TIENet® 350 Ex Area Velocity Sensor

Installation and Operation Guide

TELEDYNE ISCO
Everywhereyoulook™

Manual #69-4853-001

Revision G, August 2023

Foreword - Water and Wastewater Products

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 a problem persists, call or e-mail Teledyne ISCO technical support for assistance. Simple difficulties can often be diagnosed over the phone. For faster service, please have your serial number ready.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by technical support, including the use of the Return Merchandise Authorization (RMA) specified. Be sure to include a note describing the malfunction. This will aid in the prompt repair and return of the equipment. **No item may be returned for service without a Return Material Authorization (RMA) number issued by Teledyne.**

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:	isco.orders@teledyne.com	

Technical Support

Phone:	Toll Free (866) 298-6174 (Samplers and flowmeters)
Email:	iscowatersupport@Teledyne.com
Return equipment to:	4700 Superior Street, Lincoln, NE 68504-1398

Other Correspondence

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

Warranty and Operation Manuals can be found on our website at:

www.teledyneisco.com

General Warnings

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.

⚠ AVERTISSEMENT

Éviter les usages périlleux! Si vous utilisez cet instrument d'une manière autre que celles qui sont specifiées dans ce manuel, la protection fournie de l'instrument peut être affaiblie; cela augmentera votre risque de blessure.

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® Model 350 Ex Area Velocity Sensor

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TIENet® Model 350 Ex Area Velocity Sensor

Section 1 Introduction

The Teledyne ISCO TIENet 350 Ex Area Velocity Sensor measures flow stream average area velocity and liquid level. The information is provided to the Signature® or DuraTracker flow meter in order to calculate the flow rate and total flow of the stream. To operate with the 350 Ex sensor, the Signature requires software version **1.18** or later.

1.1 Description

The 350 Ex sensor is mounted in the flow stream, normally at the bottom of the channel. It measures average velocity using continuous ultrasonic sound waves to produce a Doppler effect, in which the frequency of a wave (such as sound) passed between two bodies is relative to the motion of each. As they move nearer to each other, the frequency increases; as they move apart, the frequency decreases.

The 350 Ex sensor measures liquid level using an internal differential pressure transducer.

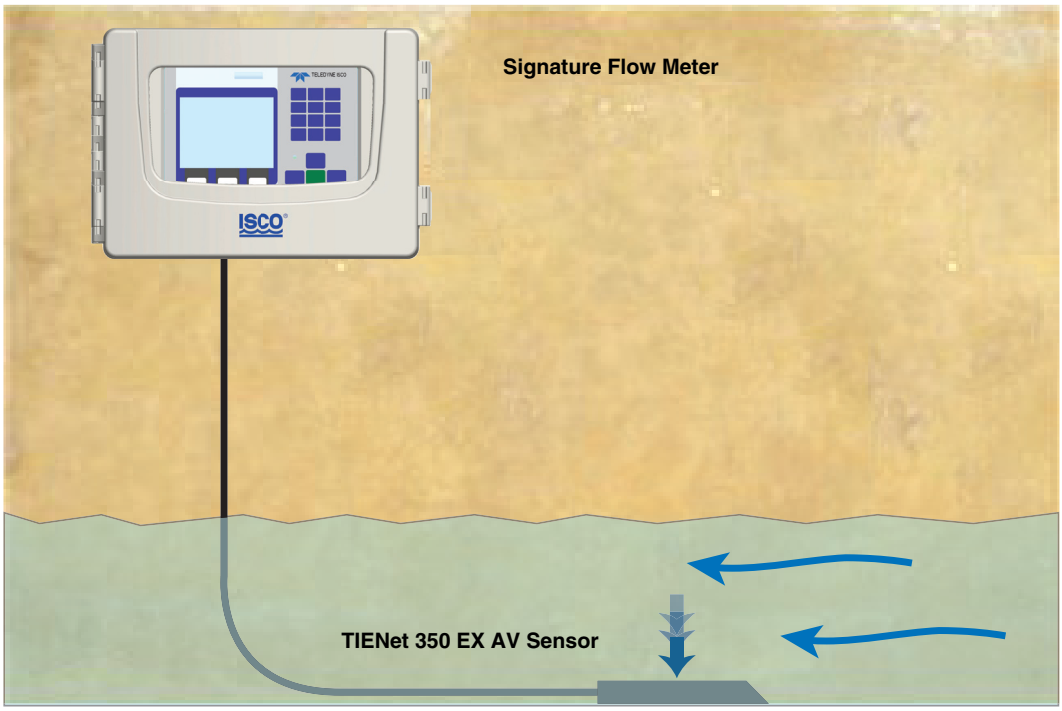
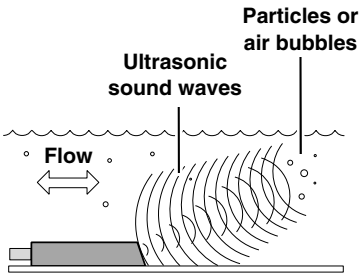


Figure 1-1 Basic non-Hazardous location Signature system with 350 Ex (mounting hardware not shown)

The 350 Ex AV sensor is available with a 10m, 23m, or cut-to-length cable. For greater distances, external connection via conduit, and connection of an additional TIENet device, the TIENet Ex Air Reference Box is available. Bulk TIENet cable may also be used for greater distances.

Figure 1-2 TIENet Model 350 Ex Area Velocity Sensor

1.1.1 350 Ex Velocity Operation



The 350 Ex area velocity sensor contains a pair of ultrasonic transducers. One transducer transmits the ultrasonic sound wave. As the transmitted wave travels through the stream, particles and bubbles carried by the stream reflect the sound wave back at the sensor. The second transducer receives the reflected wave.

The sensor determines the frequency shift between the transmitted and received waves. An increase or decrease in the frequency of the reflected wave indicates forward or reverse flow. The degree of change is proportional to the velocity of the flow stream.

1.1.2 350 Ex Level Operation

The 350 Ex sensor's internal differential pressure transducer measures the liquid level. The transducer is a small piezo-resistive chip that detects the difference of the pressures felt on the inner and outer face.

The stainless steel outer diaphragm is exposed to the flow stream through the ports under the sensor. The pressure felt on the outer diaphragm is transferred to the outer face of the transducer. The inner face of the transducer is referenced to the atmosphere through the internal vent tube that runs the full length of the sensor cable.

The difference between the pressures exerted on the transducer is the hydrostatic pressure, which is proportional to the level of the stream above the transducer. The analog representation of the hydrostatic pressure is digitized and sent to the Signature or DuraTracker as an RS-485 half-duplex signal.

1.2 Technical Specifications

Table 1-1 350 Ex TIENet Sensor Specifications[a]

Sensor Dimensions	2.2 x 3.9 x 16.2 cm	0.88 x 1.52 x 6.37 in
Standard Cable Length	10 or 23 m	32.8 or 75.5 ft
Max Sensor Cable Length	30.5 m	100 ft
Cable Diameter	10.2mm ±0.254mm	0.402 in ±0.010 in
Minimum Bend Radius	15.24 cm	6 in
Maximum Cabling from flowmeter w/ ex Ref Air Box	150 m	493 ft
Typical Weight w/ 10 m Cable w/ 23 m Cable	 1.66 kg 3.28 kg	 3.66 lb 7.24 lb
Body Materials	PDVF	
Cable Materials	UV-Rated PVC	
Temperature Range Operation Storage	 0 to 60 °C -40 to 70 °C	 32 to 140 °F -40 to 158 °F
Power Input Voltage Supply Current @ 12VDC Nominal	 7 to 13.2 VDC Measurement: 100 mA	
Level Measurement		
Technology	Submerged differential linear pressure transducer with integral digital temperature compensation coefficients.	
Range[b]	0.010 to 3.05 m	0.033 to 10 ft.
Pressure Rating	5 PSI	
Maximum Submersible Depth	10.0 m	32.8 ft
Accuracy[c]	± 0.10% FS	
Typical Long Term Stability	± 0.007m/yr	± 0.023 ft/yr
Compensated Temperature Range	0 to 70°C	32 to 158°F
Velocity Measurement		
Technology	Continuous wave Doppler ultrasonic	
Frequency	500 kHz	
Transmission Angle	20° from horizontal	
Velocity Direction	Bi-Directional (User selectable)	
Typical Minimum Depth for Velocity Measurement	2.5 cm	1.0 in

Table 1-1 350 Ex TIENet Sensor Specifications[a] (Continued)			
Range	-1.5 to +6.1 m/s		-5 to +20 ft./s
Accuracy[d]	Velocity	Error	
	-5 to +5 ft./s: 5 to 20 ft./s:	-1.5 to +1.5 m/s 1.5 to 6.1 m/s	±0.1 ft./s (±0.03 m/s) ±2% of reading

a. All specifications are subject to change without notice.
b. Actual vertical distance between the area velocity sensor and the liquid surface
c. Maximum non-linearity, hysteresis, and temperature error from actual liquid level
d. Uniform velocity profile, speed of sound 1480 m/s (4850 ft/s)

1.3 Optional LaserFlow Applications

Some applications using the Teledyne ISCO LaserFlow™ remote-sensing velocity sensor require provisions for continued measurement in the event of submersion, or for redundant flow measurement of the same flow stream.

The 350 Ex sensor can be added to a LaserFlow system to fill either of these requirements. For more information, refer to the LaserFlow user manual.

1.4 Accessories

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

The 350 Ex Area Velocity Sensor can be installed using ISCO's mounting rings listed below. A Low Profile Carrier is optional when attaching the 350 Ex to a mounting ring (not for use with the Street Level Installation System).

TIENet 350 Ex AV Sensor w/ 10m Cable 60-4854-010
TIENet 350 Ex AV Sensor w/ 23m Cable 60-4854-011
TIENet 350 Ex AV Sensor w/ 2ft Cable and Connector, Surcharge 60-4854-012
TIENet 350 Ex AV Sensor w/ 10m Cable and Connector 60-4854-013
TIENet 350 Ex AV Sensor w/ 23m Cable and Connector 60-4854-014

Cord grip fitting, ¾" NPT, for TIENet cable 209-0073-12
Bulk TIENet Cable, Cut to Length 60-4304-050
TIENet Ex Reference Air Box, 10 m 68-4800-025
TIENet Ex Reference Air Box, 23 m 68-4800-026
TIENet Ex Reference Air Box, cut to length 68-4800-027

Signature Flow Meter Exterior desiccator
(required for use with 330 and 350 Ex TIENet devices) 60-4304-092
Silica gel desiccant, 1.5-lb container 60-2004-233

Low Profile Carrier
(attaches the 350 Ex sensor to a standard-size ring or plate)
(With plastic ties & instructions) 60-3204-029
Mounting Ring Hardware Kit
(Do not use w/ Street Level Installation System) 60-2504-035
Extra Mounting Screws for use with Mounting Rings 231-5113-06

Standard Spring Rings
(Includes plastic cable ties to fasten the cable and a manual)
6" Dia..... 68-3200-007
8" Dia..... 68-3200-008
10" Dia..... 68-3200-009
12" Dia..... 68-3200-010
15" Dia..... 68-3200-011

Standard Scissors Rings
(Includes a base section, scissors mechanism, extensions, plastic cable ties, and manual)
16-24" Pipe..... 68-3000-042
26-38" Pipe..... 68-3000-043
38-44" Pipe..... 68-3000-044
44-48" Pipe..... 68-3000-045
60" Pipe..... 68-3000-046
72" Pipe..... 68-3000-047
16-60" Pipe..... 68-3000-048
Base Section *(with plastic cable ties and manual)*..... 60-3004-169
Street Level Installation System Multi-section Pole *(Includes manual. To complete your system, you must also order a Street Level Mounting Ring)*..... 60-3204-012
Street Level Mounting Ring for 6" dia. pipe..... 60-3204-014
Street Level Mounting Ring for 8" dia. pipe..... 60-3204-015
Street Level Mounting Ring for 10" dia. pipe..... 60-3204-016
Street Level Mounting Ring for 12" dia. pipe..... 60-3204-017
Street Level Mounting Ring for 15" dia. pipe..... 60-3204-018

1.4.1 Ordering Information

Options and accessories can be purchased by contacting Teledyne ISCO's Customer Service Department, or from our Online store.

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

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

https://store.teledyneisco.com/

> ☑ ***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.

1.5 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.

TIENet® Model 350 Ex Area Velocity Sensor

Section 2 Installation

The Signature or DuraTracker Flow Logger does not have to be mounted near the flow stream. You can install the flow meter itself at a convenient, protected location and route the sensor cable to the measurement point (maxiumum length of 150 meters or 493 feet if using Ex Reference Air Box). Proper installation of the 350 Ex sensor is critical for accurate measurement.

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.

2.1.2 Hazardous Locations

Installation in classified hazardous locations must meet specific conditions in order to fulfill safety requirements. Installation must be performed only by trained and qualified personnel.

⚠ WARNING

All elements of an installation must be certified as intrinsically safe in order to meet the installation requirements of hazardous locations. The Signature Flowmeter and DuraTracker is not a certified intrinsically safe device. Therefore, the 350 Ex AV Sensor cannot be connected directly to the Signature Flowmeter or DuraTracker and meet the safety requirements for hazardous locations. The DuraTracker Ex is an intrinsically safe device and meets the safety requirements for hazardous locations.

2.2 Installing the 350 Ex AV Sensor

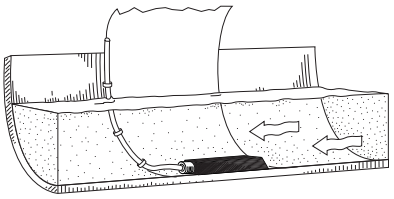
Prior to mounting the sensor in the flow stream, check the displayed level reading. In open air, the reading should be zero. If not, adjust the level to zero from the Level Adjustment screen (refer to "Setting the 350 Ex Level" on page 3-6).

> **☑ Note**
>
> If the 350 Ex sensor is part of the optional submerged functionality for a LaserFlow system, the initial level setting is the measured distance from the bottom of the channel to the bottom of the LaserFlow sensor. See LaserFlow manual for installation.

2.2.1 Installation Considerations

See Section 2.2.2 for a summary of sensor mounting options for round pipe installations. Sensor installation is discussed in detail in *ISCO's Mounting Rings Instruction Manual*, which explains how to mount the 350 Ex sensor in flow streams using spring rings, scissors rings, a street level installation tool, and mounting plates.

Several factors concerning installation may affect your system's performance. Please review the following to understand how to obtain the best results:

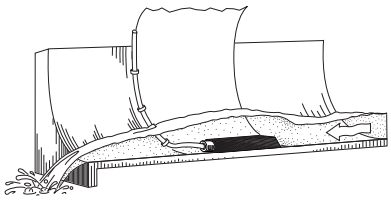


Ideal Conditions - Uniform

Uniform flow - The 350 Ex sensor provides the best results in flow streams with uniform flow. An example of uniform flow is shown at left.

Avoid poor channel conditions - Poor channel conditions may cause incorrect or erratic readings. Areas to avoid are:

- Outfalls or channel intersections
- Flow streams at very low levels with high flow rates
- Turbulence
- Channel sections that are apt to collect debris or silt
- Depths that consistently run below 25 mm (1 inch)



Poor Conditions

The 350 Ex sensor can detect levels above approximately 1.0 cm (0.4 inch) and typically can measure velocities in streams as low as 25 mm (1 inch). Streams that run consistently below 1 inch are not a good application for the 350 Ex sensor.

