.

2.2.6 Temperature

Changes in ambient temperature significantly affect the velocity of sound. If ambient temperature changes rapidly, there may be a delay before the ultrasonic transducer's temperature sensor can activate temperature compensation.

☑ *Note*

If the sensor will be installed outdoors in direct sunlight, use a sunshade to prevent heating of the sensor housing.

2.2.7 Waves

Waves on the surface of the flow stream can deflect the ultrasonic signal, causing erroneous readings or total loss of signal. The flow meter software is able to reject occasional readings that deviate substantially from normal.

2.2.8 Wind

Strong winds can significantly reduce the strength of the ultrasonic return echo. Narrow beams can result in the sound being blown away; likewise, greater distances to the flow stream surface are more subject to distortion in strong winds.

2.3 Connecting the Cable

The LaserFlow cable will have one of two different connector types: Unterminated for the Signature® Flow Meter (Section 2.3.1), and TIENet plug for the 2160 LaserFlow Module (Section 2.3.2).

2.3.1 Cable Connection: Signature Flow Meter

External TIENet devices such as the LaserFlow are all connected to the Signature flow meter in the same manner, usually using conduit or cord-grip cable fittings. Multiple external TIENet devices can be connected simultaneously.

Refer to your Signature flow meter manual for instructions on accessing the instrument's interior components.

⚠ WARNING

Before proceeding, ensure that the flow meter has been disconnected from mains power.

Note

The steps that follow include instructions for installing cord-grip fittings. Some applications will use user-supplied 3/4" ID conduit for cable routing.

1. Remove one of the 6-position plug-in terminal strip connectors from the case board.

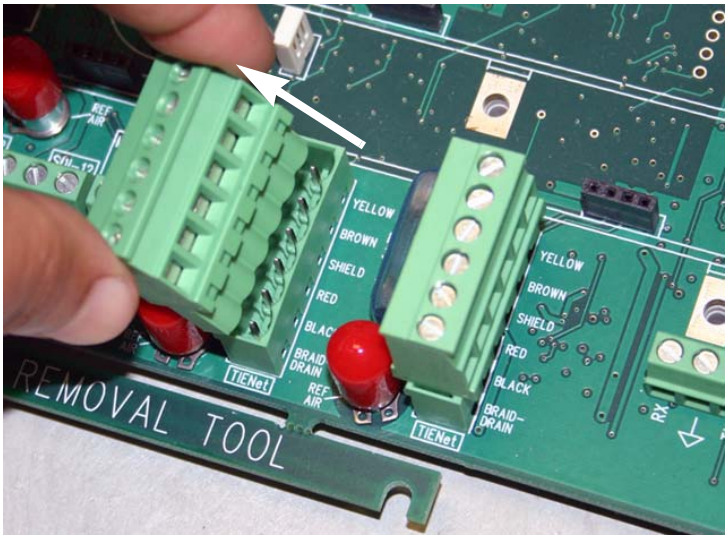


Figure 2-2 TIENet Device terminal strips

2. If using a cord-grip fitting, install the cable nut in the appropriate opening on the bottom of the Signature enclosure, securing it to the wall with the lock nut (concave side facing wall).

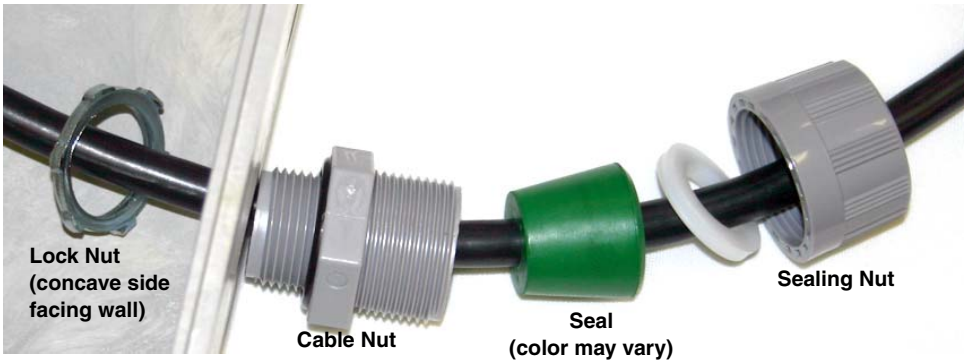


Figure 2-3 Installing cable with a cord-grip fitting

3. Feed the TIENet device cable end through the sealing nut and seal, and through the cable nut. Lightly tighten the sealing nut, just enough to hold the cable in place while installing the connector.

4. Attach the wire ends to the terminal strip as shown in Figure 2-4), then press the terminal strip back down into its socket on the case board, as shown in Figure 2-5, taking care not to strain any wire connections. Gently tug each wire when finished, to verify secure connection to the screw terminals.

Note

The SHIELD wire is the bare drain emerging from the foil shield around the YELLOW and BROWN wires. The BRAID-DRAIN wire is the bare drain emerging from the surrounding braided shield inside the cable jacket. It is not necessary to prevent the two braids from coming into contact with each other.

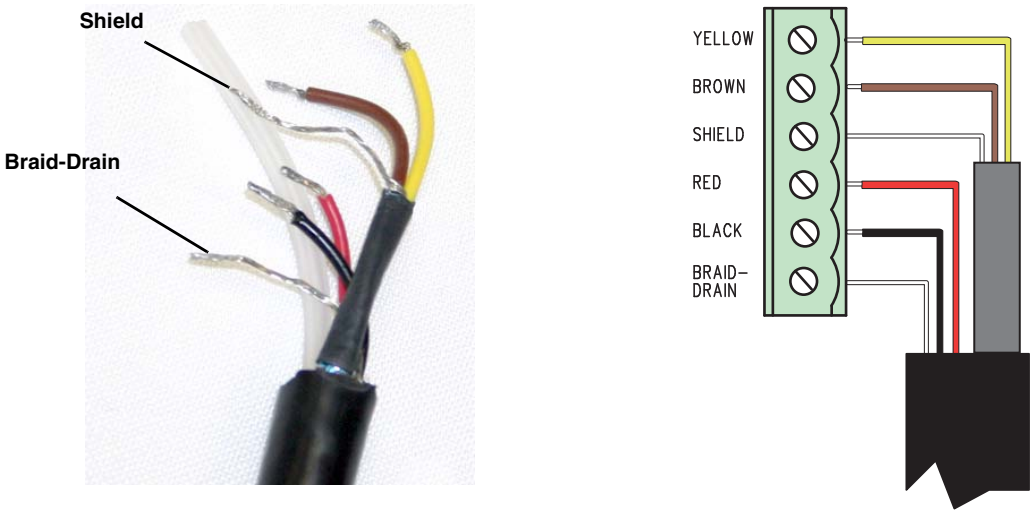


Figure 2-4 TIENet Device terminal connections

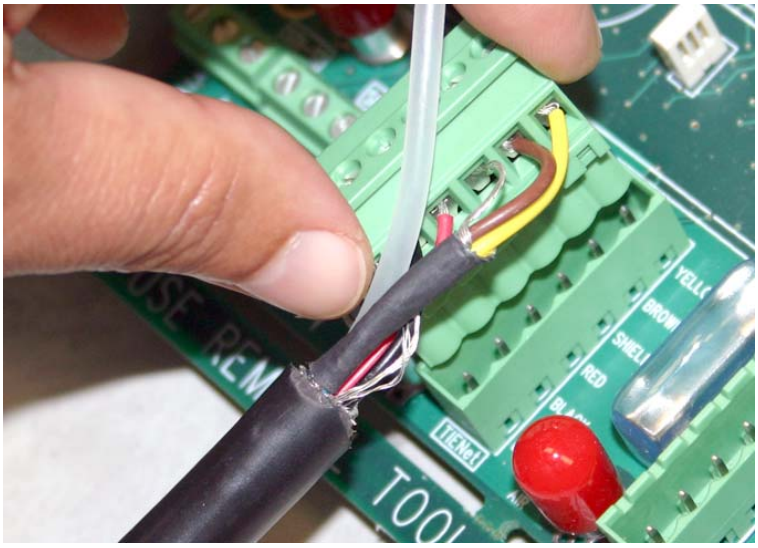


Figure 2-5 Attach wired terminal strip to case board socket

5. Insert the reference tubing into the REF AIR port on the case board, pushing it down inside the silicon tubing. B**e careful not to bend or kink the reference tubing.**

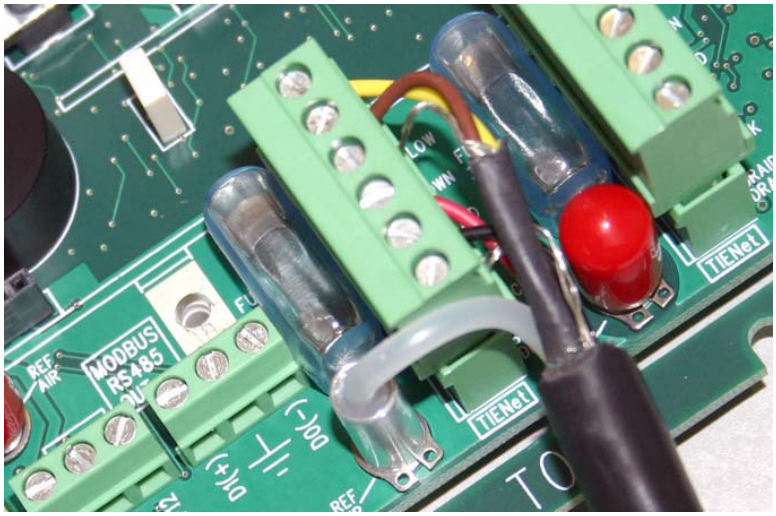


Figure 2-6 Insert the cable reference tubing into the case board reference port

6. Gently tug the cable downward, to remove any slack within the enclosure, taking care not to put any stress on the connections.
7. Tighten the cord grip sealing nut (Figure 2-7).

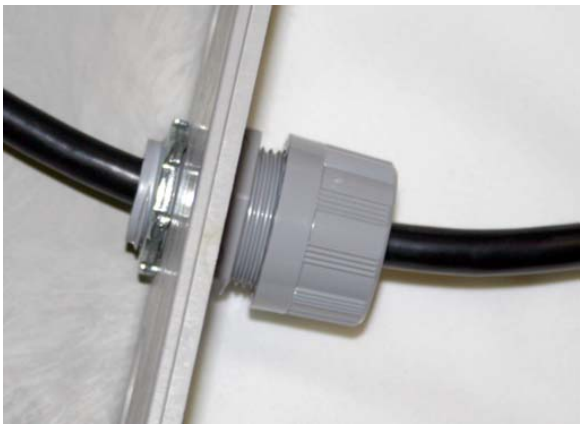


Figure 2-7 Position and secure the cable

⚠ CAUTION

If you are using conduit instead of the cord-grip fitting, the conduit must be sealed to prevent harmful gases and moisture from entering the Signature enclosure. Failure to seal conduit could reduce equipment life.

8. Close the front panel and fasten it shut with the two Phillips screws.

2.3.2 Cable Connection: 2160 LaserFlow Module

1. Prepare the 2160 receptacle by removing the cap (press down on the spring clip and pull out the cap).

Figure 2-8 Preparing the 2160 connector receptacle

2. Remove the cap from the LaserFlow TIENet plug and push the protective caps on the module and sensor together.
3. Aligning the pins on the LaserFlow cable with those in the connector receptacle, push the sensor connector into the receptacle until the spring release clicks.

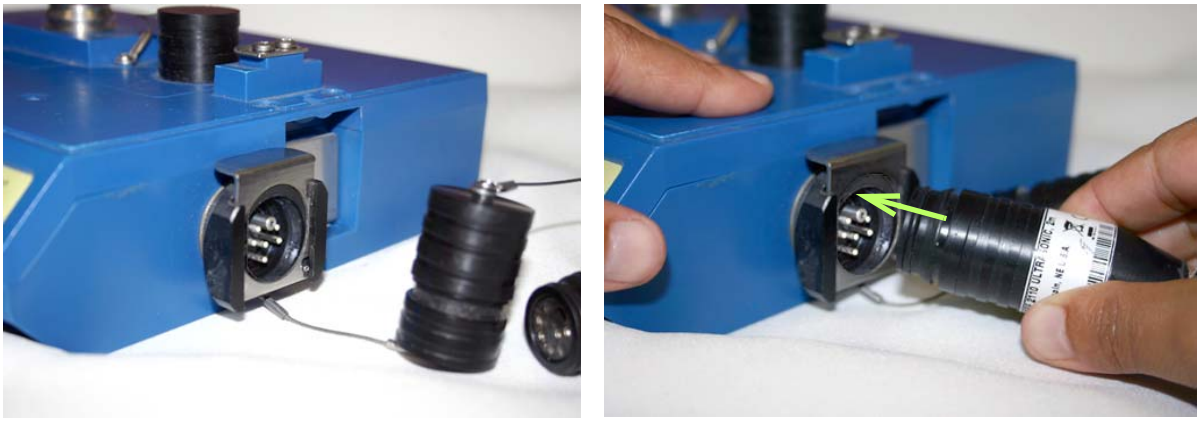


Figure 2-9 Secure caps and connect LaserFlow to 2160

4. To be certain that the connectors are locked, lightly pull on the cable connector; the cable should be held in place by the spring release clip.

2.4 Sensor Installation Tools and Requirements

The Signature Flow Meter or 2160 LaserFlow Module does not have to be mounted near the flow stream. You can install the flow meter at a convenient, protected location and route the sensor cable through user-provided conduit back to the flow meter.

Proper installation of the LaserFlow is critical for accurate measurement.

2.4.1 Tools Required

To install the LaserFlow sensor over the flow stream, you will need the following tools:

- Wall Mount Kit (see Section 2.5.1), if mounting on wall
  - 7/16" Open Wrench
  - 9/16" Open Wrench
- Temporary Mount Kit (see Section 2.6.1), if application is temporary
  - 7/16" Nut Driver
- Sensor Retrieval Arm (optional from Teledyne Isco)

2.4.2 Sensor and Mounting Equipment Dimensions

Complete mounting assembly dimensions are provided in Figures 2-10 through 2-13.

Refer to the appropriate drawing(s) when planning your installation and adjusting your mounting hardware.

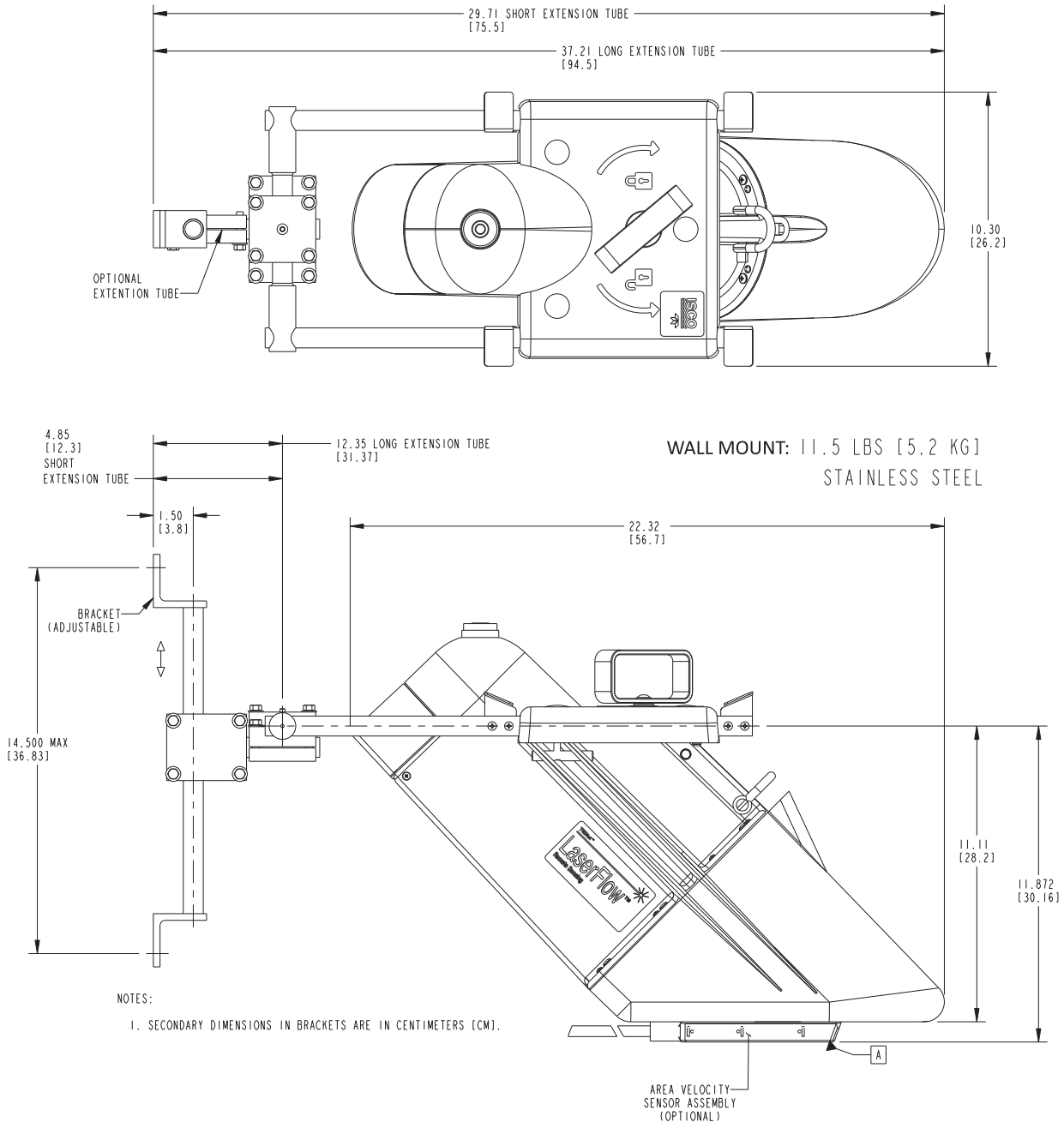


Figure 2-10 Overall dimensions including wall mount hardware (part 1)

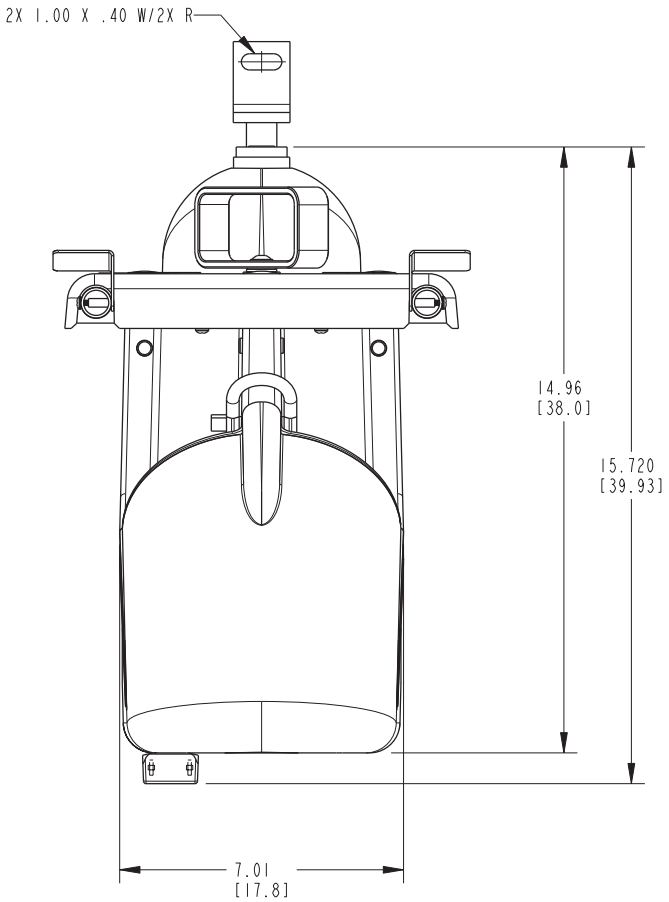
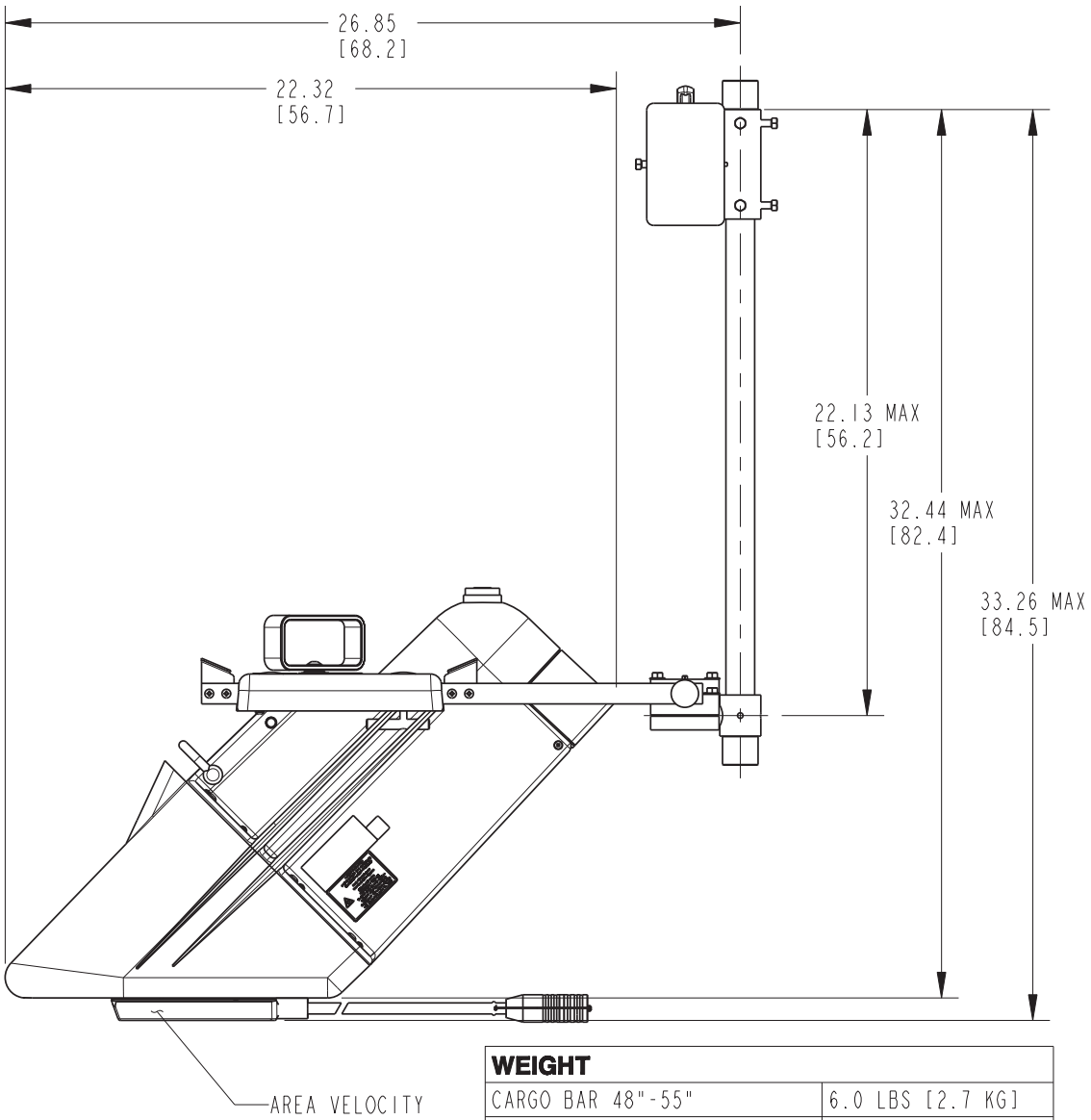


Figure 2-11 Overall dimensions including wall mount hardware (part 2)



NOTES:
1. SECONDARY DIMENSIONS IN BRACKETS ARE IN CENTIMETERS [CM].

WEIGHT	
CARGO BAR 48"-55"	6.0 LBS [2.7 KG]
CARGO BAR 54"-66"	6.5 LBS [2.9 KG]
CARGO BAR 63"-84"	7.4 LBS [3.4 KG]
CARGO BAR 83"-114" (SHOWN)	9.0 LBS [4.1 KG]
MOUNT	11.7 LBS [5.3 KG]
FORCES	
TOTAL FORCE	350 LBS [158.8 KG]
MAX LOAD	45 LBS [20.4 KG]
MATERIAL	
CARGO BAR	ALUMINUM
HANDLE & HYDRAULIC HOUSING	NYLON
FOOT	RUBBER
MOUNTING HARDWARE	STAINLESS STEEL

Figure 2-12 Overall dimensions including temp mount hardware (part 1)

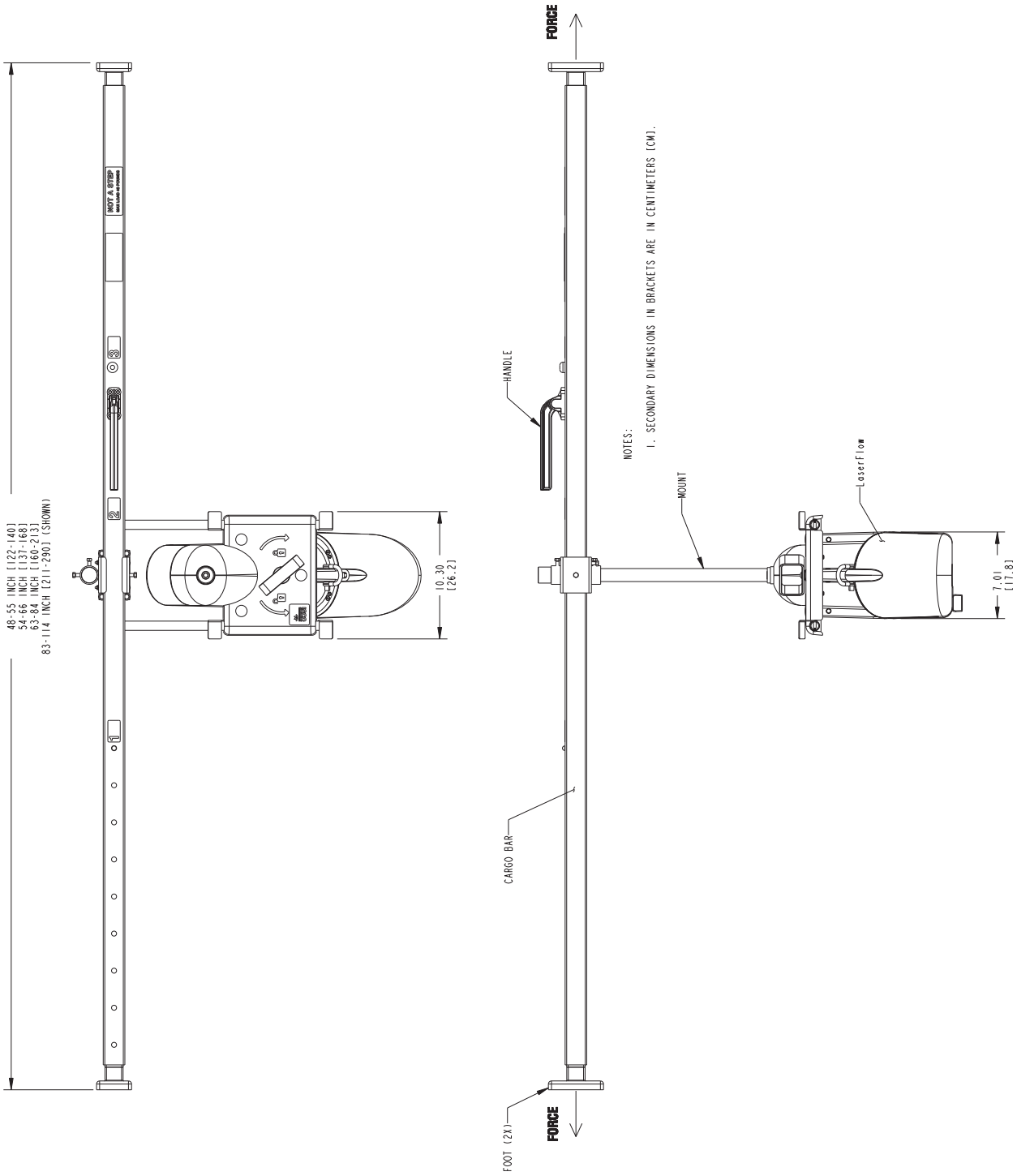
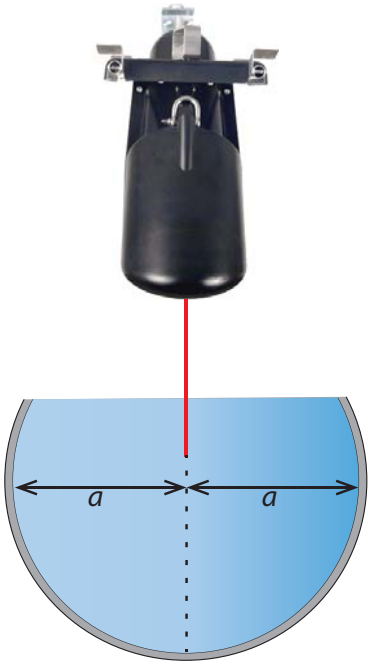


Figure 2-13 Overall dimensions including temp mount hardware (part 2)

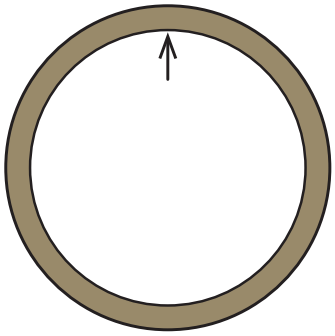
2.4.3 Sensor Positioning and Requirements

Figure 2-14, at left, shows constants that serve as reference points when planning the positioning of the sensor.

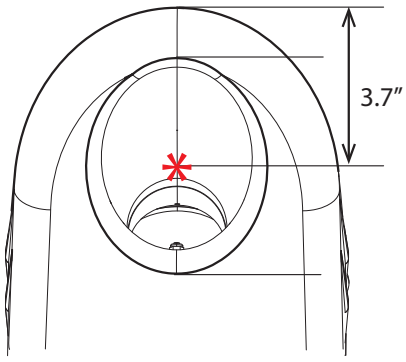
Figure 2-15, on the next page, shows a typical LaserFlow manhole installation.



Center of the pipe



Top of pipe inside wall



Distance from sensor tip to laser beam exit point (vertex of 45° angle)

Figure 2-14 Sensor installation constants

⚠ CAUTION

For proper function, the requirements listed here must be followed exactly.

Requirements:

- Permanent Installations: Install the wall bracket perpendicular to the x-axis.
  Temporary Installations: Install the cargo bar perpendicular to the y-axis.
- Always center the LaserFlow (and middle laser beam) relative to the pipe walls, and always use the attached circular bubble level for vertical alignment.
- Mount the LaserFlow sensor with the bottom parallel with the water surface.
- Align the bottom of the LaserFlow with the top of the inside wall of the inlet pipe, and as close as possible to the pipe mouth without obstructing the laser.
  To accomplish this, refer to Figure 2-14 at left, Figure 2-15 on the next page, and the following important figures:
  - The point at which the laser exits the sensor mouth is **3.7" (9.4 cm)** from the front tip of the sensor, or the center of the opening.
  - The laser beam exits the sensor mouth at a **45° angle**.
    (If the sensor bottom is parallel with the water surface, the laser beam will also strike the water surface at a 45° angle.)

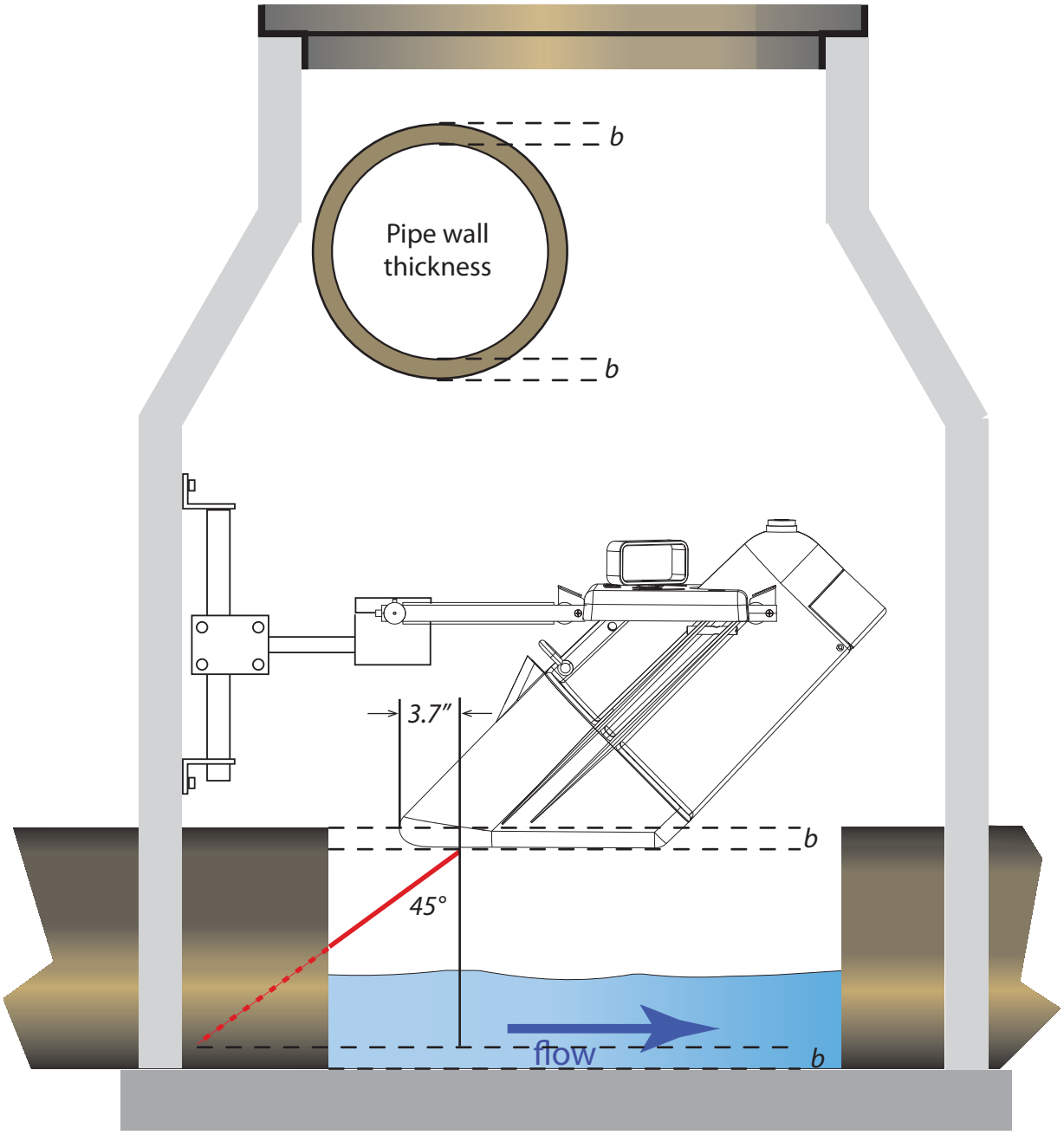


Figure 2-15 Typical manhole installation

2.5 Wall Mounting Kit

For wall mounting, identify the components listed in Figure 2-16 and Table 2-1, and perform the steps that follow. Order numbers for parts and fasteners are provided in Appendix A.

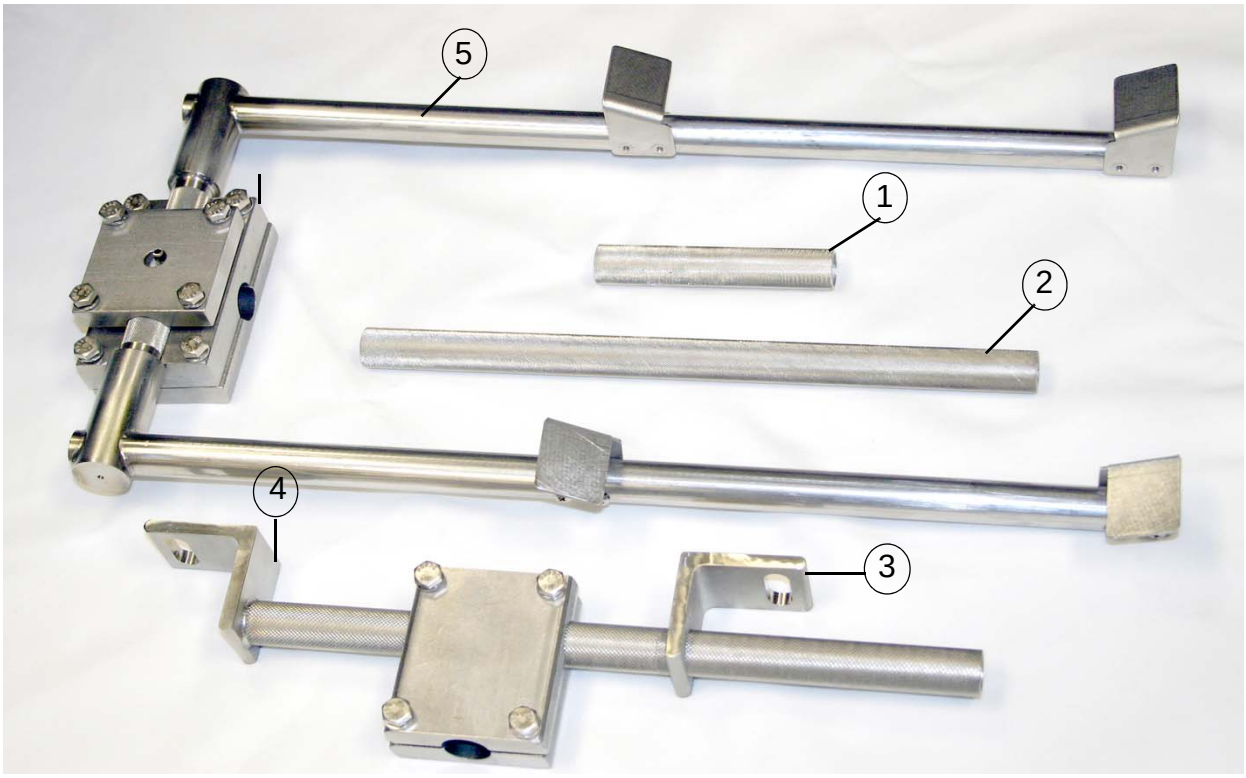


Figure 2-16 Wall mounting kit (Numbers correspond with Table 2-1)

Table 2-1 Wall Mounting Kit

Item (Callout #)	Description
1	Tube Coupler (short)
2	Tube Coupler (long)
3	Bottom Wall Mount Angle Bracket (adjustable)
4	Mounting Shaft
5	Sensor Carrier
	SST Anchor Stud Assembly & Spring Lock Washers (for fastening brackets to wall)

2.5.1 Wall Mount Installation

Refer to the dimensions and requirements in Figure 2-15 while performing the following steps.

> **Note**
> Stud anchors for concrete are provided in the mounting kit.

1. Bolt or anchor the bottom angle bracket to the wall.
2. Slide the mounting shaft into the bottom angle bracket and bolt or anchor the mounting shaft to the wall.
3. Insert either the long or short tube coupler into the hole formed by the vertical clamp. Adjust the clamps to the desired height and cross-tighten the four bolts evenly until the clamp and tube coupler are firmly attached.

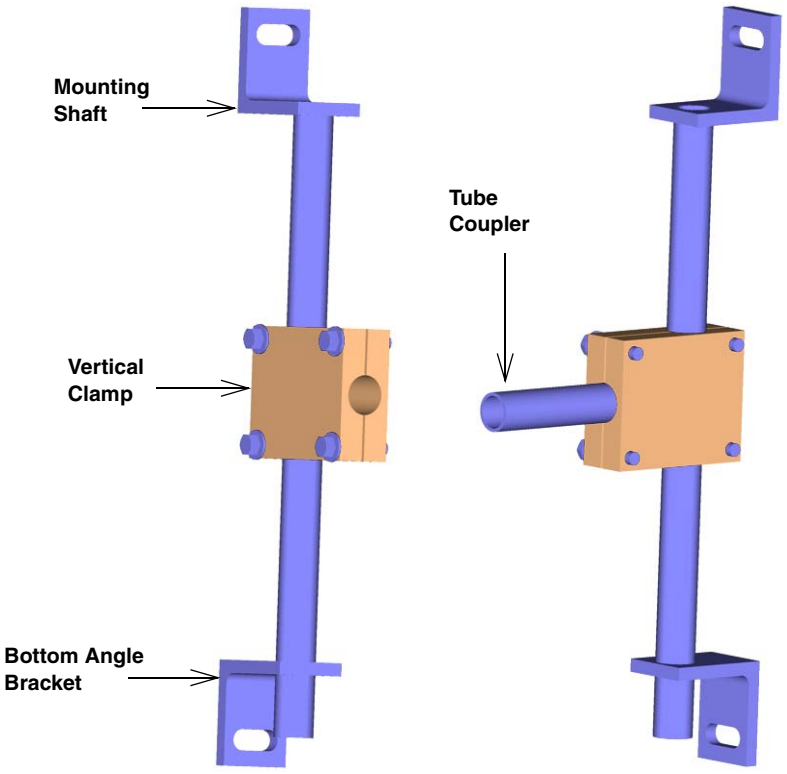


Figure 2-17 Wall Mount: Vertical clamp and vertical clamp with coupler inserted

4. Push the sensor carrier clamp onto the tube coupler until the coupler appears on the other side of the clamp. Align the carrier with both arms parallel to the flow surface and cross-tighten the bolts so the carrier is held firmly in position.
   Note that some realignment will be necessary following installation of the LaserFlow sensor; ensure that all hardware is tightened following final alignment.

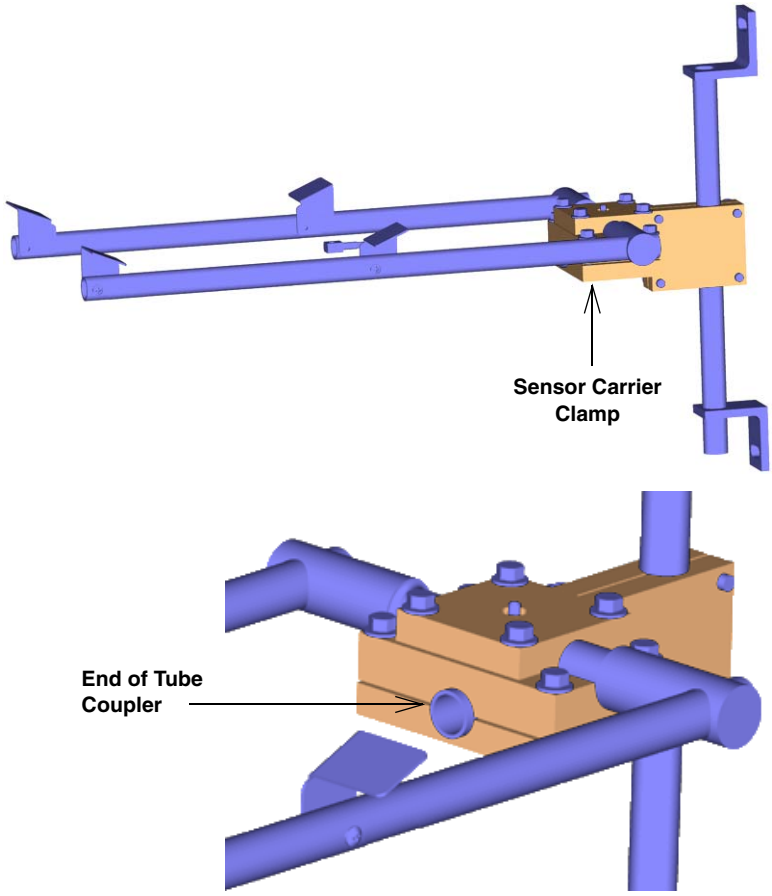


Figure 2-18 Wall Mount: Sensor carrier installed on tube coupler

☑ Note

After initial installation and sensor alignment, the remaining steps are often possible to perform from above ground, with the optional sensor retrieval arm.

⚠ WARNING

If lowering the LaserFlow from above ground, ensure that it does not become dislodged on the way down, possibly endangering any personnel who may still be below ground.

5. Lower the LaserFlow sensor onto the mounting bracket between the front and rear alignment tabs, with the two mounting block grooves resting on the two carrier arms. The sensor can be installed on the carrier facing inward or outward, depending on installation requirements.

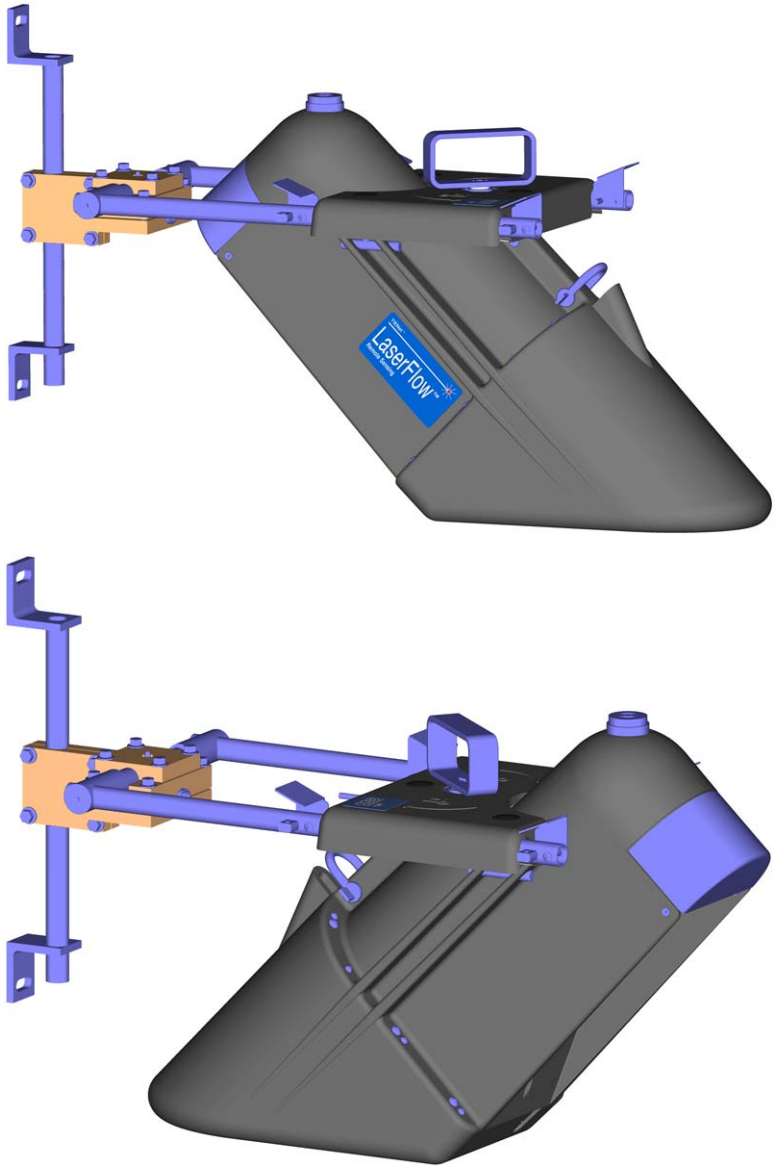
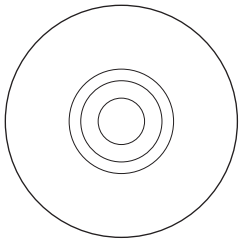


Figure 2-19 Wall Mount: Place the sensor on the carrier

6. Turn the locking handle clockwise until it locks the sensor in place.

Figure 2-20 Turn the locking handle clockwise until sensor is locked into place (shown with sensor retrieval arm, described in Section 2.7)

7. Using the bubble level on top of the sensor as a guide, adjust the carrier by loosening the appropriate bolts in the sensor carrier clamp such that the bubble in the level falls within the concentric rings.
8. Turn the laser on to make final adjustments so that the laser beam hits the flow stream at the exact center of the pipe (refer to Section 3.4 for Signature or Section 4.3 for 2160).



☑ Note

Additional assistance in adjusting the sensor's position may be obtained by activating and observing the 360 X-Axis (roll) and 360 Y-Axis (pitch) parameters.

9. Following final adjustments, ensure that all mounting bracket fasteners are tightened.

2.6 Temporary Mounting Kit

For temporary applications, refer to the components listed in Figure 2-21 and Table 2-2, and perform the steps that follow. Parts can be ordered separately or as a kit. Order numbers for parts and fasteners are provided in Appendix A.

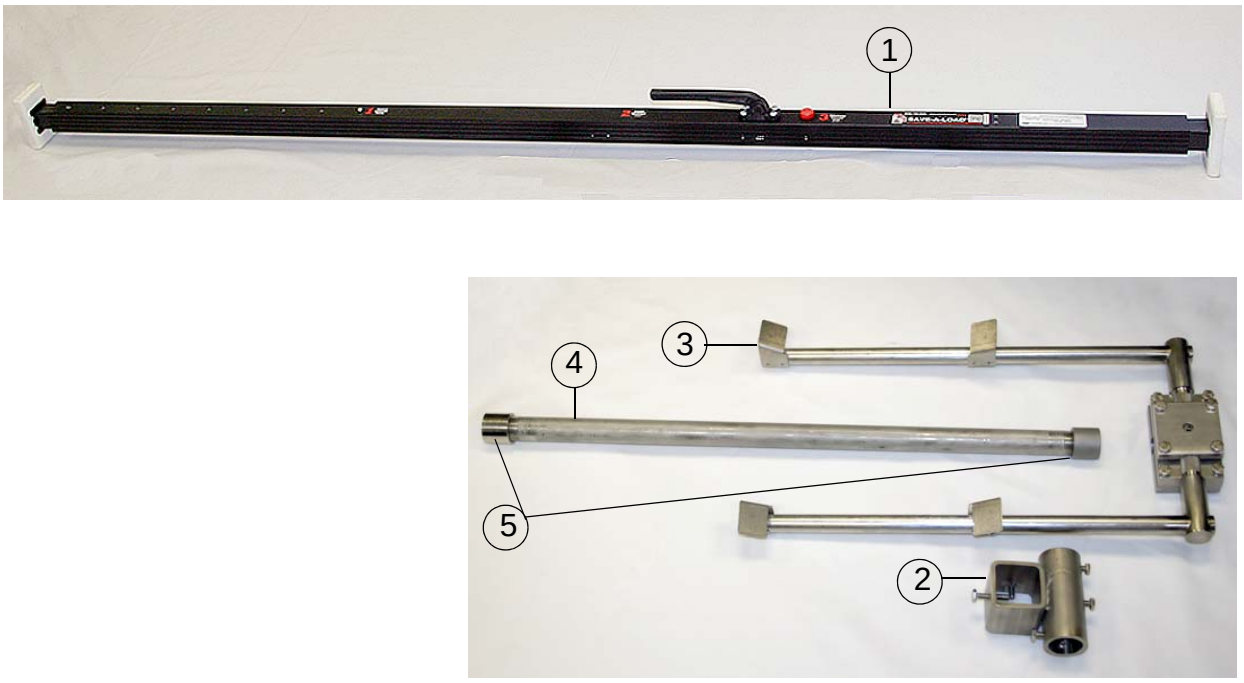


Figure 2-21 Temporary mounting kit (Numbers correspond with Table 2-2)

Table 2-2 Temporary Mounting Kit

Item (Callout #)	Description
1	Cargo Bar
2	Coupler Assembly
3	Sensor Carrier
4	24" Pipe
5	Cap (2)

2.6.1 Temporary Mounting Installation

The temporary mounting kit is rated for up to 45 lbs (20.5 kg).

When installing the sensor with the temporary mounting kit, ensure that the sensor carrier is positioned for easy installation and removal of the sensor.

1. Slide the foot out of the stationary end of the cargo bar.

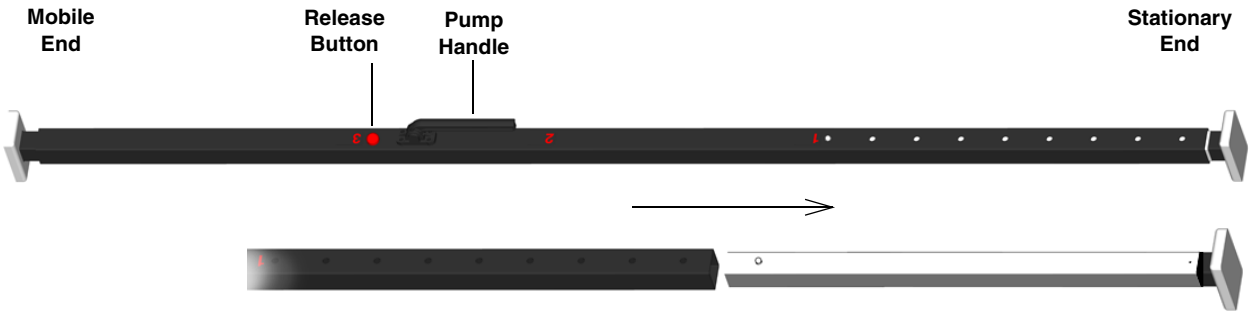


Figure 2-22 Temp Mount: Remove stationary foot

2. Slide the coupler onto the bar, tightening the two coupler bolts (see Figure 2-24) enough to prevent it from sliding around during the rest of the installation.
3. Reinsert the foot in the stationary end of the cargo bar.

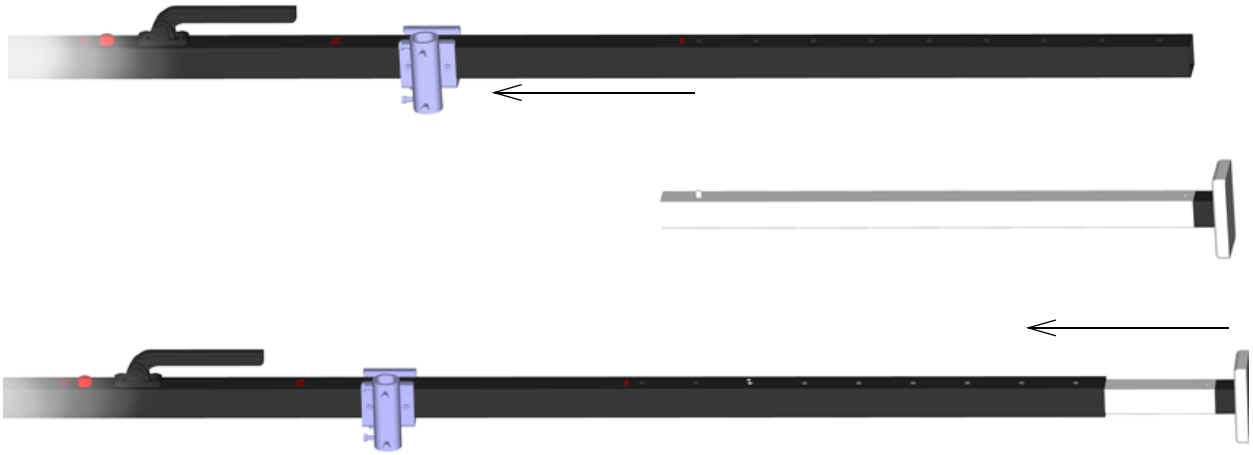


Figure 2-23 Temp Mount: Install coupler, replace stationary foot

4. In the manhole or vault, position the cargo bar for installation. Place the mobile end against the wall. and extend the stationary end as far as possible.
5. Pump the handle fully up and down approximately 10 times, until the hydraulic tension presses the stationary foot firmly against the opposite wall.

> ☑ ***Note***
>
> To release the hydraulic pressure, press the red rubber button next to the pump handle.