The example at left shows a few of these poor conditions. The outfall is drawing down the liquid level and the 350 Ex sensor is disturbing the flow. In this example, the 350 Ex sensor should be moved forward to avoid the drawdown near the outfall.

Liquid properties - Velocity measurements depend on the presence of some particles in the stream, such as suspended solids or air bubbles. If the stream lacks particles, it may be necessary to aerate the water upstream from the sensor.

Handle with care - Abusive handling will damage the 350 Ex sensor. Although the 350 Ex sensor will survive normal handling and installation, treat the sensor with reasonable care. The internal components cannot be repaired.

Protect the cable - The vent tube inside the cable must remain open. Do not kink the cable or overtighten the plastic ties while securing the cable. Never allow water to enter the unterminated end of the cable or the vent tube.

Secure the cable - Secure the cable in place. Tying off the cable prevents lost equipment if excessive flow dislodges the sensor and its mounting.

2.2.2 Mounting Rings

Consult your ISCO Mounting Rings Installation and Operation Guide for detailed hardware information.

The following sections describe sensor installation using the two options available for mounting the 350 Ex sensor in pipes or round-bottomed flow streams. For pipes up to 15" (38 cm) in diameter, **stainless steel self-expanding mounting rings** (**Spring Rings**) are available. For pipes larger than 15" in diameter, Teledyne ISCO offers the **Scissors Rings (Universal Mounting Rings)**. Area velocity sensors can also be installed using primary measuring devices.

⚠ CAUTION

Use gloves and eye protection when assembling and installing the rings in a pipe. Though deburred, the edges of the stainless steel can cut if improperly handled. *Please read the information in the Teledyne ISCO Mounting Rings Manual on how best to install this device.*

2.2.3 Spring Rings

To install a spring ring, compress the ring, slip it inside the pipe, and then allow it to spring out to contact the inside diameter of the pipe. The inherent outward spring force of the ring firmly secures it in place. A typical self-expanding mounting ring (with a probe mounted on it) is shown in Figure 2-1.

These mounting rings are available for use in pipes with inside diameters of 15.2 cm (6"), 20.3 cm (8"), 25.4 cm (10"), 30.5 cm (12"), and 38.1 cm (15"). The ISCOISCO part numbers for the various size mounting rings available are listed in Appendix B. These part numbers include not only the ring, but also the miscellaneous hardware necessary to mount the sensor on the ring.

⚠ CAUTION

Always wear durable, work-safe gloves when handling the rings (either type). The metal is finished, but there is still a possibility of cutting your hands on the edges.

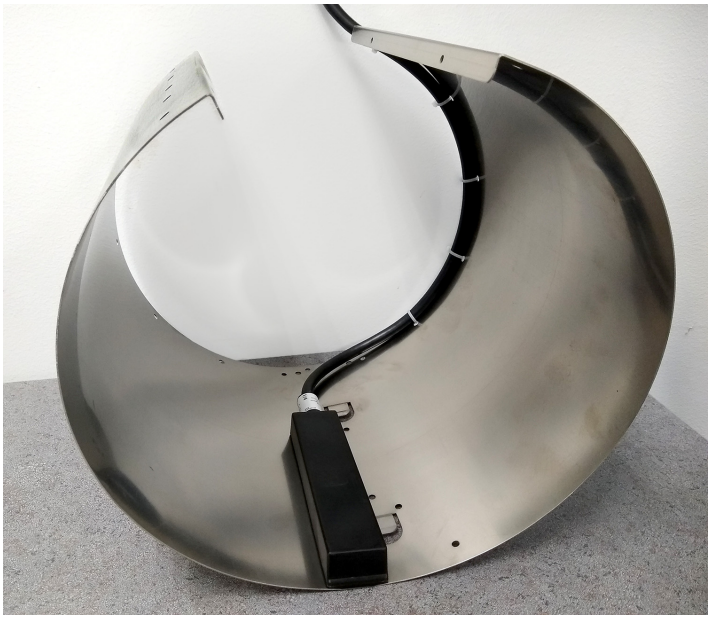


Figure 2-1 Sensor Installed on a Spring Ring

Attaching the Sensor to the Ring

Attach the 350 Ex sensor to the ring either by using two 4-40x$^{3}/_{8}$ Flathead screws or by snapping the optional probe carrier to the ring. This second method of attaching the sensor allows for easy removal in case service is needed later.

☑ Note

Proper electrical grounding cannot be achieved while using the optional probe carrier. The optional probe carrier cannot be used in hazardous locations.

⚠ CAUTION

Make sure the slots on the sensor carrier are completely pressed into the tabs on the ring. This is particularly important where there is any possibility of reverse flows, or where flows are of high velocity. If the AV sensor is not fully pressed into the mounting ring tabs, it might come loose in the stream, and could possibly be damaged or lost.

Make sure the sensor cable is securely fastened along the back (downstream) edge of the ring. Otherwise, the sensor may provide **inaccurate level readings** under conditions of high velocity.

To complete the sensor-spring ring assembly procedure, attach the sensor cable to the downstream edge of the ring. Follow the cable routing shown in Figure 2-1. Other routing may affect measurement accuracy. The cable can create a stilling well downstream from the sensor, causing the level to read low. Use the

self-locking plastic ties supplied with the ring. Install the ring in the pipe by compressing it. Press inward on both sides and slide the ring into the pipe.

Route the sensor cable out of the stream and secure it in position by placing the ties through the holes in the mounting ring and then locking them around the cable, as shown in Figure 2-1.

⚠ CAUTION

Do not overtighten the plastic cable ties; they should be tightened just enough to secure the cable in place, without greatly indenting the cable. Overtightening the plastic ties may collapse the reference tube in the cable, blocking it.

The spring ring may need anchoring. Under conditions of high velocity (greater than 1.5 meters per second or 5 feet per second), the ring may not have sufficient outward spring force to maintain a tight fit inside the pipe. The ring may start to lift off the bottom of the pipe, or may even be carried downstream.

This problem is more prevalent in the larger diameter pipes and in pipes with smooth inside surfaces, such as plastic pipes. If any of these conditions are present, or if movement of the mounting ring is detected or suspected, you must anchor the ring in place. You can do this by driving screws through the ring into the pipe, or by other appropriate means. If there is a problem with the smaller diameter rings, it may be sufficient to simply increase the outward spring force of the ring by flattening the ring slightly.

2.2.4 Scissors Mounting Ring

For pipes larger than 15" in diameter, Teledyne ISCO offers the adjustable Scissors Ring (also known as the Universal Mounting Ring). This device consists of two or more metal strips that lock together with tabs to form a single assembly. There is a base section where the sensors are mounted, two or more extension sections (usually), and a scissors section at the top that expands the entire assembly and tightens it inside the pipe. The scissors section contains a long bolt that increases the length of the section as it is tightened.

The assembled scissors rings fit pipe diameters from 16" to 80". Secure the unit in place by tightening the scissors mechanism with a 5/8" socket wrench or other suitable tool. Ring sections are .040" thick half-hard 301 stainless steel sheet. All other parts are also stainless steel, except for the plastic cable ties in the hardware kit.

Each extension, 1, 2, 3, and 4, adds 9.0", 21.5", 31.5", or 41.5", respectively, to the circumference of the ring. Used alone, the base section fits a pipe that is approximately 16" to 19" in diameter. The 9.0" (smallest) extensions can be used to take up or remove slack, to bring the scissors mechanism into a position where it can be effectively tightened.

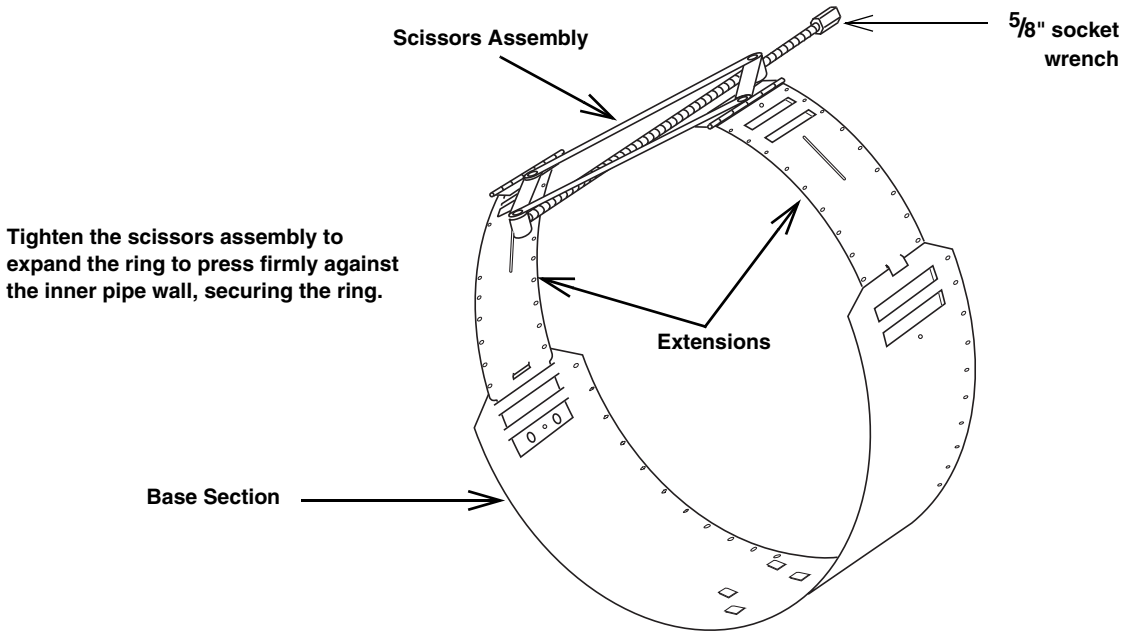


Figure 2-2 Scissors Ring adjustment

☑ *Note*

The hardware kit includes flat head screws and nuts.Teledyne ISCO strongly recommends bolting the assembled sections together before installation, using the holes provided for that purpose. This can greatly increase safety and prevent the assembly from being torn apart.

Do not overtighten the mechanism. It is designed to flex somewhat to provide a positive lock, once moderately tightened.

For installations in larger channels and/or high flow, extensions 2, 3, and 4 have slots for attaching the ring to the channel wall using appropriate anchoring hardware.

To prevent debris from catching on the probe cable, it is important to attach the cable to the mounting ring so it offers as little resistance to the flow as possible. Attach the sensor cable to the downstream edge of the ring, using the self-locking plastic ties supplied with the ring. Place the ties through the holes in the mounting ring and then lock them around the cable.

⚠ CAUTION

Do not overtighten the plastic cable ties; they should be tightened just enough to secure the cable in place, without greatly indenting the cable. Overtightening the plastic ties may collapse the reference tube in the cable, blocking it.

2.2.5 Completing the Sensor Installation

The 350 Ex sensor installation is finished by securing any excess sensor cable using cable clamps or other means.

The reference tube inside the cable can be restricted or blocked if the cable is kinked, sharply bent, coiled, or otherwise pinched. The sensor cable should be handled and mounted with care.

A damaged cable can affect the operation of the sensor, particularly if the reference air tube inside the cable is collapsed or blocked.

⚠ CAUTION

If there is any distance between the point where the sensor cable leaves the mounting apparatus and the location of the flow meter, *be sure* to attach the cable to the flow stream wall to prevent it from moving, tangling, and trapping debris. Install the cable so that it is not at risk of damage resulting from other activity taking place in the area.

2.3 Installation in Hazardous Locations

Read all labels carefully before installing the equipment!

The TIENet Model 350 Ex device is ATEX-approved for use in potentially explosive atmospheres when specific conditions are met, as described in the control drawing in reference to "X" Marking.

The 350 Ex is certified Group II, Category 1G equipment for use in gas hazard zones 0, 1, and 2 (European standards), and Class I Division 1 (North American standards).

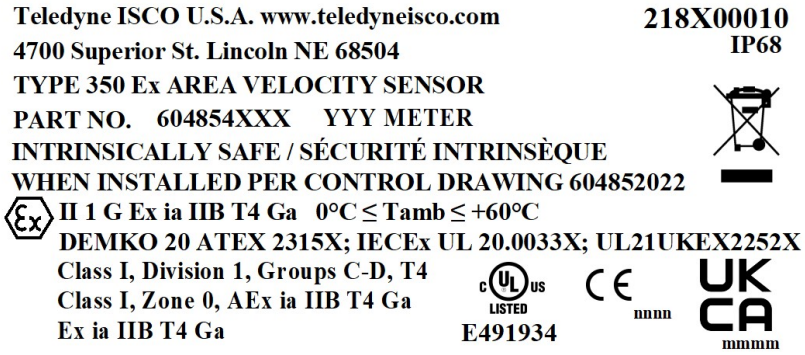


Figure 2-3 Sensor labeling regarding hazloc installations

Installation should be performed with respect to nationally recognized codes that cover wiring practices such as NEC or CEC. Installation must be performed only by trained, qualified personnel.

Barriers or isolators required for certifiable safe installation are the responsibility of the user. Refer to the control drawings provided in Figures 2-4 through 2-8.

CONTROL DRAWING, 350Ex TIENET 604852022 REV H 8/27/21

350 Ex Area Velocity Sensor with Safe Area Host Device

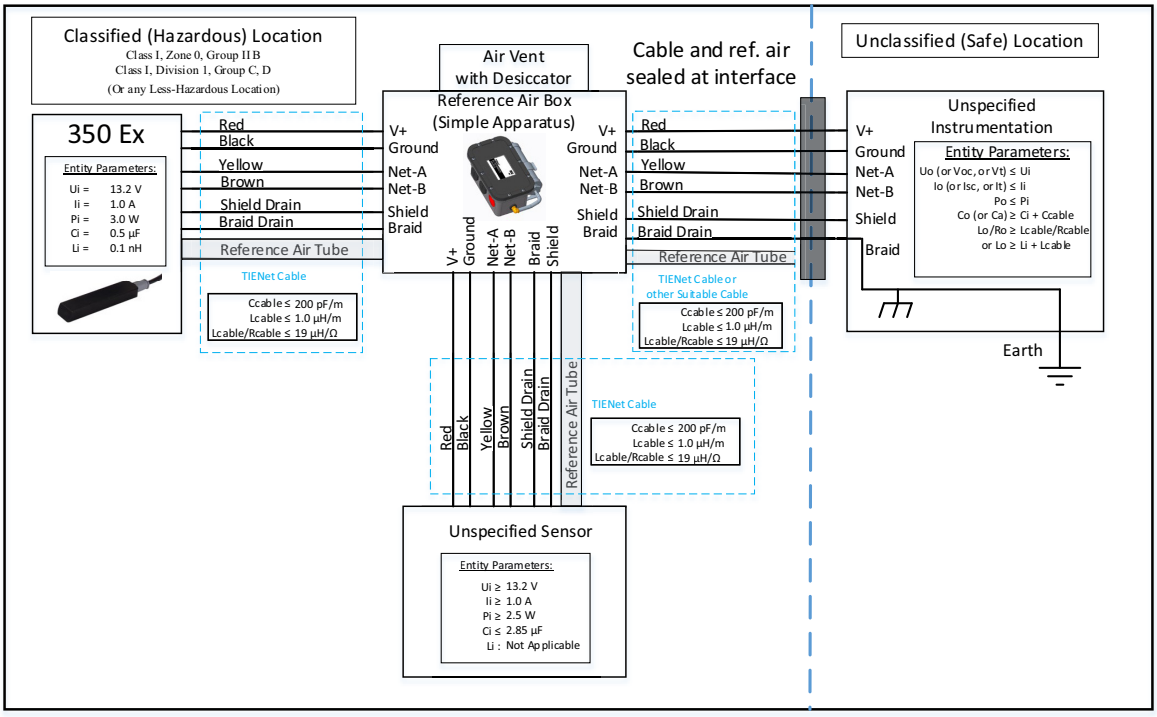


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Figure 2-4 350 Ex Area Velocity Sensor with Safe Area Host Device

CONTROL DRAWING, 350Ex TIENET 604852022 REV H 8/27/21

350 Ex Area Velocity Sensor with Safe Area Host Device Cont.

Notes:

1. "Unspecified Instrumentation" must be installed in accordance with its manufacturer's control drawing.

2. In the United States, wiring methods must be in accordance with the National Electrical Code (NEC), ANSI/NFPA 70, Article 504. In Canada, wiring methods must follow the Canadian Electric Code (CEC), Section 18. In countries that follow the IECEx certification scheme, wiring methods must follow IEC 60079-14. Installations in other countries must follow local installation codes.

3. Keep unshielded wire lengths as short as possible.

4. Wiring from the 350 Ex to the Reference Air Box must use the integral TIENet cable. Maximum total length of cable between the "Unspecified Instrumentation" and the 350 Ex is 150 meters.

5. Capacitance of the wiring from the "Unspecified Instrumentation" to the 350 Ex and any additional sensors shall be calculated and must be included in the system calculations. The marked capacitance, Co or Ca, must be greater than the 350 Ex capacitance (Ci), plus capacitance of any additional sensors (Ci), plus combined capacitance of all cables (Ccable). See Table 1 for figures pertaining to 350 Ex with integral TIENet cable.

6. For inductance calculations, cable length restrictions may be ignored if the Lcable/Rcable (Li/Ri) is less than the Lo/Ro of the "unspecified instrumentation". If Lcable/Rcable (Li/Ri) is not available for the wiring or if the 'Unspecified Instrumentation' is not provided with Lo/Ro , then total inductance (Ltotal) must be calculated for the wiring using Li + Lcable and Ltotal must not exceed the Lo of the 'Unspecified Instrumentation'.

7. The reference tube from the 350 Ex sensor must terminate in the classified area. Use a Reference Air Box (simple apparatus) to terminate the reference tube. Any reference tube exiting the classified area must be terminated in the classified area.

8. The entire cable (including any reference tube) exiting the classified area must be terminated in accordance with NEC, CEC, or other local installation code.

"X" Marking

The "X" marking on the 350 Ex sensor label indicates potential hazards if the following specific conditions are not met:

1. The enclosure of the 350 Ex sensor is made of non-conductive Kynar which can create an electrostatic hazard. When not installed under water, a conductive mounting bracket must be used. After installation, the bracket must ensure that the area of each uncovered surface is less than 25 cm^2.

   WARNING: Potential electrostatic charging hazard. See instructions,
   AVERTISSEMENT: Danger potentiel de charges électrostatiques – Voir instructions.

2. The metallic mounting inserts are isolated from the circuit and are not grounded. The maximum measured value of capacitance from the insert to earth is 6.2pF. To eliminate this potential hazard install the sensor using metal mounting hardware in the flow channel or mount the sensor to the nose of a LaserFlow Ex in its normal Surcharge application.

Table 1

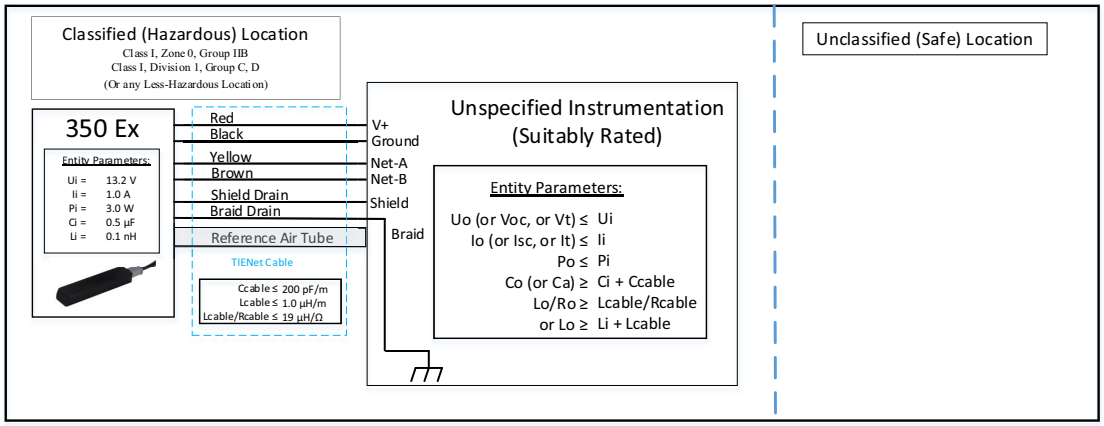
Integral Sensor Cable Length	**0m**	**5m**	**10m**	**23m**	**50m**	**150m**
Ci + Ccable (µF)	0.500	0.501	0.501	0.502	0.505	0.516
Li/Ri (µH/Ω)	-	19	19	19	19	19

2

Figure 2-5 350 Ex Area Velocity Sensor with Safe Area Host Device Notes

CONTROL DRAWING, 350Ex TIENET 604852022 REV H 8/27/21

350 Ex Area Velocity Sensor with Classified Area Host Device



3

Figure 2-6

Figure 2-7 350 Ex Area Velocity Sensor with Classified Area Host Device

CONTROL DRAWING, 350Ex TIENET 604852022 REV H 8/27/21

350 Ex Area Velocity Sensor with Safe Area Host Device Cont.

Notes:

1. "Unspecified Instrumentation" must be installed in accordance with its manufacturer's control drawing.
2. In the United States, wiring methods must be in accordance with the National Electrical Code (NEC), ANSI/NFPA 70, Article 504. In Canada, wiring methods must follow the Canadian Electric Code (CEC), Section 18. In countries that follow the IECEx certification scheme, wiring methods must follow IEC 60079-14. Installations in other countries must follow local installation codes.
3. Keep unshielded wire lengths as short as possible.
4. TIENet cable is integral to the 350 Ex. No other cable may be used. Maximum total length of TIENet Cable is 150 meters.
5. Capacitance of the wiring from the 350 Ex to the "Unspecified Instrumentation" shall be calculated and must be included in the system calculations as shown above. The marked capacitance, Co or Ca must be greater than the 350 Ex capacitance (Ci) plus the cable capacitance (Ccable). See Table 1.
6. For inductance calculations, cable length restrictions may be ignored if the Lcable/Rcable (Li/Ri) is less than the Lo/Ro of the "unspecified instrumentation". If Lcable/Rcable (Li/Ri) is not available for the wiring or if the 'Unspecified Instrumentation' is not provided with Lo/Ro , then total inductance (Ltotal) must be calculated for the wiring using Li + Lcable and Ltotal must not exceed the Lo of the 'Unspecified Instrumentation'.

"X" Marking

The "X" marking on the 350 Ex sensor label indicates potential hazards if the following specific conditions are not met:

1. The enclosure of the 350 Ex sensor is made of non-conductive Kynar which can create an electrostatic hazard. When not installed under water, a conductive mounting bracket must be used. After installation, the bracket must ensure that the area of each uncovered surface is less than 25 cm^2.

   WARNING: Potential electrostatic charging hazard. See instructions,
   AVERTISSEMENT: Danger potentiel de charges électrostatiques – Voir instructions.

2. The metallic mounting inserts are isolated from the circuit and are not grounded. The maximum measured value of capacitance from the insert to earth is 6.2pF. To eliminate this potential hazard install the sensor using metal mounting hardware in the flow channel or mount the sensor to the nose of a LaserFlow Ex in its normal Surcharge application.

Table 1

Integral Sensor Cable Length	0m	5m	10m	23m	50m	150m
Ci + Ccable (µF)	0.500	0.501	0.501	0.502	0.505	0.516
Li/Ri (µH/Ω)	-	19	19	19	19	19

4

Figure 2-8

Figure 2-9 350 Ex Area Velocity Sensor with Classified Area Host Device Notes

CONTROL DRAWING, 350Ex TIENET 604852022 REV H 8/27/21

DESCRIPTION OF CHANGE	DATE	BY
Rev. F – Updated parameters and note 5 page 2 for multiple sensors	6/16/21	BSH
Rev. G – Updated note 6 on pages 2 and 4, added “or Lo ≥ Li + Lcable”	6/30/21	BSH
Rev. H – Updated label on page 5 for UKCA information	8/27/21	BSH

5

Figure 2-10

Figure 2-11 350 Ex Area Velocity Sensor Markings

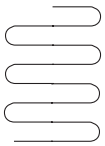
☑ Note

A TIENet barrier (PN# 60-4364-112) is available from Teledyne ISCO's customer service.

⚠ WARNING

Do not coil the sensor cable; this will form an inductor and create a hazard. The cable should be kept as short as is practical. If necessary, use a serpentine loop (see figure at left) instead.

Serpentine loop



2.3.1 Important Information Regarding "X" Marking

The ATEX labeling on the serial tag of the 350 Ex device includes a number ending in "X". The X marking indicates that there are specific conditions that must be met in order for the equipment to comply with intrinsic safety requirements. Refer to the control drawing (Figures 2-4 through 2-8).

2.3.2 Electrical Requirements

Always refer to the electrical values listed on the control drawing (Figures 2-4 through 2-8) when connecting associated apparatus (i.e. power supply, network interface, etc.).

This labeling indicates the maximum input voltage (Ui), maximum input current (Ii), and maximum power (Pi) that can be present at the specified terminals without invalidating intrinsic safety.

The power supply parameter allowances *must exceed* maximum internal capacitance (Ci) and either the maximum internal inductance (Li), or the maximum internal inductance-to-resistance ratio (Li/Ri) of the 350 Ex device and integral cable. These parameters are established on the Safety and Certification sheet and are available by contacting Teledyne ISCO.

2.3.3 Ambient Environment

Installation in designated hazardous areas must fall within the temperature range of 0 to 60 °C, as specified on the serial tag labeling.

2.4 Street Level Installation System

The Street Level Installation System provides a way to install ISCO sensors in round pipe sewers without having to enter the manhole. The system includes an insertion tool with a multi-section pole and five differently-sized expansion rings (6", 8", 10", 12", and 15") with an adjustable strap for each ring. The six pole extensions and the adjustable strap allow installation of the expansion rings in manholes as deep as 15 feet.

For more information about the Street Level Installation System, contact your Teledyne ISCO representative.

2.5 Connecting to TIENet barrier

Refer to TIENet Barrier Installation Guide Teledyne ISCO Part No. 60-4803-079

2.6 Connecting the 350 Ex AV Sensor to the DuraTracker

The sensor cable attaches to the sensor receptacle on the DuraTracker. To connect the 350 Ex:

1. Remove the protective caps:
   a. On the DuraTracker, push down on the sensor release while pulling the protective cap from the receptacle.

Figure 2-12 Removing the protective cap from the DuraTracker

   b. On the sensor cable, pull the cap from the end of its plug.
2. Prepare the 350 Ex AV plug:
   a. Inspect the plug. It should be clean and dry. Damaged O-rings must be replaced. Spare O-rings are supplied in the maintenance kit.
   b. Coat the O-ring's sealing surface with a *silicone* lubricant.

⚠ CAUTION

Do not use petroleum-based lubricants. Petroleum-based lubricants will cause the O-ring to swell and eventually deteriorate. Aerosol silicone lubricant sprays often use petroleum based propellants. If you are using an aerosol spray, allow a few minutes for the propellant to evaporate before proceeding.

3. Align and insert the connector. The sensor release will "click" when the sensor connector is fully seated.

Figure 2-13 Inserting the connector

4. Connect the two caps together.

Figure 2-14 Connecting the caps

2.7 Connecting the 350 Ex AV Sensor to the Signature

External TIENet devices such as the 350 Ex are all electrically 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

The Signature Flow Meter is not a certified intrinsically safe device. If you are using the 350 Ex AV sensor in a hazardous location, you must use a certified intrinsically safe flow meter such as the DuraTracker EX or a barrier such as the TIENet Barrier (Teledyne ISCO P/N 604364112).

⚠ 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.

⚠ 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.

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

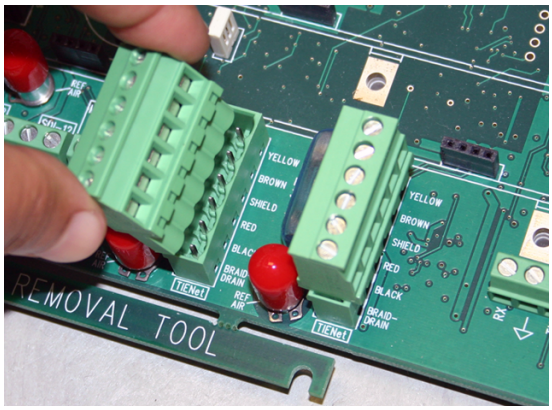


Figure 2-15 TIENet Device terminal strips

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).
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.

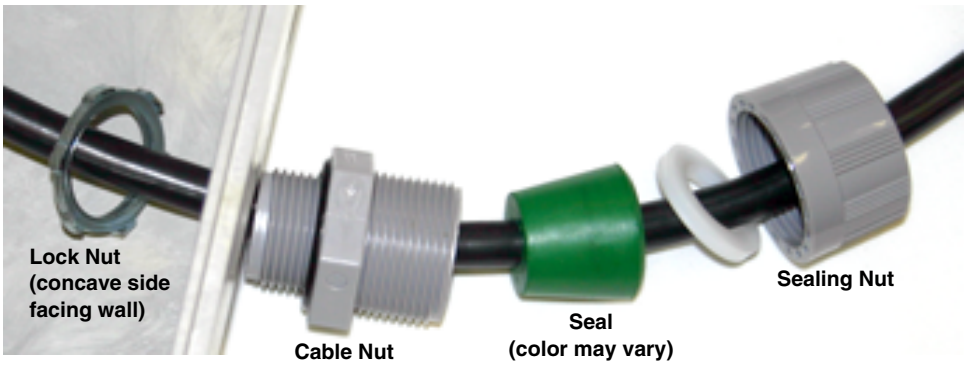


Figure 2-16 Installing cable with a cord-grip fitting

4. Attach the wire ends to the terminal strip as shown in Figure 2-17, then press the terminal strip back down into its socket on the case board, as shown in Figure 2-18, 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.