6. Position the coupler over the center of the flow stream and tighten the coupler bolts on the back and bottom.

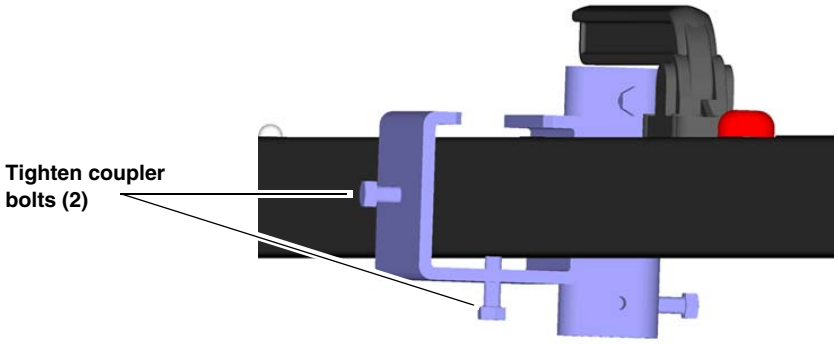


Figure 2-24 Temp Mount: Securing the coupler

7. Remove the end caps from the 24" pipe and slide one end through the knuckle on the sensor carrier.
8. Reinstall the cap on the bottom end. Turn the assembly top-side up and slide the knuckle down to rest on the bottom cap.

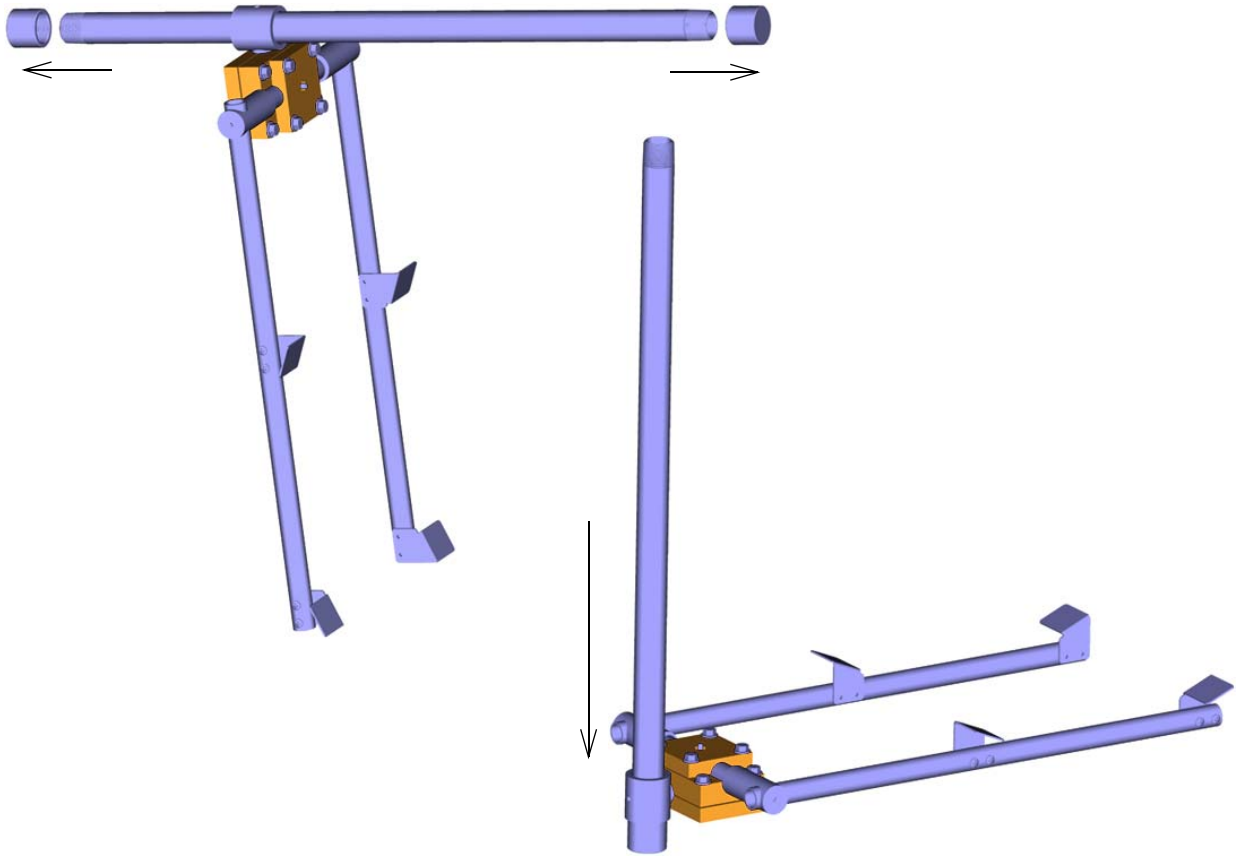


Figure 2-25 Temp Mount: Install sensor carrier/knuckle onto 24" pipe

9. Slide the pipe up through the coupler tube. Replace the other pipe cap.
10. Rotate the carrier to proper orientation and tighten the 4 bolts on the coupler tube.
11. Fine-tune the carrier orientation and tighten the 2 bolts on the carrier knuckle.

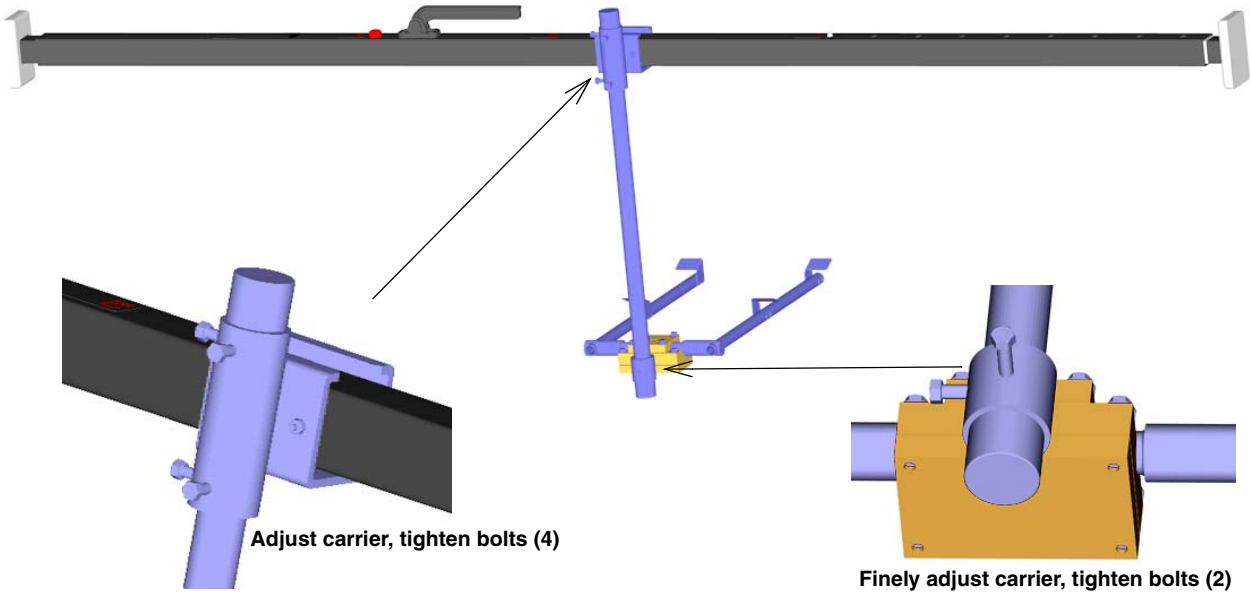


Figure 2-26 Installing the sensor carrier

☑ Note

After initial installation and sensor alignment, the remaining steps are often possible to perform from above ground, with the optional sensor retrieval arm.

⚠ WARNING

If lowering the LaserFlow from above ground, ensure that it does not become dislodged on the way down, possibly endangering any personnel who may still be below ground.

12. Lower the LaserFlow sensor onto the mounting bracket between the front and rear alignment tabs, with the two mounting block grooves resting on the two carrier arms. The sensor can be installed on the carrier facing inward or outward, depending on installation requirements.

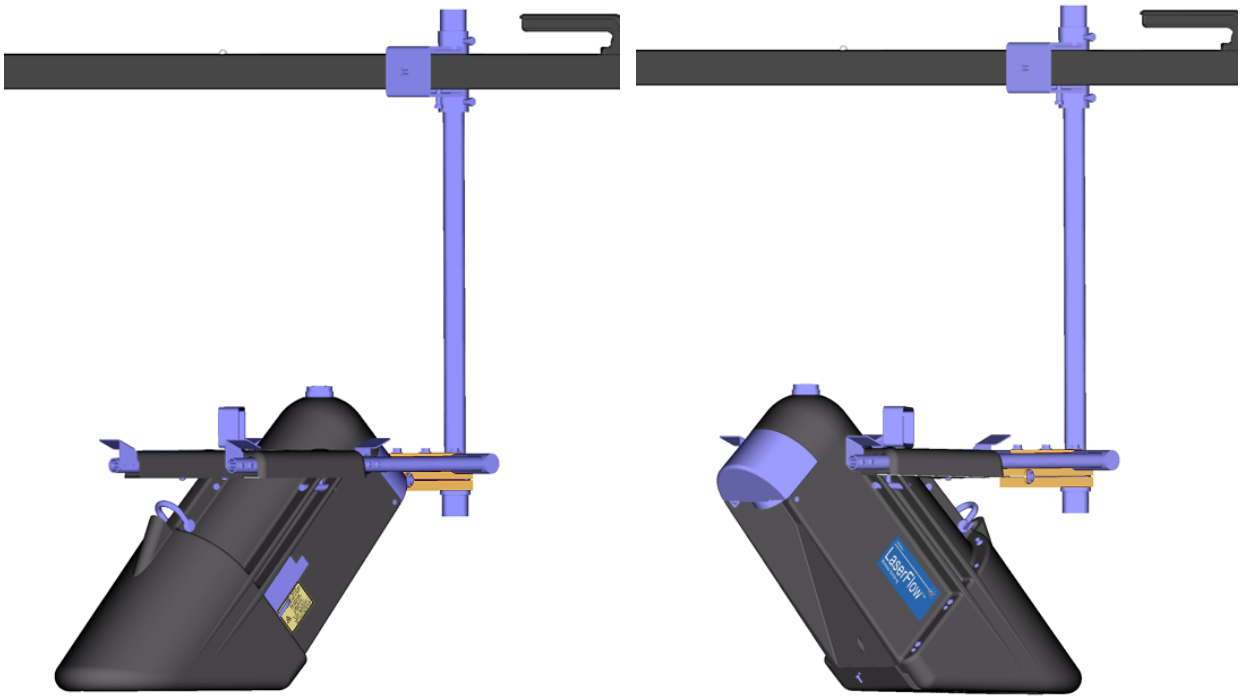
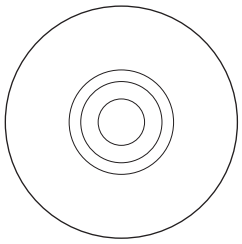


Figure 2-27 Temp Mount: Place the sensor on the carrier

13. Turn the locking handle clockwise until it locks the sensor in place.

Figure 2-28 Turn the locking handle clockwise until sensor is locked into place (shown with sensor retrieval arm, described in Section 2.7)



14. Using the bubble level on top of the sensor as a guide, adjust the carrier by loosening the appropriate bolts in the sensor carrier clamp such that the bubble in the level falls within the concentric rings.
15. Turn the laser on to make final adjustments so that the laser beam hits the flow stream at the exact center of the pipe (refer to Section 3.4 for Signature or Section 4.3 for 2160).
16. Following final adjustments, ensure that all mounting bracket fasteners are tightened.

2.6.2 Offset Carrier from Cargo Bar

For installations where the temp mount assembly alone cannot suspend the sensor directly over the center of the flow, an optional elbow pipe is available to create an offset of 6" from the cargo arm.

Simply install it between the 24" pipe and the knuckle, as shown below.

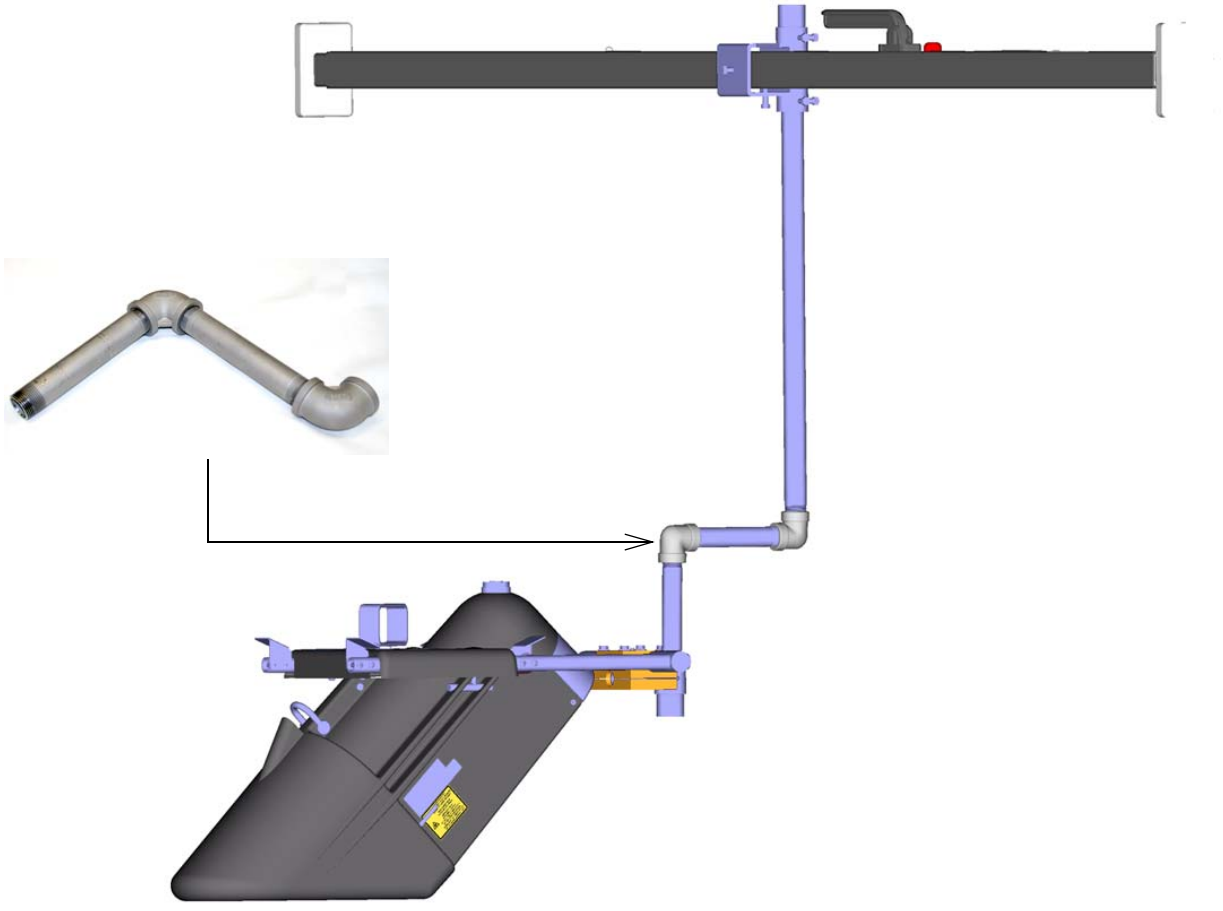


Figure 2-29 Temp Mount: Optional elbow pipe for offset

2.7 Optional Sensor Retrieval Arm

Following initial installation and adjustment, the sensor can be installed or removed as needed without manhole entry in most situations, using the optional retrieval arm to grasp the handle.

The sensor retrieval arm can extend to a maximum of 23 ft.

⚠ DANGER

Explosion hazard. The retrieval arm is not intrinsically safe. Do not use in hazardous locations.

⚠ DANGER

Electrocution hazard. Maintain a minimum of 10 feet from power lines.

Figure 2-30 Optional Sensor Retrieval Arm

TIENet™ 360 LaserFlow™ Velocity Sensor

Section 3 Setup with Signature® Flow Meter

The LaserFlow sensor is compatible with both the Isco Signature Flow Meter and the Isco 2160 LaserFlow Module. For 2160 setup instructions, refer to Section 4. For complete information about the Signature Flow Meter, refer to the Signature Flow Meter user manual.

3.1 Configuring the System

To configure the Signature flow meter for operation with the LaserFlow sensor, press MENU (B) to access the top menu, and select Hardware Setup. For all TIENet devices including the LaserFlow, select Smart Sensor Setup (TIENet).

3.1.1 Updating the Device List

When the LaserFlow sensor has been physically added to the system, select Perform Scan so that the flow meter detects it. When the scan is complete, the LaserFlow (model number **360**) appears in the list of connected devices, ready to be configured with the steps shown in Figure 3-2.

> ☑ ***Note***
>
> From the Hardware Setup menu, "Configure" refers to defining and selecting the parameters for each connected device.

The parameters that will appear for the LaserFlow sensor are:

360 Distance – Distance between the bottom of the sensor and the surface of the flow stream (refer to Section 3.2.2).

360 Level – Level of the flow stream surface

360 Velocity – Average velocity of the flow stream

360 Case Temperature – Internal temperature of the LaserFlow sensor housing

360 Laser Temperature – Temperature of the laser assembly

360 X-Axis – Tilt about the 'x' axis (roll)

360 Y-Axis – Tilt about the 'y' axis (pitch)

360 Laser Diode Current – Current draw of the laser diode

360 Ultrasonic Signal – Strength of the ultrasonic return echo

360 Board Current – Current draw of the laser amplifier board

360 Air Temperature – Temperature of surrounding (ambient) air

360 Flow Direction – Flow stream direction. 1=Forward; 0=Reverse; 2=Error

360 Doppler Power – Strength of the laser Doppler signal for velocity

If your system includes the optional submerged functionality or redundant measurement, the TIENet 350 Area Velocity sensor also appears in the list of connected devices, with its own list of parameters.

The name of any parameter can be customized by highlighting it and pressing Enter ( ) to display the character grid. Navigate the grid using the arrow keys. Select characters with Enter and clear characters with Delete ( ).

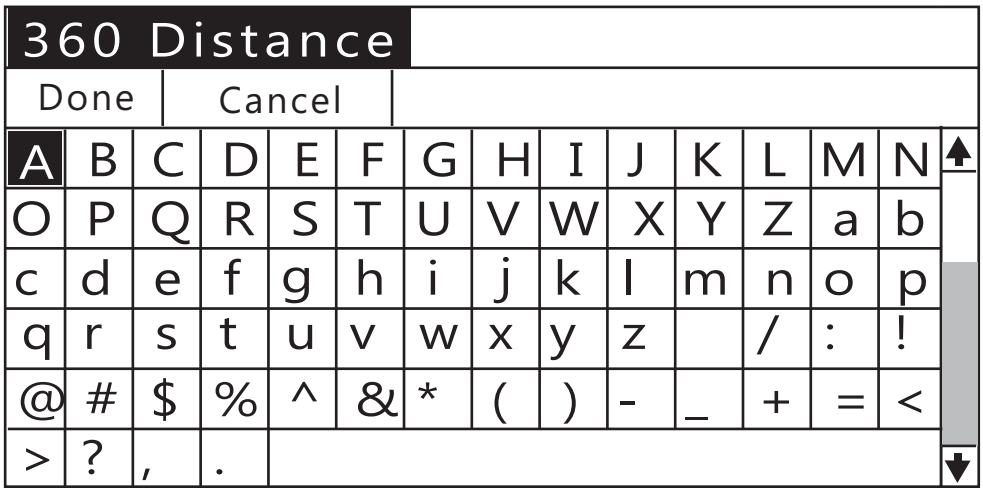


Figure 3-1 Character grid

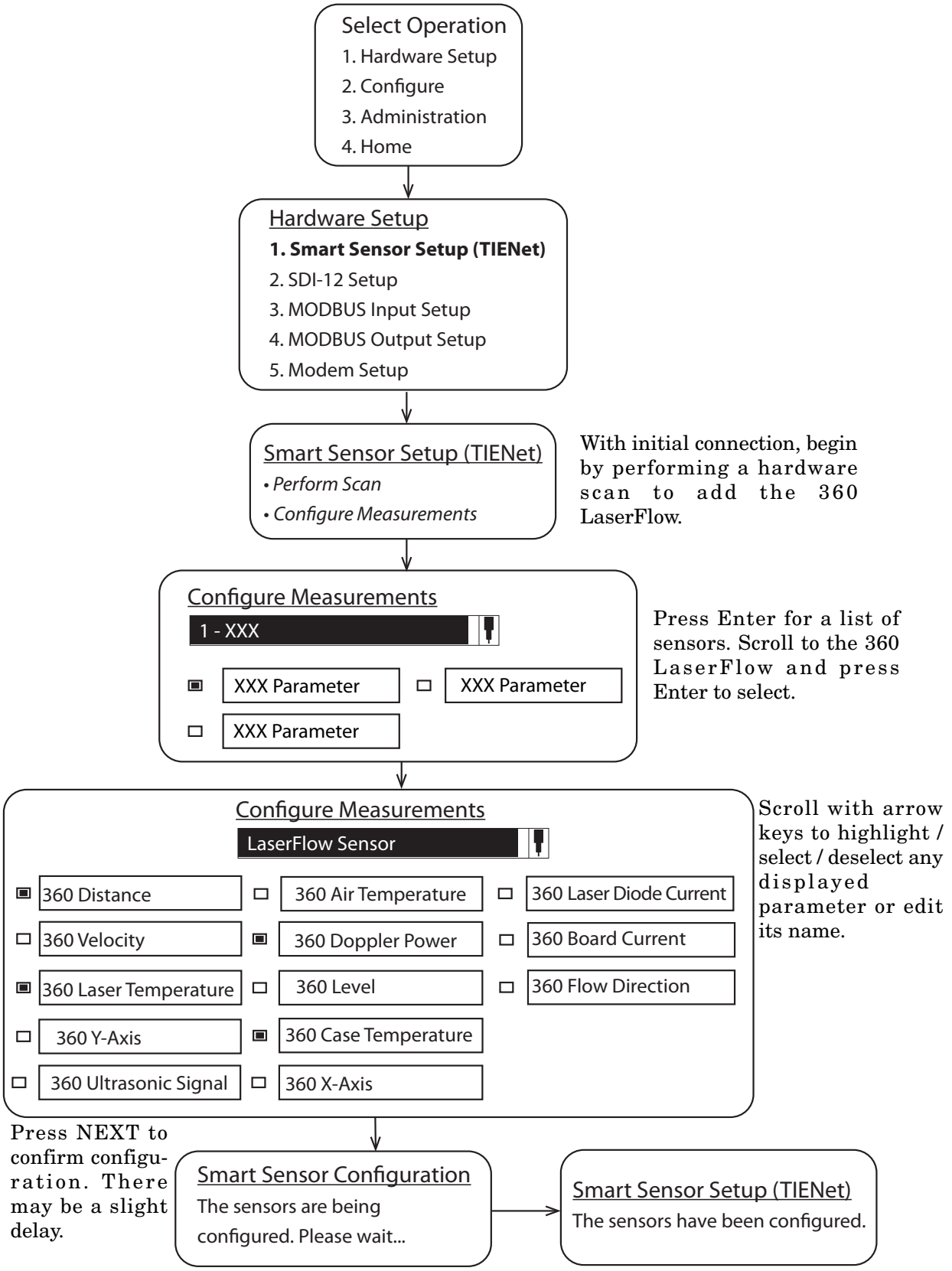


Figure 3-2 Menu Tree: LaserFlow Configuration

3.2 Measurement Setup

From Measurement Setup (Figure 3-3), select Level Input Setup to define the blanking distances or adjust the current level, and Velocity Input Setup to set velocity direction and access advanced settings.

> **Note**
> Refer to your Signature user manual for information about Flow Rate Input Setup and Volume Input Setup.

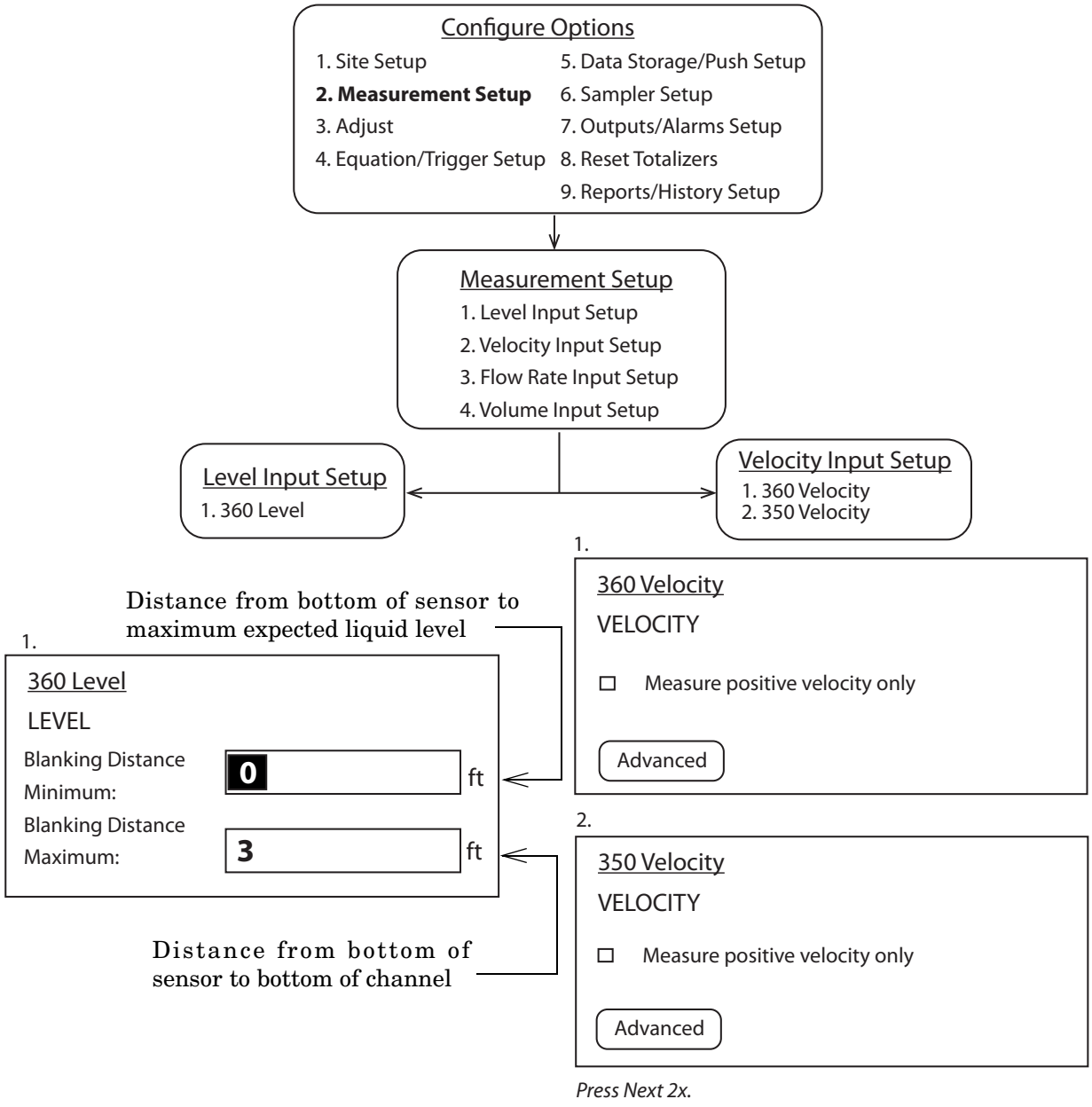


Figure 3-3 Measurement Setup: Sensor input settings (optional 350 AV Sensor also shown)

3.2.1 360 Level

The **Minimum Blanking Distance** is the distance from the bottom of the sensor to the liquid surface at the highest expected level. Depending on the elevation of your sensor, this value may be increased to help ensure that echoes read by the flow meter come only from the surface of the flow stream, and not off the walls or sides of the channel.