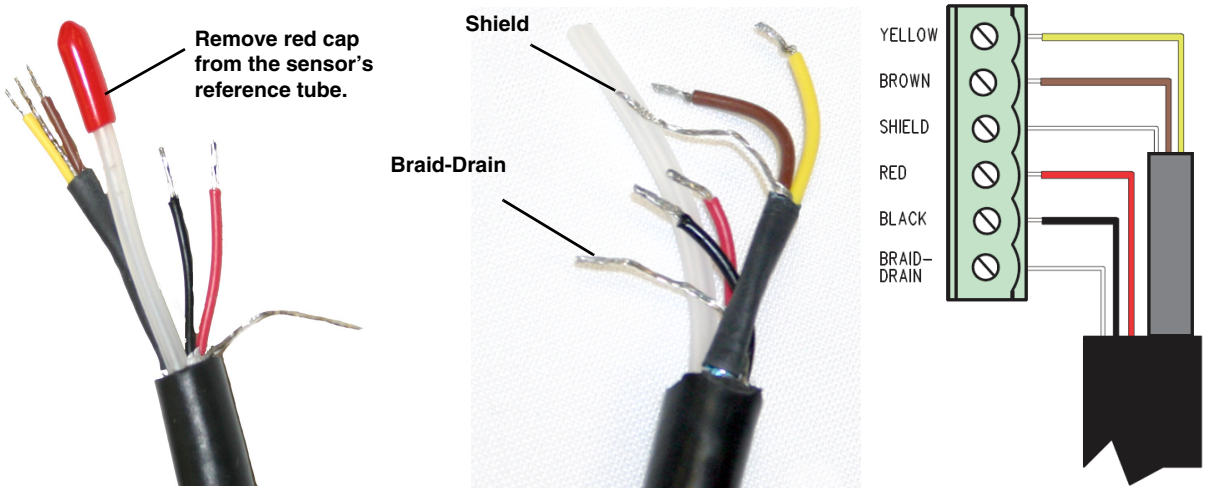


Figure 2-17 TIENet Device terminal connections

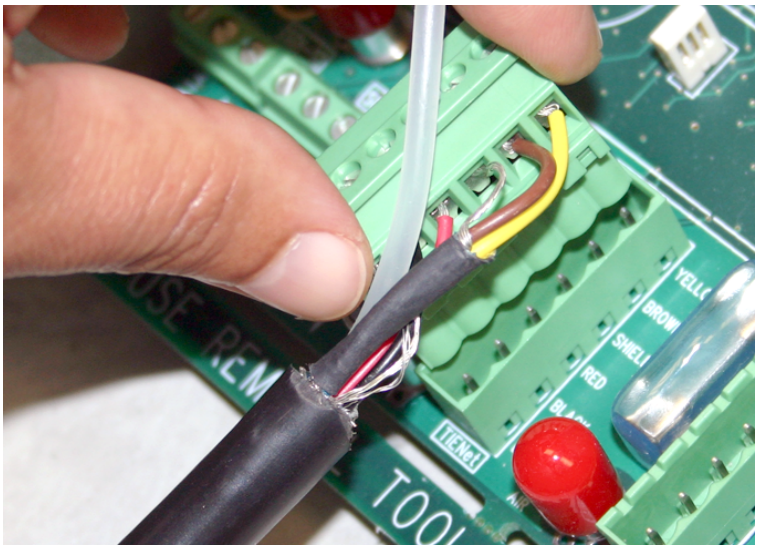


Figure 2-18 Attach wired terminal strip to case board socket

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 kink the reference tubing.**

Note:
Remove the red cap from the reference port, on the case board next to the TIENet connector, being used by the 350 Ex sensor.

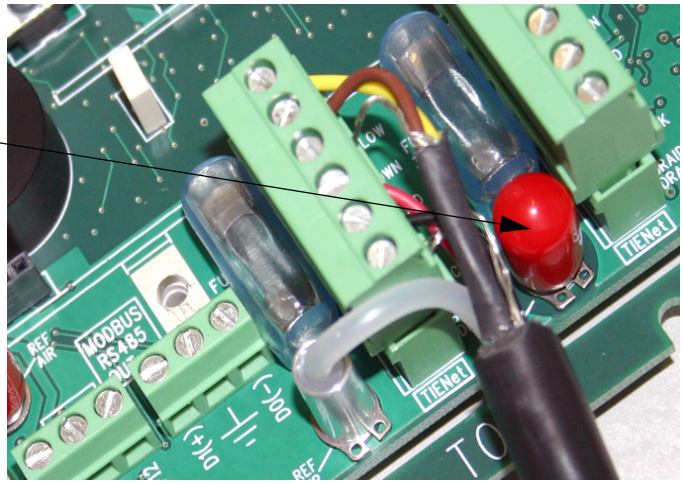


Figure 2-19 Insert the cable reference tubing into the case board reference port

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 2-20).

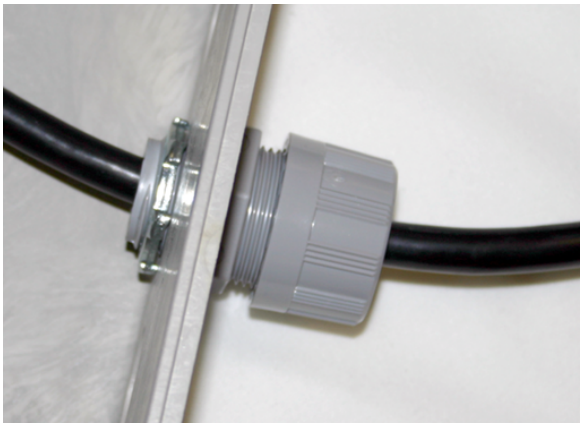


Figure 2-20 Position and secure the cable

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

⚠ 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.

2.8 Reference Line Support

The optional, water tight Ex Reference Air Box allows easy reference to measurement area and enables a variety of configurations for adding length, as well as connecting two 350 Ex devices at once. The Ex Reference Air Box connects to a barrier or isolator such as the TIENet Barrier (Teledyne ISCO P/N 604364112). The barrier can then be connected to a Signature or DuraTracker flow meter in the safe area.

⚠ WARNING

All elements of an installation must be certified as intrinsically safe in order to meet the installation requirements of hazardous locations. The Ex Reference Air Box is a certified intrinsically safe device. Follow the control drawing for safe installation.

⚠ WARNING

The air reference line must be terminated in the classified area.

Adding Length Between Signature and Sensors

Distance can be increased by installing the Air Reference Box closer to the field-mounted TIENet device(s) and adding a custom-length TIENet cable between the box and the flow meter. The maximum distance between system components is 150 meters (493 feet).

Distances Greater than 100 Feet

If the total distance is greater than 30.5 meters (100 feet), the reference air line must be vented before the 30.5 meters.

The TIENet Ex Air Reference box with reference air is designed for this purpose. The desiccator tube mounted on the side vents dried air to its interior.

2.9 Preparing the Signature Flow Meter

In order to operate with the 350 Ex AV sensor, the Signature must have an external desiccator installed if not using the Ex Reference Air Box and the unit is not in a classified area.

2.9.1 External Desiccator

For Signature systems using the TIENet 350 Ex Area Velocity Sensor, and/or the 330 Bubbler Module, the external desiccator dries the air for a pressure transducer reference and air supply for the bubbler.

Signature systems utilizing a 330 Bubbler Module will already have a desiccator installed. If you are adding a 350 Ex AV sensor to a non-bubbler system, you will also need to add an external desiccator.

Remove the two red protective end caps from the ports before installing a new cartridge.

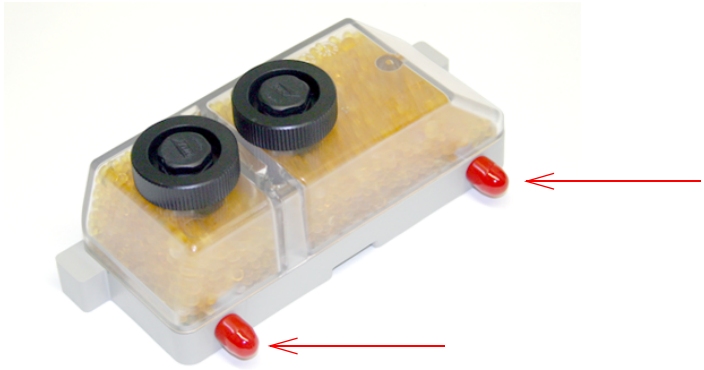


Figure 2-21 Remove red caps before installing external desiccant cartridge

The desiccant cartridge is held in place by a spring tab on the side of the flow meter. Slide the cartridge onto the tab, engaging the two ports with the openings in the side of the Signature.

Figure 2-22 Installing the external desiccant cartridge

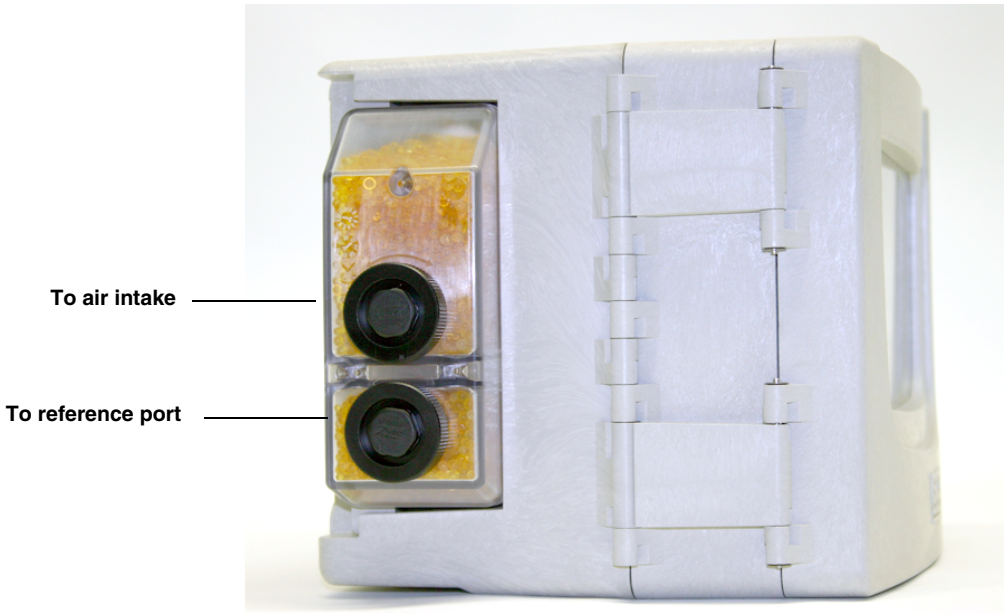


Figure 2-23 External desiccator, installed

The desiccant cartridge requires periodic maintenance. Refer to Section 5.3 *External Desiccator* for instructions.

Optimizing drying power

Some Signature flow meters have a single piece of tubing installed between the reference port and the humidity connector, and a cap plug on the intake port. While a Signature with this tubing configuration will operate satisfactorily with the 350 Ex AV sensor in most situations, you can configure the tubing to utilize both chambers of the external desiccator to increase drying power.

Items required:

- Plastic 'Y' Fitting
- 0.25 x 0.125 silicone tubing (Two 2-inch pieces)

Procedure:

1. Remove the cap plug.
2. Disconnect the tubing from the humidity connector and reroute it behind the ribbon cable.
3. Connect both the reference port tubing and the intake port tubing to the 'Y' connector.
4. Connect the 'Y' connector to the humidity connector (Figure 2-24).

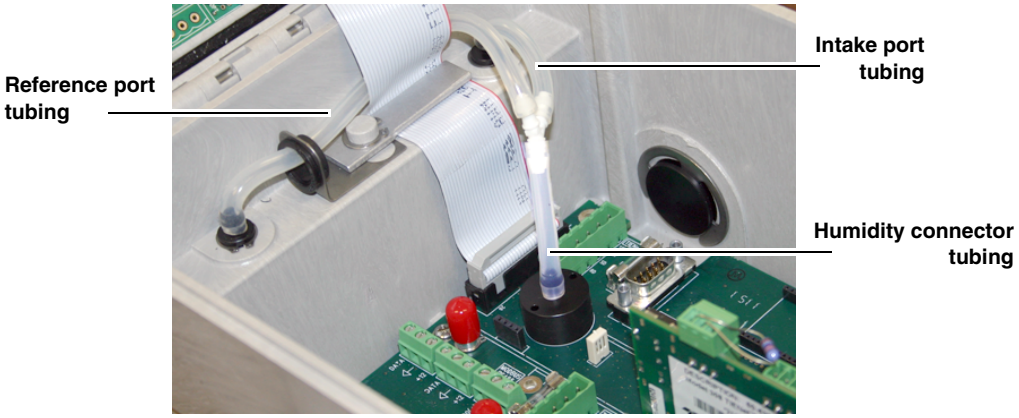


Figure 2-24 Tubing configuration for optimal drying power

TIENet® Model 350 Ex Area Velocity Sensor

Section 3 Setup and Programming for the Signature

3.1 Configuring the System

To configure the Signature flow meter for operation with the TIENet 350 Ex sensor, press MENU (B) to access the top menu, and select Hardware Setup. For all TIENet devices including the 350 Ex, select Smart Sensor Setup (TIENet).

3.1.1 Updating the Device List

When the 350 Ex is physically added to the system, select Perform Scan so that the flow meter detects it. When the scan is complete, the 350 Ex appears in the list of connected devices, ready to be configured with the steps shown in Figure 3-2 on the following page.

> ☑ ***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 350 Ex sensor are:

350 Level	350 Temperature
350 Velocity	350 Velocity Signal
350 Velocity Spectrum	350 Vel Spectrum Ratio
350 Sense Voltage	

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 ().