The **Maximum Blanking Distance** is the distance between the bottom of the sensor and the bottom of the channel (i.e., zero level). You can enter a larger value than calculated, if you prefer.

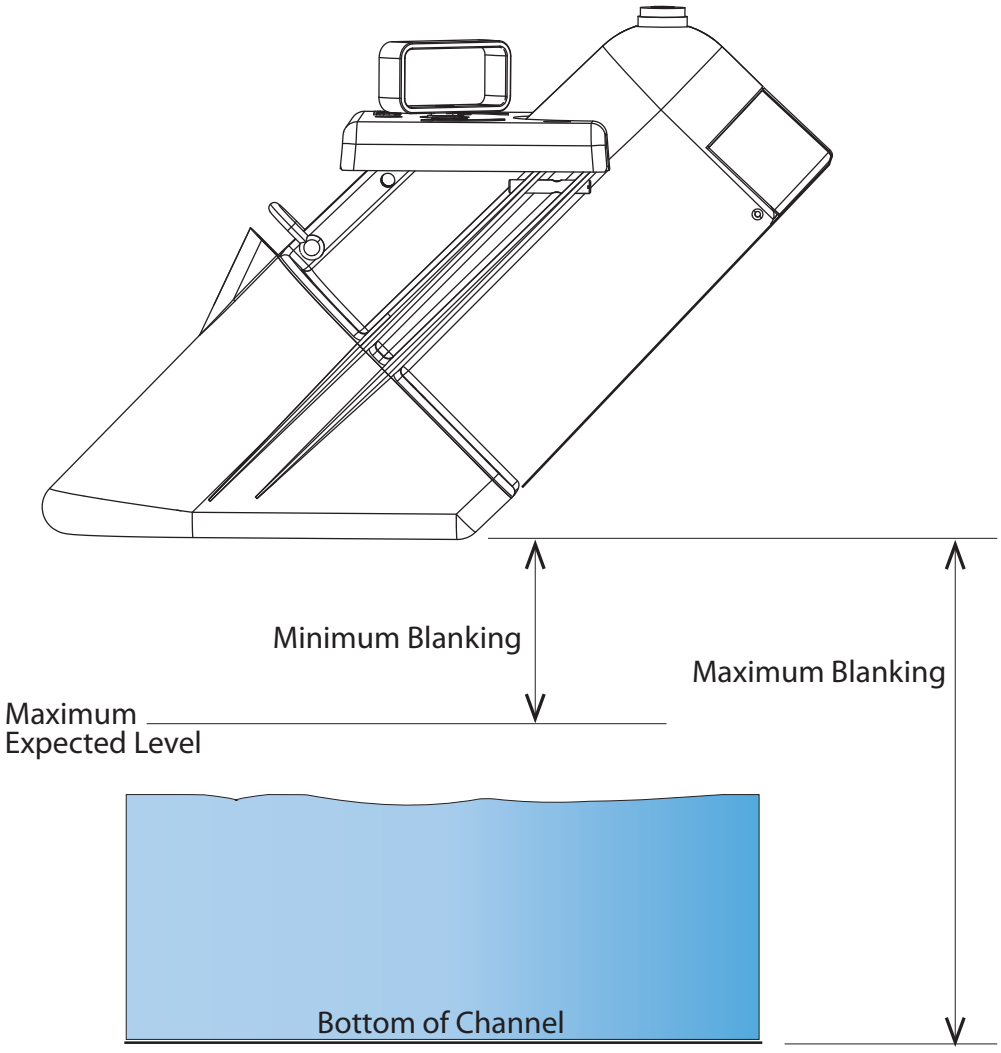


Figure 3-4 LaserFlow Ultrasonic Level: Determine blanking distances

3.2.2 360 Velocity

The LaserFlow takes a second velocity measurement to determine the direction of the flow. When the *Measure positive velocity only* setting is selected, the LaserFlow will not attempt to determine flow direction. Selecting this setting will save power. This setting is on by default.

3.2.3 LaserFlow Velocity Advanced Settings

The sensor is pre-programmed at the factory with the **Advanced Settings** for your application. Should your application require the addition of any correction factors, the Advanced button opens the Advanced settings window (refer to Figure 3-5).

Prior to making any changes to the Advanced settings, record the factory settings in case you need to restore them later.

Input velocity coefficients can be adjusted for A, B, and C, where:

$V = A\ (\text{offset}) + BV\ (\text{slope}) + CV^2\ (\text{second-order parameter})$.

The value for Spectral Averages may be used to reduce noise and improve signal strength. The default setting is 5,000. If persistent low signal strength or velocity dropouts are indicated, enter a high value, such as 10,000. If signal quality and measurement improve, try entering a lower value, such as 7,500, observing the signal quality. The lower the value for Spectral Average, the less time required for each complete measurement, reducing power usage. Adjust the value to determine a number that balances power usage with satisfactory signal quality and readings.

The Re-Home Count refers to the number of readings before the laser returns to home position. The default setting is 30. If persistent low signal strength or velocity dropouts are indicated, enter a lower value to fine-tune the homing function.

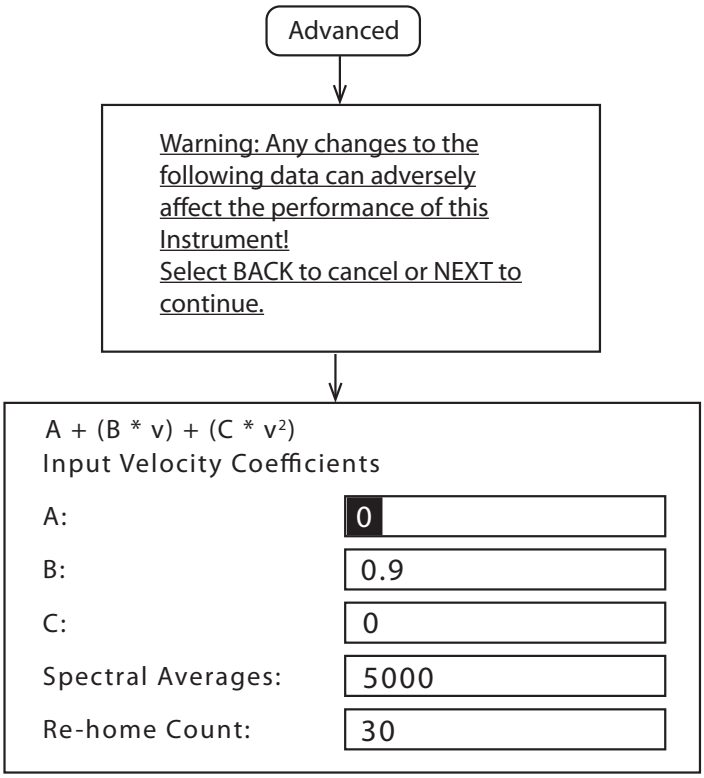


Figure 3-5 Measurement setup: Advanced settings for LaserFlow sensor

3.2.4 Adjust 350 Level (Optional)

If your system includes the optional surcharge sensor, it is also capable of measuring level with a pressure differential transducer.

The Level Adjustment screen is accessed via the Shortcuts menu on the Signature. From this screen, you can also update the display to show the current level of the stream.

Press SHORTCUTS (A) and select Adjust Level.

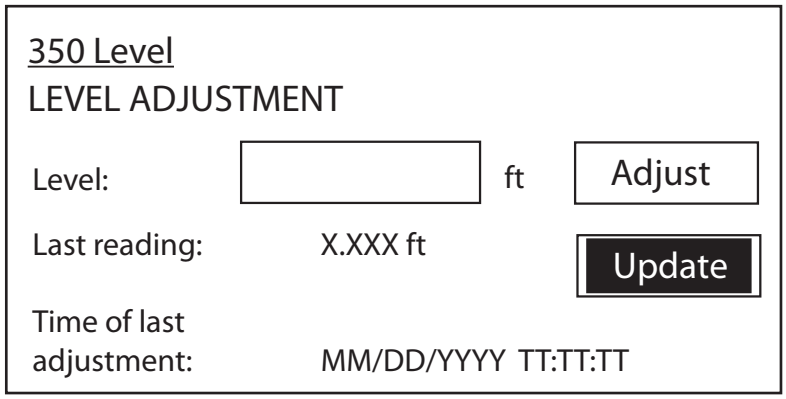


Figure 3-6 350 Level adjustment screen

To set an initial or new level, enter the value in the field next to **Level**, and select **Adjust**. To update the current reading, select **Update**.

Following installation, measure the distance between the bottom of the channel and the bottom of the LaserFlow to obtain the initial value for 350 Level (Figure 3-7).

It is recommended that the variable data storage rate function be used to trigger 350 velocity and level measurement based on a Level threshold.

Alarm setup and activation are explained in the Signature user manual under Outputs/Alarms Setup.

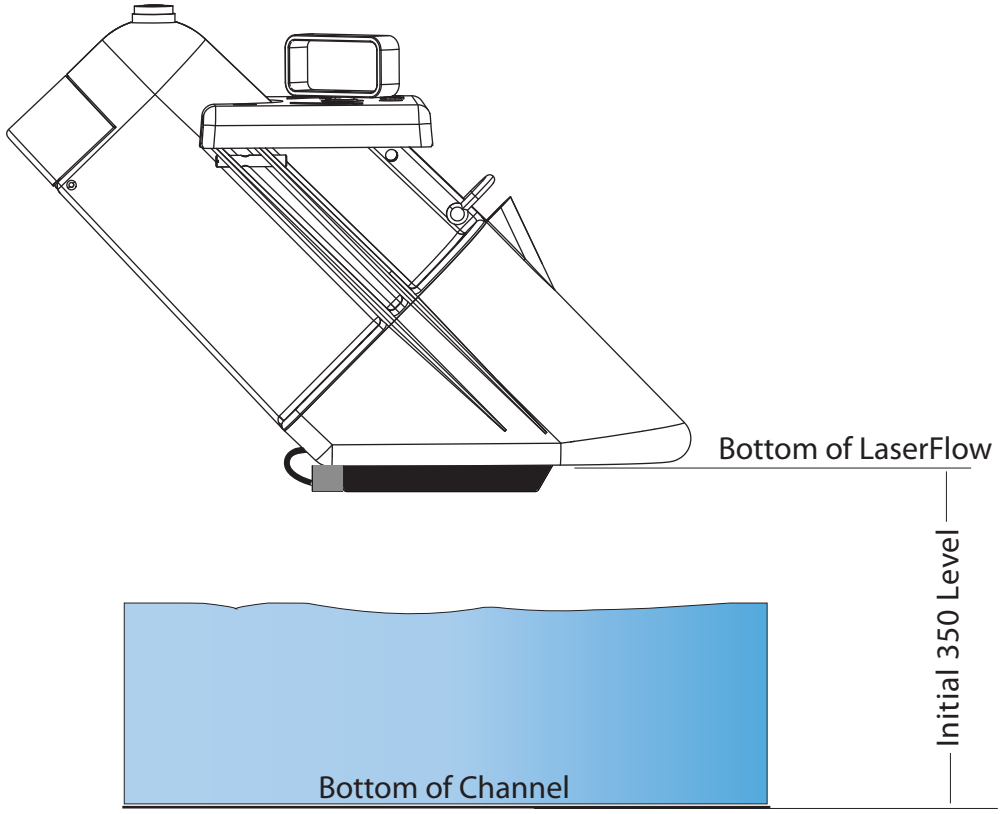


Figure 3-7 Submerged functionality: Initial 350 Level setting

3.2.5 350 Velocity (Optional)

If your system includes the optional submerged functionality or redundant measurement, it is also capable of measuring velocity with a continuous wave Doppler sensor.

The *Measure positive velocity only* setting causes any negative readings to be discarded in the average velocity calculation. If this is set to false, both positive and negative readings are used.

3.2.6 350 Advanced Settings (Optional)

The sensor is pre-programmed at the factory with the **Advanced Settings** for your application. Should your application require the addition of any correction factors, the Advanced button opens the Advanced settings window (Figure 3-8).

Prior to making any changes to the Advanced settings, record the factory settings in case you need to restore them later.

Input velocity coefficients can be adjusted for A, B, and C, where:

$V = A \text{ (offset)} + BV \text{ (slope)} + CV^2 \text{ (second-order parameter)}$.

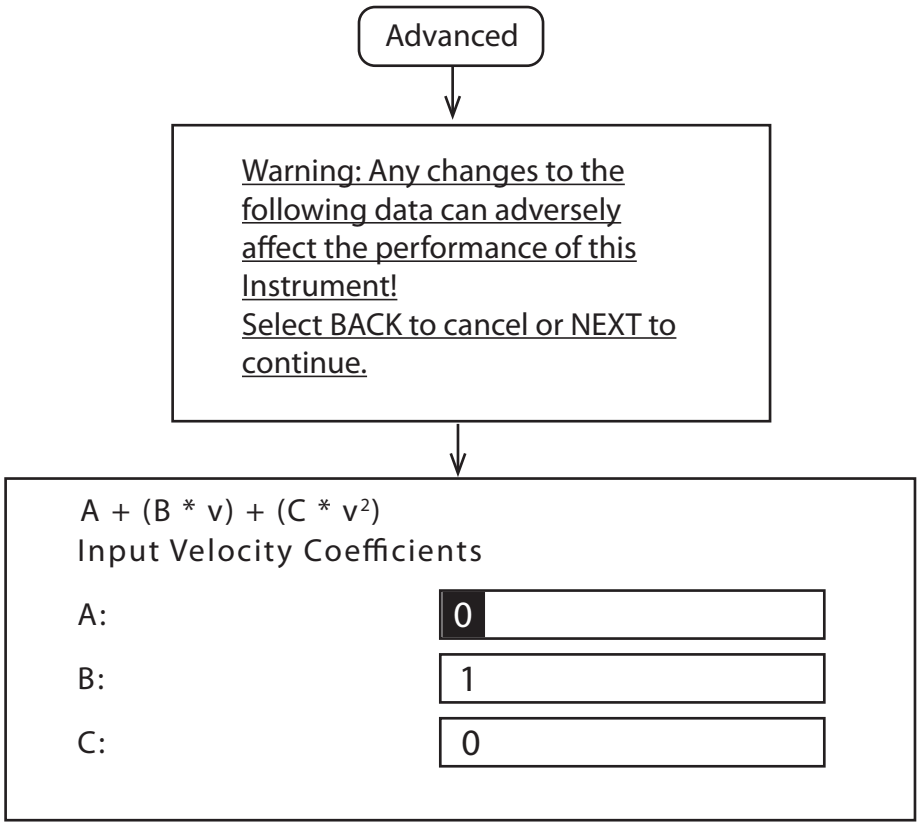


Figure 3-8 Measurement setup: Advanced settings for 350 AV sensor

3.3 360 Velocity Grid

The 360 Velocity screen has a grid containing 15 possible measurement points. Use the Shortcuts > Adjust function to navigate to this screen (refer to Figure 3-9).

The measurement points are activated and deactivated with the arrow and Enter keys. To save the measurement settings, highlight Update and press Enter.

As the LaserFlow begins to take readings, the grid becomes populated with a velocity reading and time stamp for each active measurement point (points where a valid reading could not be obtained will display the word "invalid").

Prior to operation, the LaserFlow sensor must be set up for measurement using the 360 Velocity grid. Refer to Section 3.4.

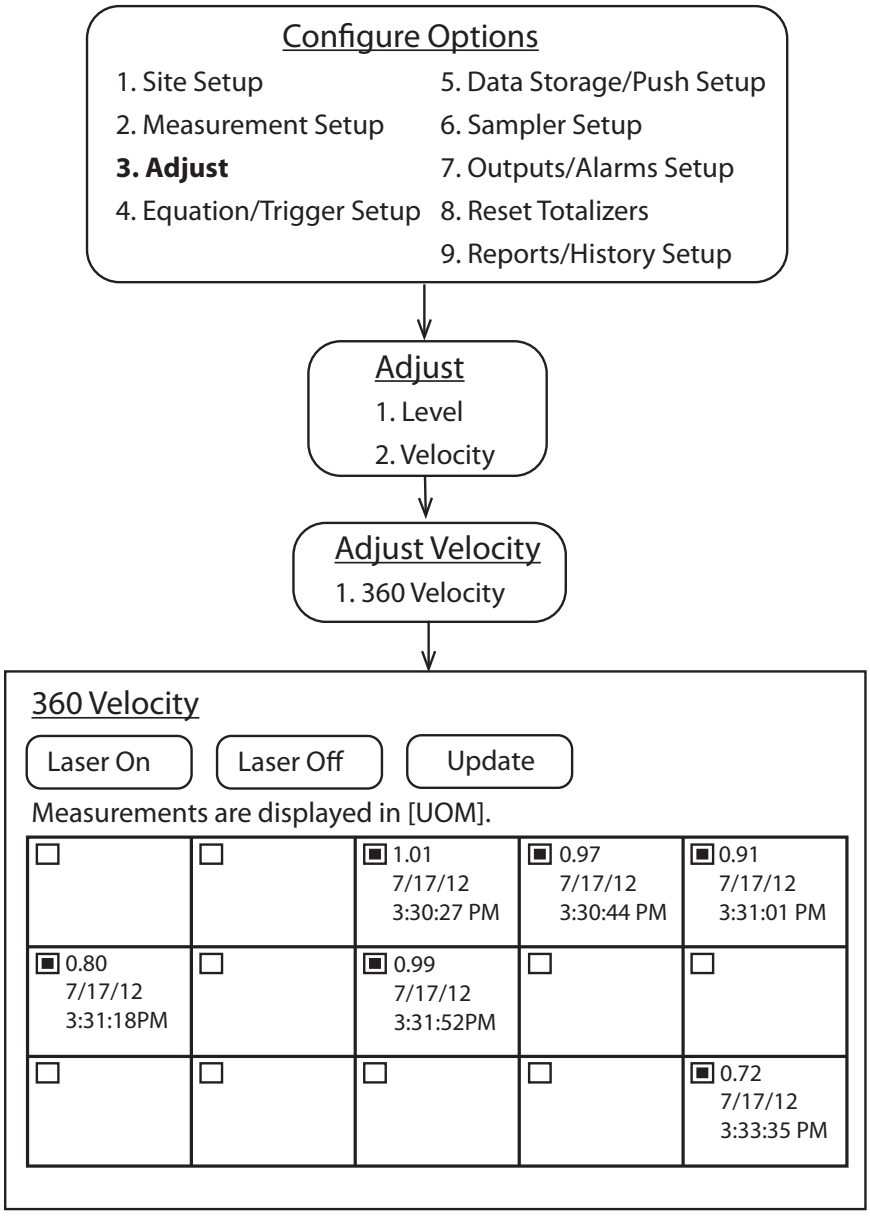
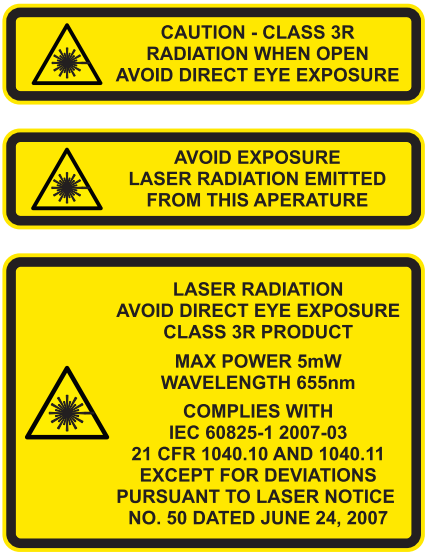


Figure 3-9 360 Velocity grid

3.4 Sensor Positioning and Adjustment



3.4.1 Centering the LaserFlow Sensor

Proper positioning of the LaserFlow sensor is critical for optimal velocity measurement. In center position, the laser beam must strike the flow stream precisely in the center.

For this final adjustment, ensure that only the top center measurement point is activated (Figure 3-10).

Laser On

Select Laser On and press Enter. This will keep the laser beam on continuously for 10 minutes or until Laser Off is selected, allowing the beam to be used for fine-tuning the sensor's position.

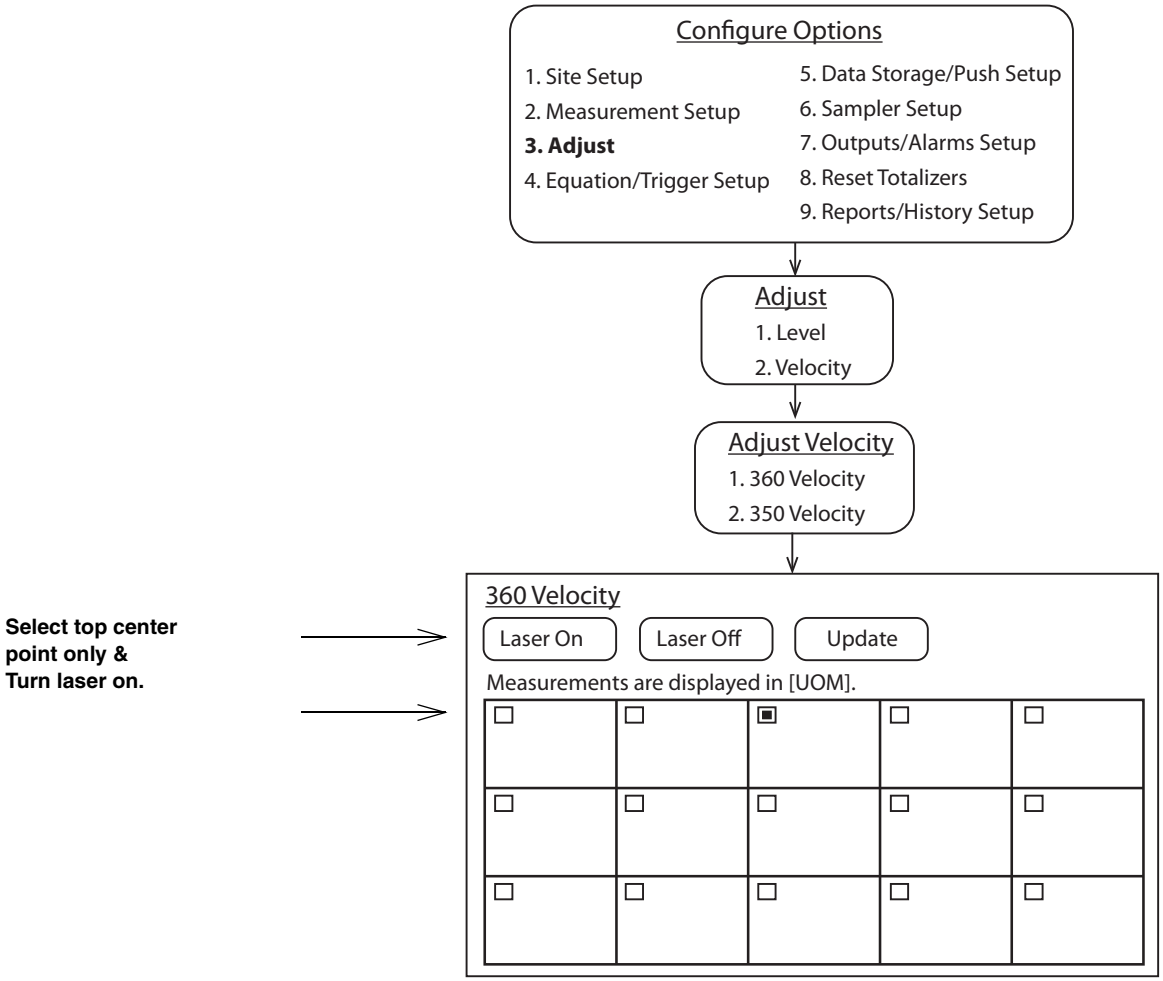


Figure 3-10 Laser velocity adjustment and positioning - Signature

When positioning is complete, **tighten all mounting hardware**.

3.4.2 Laser Velocity Measurement Point Selection

Once the LaserFlow sensor is installed over the flow stream, some installations may only require the center laser position for velocity measurement.

For installations requiring multiple measurement points, the next step is to determine which points will be used. To do so, activate all 15 points and wait for all of them to display their readings (approximately 15 minutes).

Each point will display either a velocity reading and time stamp, or the word “invalid.” Deselect all invalid points, as well as any others determined to be unnecessary (the fewer points selected, the less time required to complete one velocity measurement).

Select all 15 measurement points and Update.

360 Velocity

Laser On | Laser Off | Update

Measurements are displayed in [UOM].

☑ Invalid	☑ Invalid	☑ 1.01 7/17/12 3:30:27 PM	☑ 0.97 7/17/12 3:30:44 PM	☑ 0.91 7/17/12 3:31:01 PM
☑ 0.80 7/17/12 3:31:18PM	☑ Invalid	☑ 0.99 7/17/12 3:31:52PM	☑ Invalid	☑ Invalid
☑ Invalid	☑ Invalid	☑ Invalid	☑ Invalid	☑ 0.72 7/17/12 3:33:35 PM

Deselect invalid (and undesired) points and Update.

360 Velocity

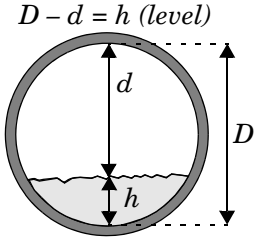
Laser On | Laser Off | Update

Measurements are displayed in [UOM].

☐	☐	☑ 1.01 7/17/12 3:30:27 PM	☑ 0.97 7/17/12 3:30:44 PM	☑ 0.91 7/17/12 3:31:01 PM
☑ 0.80 7/17/12 3:31:18PM	☐	☑ 0.99 7/17/12 3:31:52PM	☐	☐
☐	☐	☐	☐	☑ 0.72 7/17/12 3:33:35 PM

Figure 3-11 Selection of velocity measurement points

3.4.3 Ultrasonic Level Adjustment



Once the LaserFlow sensor is installed over the flow stream, measure the present liquid level (see figure at left) and enter this value for Level, under Adjust options. Then highlight **Adjust** and press Enter to confirm.

From this screen, you can also update the display to show the current level of the stream.

☑ Note

Level adjustment of a newly installed and activated sensor should be performed only after the sensor is allowed to stabilize under site conditions (allow approximately one hour per 10 °F difference between storage and operating environments).