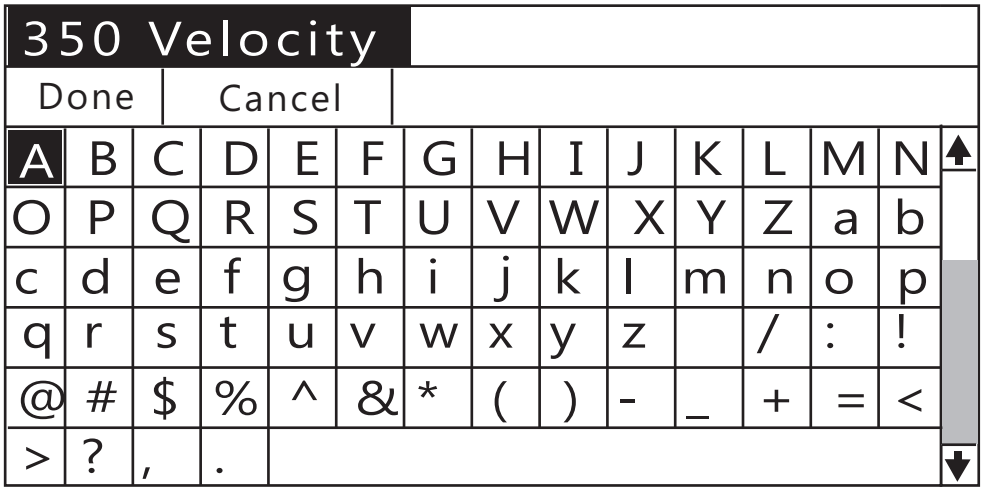


Figure 3-1 Character grid

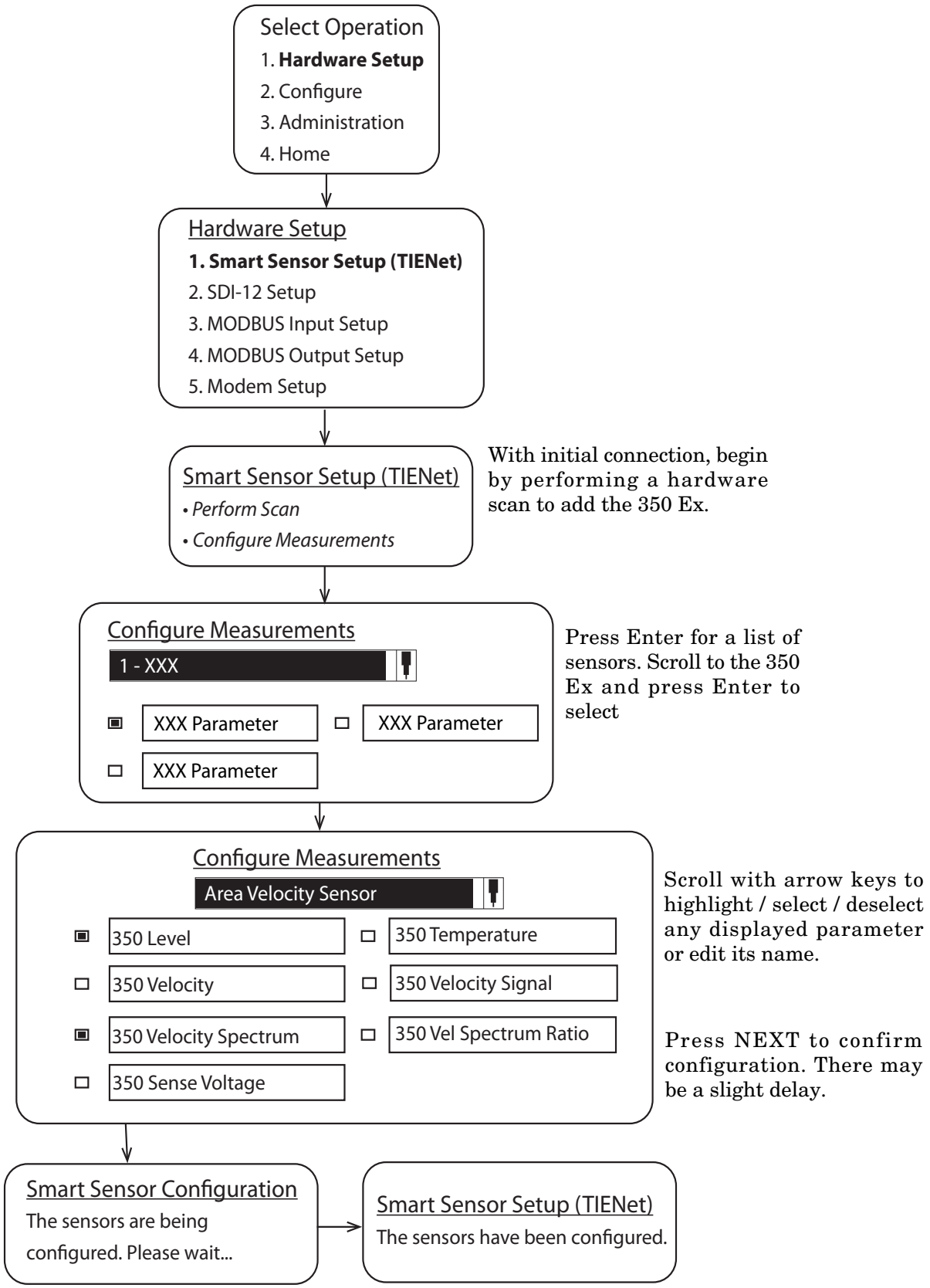


Figure 3-2 Menu Tree: 350 Ex Configuration

3.2 Measurement Setup

From Measurement Setup (Figure 3-4), you can set up velocity measurement or make changes to the advanced settings.

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

3.2.1 Setting the 350 Ex Level

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.

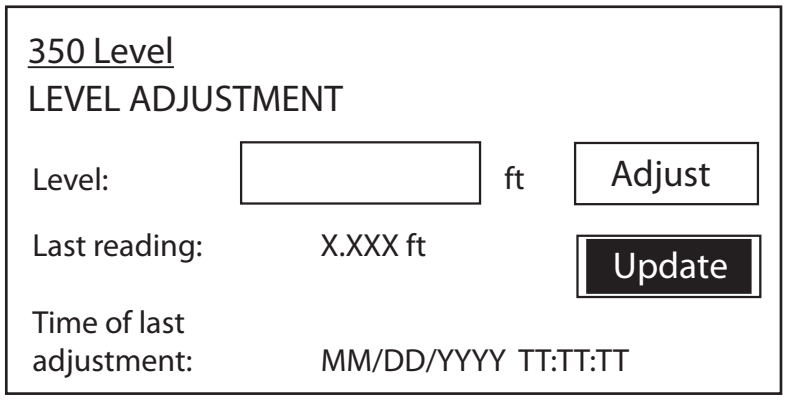


Figure 3-3 350 Ex Level adjustment screen

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**.

Prior to mounting the sensor in the flow stream, check the displayed level reading. In open air, the reading should be zero. If not, adjust the level to zero.

> **Note**
> If the 350 Ex sensor is part of the optional submerged functionality for a LaserFlow system, the initial level setting is the measured distance from the bottom of the channel to the bottom of the LaserFlow sensor.

Following the 350 Ex sensor installation in the flow stream, another measurement device can be used to verify the 350 Ex level reading. Allow the sensor to operate in the stream for approximately 30 minutes prior to verifying the level.

3.2.2 350 Ex Velocity

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 reported.

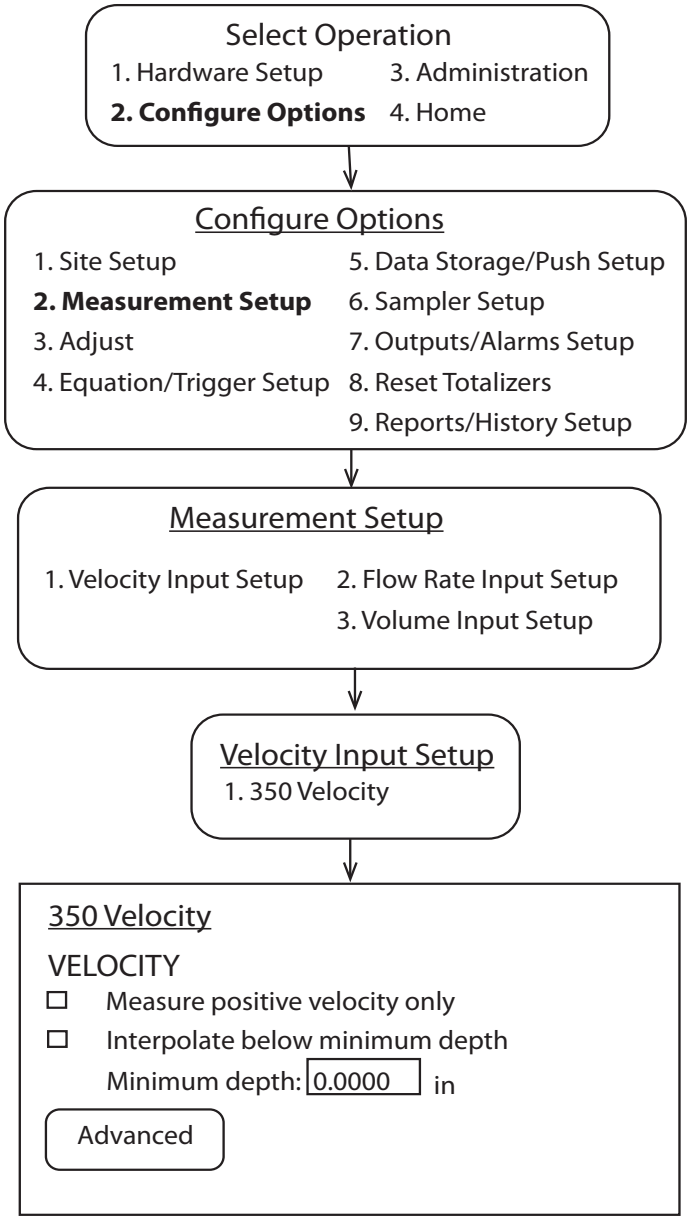


Figure 3-4 Configuring level and velocity measurement

3.2.3 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 (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:

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

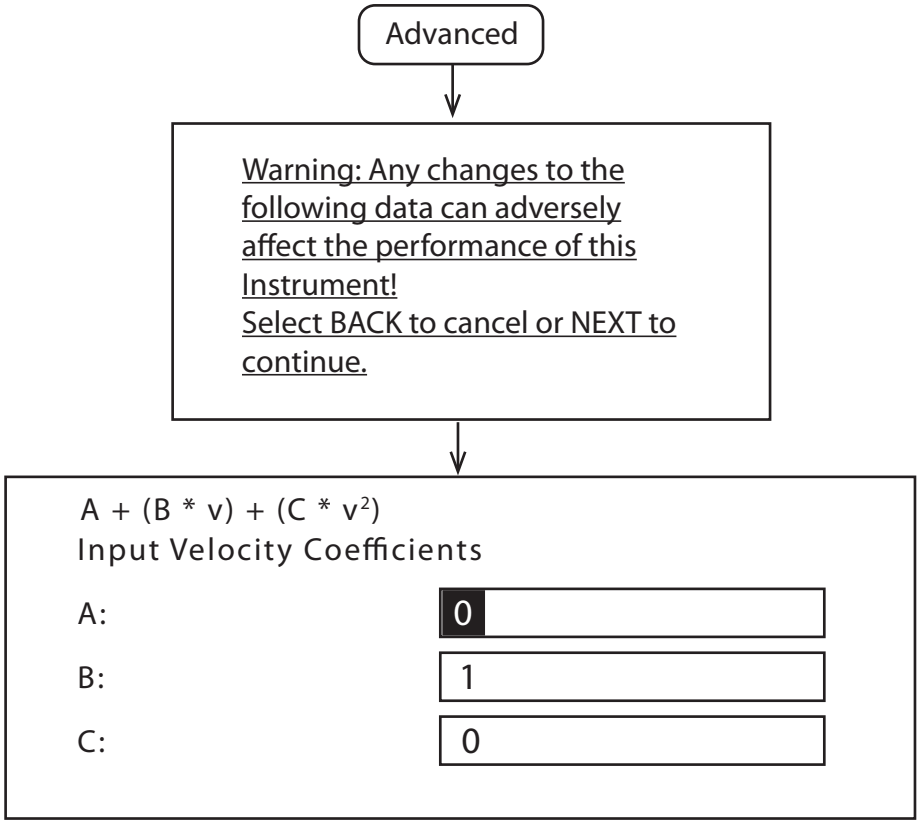


Figure 3-5 Measurement setup: Advanced settings for 350 Ex AV sensor

TIENet® Model 350 Ex Area Velocity Sensor

Section 4 Setup and Programming for the DuraTracker

The TIENet 350 Ex Area Velocity Sensor is compatible with the DuraTracker and DuraTracker EX Flow Meter. For Signature setup instructions, refer to Section 3.

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

This section of the manual assumes the DuraTracker site is already configured in Flowlink and the DuraTracker 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 DuraTracker, refer to the DuraTracker Installation and Operation Guide.

4.1 Activating Connected Sensors

To add an available (connected) 350 Ex AV sensor and activate it in Flowlink, select the TIENet tab, then click the "SCAN" button to detect any newly connected sensors. Devices will appear in the available TIENet Devices pane. Highlight the appropriate device(s) and click the "Add" button to activate.

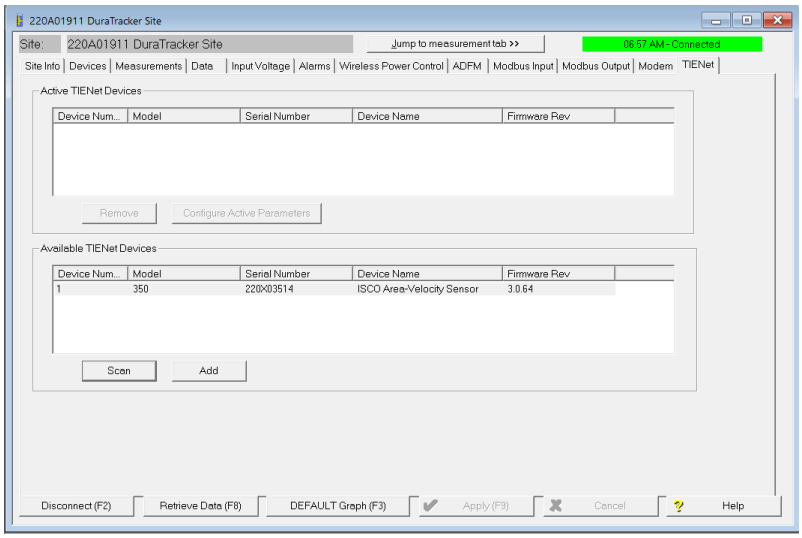


Figure 4-1 Activate connected sensors in Flowlink

A TIENet Measurements window will display all avaiable measurements. You may un-check any measurements you do not want to store. Then click the "OK" buttion.

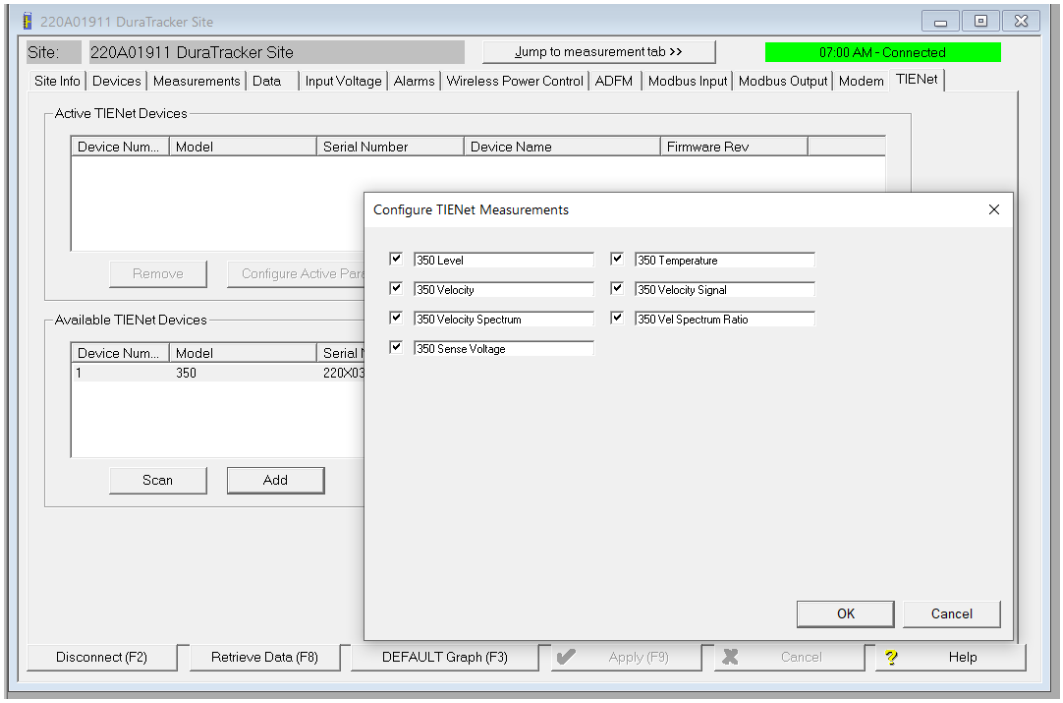


Figure 4-2 Configuring TIENet Measurements

The device will now appear in the Active TIENet Devices window.

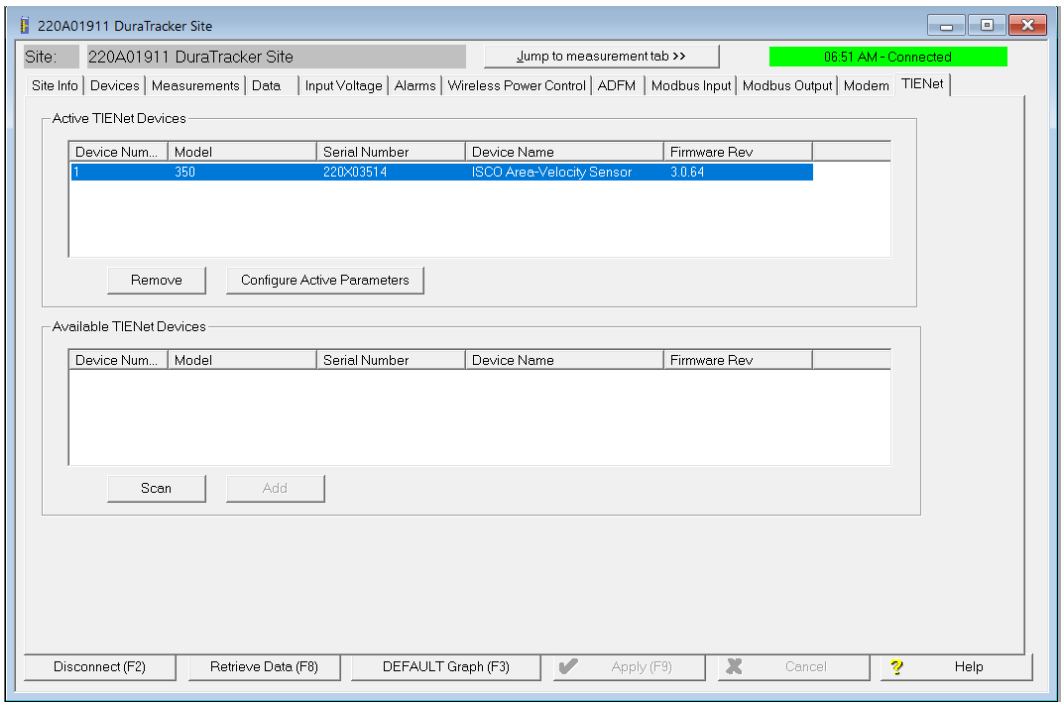


Figure 4-3 Active TIENet Devices

4.2 Measurement Display and Settings

The **Measurements** tab in the Site window lists the data types being measured by the DuraTracker and displays real-time measurements.

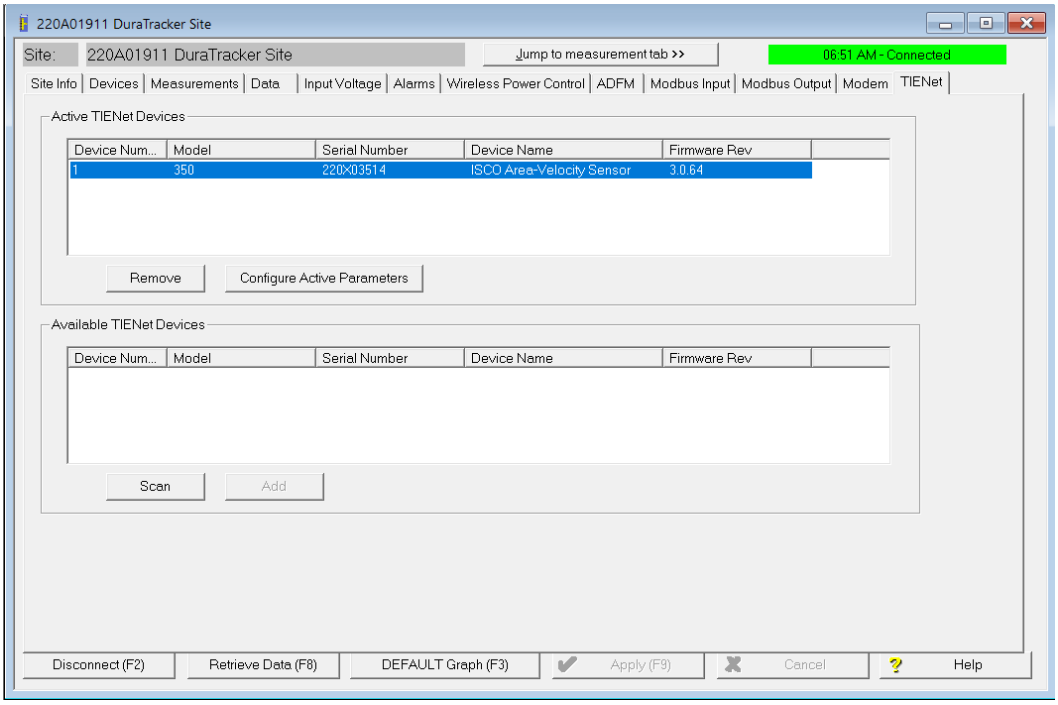


Figure 4-4 Measurements tab: Displays real-time measurements

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 over the DuraTracker. Explanations for the listed measurements are provided in Figure 4-5.

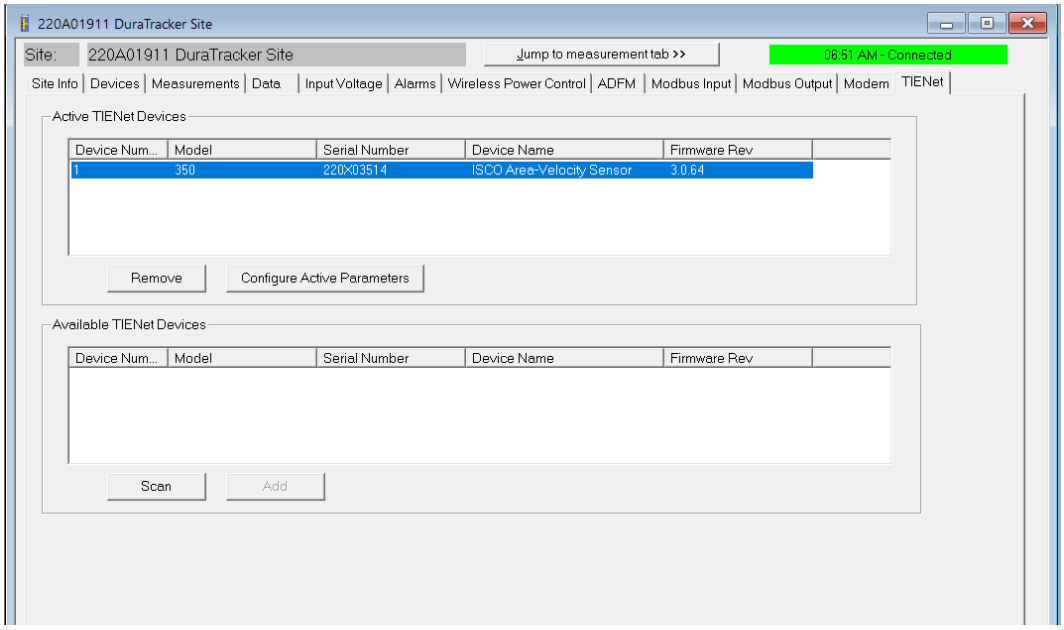


Figure 4-5 Drop down list of measurements for DuraTracker

Click on any parameter on the Measurements tab or in the Jump to Measurements tab 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, select 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.

4.3 Program Settings

While connected, Flowlink displays the *Site View* window. This window contains all of the program settings that control the site's operation. The settings are grouped, or categorized, using five tabs: Site Info, Devices, Measurements, Data and TIENet.

Essential Settings

Some program settings are essential to the operation of the 350 Ex. Two program settings should always be verified when setting up a new site:

- **Level -** Enter a liquid level measurement to adjust the level readings from the AV Sensor (**4.3.1**).
- **Zero Level Offset** – If the AV Sensor is not installed in the bottom-center of the channel, the distance the AV Sensor is offset must be entered (4.3.2).

These two program settings directly affect the data collection. Incorrect settings may introduce errors in the measured data, many of which may prove to be difficult to correct afterwards.

Changing a Setting

After modifying a setting, click on the APPLY button (or press F9 on your keyboard). Flowlink sends the change to the DuraTracker and updates the site's settings in its Flowlink database.

4.3.1 Level

A measurement of the actual liquid level must be taken to adjust the level readings. The value of this measured depth should be entered on the *Level* measurement tab in Flowlink.

Measurement Location

The location of your measurements can affect the flow conversion results. An understanding of how the AV Sensor measures level and velocity will help you determine where the measurements should be taken.

The AV Sensor transmits an ultrasonic sound wave. It propagates from the front of the sensor in a cone-shaped pattern. From within this cone, the AV Sensor measures the stream velocity. Therefore, it is best to measure level from a point inside the cone. Since this cone cannot be seen, a general rule is to measure in front of the sensor along the channel centerline at a distance equal to the liquid depth. For example, if the stream is one foot deep, take the level and channel dimension measurements one foot upstream from the sensor. As mentioned in section 2.3, it is most convienent to adjust to zero outside of the water before installing the first time. If the flow at this point is turbulent, consider relocating the sensor.

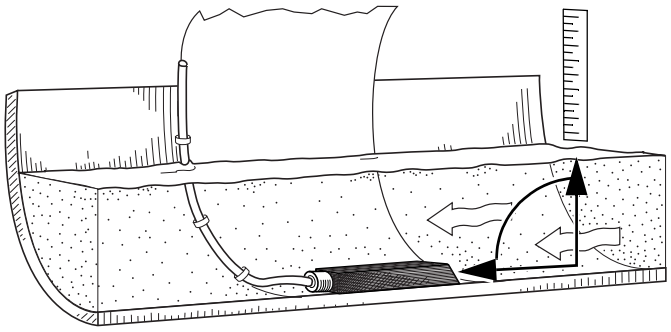
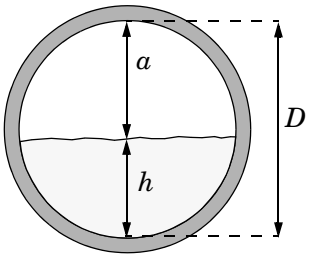


Figure 4-6 Preferred Measurement Location

Do not measure the level and channel dimensions right at the sensor, as the sensor and the mounting ring may cause a slight "jump" or localized rise in the level. At very low levels and high velocities, this jump in the liquid surface may become quite significant.



Level (h) = D – a

In round pipes it is possible to measure the level without disturbing the stream surface. This method is preferred. Refer to the diagram in the margin. First measure the inside diameter of the pipe (*D*). Then measure the airspace (*a*) from the liquid surface to the peak of the inside diameter. Average this measurement if the surface is not calm. The level measurement that you enter (*h*) is calculated by subtracting the distance above the liquid (*d*) from the diameter (*D*). If difficult channel conditions keep you from making the measurements as described above, another site should be considered.

4.3.2 Velocity Measurement Offset

AV Sensors are sometimes offset in the channel to avoid heavy concentrations of silt, or to maximize the level resolution over a specific range. When the AV Sensor is offset, an offset distance must be entered on the *Velocity* measurement tab in Flowlink.

Refer to Figure 4-7. Enter a value for the vertical distance the sensor is installed above the true zero level of the stream. For example, if the sensor is mounted on the side of the pipe two inches higher than the true zero level (the bottom center of the pipe), the Zero Level Offset is two inches. If the sensor is mounted at the bottom of the channel, enter zero.

> **☑ Note**
>
> Do not confuse the circumferential distance between true zero and the location of the AV Sensor with the vertical distance (height). If you install the AV Sensor at the true zero level of the pipe or channel, you would enter “0” for the offset (ignoring the thickness of the mounting ring).