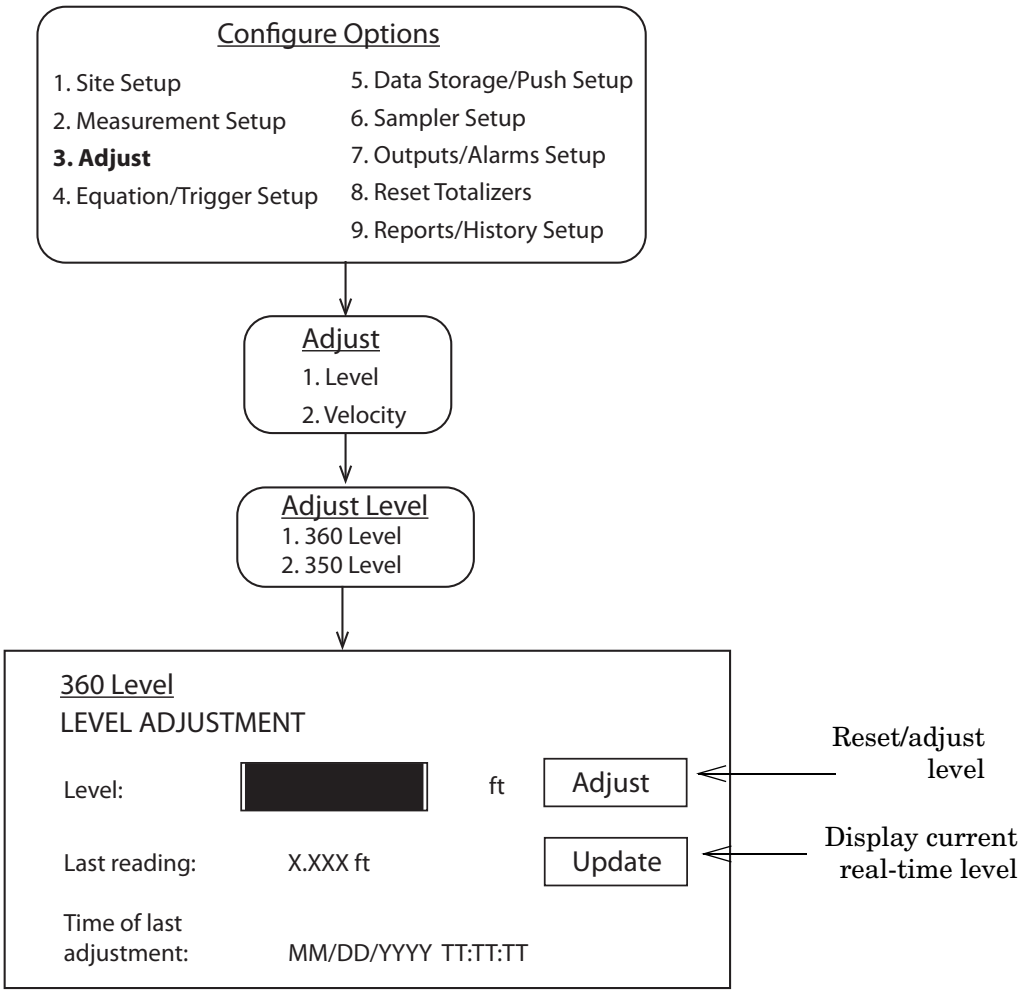


Figure 3-12 Ultrasonic level adjustment

3.5 Contact Teledyne Isco

If you have further questions about the installation, operation, and maintenance of your TIENet device, please contact Environmental Product Support at:

Teledyne Isco
4700 Superior St.
Lincoln, NE 68504

Phone: 866 298-6174 or 402 464-0231
Fax: 402 465-3022
E-mail: IscoService@teledyne.com

TIENet™ 360 LaserFlow™ Velocity Sensor

Section 4 Setup with 2160 LaserFlow Module

The LaserFlow sensor is compatible with both the Isco 2160 LaserFlow Module and the Isco Signature Flow Meter. For Signature setup instructions, refer to Section 3.

The 2160 is programmed and set up using Isco Flowlink® software. This section of the manual describes activation of connected sensors, and basic LaserFlow and optional TIENet 350 level and velocity measurement setup.

This section of the manual assumes the 2160 site is already set up in Flowlink, and the 2160 module is connected to Flowlink. Detailed Flowlink instructions are available in the Flowlink Windows Help and also in the Flowlink software user manual. For complete information about the 2160 LaserFlow Module, refer to the 2160 user manual.

4.1 Activating Connected Sensors

To add an available (connected) LaserFlow sensor or optional 350 AV sensor and make it active in Flowlink, open the TIENet tab (Figure 4-1), highlight the desired 2160 module, and click Configure...

In the Add/Remove window, click Scan to detect any newly connected LaserFlow or 350 Area Velocity sensors. They will appear in the Available TIENet Devices window.

Highlight the desired device(s) and click Add to make them active. Active TIENet devices will appear in the Active TIENet Devices window. Click OK.

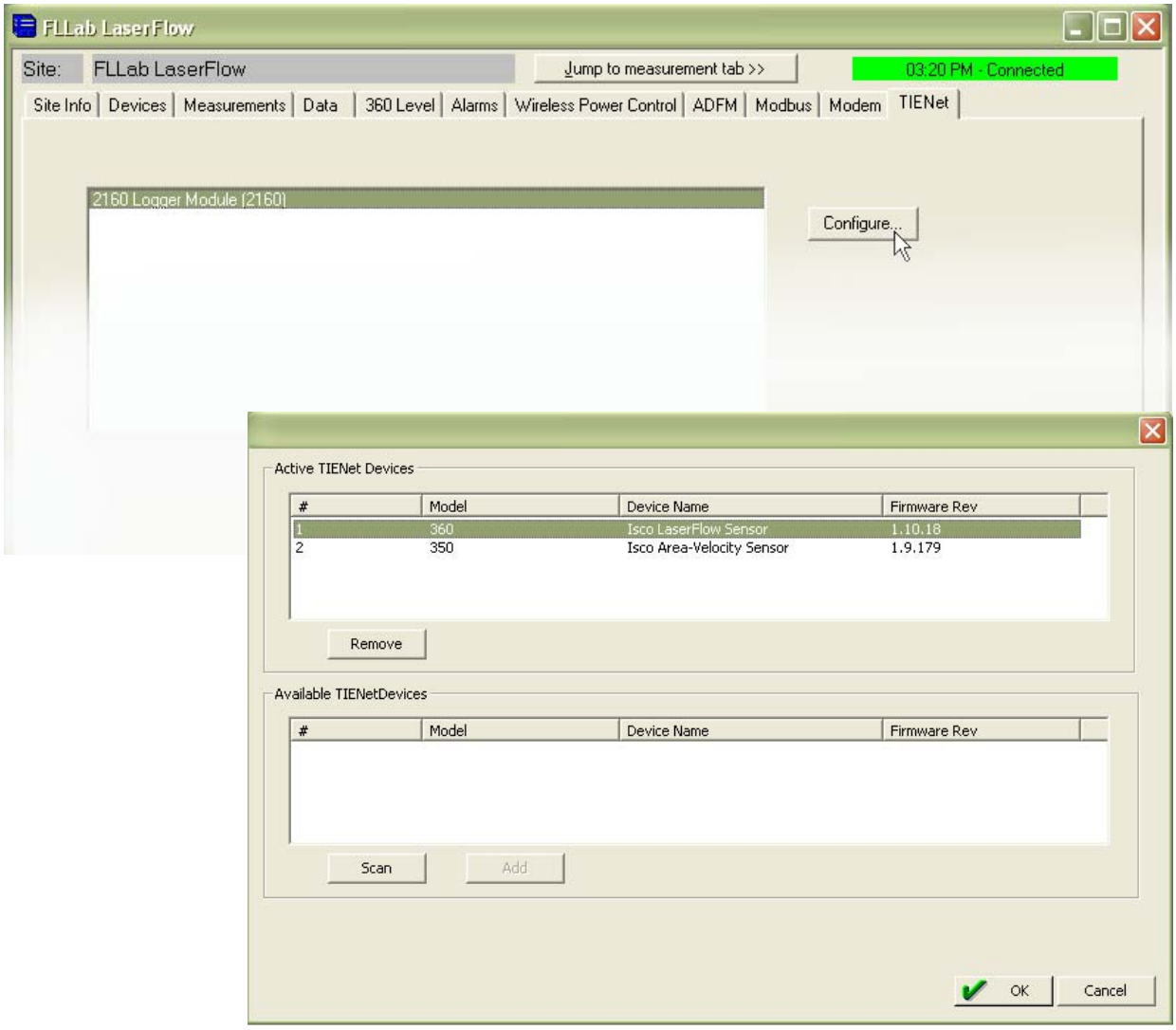


Figure 4-1 Activating connected sensors in Flowlink

4.2 Measurement Display and Settings

In Flowlink, the **Measurements** tab in the Site window lists the data types being measured by the 2160 and displays their real-time measurements.

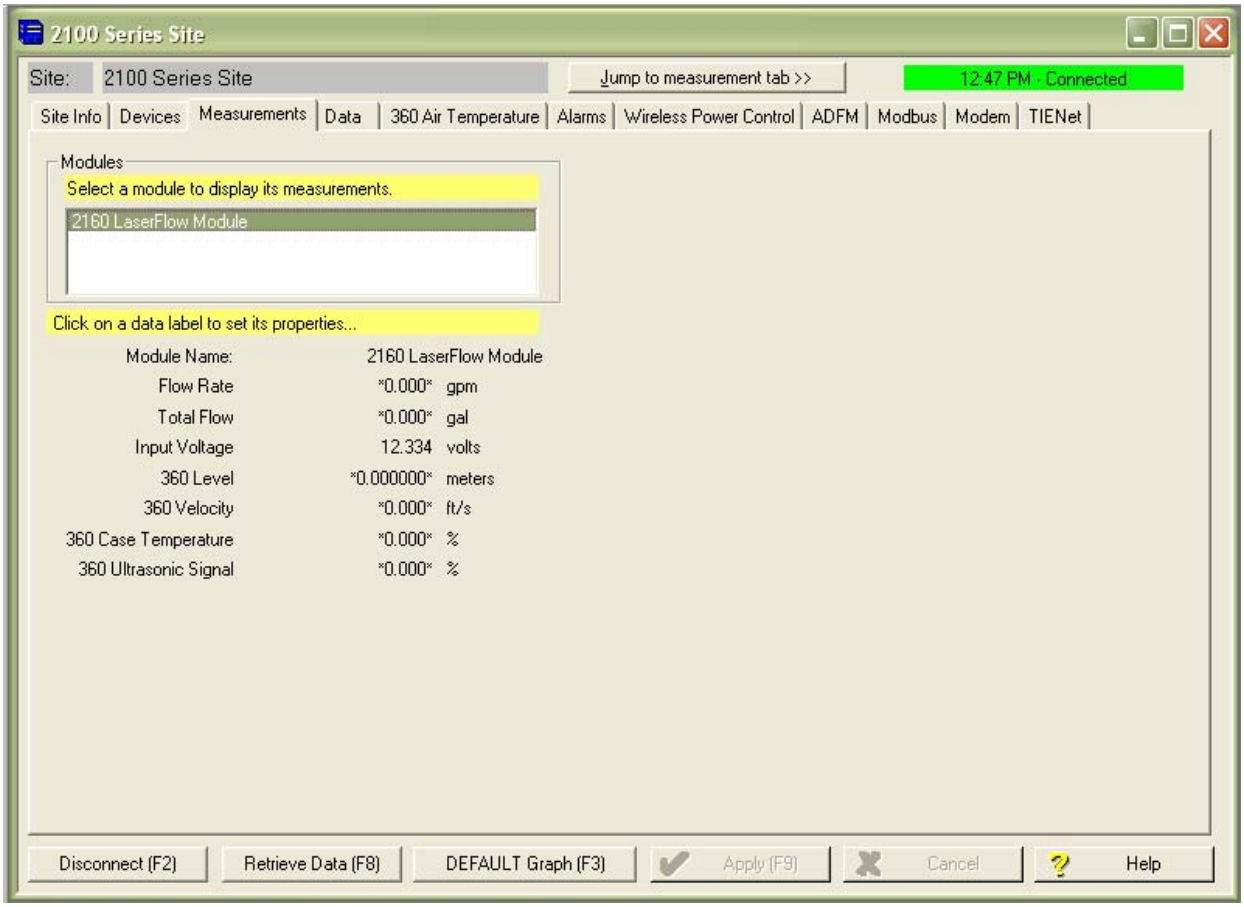


Figure 4-2 Measurements Tab: Displays all real-time measurements

To select and configure any parameter for your connected devices, click the **Jump to measurement tab >>** button at the top of the Site window and hover the pointer over the 2160. If your system includes the optional submerged functionality or redundant measurement, additional parameters will appear for the connected TIENet 350 Area Velocity sensor. Explanations for some of the listed measurements are provided in Figure 4-3.

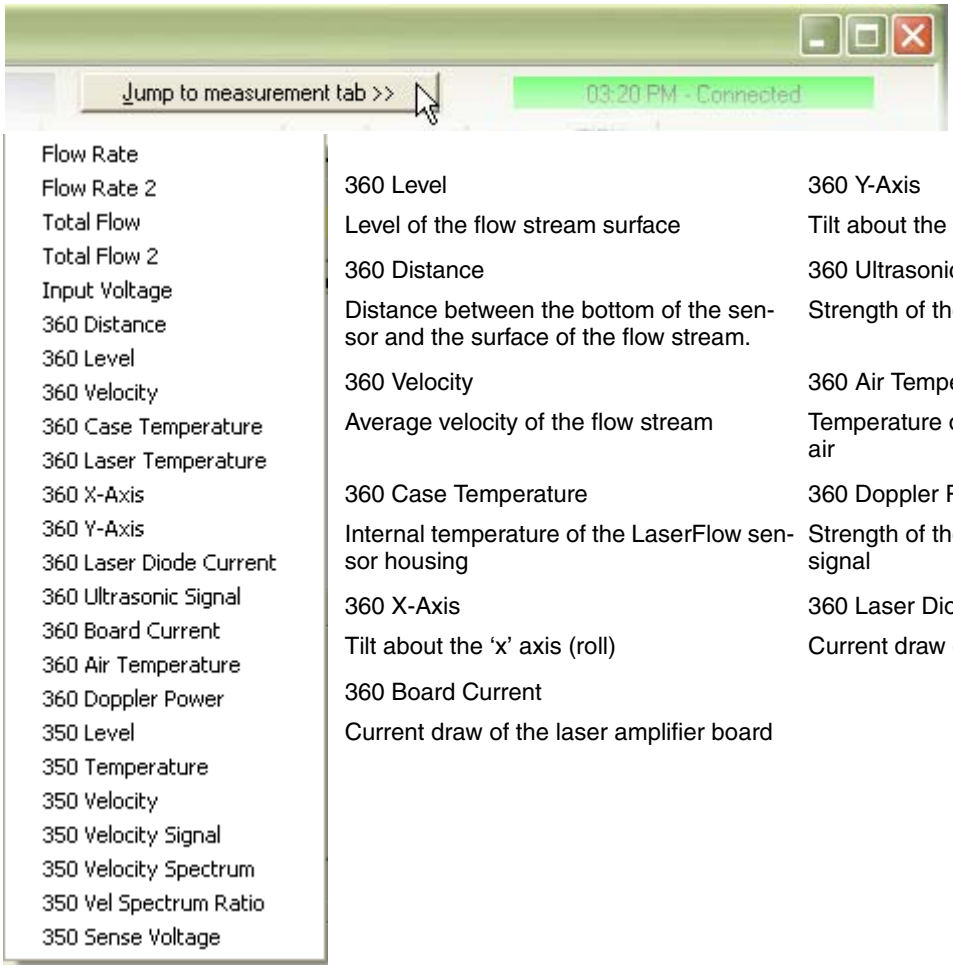


Figure 4-3 Drop down list of measurements for 2160 Module

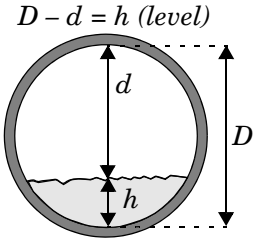
Click on any parameter on the Measurements tab or in the Jump to list to open a dedicated tab to view details or set up data storage.

To prevent a parameter from being displayed on the Measurements tab, check the **Hide in Measurements** box.

The settings for level and velocity input are defined on their respective tabs in Flowlink. To save any changes made to the settings, click the **Apply** button at the bottom of the tab.

4.2.1 360 Level

Ultrasonic Level Adjustment



The **Measurement** field displays the most recent level reading.

Once the LaserFlow sensor is installed over the flow stream, measure the present liquid level (see figure at left). Enter this value in the Adjust level field. After you click Apply, the level you entered will appear in the Measurement field.

Note

Level adjustment of a newly installed and activated sensor should be performed only after the sensor is allowed to stabilize under site conditions (allow approximately one hour per 10 °F difference between storage and operating environments).

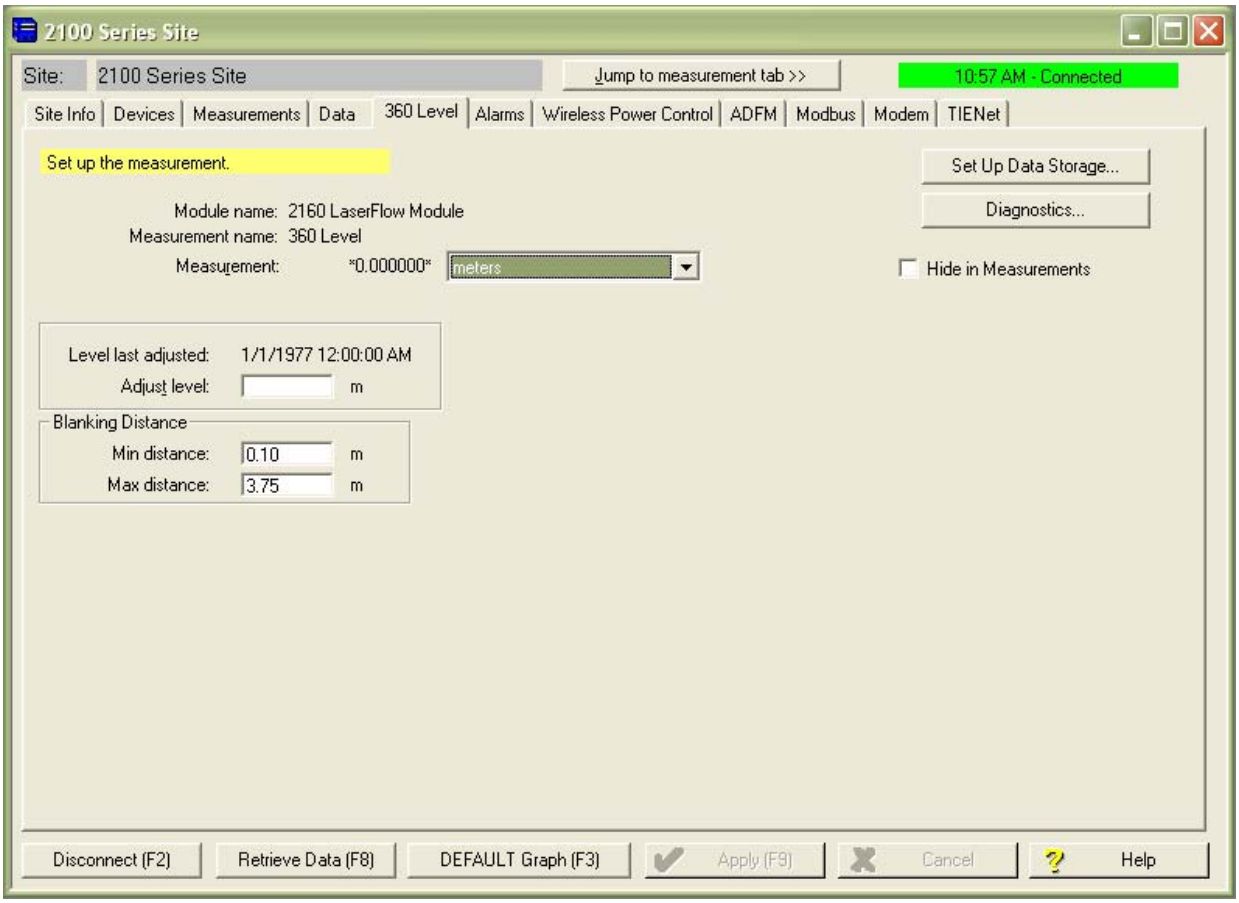


Figure 4-4 360 Level Measurement tab in Flowlink

The **Minimum Blanking Distance** is the distance from the bottom of the sensor to the liquid surface at the highest expected level. Depending on the elevation of your sensor, this value may be increased to help ensure that echoes read by the flow meter come only from the surface of the flow stream, and not off the walls or sides of the channel.

The **Maximum Blanking Distance** is the distance between the bottom of the sensor and the bottom of the channel (i.e., zero level). You can enter a larger value than calculated, if you prefer.

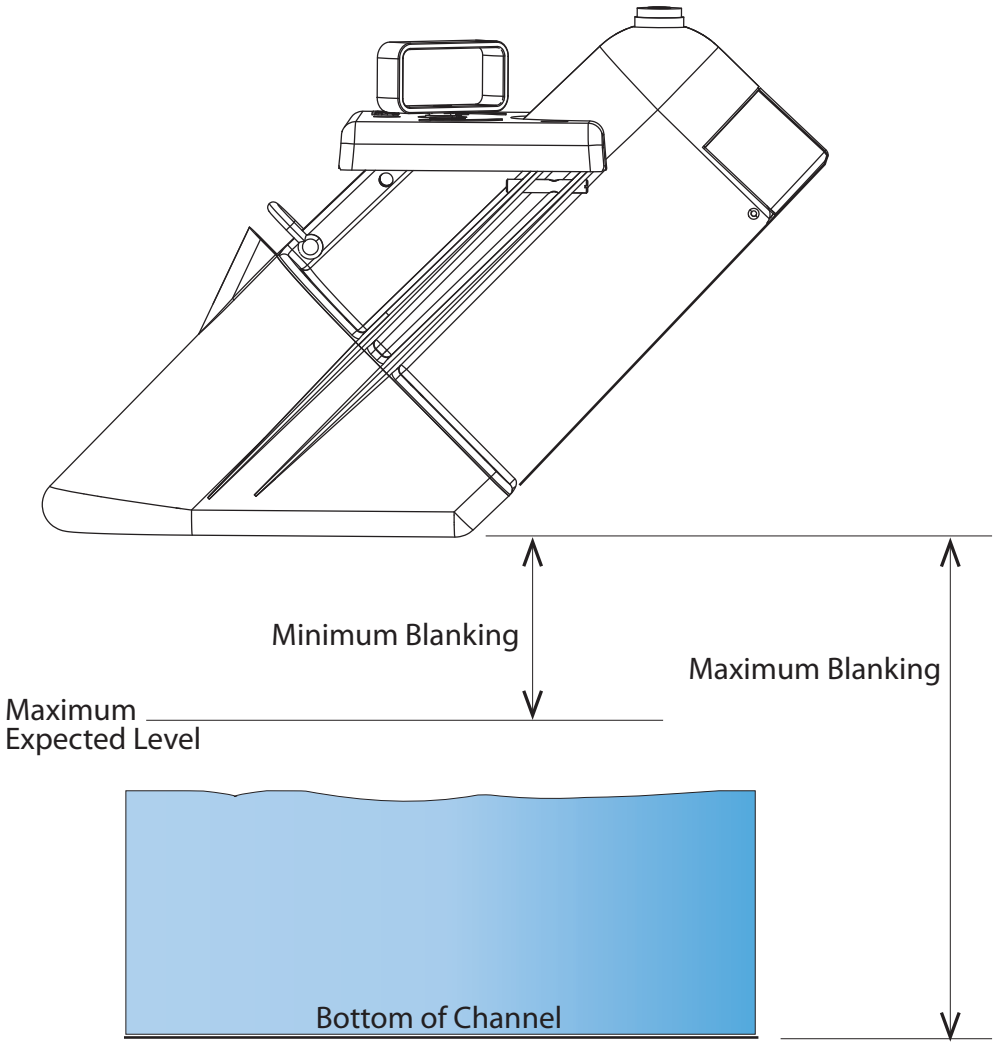


Figure 4-5 360 Level: Setting blanking distances

4.2.2 360 Velocity

The 360 Velocity measurement tab has a grid containing 15 possible measurement points. The measurement points are activated and deactivated by checking or unchecking their boxes. To save the measurement settings, click Apply (F9).

As the LaserFlow begins to take readings, the grid becomes populated with a velocity reading and time stamp for each active measurement point (points where a valid reading could not be obtained will display the word “invalid”).

Prior to operation, the LaserFlow sensor must be set up for measurement using the 360 Velocity grid. Refer to Section 4.3 *Sensor Positioning and Adjustment*.

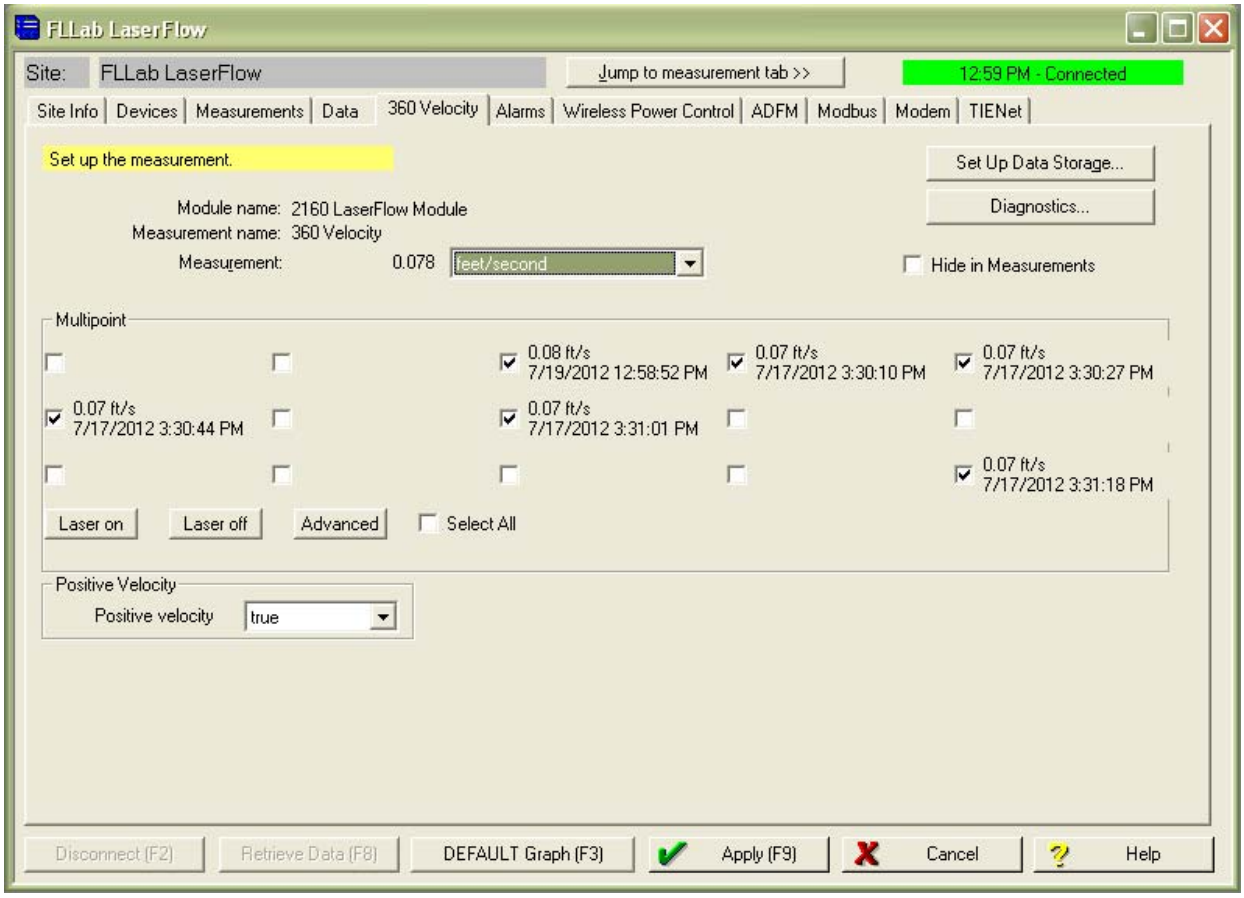


Figure 4-6 360 Velocity Measurement tab in Flowlink

The LaserFlow takes a second velocity measurement to determine the direction of the flow. When the *Measure positive velocity only* setting is selected, the LaserFlow will not attempt to determine flow direction. Selecting this setting will save power. This setting is on by default.

The **LaserFlow Advanced Settings** are pre-programmed into the sensor at the factory. However, if your application requires the addition of any correction factors, the Advanced button opens the Advanced settings window (refer to Figure 4-7).

Prior to making any changes to the Advanced settings, record the factory settings in case you need to restore them later.

Input velocity coefficients can be adjusted for A, B, and C, where:

$V = A$ (offset) + BV (slope) + CV^2 (second-order parameter).

The value for Spectral Averages may be used to reduce noise and improve signal strength. The default setting is 5,000. If persistent low signal strength or velocity dropouts are indicated, enter a high value, such as 10,000. If signal quality and measurement improve, try entering a lower value, such as 7,500, observing the signal quality. The lower the value for Spectral Average, the less time required for each complete measurement, reducing power usage. Adjust the value to determine a number that balances power usage with satisfactory signal quality and readings.