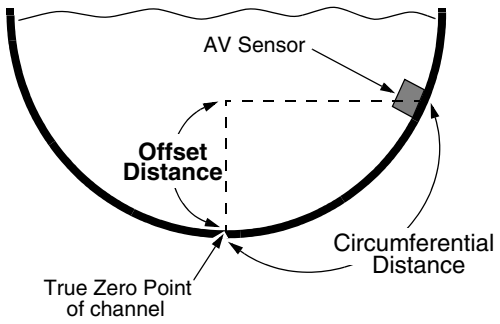


Figure 4-7 Zero Level Offset Measurement

4.3.3 350 Ex Level

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

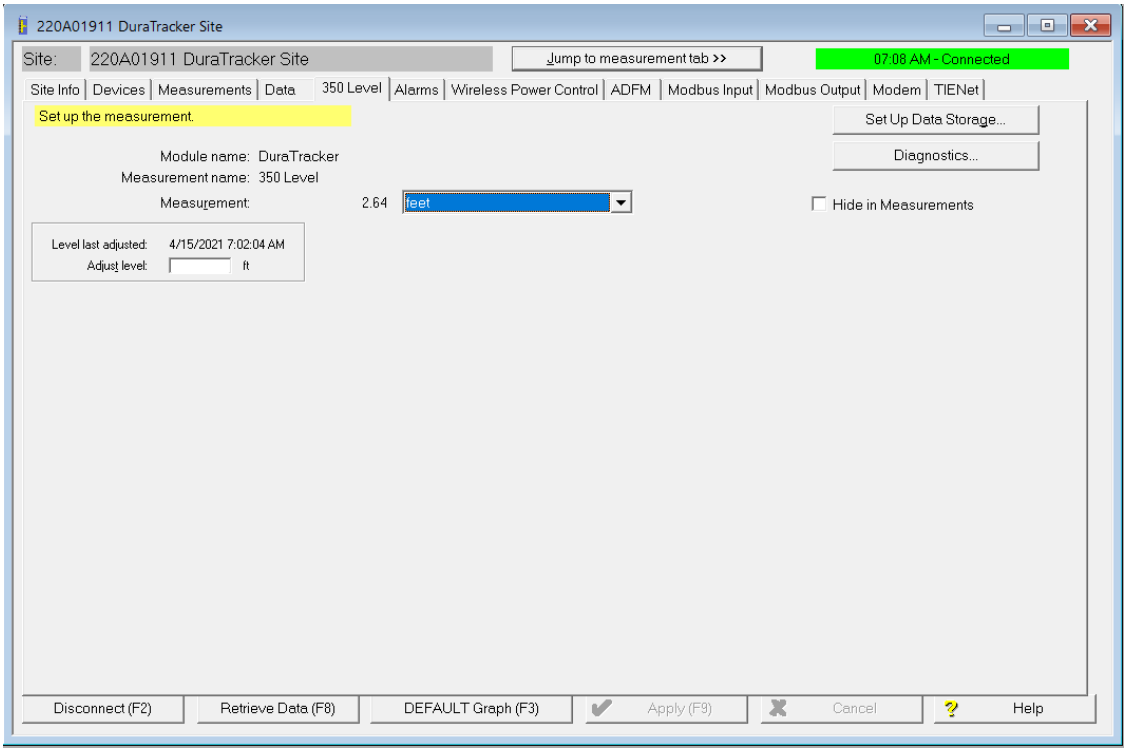


Figure 4-8 350 Ex Level Measurement tab in Flowlink

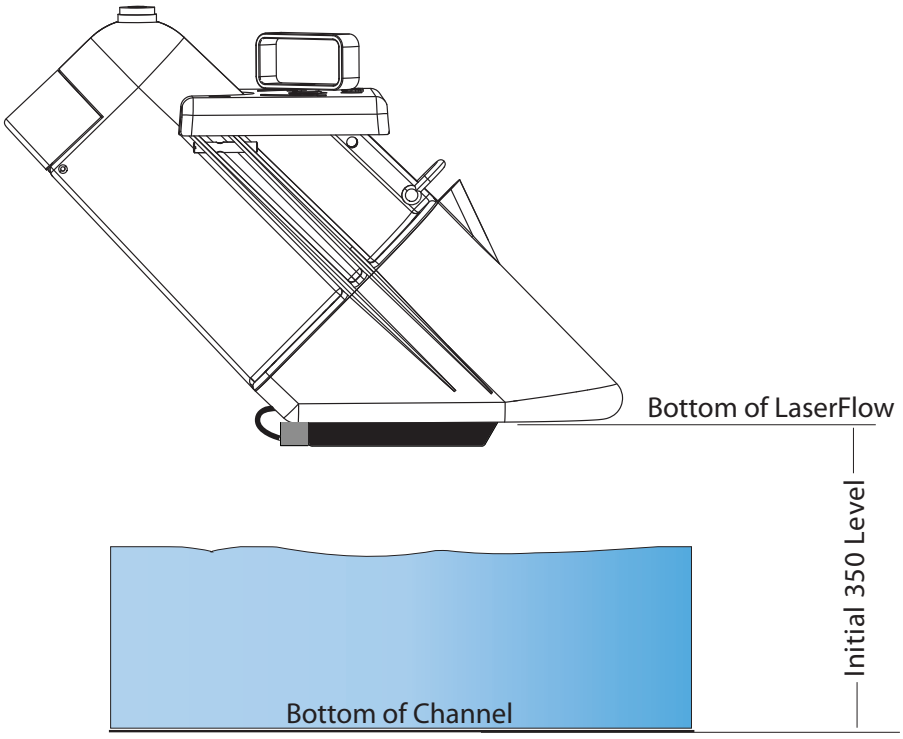


Figure 4-9 Submerged functionality: Initial 350 Ex Level setting

4.3.4 350 Ex Velocity

The 350 Ex AV Sensor is capable of measuring velocity with a continuous wave Doppler sensor.

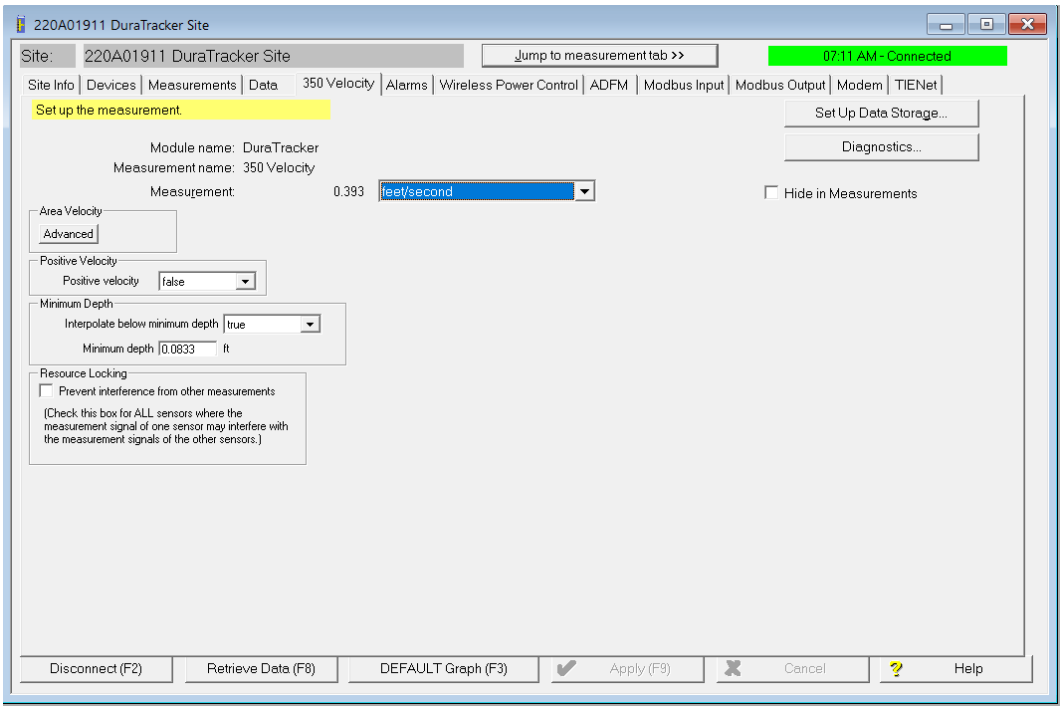


Figure 4-10 350 Ex Velocity Measurement tab in Flowlink

The **Positive Velocity** setting, when set to “true”, the LaserFlow will not attempt to determine flow direction and negative readings are discarded in the average velocity calculation. Selecting this setting will save power. This setting is set to “true” by default.

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

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

$\overline{V} = A\ (offset) + B^{*}(Measured\ Velocity) + C^{*}(Measured\ Velocity)^{2}$

Coefficient A is an additive offset value to correct the Measured Velocity for any additive bias. The value for A must be expressed in units of meters/second.

Coefficient B is a multiplicative scalar for correcting the Measured Velocity for any linear multiplicative bias. The value for B is unitless.

Coefficient C is another scalar to correct the Measured Velocity for any nonlinear bias. The value for C must be expressed in units of seconds/meter, so that the resulting value for the Reported Velocity Reading will be in units of meters/second.

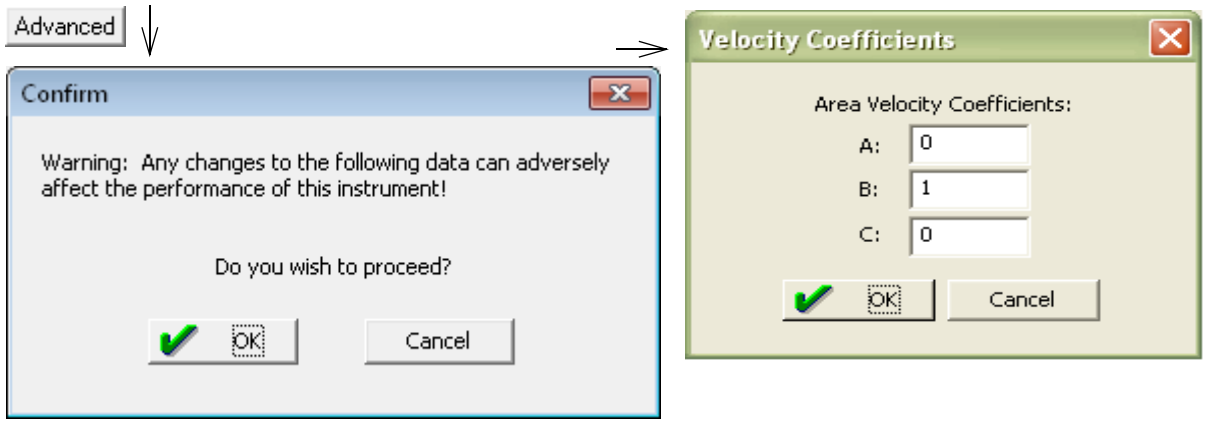


Figure 4-11 350 Ex Velocity tab: Advanced settings for optional TIENet 350 Ex AV sensor

TIENet® Model 350 Ex Area Velocity Sensor

Section 5 Maintenance

5.1 Maintenance

The following tables are recommended maintenance checks to ensure proper operation. As site conditions may vary, increase the frequency of inspections as needed.

Severity of humidity and likelihood of ragging (blockage at a specific site) must be considered when determining regularly scheduled maintenance. In general the below maintenance intervals are recommended if the site has a history of silting.

Table 5-1 Recommended Maintenance Interval (Velocity >1.5/sec)

Action	Recommended Frequency	Reference
Check Desiccant	6 months	Sect.5.3
In Pipe or Channel Cleaning	2 months	Section 5.4
Sensor Cleaning	12 months	Sect 5.5

Table 5-2 Recommended Maintenance Interval (Velocity <1.5/sec)

Action	Recommended Frequency	Reference
Check Desiccant	6 months	Sect. 5.3
In Pipe or Channel Cleaning	Monthly	Section 5.4
Sensor Cleaning	12 months	Sect 5.5

5.2 Firmware Updates

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.

If your system uses a DuraTracker, the sensor firmware can also be updated using the "Update Software" tool included with Flowlink software. Refer to the software help windows for step-by-step instructions.

5.3 External Desiccator

When dry, the loose silica gel desiccant inside the chambers is orange or yellow. When the desiccant becomes saturated with moisture, it turns green or blue, indicating that the intake air and reference line are no longer protected from humidity.

> **Note**
>
> Teledyne ISCO recommends checking the desiccant at least every 6 months, and changing/renewing the desiccant before the entire compartment has changed color.

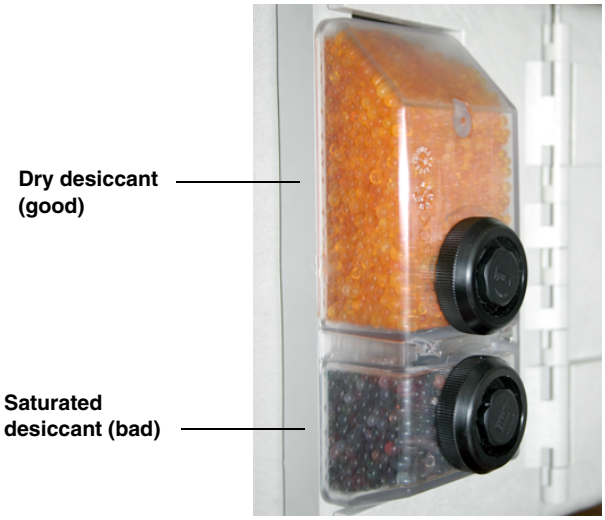


Figure 5-1 Desiccant indicating saturation

5.3.1 Signature

The desiccant cartridge is held in place by a spring tab on the side of the Signature flow meter. Press against the front of the cartridge to disengage it from the unit.

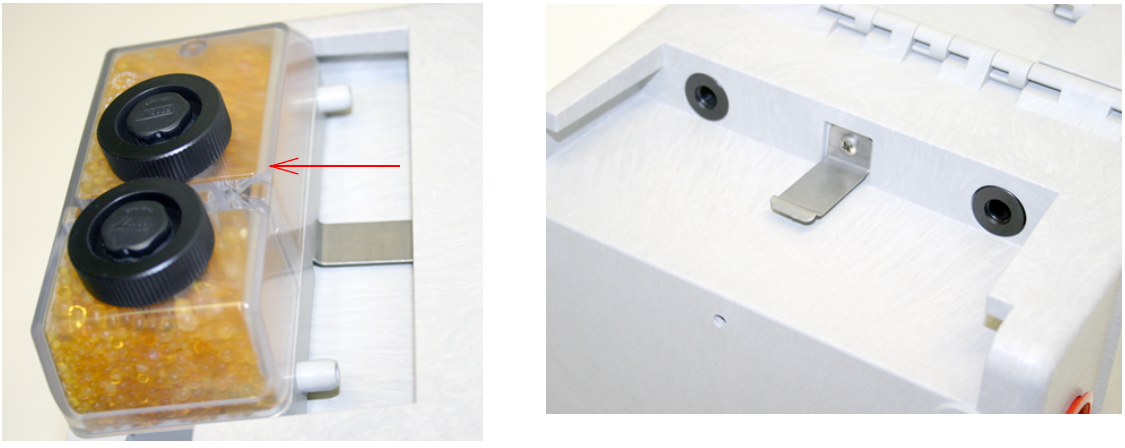


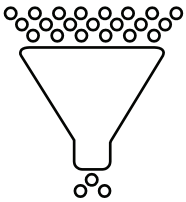
Figure 5-2 Removing the external desiccant cartridge

Unscrew the two black caps and carefully pour the desiccant out.

If removal is difficult, screw the caps back in and unscrew again.

Gently knock the caps and the cartridge against a hard surface to free any small particles in the threads, as these can hinder proper sealing and cause wear.

Using a funnel, fill both chambers with dry desiccant, replace the caps, ensuring that they are fully engaged. Press the cartridge back into place on the side of the flow meter.



Use a funnel to refill the desiccator.

Note

If this is a new desiccant cartridge, remove the two red protective end caps from the ports before installing a new cartridge.

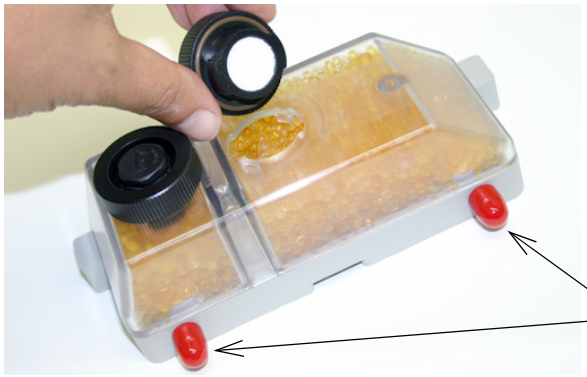


Figure 5-3 Opening the desiccant cartridge chambers

5.3.2 DuraTracker

The desiccant is contained within the cartridge located between the battery banks. To remove the cartridge, unscrew the cap 1/4 turn counter-clockwise, and slide the cartridge out of the unit.

The clear tube reveals the silica gel desiccant inside. To replace the desiccant:

1. Hold the cartridge upright with the cap at the top.
2. Push the cap off of the cartridge.
3. Empty the saturated silica gel desiccant beads or granules into a separate container.
   - For instructions on how to reactivate saturated silica gel desiccant, see Section 6.4.2.
4. Fill the tube with new or reactivated silica gel desiccant.
5. Press the cap back onto the cartridge.

6. Slide the cartridge into the DuraTracker battery compartment, and tighten the cap 1/4 clockwise to seal the cartridge in place.

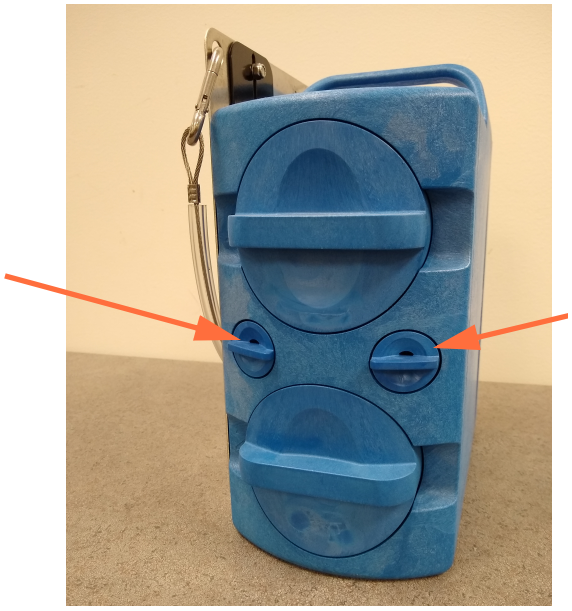


Figure 5-4 desiccant caps

5.3.3 Reactivation Desiccant

Once saturated, silica gel desiccant can no longer suitably protect the DuraTracker from moisture. The silica gel desiccant can be reactivated as described below:

1. Pour the saturated silica gel desiccant into a heat resistant container.

⚠ CAUTION

Do not heat the silica gel desiccant cartridge assembly. It will melt.