The Re-Home Count refers to the laser motor's stored reference to its home position. The default setting is 30. If persistent low signal strength or velocity dropouts are indicated, enter a lower value to fine-tune the homing function of the laser's motor.

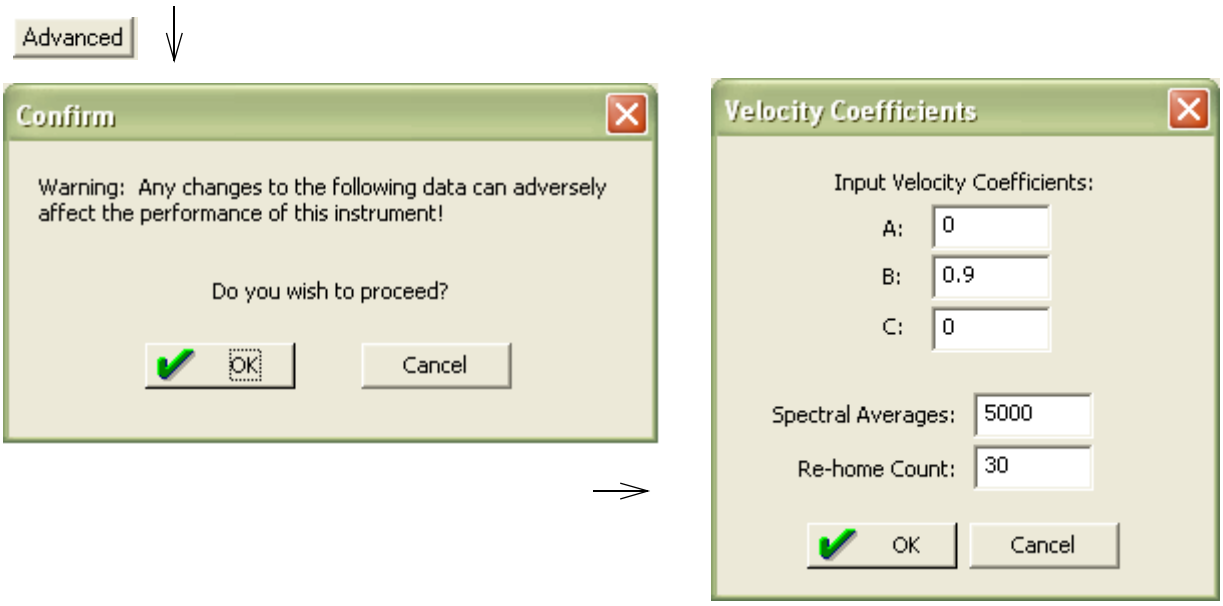


Figure 4-7 360 Velocity Tab: Advanced settings

4.2.3 350 Level (Optional)

If your system includes the optional surcharge sensor, it is also capable of measuring level with a pressure differential transducer. To set an initial or new level, enter the value in the **Adjust level** field. After you click Apply, the level you entered will appear in the Measurement field.

During setup for the optional surcharge functionality, measure the distance from the bottom of the channel to the bottom of the LaserFlow to set the initial level reading. Refer to Figure 4-9.

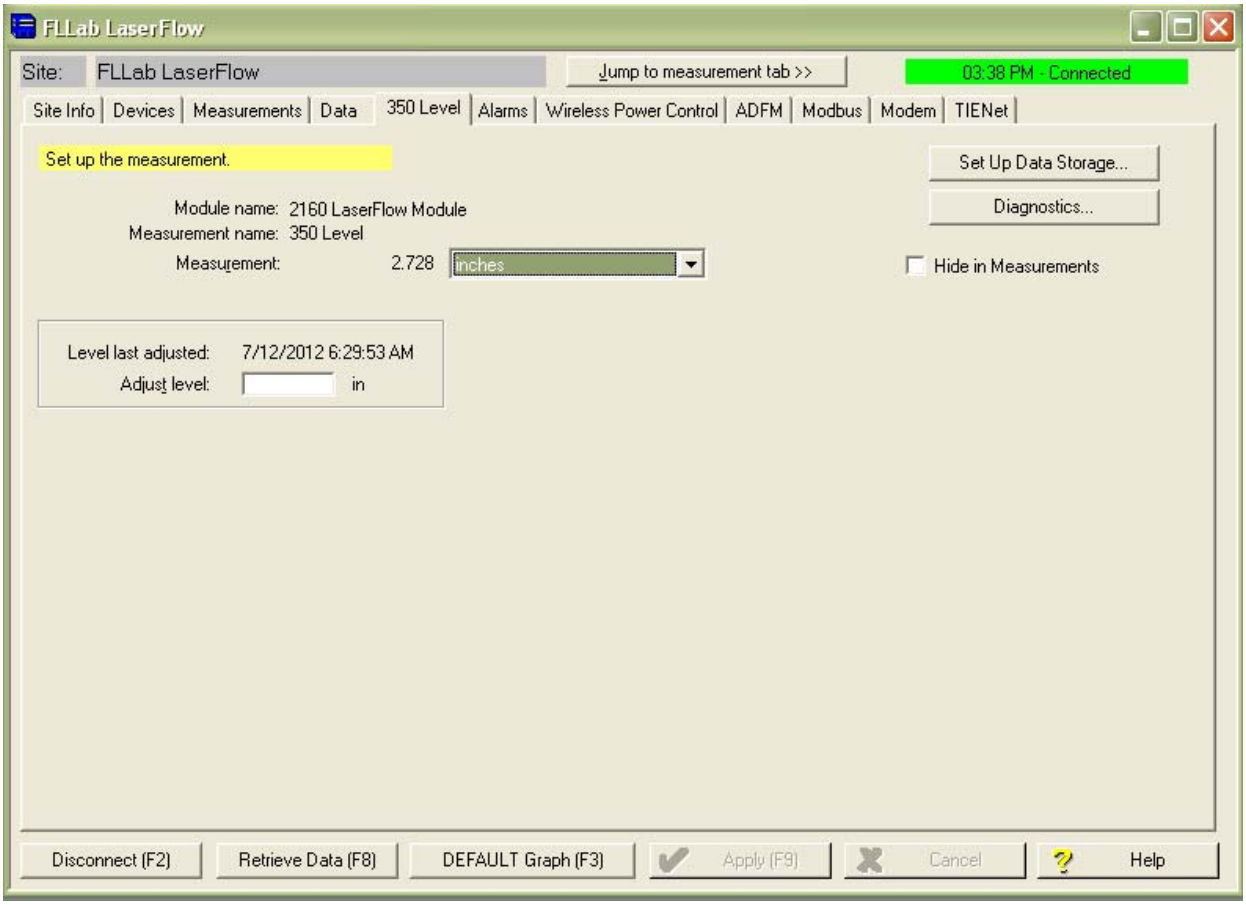


Figure 4-8 350 Level Measurement tab in Flowlink

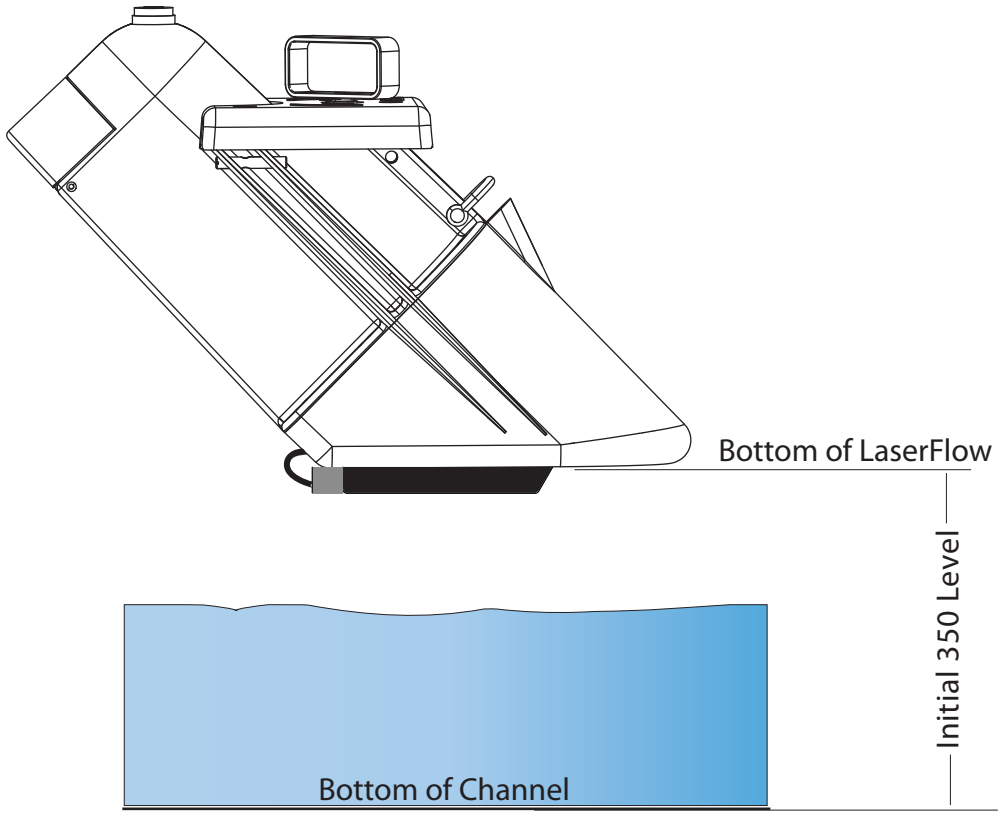


Figure 4-9 Submerged functionality: Initial 350 Level setting

Surcharge alarming

It is recommended that the variable data storage rate function be used to trigger 350 velocity and level measurement based on a Level threshold.

Alarm setup and activation are explained in the Flowlink software user manual and help windows, under Equation Builder, Condition Builder, and Threshold.

4.2.4 350 Velocity (Optional)

If your system includes the optional submerged functionality or redundant measurement, it is also capable of measuring velocity with a continuous wave Doppler sensor.

In the case of the submerged functionality, measure the distance between the bottom of the channel and the face of the pressure transducer (bottom of the LaserFlow) to obtain the initial value for 350 Level.

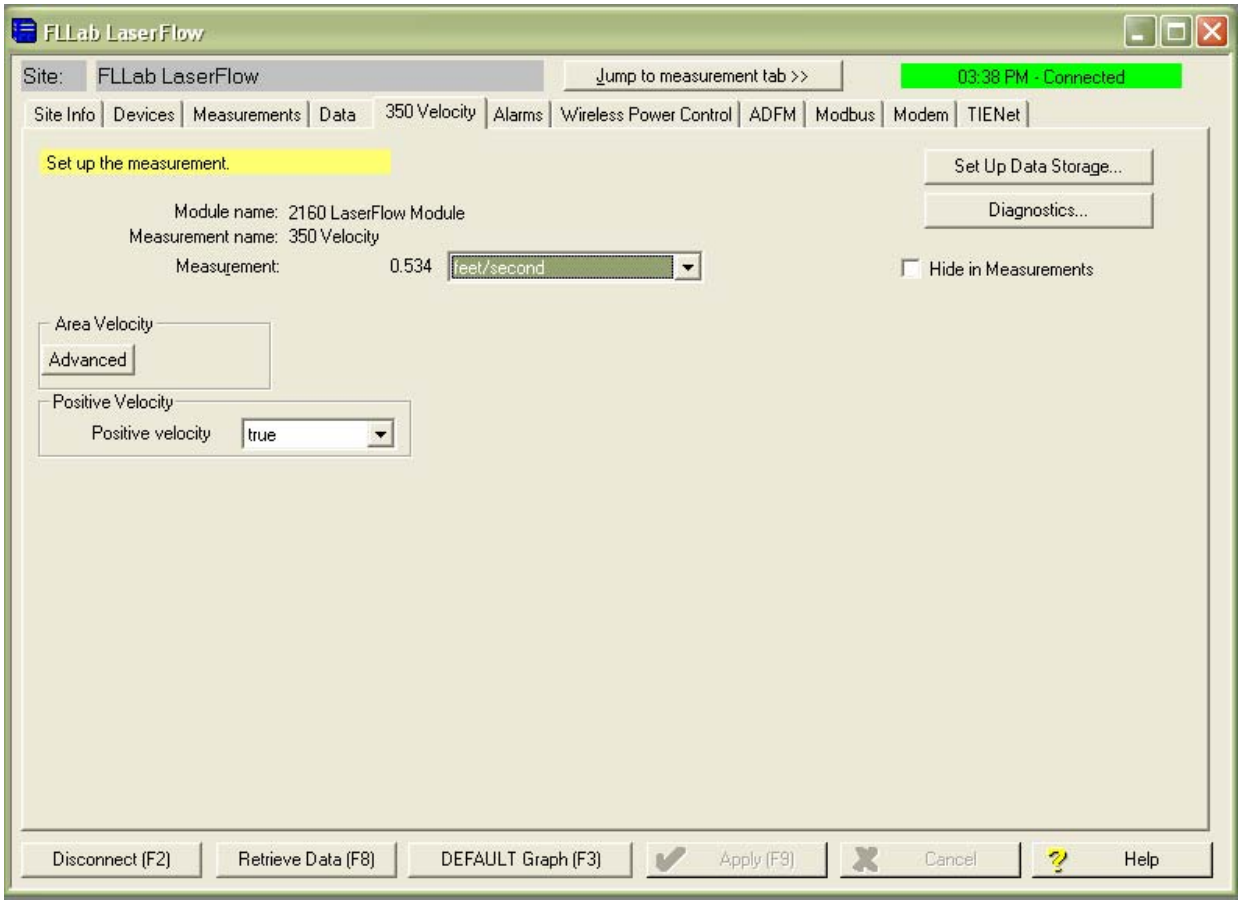


Figure 4-10 350 Velocity Measurement tab in Flowlink

The **Positive Velocity** setting, when set to true, causes any negative readings to be discarded in the average velocity calculation. If this is set to false, both positive and negative readings are used.

The **350 Advanced Settings** are pre-programmed into the sensor at the factory. However, if your application requires the addition of any correction factors, the Advanced button opens the Advanced settings window (refer to Figure 4-11).

Prior to making any changes to the Advanced settings, record the factory settings in case you need to restore them later.

Input velocity coefficients can be adjusted for A, B, and C, where:

$V = A$ (offset) + BV (slope) + CV^2 (second-order parameter).

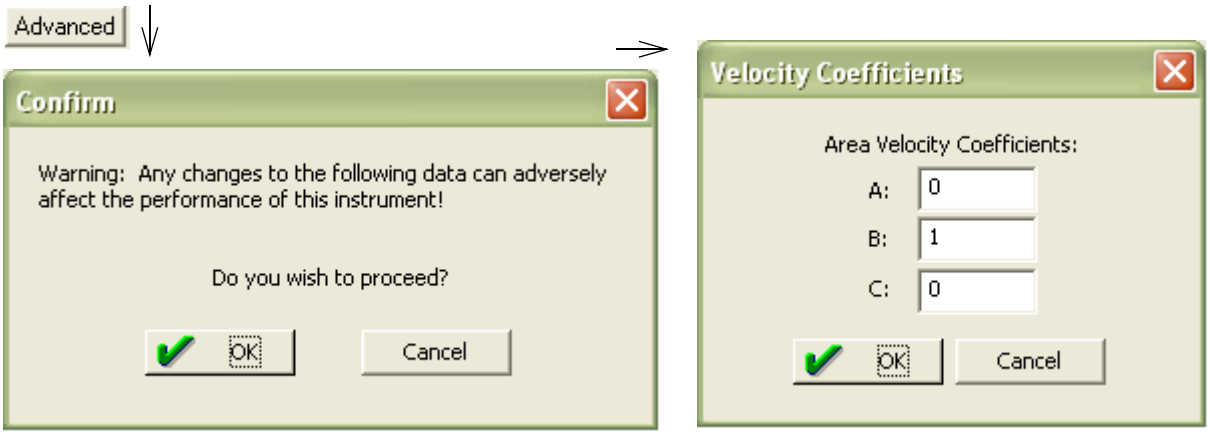
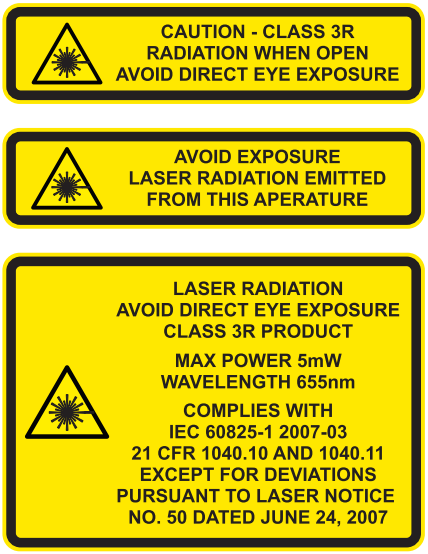


Figure 4-11 350 Velocity tab: Advanced settings for optional TIENet 350 AV sensor

4.3 Sensor Positioning and Adjustment

To set the initial level values, refer to Sections 4.2.1 (LaserFlow) and 4.2.3 (optional 350).



4.3.1 Centering the LaserFlow Sensor

Proper positioning of the LaserFlow sensor is critical for optimal velocity measurement. In center position, the laser beam must strike the flow stream precisely in the center.

For this final adjustment, ensure that only the top center measurement point is activated.

Laser on

Select Laser on and click Apply. This will keep the laser beam on continuously for 10 minutes or until Laser off is selected, allowing the beam to be used for fine-tuning the sensor's position.

When positioning is complete, **tighten all mounting hardware**.

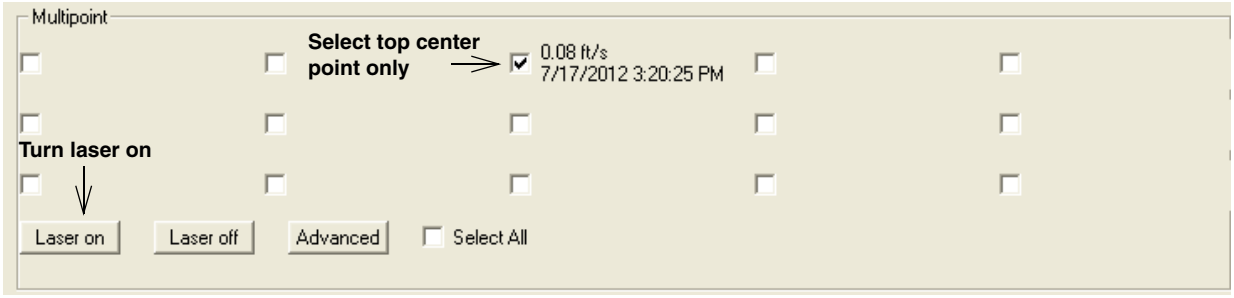


Figure 4-12 Laser velocity adjustment and positioning - 2160

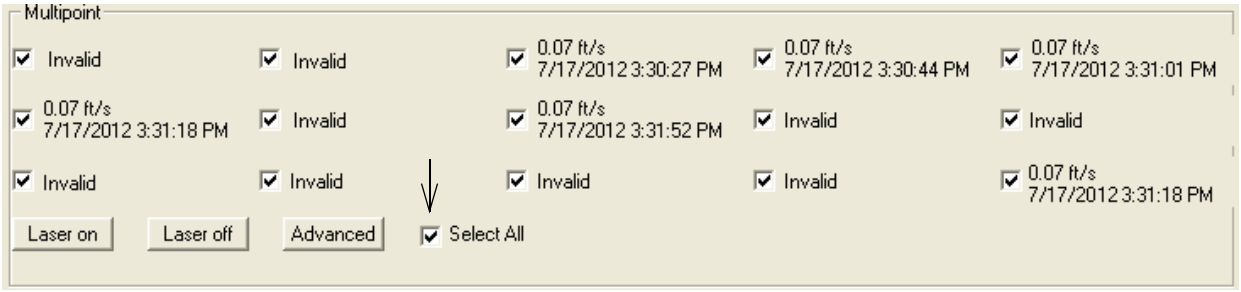
4.3.2 Laser Velocity Measurement Point Selection

Once the LaserFlow sensor is installed over the flow stream, some installations may only require the center laser position for velocity measurement.

For installations requiring multiple measurement points, the next step is to determine which points will be used. To do so, activate all 15 points and wait for all of them to display their readings (approximately 15 minutes).

Each point will display either a velocity reading and time stamp, or the word “invalid.” Deselect all invalid points, as well as any others determined to be unnecessary (the fewer points selected, the less time required to complete one velocity measurement).

Select all 15 measurement points and click Apply.



Deselect invalid (and undesired) points and click Apply.

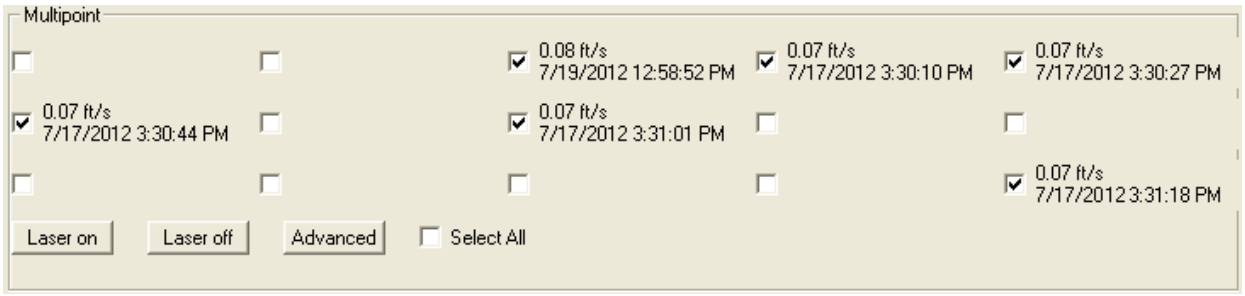


Figure 4-13 Selection of velocity measurement points

TIENet™ 360 LaserFlow™ Velocity Sensor

Section 5 Maintenance and Optional Kits

5.1 Firmware Updates

When firmware updates become available, they can be downloaded from www.isco.com or via email from the factory.

5.1.1 With Signature Flow Meter

The TIENet device's firmware is updated via the USB port on the front panel of the Signature Flow Meter. Step-by-step instructions for updating the firmware can be found in Section 2 of the Signature user manual.

5.1.2 With 2160 LaserFlow Module

The TIENet device's firmware is updated via the "Update Isco Instrument Software" tool from Flowlink for the 2160 module. Step-by-step instructions for updating the firmware can be found in the Help text of the update application.

5.2 Cleaning the Sensor Housing

The LaserFlow sensor's outer housing and ultrasonic transducer can be cleaned with warm water, mild soap, and a soft, lint-free cloth. Do not spray water on the laser window; install the protective window cap prior to cleaning.

⚠ CAUTION

Never use ordinary cloth or abrasives to clean the LaserFlow.

⚠ CAUTION

Be sure the protective window cap is installed during cleaning, storage, or shipment (refer to Section 1.7.1).

5.3 Accessing the LaserFlow's Interior

Several procedures for maintenance and options require accessing the interior of the sensor by separating the nose piece from the body, and subsequent reassembly. Refer back to this section when performing these procedures.

⚠ WARNING

Disconnect power from the LaserFlow sensor before opening the sensor housing.

Tools required

- #2 Phillips screwdriver (right-angled, if available)
- 7/16" Socket or nut driver (if only a straight Phillips is available)

5.3.1 Removing the Nose Piece

The screws that attach the nose piece to the body are difficult to access with a straight screwdriver, being somewhat obstructed by the mounting block. For this reason, you should either use a right-angled screwdriver or begin by removing the mounting block.

- If using a **right-angled screwdriver**, skip to Step 3.
- If using a **straight screwdriver**, first remove the mounting plate for better access to the screws, beginning with Step 1.

Procedure

1. Remove the 3 dome plugs from the mounting block (this may require a small flat screwdriver or similar tool).
2. Remove the 3 bolts holding the mounting block in place, and remove the mounting block.
   The bolts attach to cross-pins. Remove and set them aside.

Bolts and washers after removal, attached to their cross-pins for safe-keeping

Figure 5-1 Remove dome plugs (Bolts located underneath)

3. Remove the 6 large Phillips screws on the LaserFlow nose piece, and separate the nose from the body. **Do not remove any other screws.**

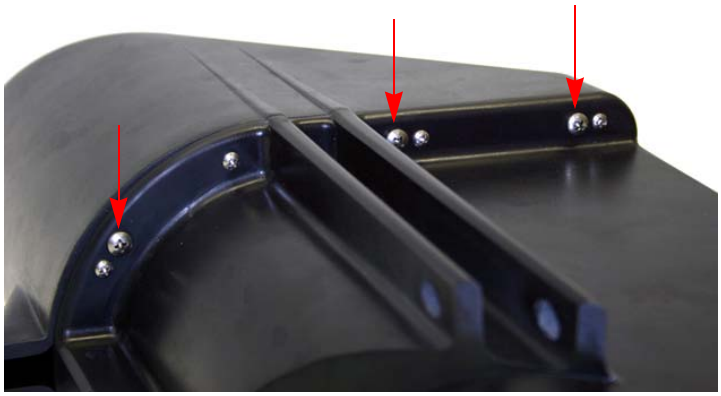


Figure 5-2 Remove large screws and nose piece (3 on each side)

5.3.2 Replacing the Nose Piece

1. Fasten the sensor back together by cross-tightening the 6 large Phillips screws in diagonal order until the two sections are flush against each other.

⚠ CAUTION

When reinstalling all self-tapping screws, avoid destroying the plastic threads. First seat each screw in its hole and, without pressing down, rotate the screw counter-clockwise until it falls into its thread groove with a "click." Then tighten the screw.

2. If applicable, reinstall the mounting block, ensuring that both flat and split washers are included.

Figure 5-3 Location and orientation of cross-pins for mounting block installation

5.4 Velocity Readings and the Laser Window

Invalid or inconsistent velocity readings may indicate debris or moisture condensation on the window protecting the laser.

An optional air blast function is available for periodic clearing of the window. Normally factory-installed, the air blast function is also offered as a user-installable kit. For installation instructions, refer to Section 5.6.

The laser window is crucial for focusing and should never be touched. Smudging or scratches can degrade the performance of the sensor. **For these reasons, cleaning the window is NOT recommended unless absolutely necessary.**

If cleaning must be performed, follow the instructions provided in Section 5.7 exactly.

5.5 Cleaning the Laser Window

The laser window is crucial for focusing and should never be touched. Smudging or scratches can degrade the performance of the sensor. **For these reasons, cleaning the window is NOT recommended unless absolutely necessary.**

⚠ CAUTION

Never touch the laser window. Never use ordinary cloth or water to clean the surface of the laser window.

Items required for cleaning

- Pre-packaged, pre-IPA-moistened, single-use, lint-free tissue, such as Zeiss Lens Cleaning Wipes or Bausch & Lomb Sight Savers®[1] Pre-Moistened Lens Cleaning Tissues.
- Kimwipes®[2] dry tissues
- Rain-X®[3] Original Glass Treatment

⚠ CAUTION

Never moisten the tissue with IPA or other solution *after* removing it from its package.

Procedure

You must access the LaserFlow's interior to clean the window. Instructions for opening and reassembling the LaserFlow are provided in Section 5.3 *Accessing the LaserFlow's Interior*.

⚠ WARNING

Disconnect power from the LaserFlow sensor before opening the sensor housing.

⚠ CAUTION

Do not attempt to clean the laser window without opening the sensor housing. Serious damage can result.

1. Sight Savers® is a registered trademark of Bausch & Lomb, Inc.
2. Kimwipes® is a registered trademark of Kimberly-Clark Corporation.
3. Rain-X® is a registered trademark of Illinois Tool Works, Inc.

1. Remove the folded tissue from its package and use the corners to lightly brush any abrasive material from the surface.
2. Unfold the tissue and gently clean the surface with downward strokes only, **keeping the tissue between your finger and the glass at all times**.
3. Examine the window closely under good lighting from all directions to ensure there are no smudges, streaks, or film on the surface.
   If the window is smudged, streaked, or still dirty, get a fresh pre-packaged tissue and repeat.
4. Next, fold a clean, dry Kimwipe tissue four times to reinforce its thickness, and gently clean the window surface with downward strokes only, **keeping the tissue between your finger and the glass at all times.**
5. Examine the window closely under good lighting from all directions to ensure there are no smudges, streaks, or film on the surface.
   If the window is smudged, streaked, or still dirty, get a fresh pre-packaged tissue and repeat.
6. Fold a fresh Kimwipe tissue as previously described and spray the closed end of it with Rain-X.

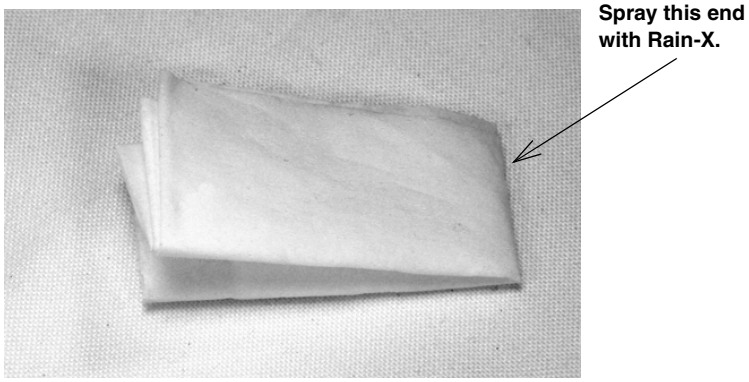


Figure 5-4 Cleaning the laser window: Moisten Kimwipe tissue w/ Rain-X

7. Apply the Rain-X to the entire window surface using downward strokes only.
8. After allowing 30 minutes for the Rain-X treatment to dry, wipe the window with another dry Kimwipe tissue, as described in step 4.
9. Carefully examine the window as previously described, and continue polishing the surface with fresh dry tissues until no streaks or film are visible.

Reassemble the sensor, following the steps provided in Section 5.3.2 *Replacing the Nose Piece*.

⚠ CAUTION

When reinstalling all self-tapping screws, avoid destroying the plastic threads. First seat each screw in its hole and, without pressing down, rotate the screw counter-clockwise until it falls into its thread groove with a "click." Then tighten the screw.

5.6 Installing the Optional Air Blast Kit

The air blast kit available from Teledyne Isco is intended for periodic clearing of the laser window.

Tools Required

To install the air blast kit, you will need the following items:

- 1/2" Open wrench
- 9/16" Open wrench
- Air blast kit from Teledyne Isco
  - PTFE Tubing with Swagelok fittings installed
  - Plastic bag w/ spare cap, ferrule, and Plastic cable ties that can be spaced 2 1/2 feet apart for the length of the power cable
- A user-supplied source of clean air, such as nitrogen, is required for this function. **Use only clean, oil-free air at no greater than 120 psig.**

5.6.1 Installation Procedure

You must access the LaserFlow's interior to install this option. Instructions for opening and reassembling the LaserFlow are provided in Section 5.3 *Accessing the LaserFlow's Interior*.

⚠ WARNING

Disconnect power from the LaserFlow sensor before opening the sensor housing.

⚠ CAUTION

While removing or installing a connection to the LaserFlow's gas inlet, always use the smaller open wrench to hold the connector in place and prevent it from turning. **Never loosen or tighten this fitting.**

⚠ CAUTION

NEVER touch the window or get it dirty.

1. Remove the connector fitting from the tubing end.

Figure 5-5 Gas tubing: Remove connector fitting

2. Using the two open wrenches, remove the cap from the gas fitting on the LaserFlow's inner panel.

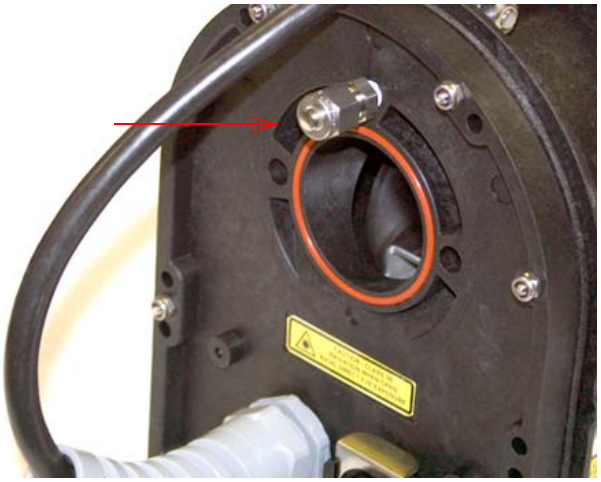


Figure 5-6 Unscrew cap from gas inlet

3. Thread the female end of the gas tubing through the shackle alongside the sensor cable, and, using both wrenches, attach it to the gas inlet.

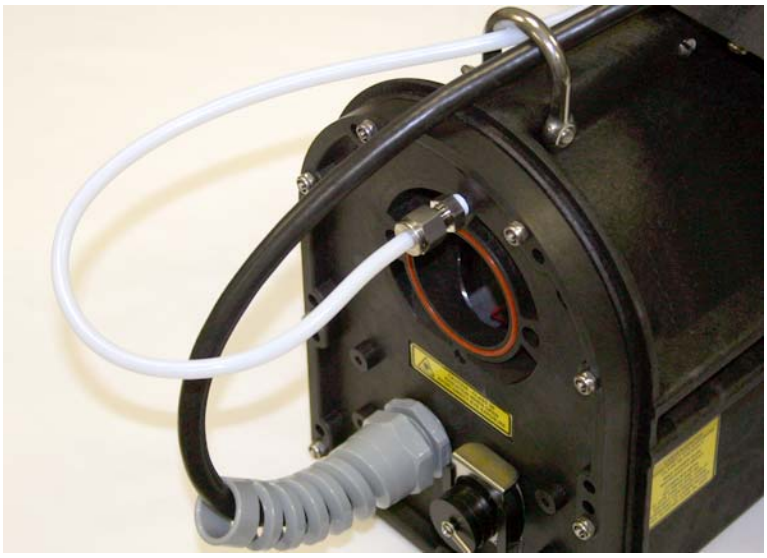


Figure 5-7 Attach gas tubing to inlet

4. Taking care not to pinch or bind the tubing and cable, arrange them in the cable slot on the top of the nose piece. Bring the two sections of the sensor housing back together.

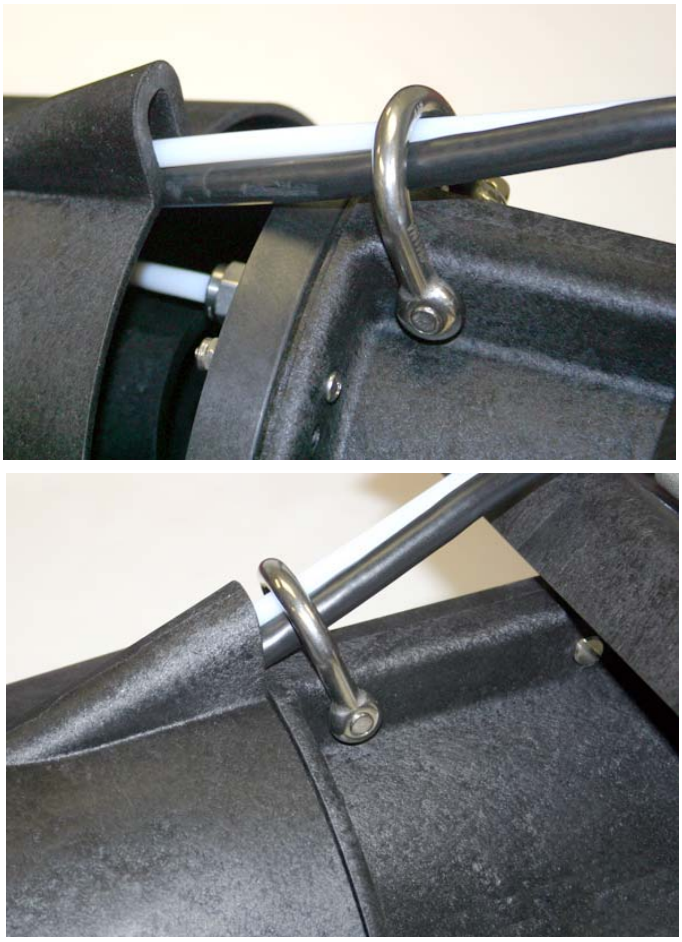


Figure 5-8 Reassembling LaserFlow: Tubing exits through cable slot

5. Remove the red cap from the other end of the tubing.
6. Slide the nut, back ferrule, and front ferrule onto the tubing, observing correct orientation as shown in Figure 5-9, with the front ferrule $^{3}/_{16}$" from the tubing end.

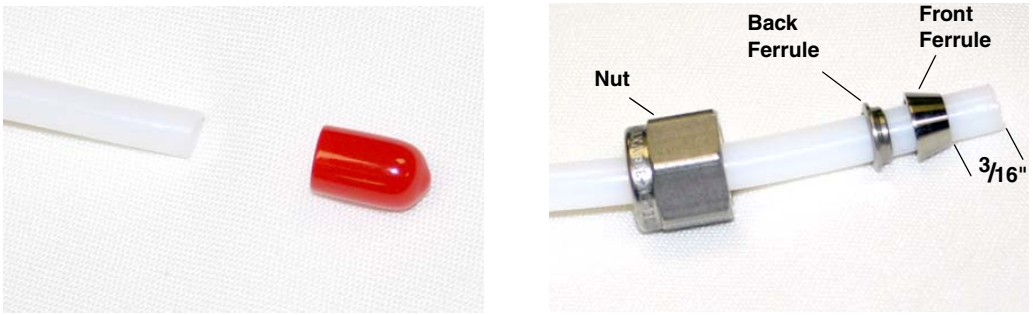


Figure 5-9 Prepare tubing gas connector for swaging

7. Use the connector fitting removed in Step 1 as a swaging tool, screw it into the nut, being careful to maintain the 3/16" gap. When the fitting is finger-tight, use the wrenches to tighten another 3/4–turn.

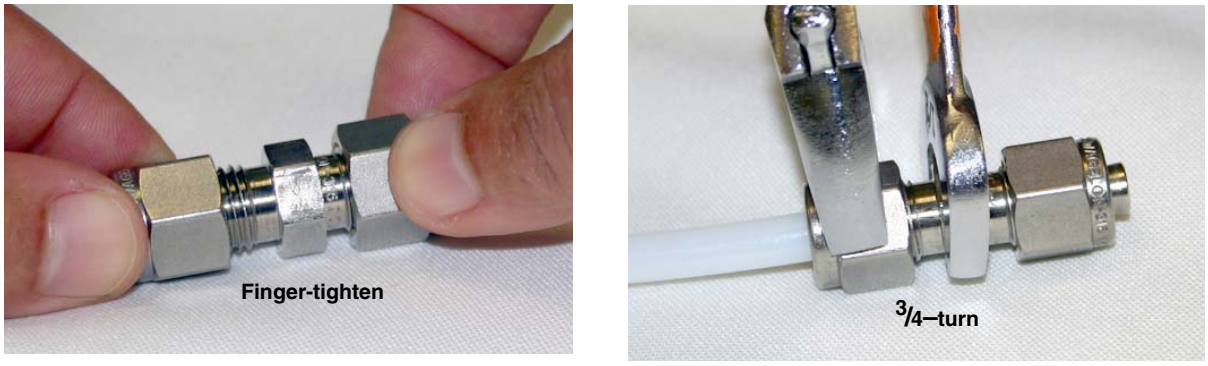


Figure 5-10 Swaging the gas connector on tubing

8. Leave the protective plug on the connector end; remove it to prepare the tubing end for connection to the gas tank.

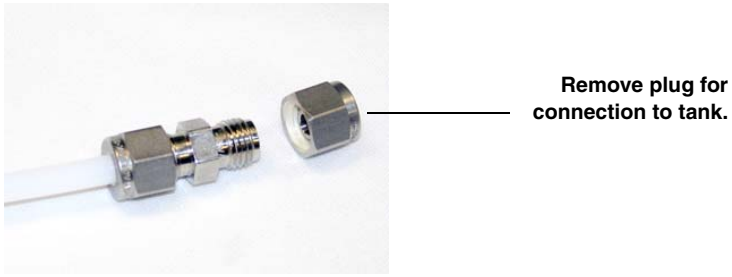


Figure 5-11 Swaged connector, ready to attach to gas tank.

Reassemble the sensor, following the steps provided in Section 5.3.2 *Replacing the Nose Piece*.

⚠ CAUTION

When reinstalling all self-tapping screws, avoid destroying the plastic threads. First seat each screw in its hole and, without pressing down, rotate the screw counter-clockwise until it falls into its thread groove with a "click." Then tighten the screw.

⚠ CAUTION

Always re-cap the male end of the gas tubing after disconnecting from the tank. Failure to do so could result in window fouling during discharge.

5.7 Installing the Optional Submerged Measurement Kit

The submerged functionality consists of a TIENet 350 Area Velocity sensor mounted on the bottom of the LaserFlow sensor. This option is normally preassembled and installed at the factory before shipment. However, it can also be installed by the user in existing systems.

Tools Required

To install the submerged measurement kit, you will need:

- Integrated 350 Kit from Teledyne Isco
  - TIENet 350 AV Sensor with 28" cable
  - Sensor mounting plate
  - 2 Flathead screws
  - 2 Lock nuts
  - 2 Flat washers
- ¼" Nut driver or open wrench

5.7.1 Installation Procedure

You must access the LaserFlow's interior to install this option. Instructions for opening and reassembling the LaserFlow are provided in Section 5.3 *Accessing the LaserFlow's Interior*.

⚠ WARNING

Disconnect power from the LaserFlow sensor before opening the sensor housing.

⚠ CAUTION

NEVER touch the window or get it dirty.

Figure 5-12 350 AV sensor with mounting plate

1. Using the flat washers and lock nuts, attach the mounting plate to the rectangular mounting holes in the bottom of the LaserFlow interior, with the tip of the 350 sensor facing front.

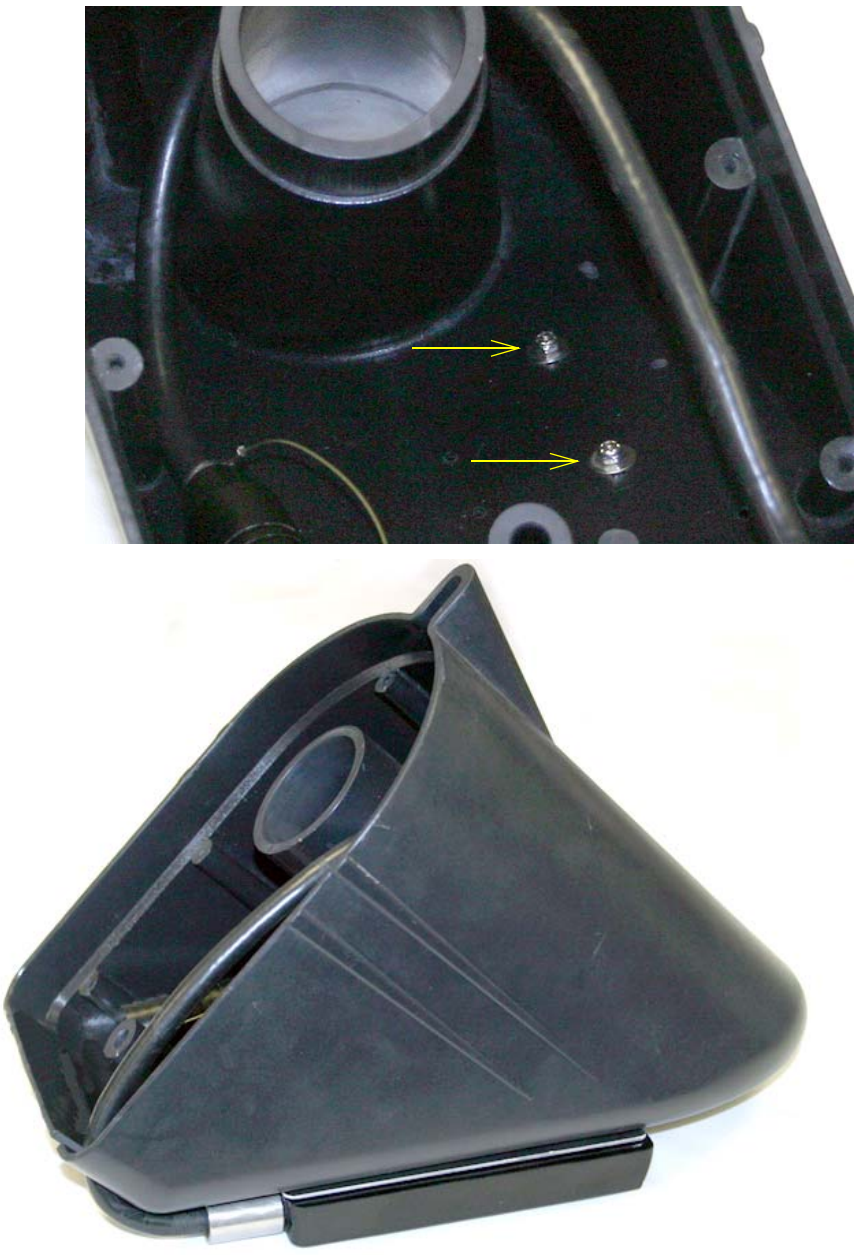
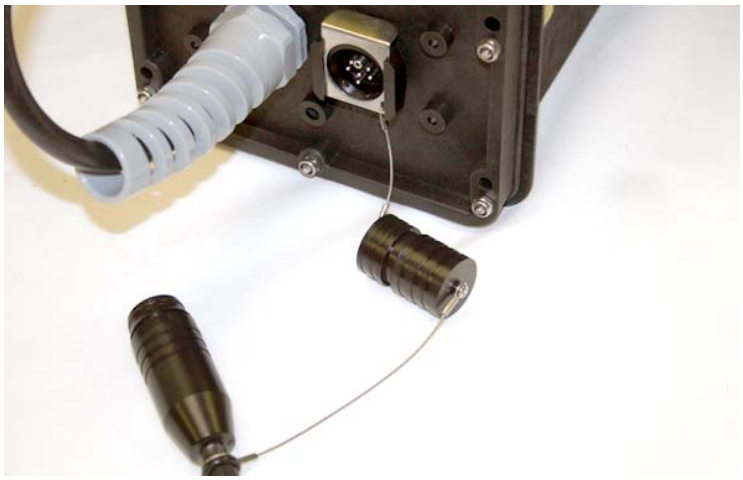


Figure 5-13 Mounting the integrated 350 AV sensor on the LaserFlow

2. Prepare the LaserFlow receptacle by removing the cap (press down on the spring release and pull out the cap).

3. Remove the cap from the 350 TIENet plug and push the protective caps of the two sensors together.



4. Aligning the pins on the LaserFlow cable with those in the connector receptacle, push the 350 connector into the receptacle on the inner wall of the LaserFlow until the spring release clicks.

Figure 5-14 Connecting the 350 AV sensor to the LaserFlow

5. Route the 350 sensor cable through the slot in the bottom of the nose piece. Route the LaserFlow cable through its slot in the top of the nose piece.
   Taking care not to pinch or bind the cables, bring the two sections of the sensor housing back together.

Figure 5-15 Reassembling the LaserFlow w / AV sensor installed

6. Reassemble the LaserFlow housing, following the steps provided in Section 5.3.2 *Replacing the Nose Piece*.

⚠ CAUTION

When reinstalling all self-tapping screws, avoid destroying the plastic threads. First seat each screw in its hole and, without pressing down, rotate the screw counter-clockwise until it falls into its thread groove with a "click." Then tighten the screw.

TIENet™ 360 LaserFlow™ Velocity Sensor

Appendix A Replacement Parts

A.1 Replacement Parts Diagrams and Listings

Replacement parts are called out in illustrations in this section. Reference the call-outs in the accompanying tables to determine the part number for the item.

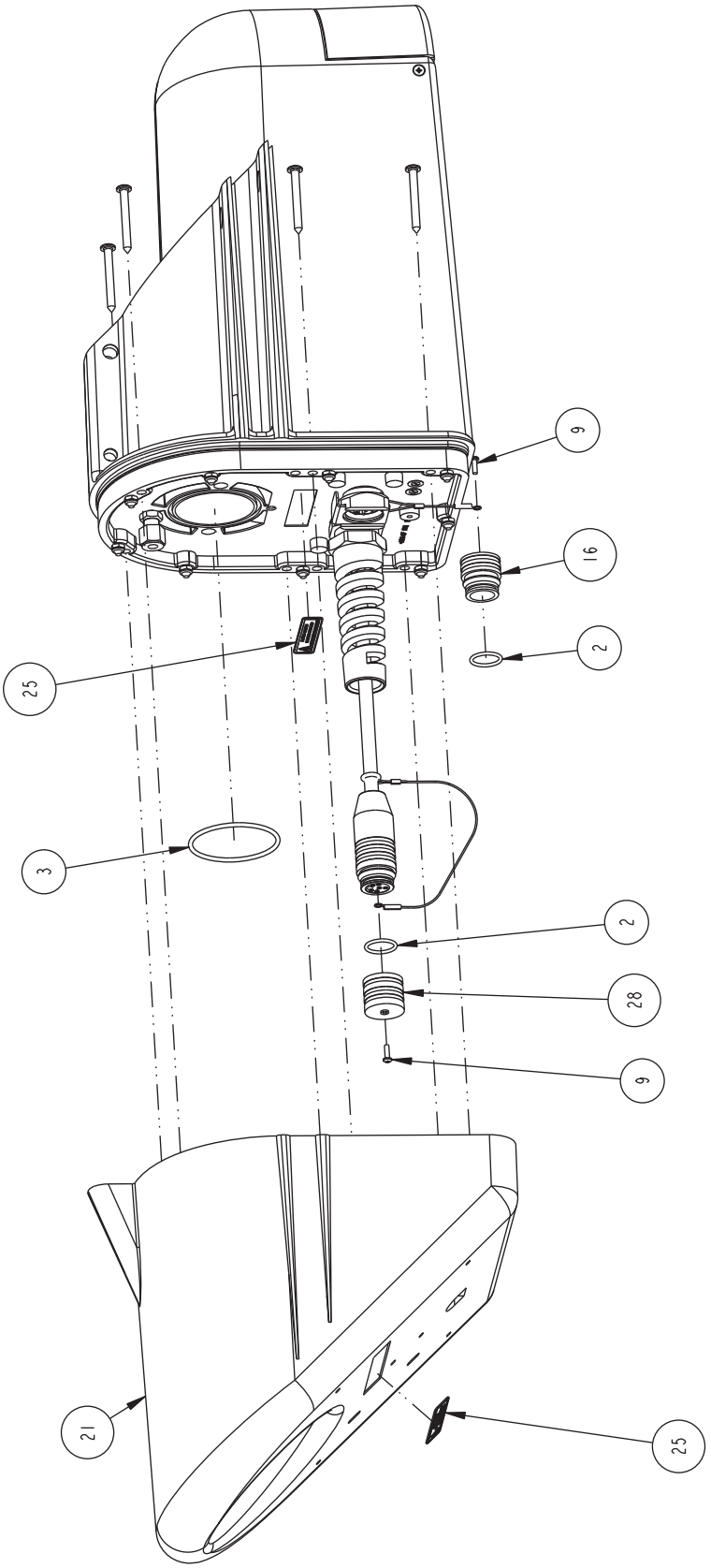
Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco
Customer Service Department
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX:(402) 465-3022

E-mail:IscoInfo@teledyne.com

A.2 LaserFlow Sensor



604362011

REPLACEMENT PARTS LIST

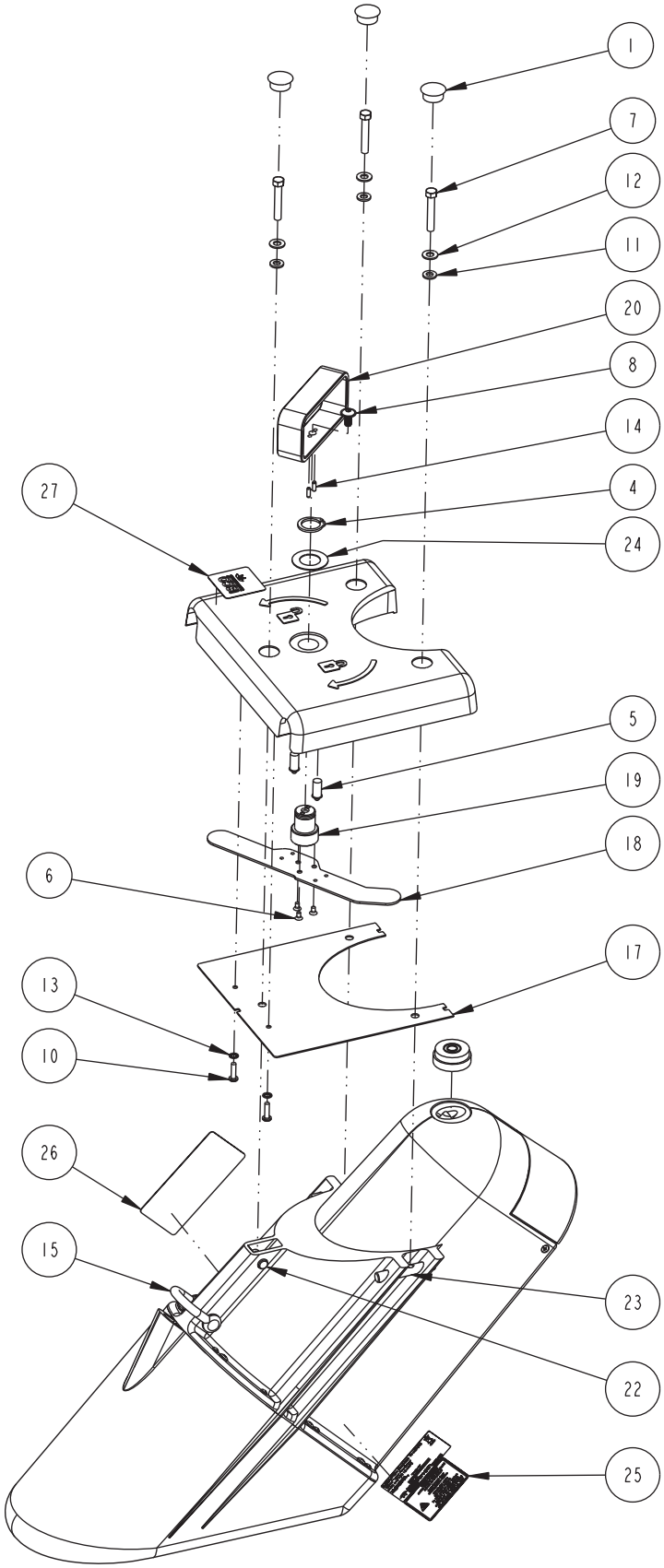
SHEET: 2 OF 4

REV: A

TELEDYNE ISCO

ITEM NO.	PART NUMBER	DESCRIPTION
2	202100669	O-RING .669ID .079 CROSS SECTION
3	202472112	O-RING 2.112ID .103 SILICONE
9	231310140	SREW SELF-TAPPING #4X3/8
16	602003076	PLUG, FEMALE PROBE
21	604363014	HORN
25	694363024	LABEL SET, LASER WARNING
28	602003075	CAP, MALE PROBE

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.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604362011