2. Heat the desiccant in a vented convection oven at 212 to 350° F (100 to 175° C) for two to three hours, or until the orange color returns.
3. Remove the desiccant from the oven and allow it to cool.
4. Store the reactivated desiccant in an air-tight container until it is ready for use.

⚠ CAUTION

It has been reported that the silica gel desiccant may produce irritating fumes when heated. Although Teledyne ISCO has not been able to reproduce these reports, it is recommended that you always reactivate desiccant in a well-ventilated room and use the recommended temperature range. As an added precaution, it is recommended that you leave the room while the reactivation process takes place.

☑ Note

The silica gel desiccant may lose its ability to remove moisture after several reactivations. This may result in more frequent maintenance requirements. If the desiccant becomes ineffective, replace it with new desiccant.

5.4 In Pipe or Channel Sensor Cleaning

Without removing the sensor from the flow stream, remove debris that may have collected in front of and around the sensor or has attached to the sensor. Use a stiff soft bristle brush such as a broom or toilet bowl brush (do not use a steel brush). Attaching a stick to the brush, extending the handle, allows access to hard to reach locations when cleaning the sensor. Using the brush, scrub in front of and around the sensor.

5.5 Cleaning

The cable and outer surfaces of the 350 Ex sensor can be cleaned with mild detergent and warm water.

⚠ CAUTION

Never allow water to enter the unterminated end of the sensor cable or reference tube.

If the flow stream carries a great deal of debris, beware of organic materials that may collect beneath the 350 Ex sensor. This material swells as it becomes saturated with water and may exert pressure on the outer diaphragm. This can damage the transducer and permanently disable the 350 Ex sensor. Keeping the ports clean not only prevents damage, but ensures that the 350 Ex sensor will respond to the hydrostatic pressure above instead of the pressure created by swollen material.

If the ports become blocked:

1. Remove the sensor from its mounting ring, plate, or carrier.
2. Gently scrape any accumulated solids off the exterior of the sensor. Use a brush and flowing water.
3. Remove debris that has accumulated in the ports.
4. The outer diaphragm is behind the small metal cover on the bottom of the sensor. It should be visible through the three small openings at the center of the cover. Gently flush the cover and holes with water to remove debris.

⚠ CAUTION

Never remove the protective diaphragm cover. Avoid using tools near the cover openings. Direct or indirect contact with the outer diaphragm can permanently damage the 350 Ex sensor.

5.6 Contact Teledyne ISCO

If you have further questions about the installation, operation, and maintenance of your TIENet device, please contact our service department at:

Teledyne ISCO
4700 Superior St.
Lincoln, NE 68504

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

TIENet® Model 350 Area Velocity Sensor

Appendix A Replacement Parts List

A.1 Replacement Parts Diagrams and Listings

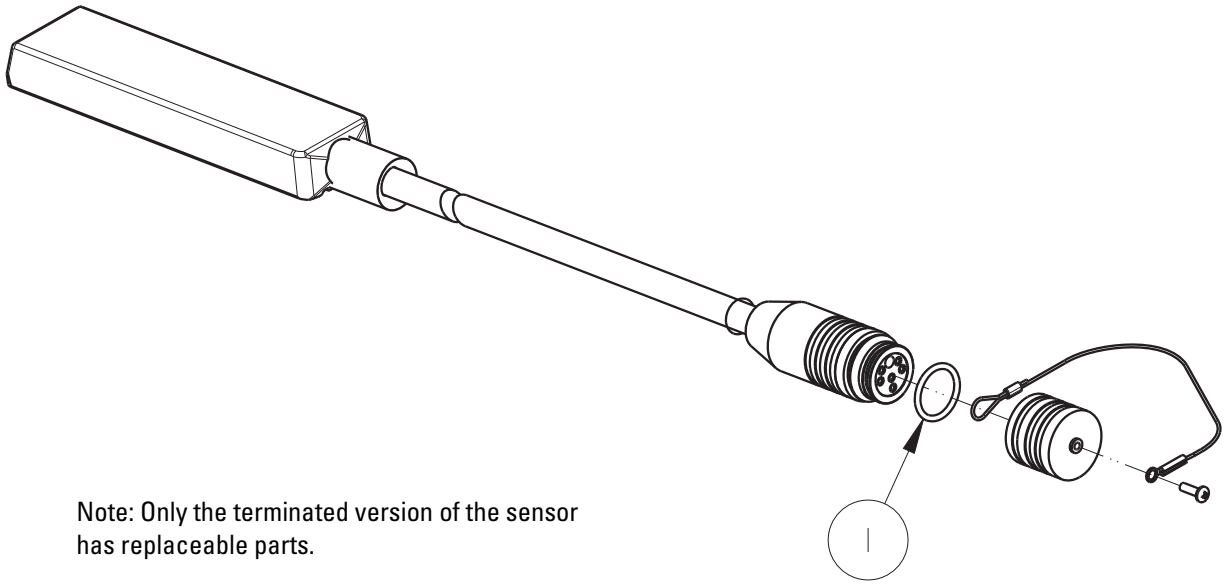
Replacement parts are called out in illustrations in this section. Reference the call-outs in the accompanying tables to determine the part number for the item.

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:IscoOrders@teledyne.com



Note: Only the terminated version of the sensor has replaceable parts.

ITEM NO.	PART NUMBER	DESCRIPTION
1	202100669	O-RING, .669ID, .079 CROSS SECTION

DRAWING NO. 60435202 3
SHEET 1 OF 2

REPLACEMENT PARTS LIST,
350 AREA VELOCITY SENSOR

TIENet® Model 350 Ex Area Velocity Sensor

Appendix B Velocity Error Codes

B.1 Introduction

Erroneous flow data can result from a number of factors. The area velocity system provides numbered error codes associated with the 350 Velocity data to assist in troubleshooting.

The error codes are viewable using Teledyne ISCO Flowlink® software. Definitions of the error codes are provided in Table B-1.

B.2 Importing Data Dump (.ddp) Files

Flow data from the Signature Flow Meter can be downloaded 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.

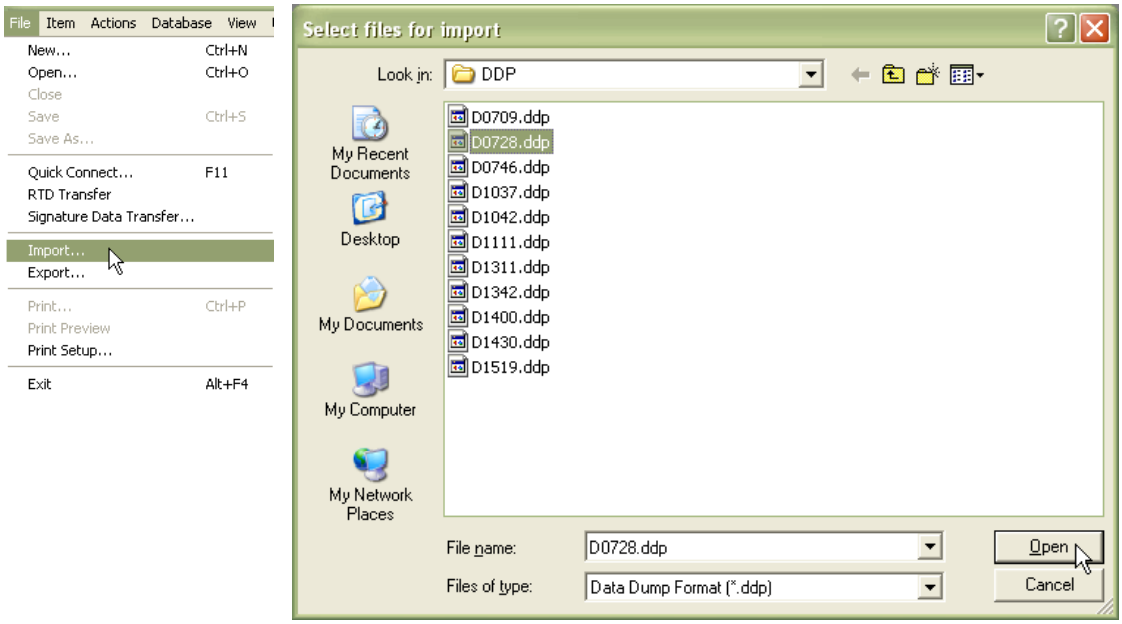


Figure B-1 Signature flow data: Selecting the .ddp file(s)

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.

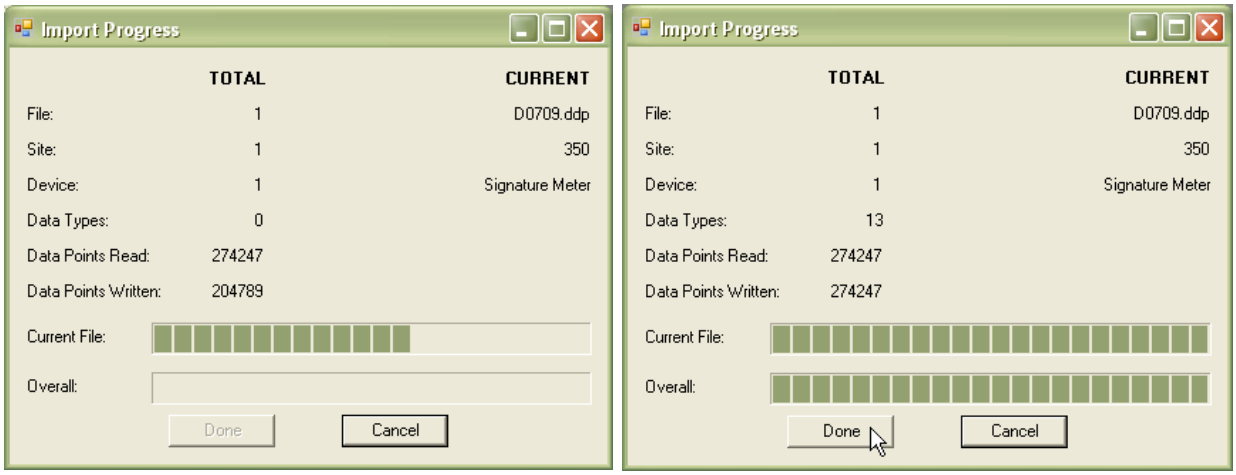


Figure B-2 Signature flow data: Importing the .ddp file

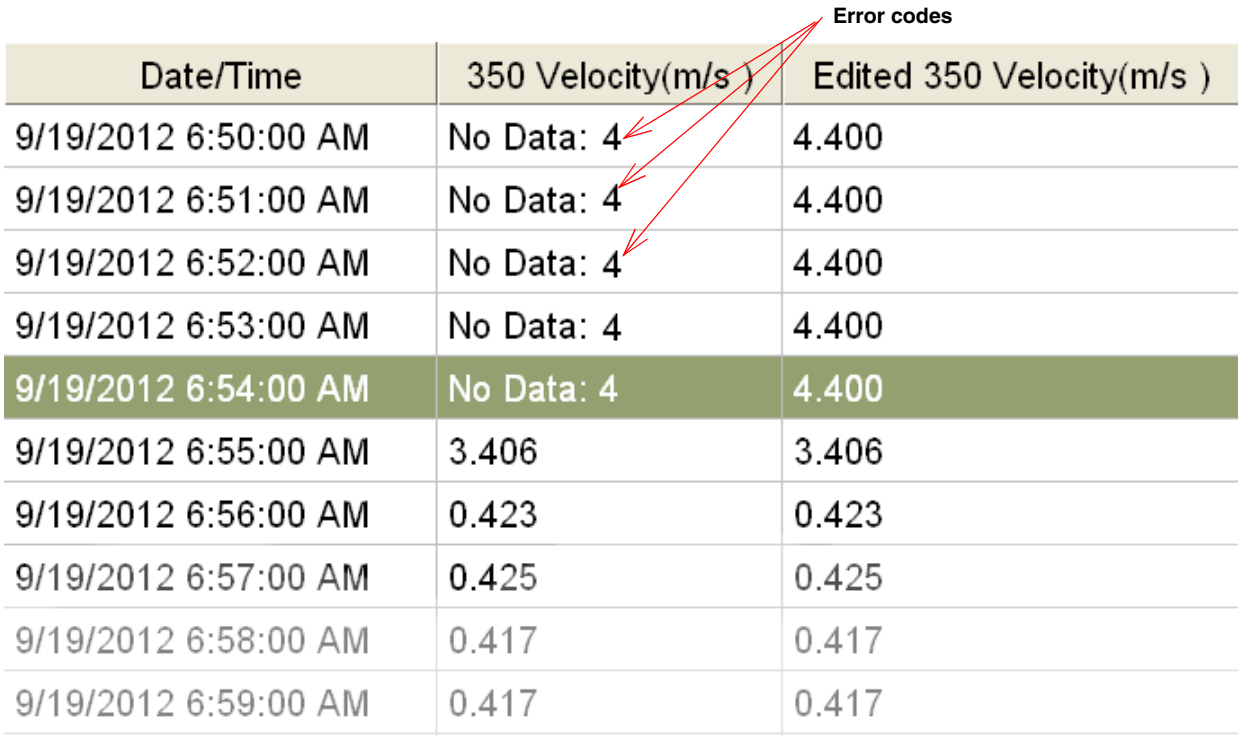
Upon completion, a new site file will appear in the Flowlink workspace.

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 350 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 350 Velocity column following the words "No Data." Definitions of the error codes are provided in Table B-1.



Date/Time	350 Velocity(m/s)	Edited 350 Velocity(m/s)
9/19/2012 6:50:00 AM	No Data: 4	4.400
9/19/2012 6:51:00 AM	No Data: 4	4.400
9/19/2012 6:52:00 AM	No Data: 4	4.400
9/19/2012 6:53:00 AM	No Data: 4	4.400
9/19/2012 6:54:00 AM	No Data: 4	4.400
9/19/2012 6:55:00 AM	3.406	3.406
9/19/2012 6:56:00 AM	0.423	0.423
9/19/2012 6:57:00 AM	0.425	0.425
9/19/2012 6:58:00 AM	0.417	0.417
9/19/2012 6:59:00 AM	0.417	0.417

Figure B-3 Identifying error codes in the 350 Ex Velocity data set

Table B-1 Definitions of 350 Velocity Error Codes

Error Code	Definitions
1: Out of Range	Measurement was out of range
2: Velocity Signal Too Weak	Not enough energy in the FFT to get a good velocity
3: Velocity Peak Not Found	No valid velocity peak found
4: Velocity Spectrum Too Flat	Spectral Energy used to calculate velocity is less than 24% of that side's total
6: Level Too Low	Level is below the user defined threshold

TIENet® Model 350 Ex Area Velocity Sensor

Appendix C Material Safety Data Sheets

C.1 Introduction

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

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Performance Packaging

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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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Belen, New Mexico 87002
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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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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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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.