REPLACEMENT PARTS LIST

SHEET: 4 OF 4

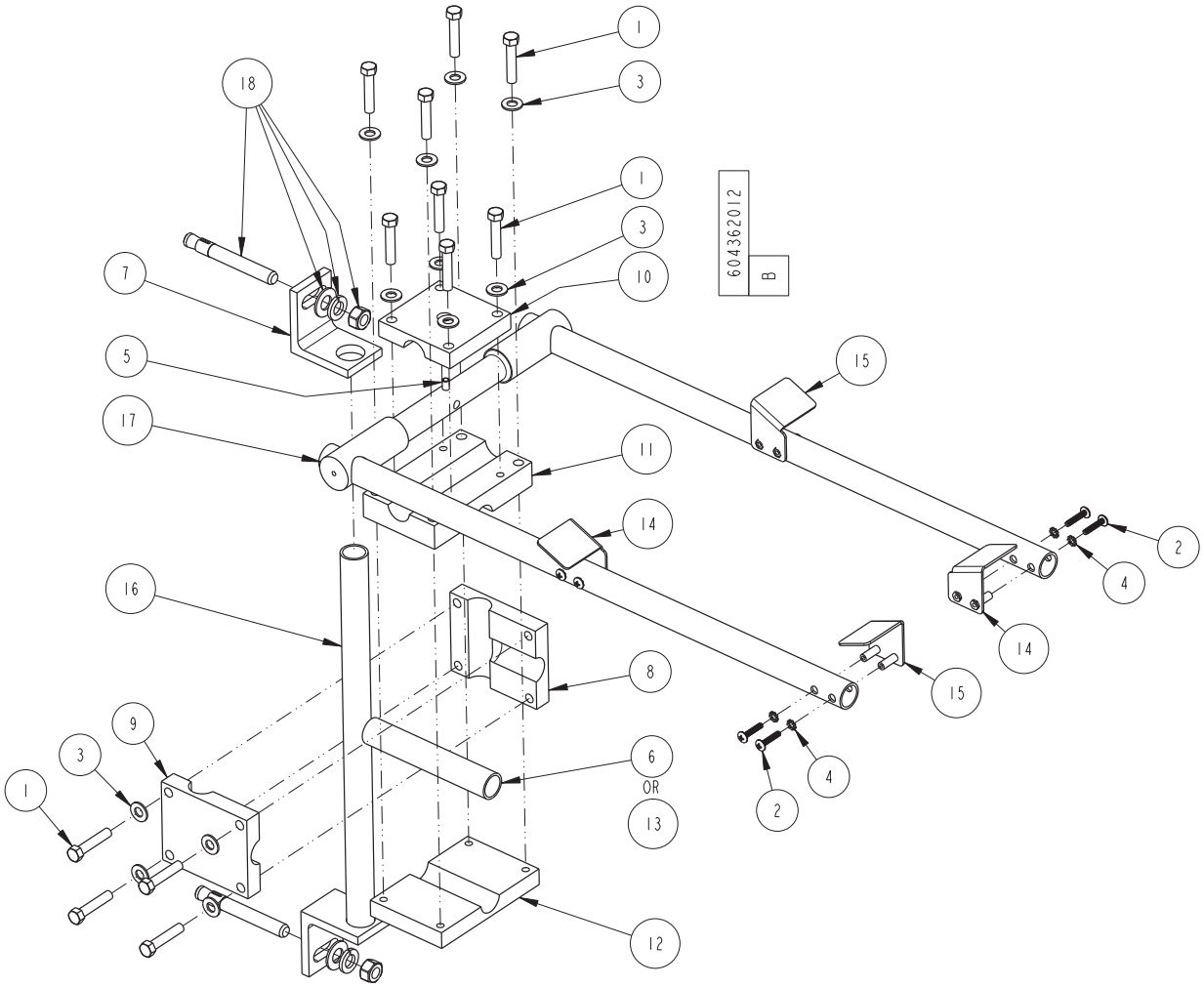
REV: A

TELEDYNE ISCO

ITEM NO.	PART NUMBER	DESCRIPTION
1	109030841	PLUG, DOME, .75 DIAMETER
4	209000276	RETAINING RING, EXTERNAL
5	209909900	SPRING PLUNGER, PUSH-FIT
6	231011404	SCREW, FLATHEAD 6-32 X 1/4
7	231115924	SCREW, CAP, 1/4-20 X 1-1/2
8	231119908	SCREW, CAP, FLANGE BUTTON HEAD
10	231310310	SCREW, SELF-TAPPING, #8X5/8
11	233011008	WASHER, FLAT, .263 ID X .500 OD
12	233112800	SPRING LOCK WASHER, 1/4
13	233211200	LOCK WASHER, INTERNAL TOOTH, #8
14	236210806	DOWEL PIN .13 X .38
15	239000001	SHACKLE WITH SCREW PIN, SST
17	604363008	PLATE, MOUNTING BLOCK
18	604363009	LOCKING TAB
19	604363010	MOUNTING SHAFT
20	604363011	MOUNTING HANDLE
22	604363019	CROSS PIN, TOP
23	604363020	CROSS PIN, SIDE
24	233015700	WASHER, FLAT, .765ID X 1.318OD
25	694363024	LABEL SET, LASER WARNING
26	694363040	LABEL, LaserFlow SENSOR
27	694363041	LABEL, ENVIRONMENTAL LOGO

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

A.3 Wall Mounting Hardware



604362012

REPLACEMENT PARTS LIST

SHEET: 2 OF 2

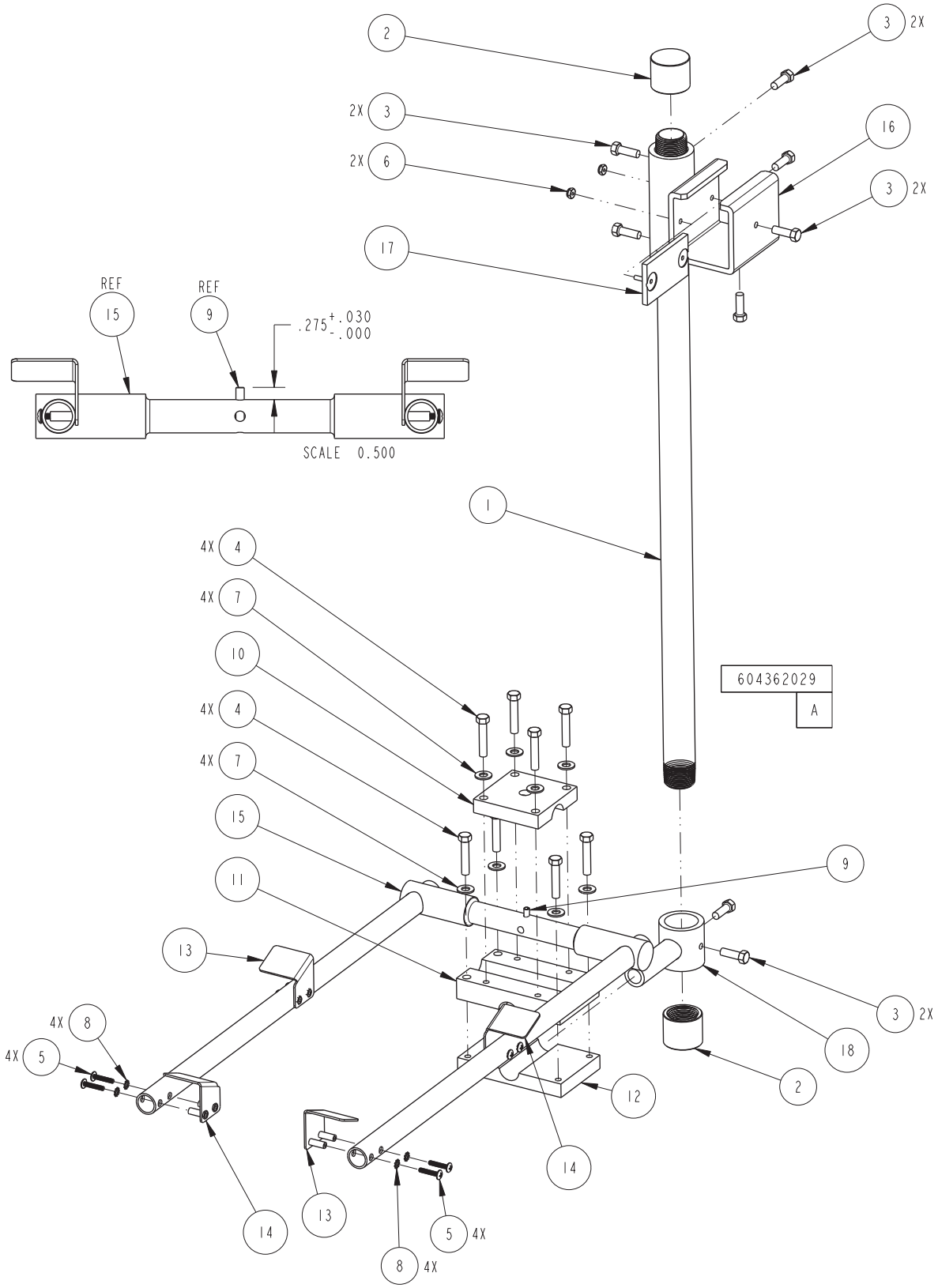
REV: B

TELEDYNE ISCO

ITEM NO.	PART NUMBER	DESCRIPTION
1	231115921	SCREW HEX 1/4-20X1-1/4
2	231518412	SCREW TRUSS HEAD 6-32 X 3/4
3	233112800	WASHER SPRING LOCK, 1/4 SST
4	233310800	WASHER LOCK, EXTERNAL TOOTH #6
5	236411214	ROLL PIN, SPRING, 3/16 X 7/8
6	604363026	TUBE, COUPLING
7	604363027	BRACKET, WALL MOUNT
8	604363029	CLAMP, VERTICAL COUPLING TUBE, R
9	604363030	CLAMP, VERTICAL COUPLING TUBE, L
10	604363031	CLAMP, CARRIER
11	604363032	CLAMP, COUPLING TUBE, TOP
12	604363033	CLAMP, COUPLING TUBE, BOT
13	604363036	COUPLING TUBE, EXTENDED
14	604368007	ALIGNMENT TAB, R
15	604368008	ALIGNMENT TAB, L
16	604368009	VERTICAL WALL MOUNT W/ BRACKET
17	604368010	HORIZONTAL CARRIER TUBE
18	604364037	ANCHOR STUD W/LOCK WSHR 3/8-16X3 SST

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

A.4 Temporary Mounting Hardware



604362029

SHEET: 2 OF 2

REV: A

REPLACEMENT PARTS LIST

TELEDYNE ISCO

ITEM NO.	PART NUMBER	DESCRIPTION
1	209016710	PIPE 3/4NPT X 24" 304 SST
2	209016711	CAP 3/4NPT 304 SST
3	231015910	HEX SCREW 1/4-20X3/4
4	231115921	HEX SCREW 1/4-20X1.25
5	231518412	SCREW TRUSS HEAD 6-32X3/4 18-8 SST
6	232914000	LOCK NUT 6-32 NYLON INSERT SST
7	233112800	SPRING LOCK WASHER 1/4 SST
8	233310800	EXTERNAL TOOTH LOCK WASHER #6 SST
9	236411214	SPRING ROLL PIN 3/16 X 7/8 SST
10	604363031	CARRIER CLAMP
11	604363032	COUPLING TUBE TOP CLAMP
12	604363033	COUPLING TUBE BOTTOM CLAMP
13	604368007	RIGHT ALIGNMENT TAB
14	604368008	LEFT ALIGNMENT TAB
15	604368010	HORIZONTAL CARRIER UTUBE
16	604368013	COUPLER WELDED ASSEMBLY
17	604368014	STUD SPACER PLATE
18	604368015	KNUCKLE WELDED ASSEMBLY

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

TIENet™ 360 LaserFlow™ Velocity Sensor

Appendix B Velocity Error Codes

B.1 Introduction

Erroneous flow data can result from a number of factors. The LaserFlow system provides numbered error codes associated with the 360 Velocity data to assist in troubleshooting.

The error codes are viewable using Isco Flowlink® software. Definitions of the error codes are provided in Table B-1. For further assistance, contact the factory.

B.2 Importing Data Dump (.ddp) Files (Signature Only)

Flow data can be downloaded from the Signature Flow Meter onto a USB flash drive in the form of a .ddp (Data Dump) file.

To download the data:

1. Connect a flash drive to the USB port on the front panel of the Signature. From the USB Options menu, select Retrieve Data.
2. Select “All data,” or specify a start date or date range, and press NEXT. The data will be stored on the connected flash drive in a folder called “ISCO.”
3. Connect the flash drive to a computer running Flowlink.
4. In Flowlink, select File > Import. When the import window appears, browse to the folder containing the desired .ddp file. Select the file and click Open.

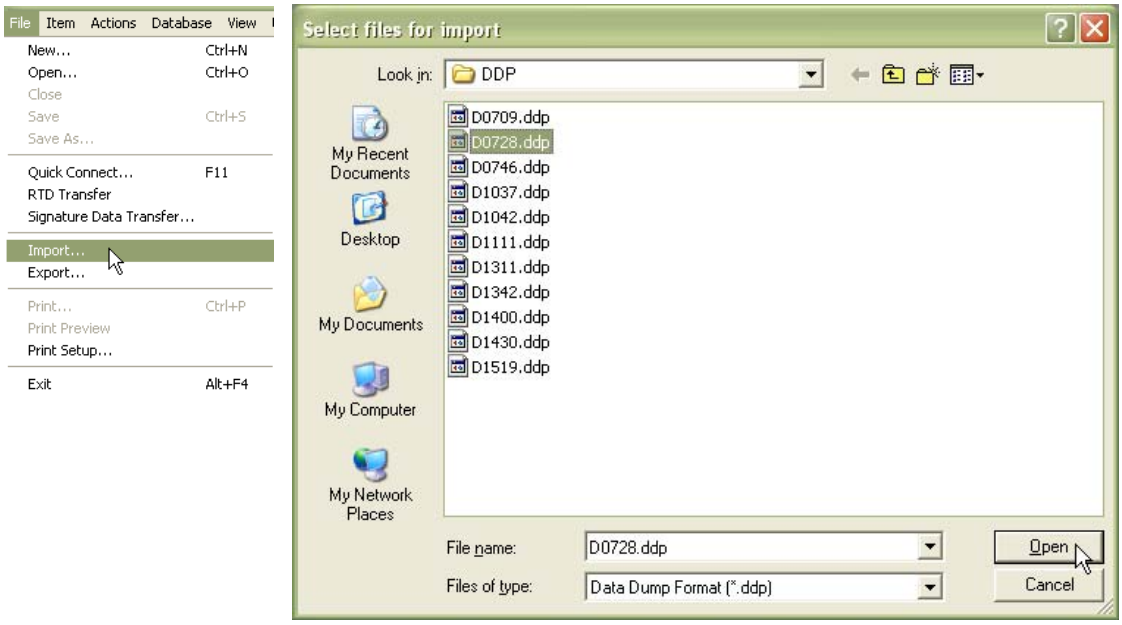


Figure B-1 Signature flow data: Selecting the .ddp file(s)

A progress window will appear, displaying the filename, site name, device type, number of data types in the site file, and progress of the download.

5. When the two progress bars have completed, click Done to close the window.

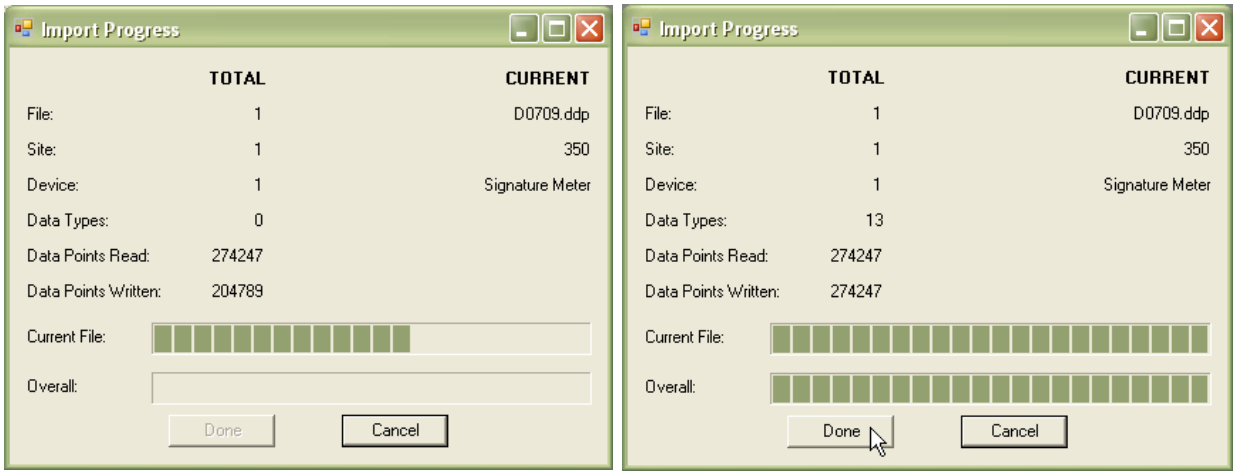


Figure B-2 Signature flow data: Importing the .ddp file

Upon completion, a new site file will appear in the Flowlink workspace.

B.3 Viewing Velocity Error Codes in Flowlink

In order to view error codes for velocity readings:

1. In the Flowlink workspace, double-click the 360 Velocity data set. When the graph appears, click the Table View button.
2. When the table appears, click the Edit/View button.

Any error codes will appear in the 360 Velocity column following the words "No Data." Definitions of the error codes are provided in Table B-1.

Date/Time	360 Velocity(m/s)	Edited 360 Velocity(m/s)
10/4/2012 1:45:00 PM	0.621	0.621
10/4/2012 2:00:00 PM	0.601	0.601
10/4/2012 2:15:00 PM	2.251	2.251
10/4/2012 2:30:00 PM	2.154	2.154
10/4/2012 2:45:00 PM	No Data: 1	2.154
10/4/2012 3:00:00 PM	1.897	1.897
10/4/2012 3:15:00 PM	No Data: 1	0.694
10/4/2012 3:30:00 PM	5.195	5.195
10/9/2012 10:00:00 AM	No Data: 7	0.000
10/9/2012 10:15:00 AM	No Data: 7	0.000

Error codes

Figure B-3 Identifying error codes in the 360 Velocity data set

Table B-1 Definitions of 360 Velocity Error Codes

Error Code	Meaning
1: Low Signal Power Error	No laser Doppler signal peak or sufficient strength is found.
2: Flow Direction Error	An error occurred while determining flow direction. This error appears only if Measure positive velocity only is deselected.
3: Ultrasonic Read Error	An error occurred during an ultrasonic reading. This includes communication errors with the ultrasonic sensor.
4: Analog-to-Digital Converter (ADC) Error	An error occurred during an ADC reading.
5: Focus Error	An error occurred while focusing the laser.
6: Digital Signal Processor (DSP) Communication Error	An error occurred during communication with the DSP.
7: Sensor not seen	Communication failed between flow meter and sensor. This could be due to the sensor being disconnected, losing power, etc.

TIENet™ 360 LaserFlow™ Velocity Sensor

Appendix C Material Safety Data Sheets

This appendix provides Material Safety Data Sheets for the desiccant used by the TIENet 360 LaserFlow Sensor.

Teledyne Isco cannot guarantee the accuracy of the data. Specific questions regarding the use and handling of the products should be directed to the manufacturer listed on the MSDS.

SORB-IT® is a registered trademark of N. T. Gates Company.

101 Christine Drive
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 861-2355

SÜD-CHEMIE
Performance Packaging

ISO 9002

MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION I -- PRODUCT IDENTIFICATION

Trade Name and Synonyms:	Silica Gel, Synthetic Amorphous Silica, Silicon, Dioxide
Chemical Family:	Synthetic Amorphous Silica
Formula:	$SiO_2.x\ H_2O$

SECTION II -- HAZARDOUS INGREDIENTS

Components in the Solid Mixture

COMPONENT	CAS No	%	ACGIH/TLV (PPM)	OSHA-(PEL)
Amorphous Silica	63231-67-4	>99	PEL - 20 (RESPIRABLE), TLV – 5	LIMIT – NONE, HAZARD - IRRITANT ˝

Synthetic amorphous silica is not to be confused with crystalline silica such as quartz, cristobalite or tridymite or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms.

This product is in granular form and packed in bags for use as a desiccant. Therefore, no exposure to the product is anticipated under normal use of this product. Avoid inhaling desiccant dust.

SECTION III -- PHYSICAL DATA

Appearance and Odor:	White granules; odorless.
Melting Point:	>1600 Deg C; >2900 Deg F
Solubility in Water:	Insoluble.
Bulk Density:	>40 lbs./cu. ft.
Percent Volatile by Weight @ 1750 Deg F:	<10%.

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SORB-IT®
Packaged Desiccant

SECTION IV -- FIRE EXPLOSION DATA

Fire and Explosion Hazard - Negligible fire and explosion hazard when exposed to heat or flame by reaction with incompatible substances.

Flash Point - Nonflammable.

Firefighting Media - Dry chemical, water spray, or foam. For larger fires, use water spray fog or foam.

Firefighting - Nonflammable solids, liquids, or gases: Cool containers that are exposed to flames with water from the side until well after fire is out. For massive fire in enclosed area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of the tank due to fire.

SECTION V -- HEALTH HAZARD DATA

Health hazards may arise from inhalation, ingestion, and/or contact with the skin and/or eyes. Ingestion may result in damage to throat and esophagus and/or gastrointestinal disorders. Inhalation may cause burning to the upper respiratory tract and/or temporary or permanent lung damage. Prolonged or repeated contact with the skin, in absence of proper hygiene, may cause dryness, irritation, and/or dermatitis. Contact with eye tissue may result in irritation, burns, or conjunctivitis.

First Aid (Inhalation) - Remove to fresh air immediately. If breathing has stopped, give artificial respiration. Keep affected person warm and at rest. Get medical attention immediately.

First Aid (Ingestion) - If large amounts have been ingested, give emetics to cause vomiting. Stomach siphon may be applied as well. Milk and fatty acids should be avoided. Get medical attention immediately.

First Aid (Eyes) - Wash eyes immediately and carefully for 30 minutes with running water.

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Belen, New Mexico 87002
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Fax: (505) 861-2355

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SORB-IT®
Packaged Desiccant

NOTE TO PHYSICIAN: This product is a desiccant and generates heat as it adsorbs water. The used product can contain material of hazardous nature. Identify that material and treat accordingly.

SECTION VI -- REACTIVITY DATA

Reactivity - Silica gel is stable under normal temperatures and pressures in sealed containers. Moisture can cause a rise in temperature which may result in a burn.

SECTION VII --SPILL OR LEAK PROCEDURES

Notify safety personnel of spills or leaks. Clean-up personnel need protection against inhalation of dusts or fumes. Eye protection is required. Vacuuming and/or wet methods of cleanup are preferred. Place in appropriate containers for disposal, keeping airborne particulates at a minimum.

SECTION VIII -- SPECIAL PROTECTION INFORMATION

Respiratory Protection - Provide a NIOSH/MSHA jointly approved respirator in the absence of proper environmental control. Contact your safety equipment supplier for proper mask type.

Ventilation - Provide general and/or local exhaust ventilation to keep exposures below the TLV. Ventilation used must be designed to prevent spots of dust accumulation or recycling of dusts.

Protective Clothing - Wear protective clothing, including long sleeves and gloves, to prevent repeated or prolonged skin contact.

Eye Protection - Chemical splash goggles designed in compliance with OSHA regulations are recommended. Consult your safety equipment supplier.

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MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION IX -- SPECIAL PRECAUTIONS

Avoid breathing dust and prolonged contact with skin. Silica gel dust causes eye irritation and breathing dust may be harmful.

* No Information Available

HMIS (Hazardous Materials Identification System) for this product is as follows:

Health Hazard	0
Flammability	0
Reactivity	0
Personal Protection	HMIS assigns choice of personal protective equipment to the customer, as the raw material supplier is unfamiliar with the condition of use.

TIENet™ 360 LaserFlow™ Velocity Sensor

Index

DECLARATION OF CONFORMITY

Application of Council Directive:	2004/108/EC -The EMC Directive 2012/19/EC– The WEEE Directive 2006/95/EC – The Low Voltage Directive
Manufacturer's Name:	Teledyne Isco
Manufacturer's Address:	4700 Superior, Lincoln, Nebraska 68504 USA Mailing Address: P.O. Box 82531, Lincoln, NE 68501 Phone: +1 (402) 464-0231 FAX: +1 (402) 465-3799
Equipment Type/Environment:	Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No:	360 Laser Flow Sensor with 2160 Laser Flow Area Velocity Module and 2191 Battery Module
Year of Issue:	2012
Standards to which Conformity is Declared:	EN 61326:2006 EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN 61010-1 2nd edition Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN60529 Special Protection offered by the Signature's Enclosure: IP-66

Standard	Description	Severity Applied	Performance Criteria
EN61000-4-2:2008	Electrostatic Discharge	Level 2 - 4kV contact discharge Level 3 - 8kV air discharge	A
EN61000-4-3:2006 /A1:2007 /A2:2010	Radiated RF Immunity	80 mHz to 2.7gHz 80% AM at 1 kHz Level 2 - 3V/m	A
EN61000-4-4:2004 /A1:2010	Electrical Fast Transient (EFT) on Mains and I/O	Level 2 - 1kV on AC lines	A
EN61000-4-5:2005	Surge on AC Lines	Level 2 - 1kV Line Common Mode Level 2 - 0.5kV Differential Mode	A
EN61000-4-6:2008	Conducted RF Immunity on Mains and I/O	150 kHz to 80 mHz Level 1 – 1V rms, 80% Modulated	A
EN61000-4-11:2004	Voltage Dips	0% during1 cycle and full cycle 70% at 25 cycles	A
CISPR11/ EN 55011:2009 /A1:1020	RF Emissions Radiated, below 1GHz and Conducted, AC Mains	Group 1, Class A Industrial, Scientific, and Medical Equipment	PASS
EN61000-3-2:2005 /A1:2008 /A2:2009 EN61000-3-3:2008	AC Harmonics, Flicker		PASS

We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of September 21. 2012.

USA Representative

-

Vikas V. Padhye Ph, D
Vice President and General Manager
4700 Superior Street
Lincoln, Nebraska 68504
Phone: 402-464-0231
Fax: 402-464-0318

TELEDYNE ISCO
Everywhereyoulook™

产品中有毒有害物质或元素的名称及含量

Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	X
接线 Wiring	O	O	O	O	O	X
内部电缆 Internal Cables	O	O	O	O	O	X
主电源线 Line Cord	O	O	O	O	O	X
直流电机 DC Motor	X	O	O	O	O	X
接头 Connectors	O	O	X	O	O	O
电池 Battery	X	X	X	O	O	O

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component's any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打"X" 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component's at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the "X"marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January; "B" is February and so on.

Teledyne Isco One Year Limited Factory Service Warranty*

This warranty exclusively covers Teledyne Isco instruments, providing a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period due to faulty parts or workmanship will be repaired at the factory at no charge to the customer. Teledyne Isco's exclusive liability is limited to repair or replacement of defective instruments. Teledyne Isco is not liable for consequential damages.

Teledyne Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Teledyne Isco, and Teledyne Isco will pay surface transportation to return the repaired instrument to the customer. Teledyne Isco will not pay air freight or customer's packing and crating charges. This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

The warranty for any instrument is the one in effect on date of shipment. The warranty period begins on the shipping date, unless Teledyne Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as charts, ribbon, lamps, tubing, and glassware; fittings and wetted parts of valves; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover products not sold under the Teledyne Isco trademark or for which any other warranty is specifically stated.

No item may be returned for warranty service without a return authorization number issued by Teledyne Isco.

This warranty is expressly in lieu of all other warranties and obligations and Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

The warrantor is Teledyne Isco, 4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to the USA and countries where Teledyne Isco does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.**

Before returning any instrument for repair, please call, fax, or e-mail the Teledyne Isco Service Department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE PROBLEM.**

Shipping Address:	Teledyne Isco - Attention Repair Service 4700 Superior Street Lincoln, NE 68504 USA
Mailing Address:	Teledyne Isco PO Box 82531 Lincoln, NE 68501 USA
Phone:	Repair service: (800) 775-2965 (lab instruments) (866) 298-6174 (samplers & flow meters) Sales & General Information: (800) 228-4373 (USA & Canada)
Fax:	(402) 465-3001
Email:	IscoService@teledyne.com

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TELEDYNE ISCO
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