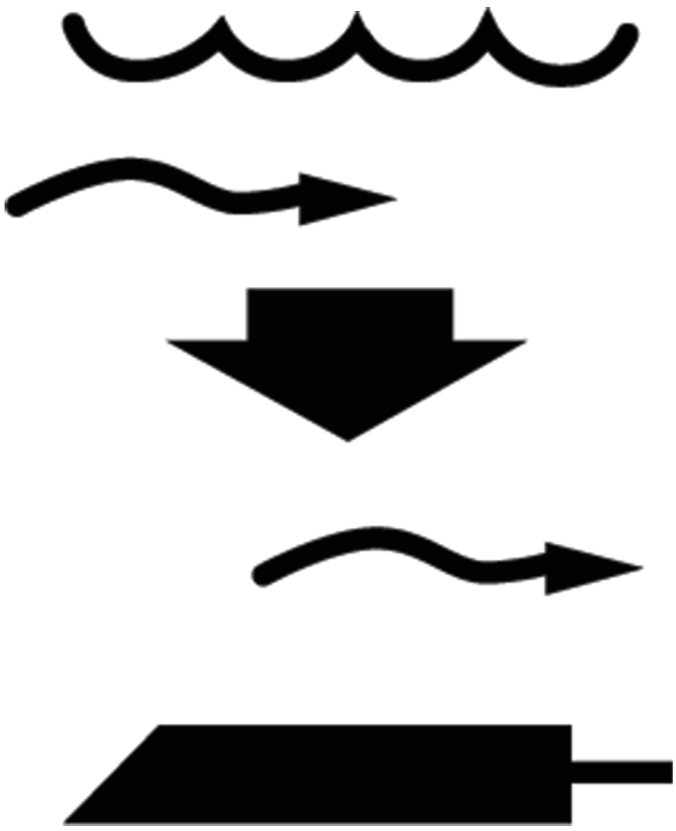
TIENet® 350
Area Velocity Sensor

Installation and Operation Guide



TELEDYNE ISCO
Everywhereyoulook™

Manual Body #69-4353-024

Revision E, August 2021

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 Area Velocity Sensor

Table of Contents

Section 1 Introduction

1.1 Description 1-1
1.1.1 350 Velocity Operation 1-2
1.1.2 350 Level Operation 1-2
1.2 Technical Specifications 1-3
1.3 Optional LaserFlow Applications 1-4
1.4 Accessories 1-4
1.4.1 Ordering Information 1-5
1.5 Unpacking Instructions 1-5

Section 2 Installation

2.1 Safety 2-1
2.1.1 Site Conditions 2-1
2.2 Reference Line Support 2-2
2.3 Preparing the Signature Flow Meter 2-3
2.3.1 External Desiccator 2-3
2.4 Connecting the Cable 2-5
2.5 Installing the 350 AV Sensor 2-9
2.5.1 Installation Considerations 2-9
2.5.2 Mounting Rings 2-10
2.5.3 Spring Rings 2-10
2.5.4 Scissors Mounting Ring 2-12
2.5.5 Completing the Sensor Installation 2-14
2.6 Street Level Installation System 2-14
2.7 Grounding Kit for Surge Protection 2-14

Section 3 Setup and Programming for the Signature

3.1 Configuring the System 3-1
3.1.1 Updating the Device List 3-1
3.2 Measurement Setup 3-4
3.2.1 350 Velocity 3-4
3.2.2 Advanced Settings 3-5
3.2.3 Setting the 350 Level 3-6

Section 4 Maintenance

4.1 Maintenance 4-1
4.2 Firmware Updates 4-1
4.3 External Desiccator 4-2
4.4 In Pipe or Channel Sensor Cleaning 4-3
4.5 Cleaning 4-3
4.6 Contact Teledyne ISCO 4-4

Appendix A Replacement Parts List

A.1 Replacement Parts Diagrams and Listings A-1

Appendix B Velocity Error Codes

B.1 Introduction B-1
B.2 Importing Data Dump (.ddp) Files B-1
B.3 Viewing Velocity Error Codes in Flowlink B-3

List of Figures

1-1 Basic Signature monitoring system with 350 (mounting hardware not shown) . 1-1
1-2 TIENet Model 350 Area Velocity Sensor 1-2
2-1 Remove red caps before installing external desiccant cartridge 2-3
2-2 Installing the external desiccant cartridge 2-3
2-3 External desiccator, installed 2-4
2-4 Tubing configuration for optimal drying power 2-5
2-5 TIENet Device terminal strips 2-6
2-6 Installing cable with a cord-grip fitting 2-6
2-7 TIENet Device terminal connections 2-7
2-8 Attach wired terminal strip to case board socket 2-7
2-9 Insert the cable reference tubing into the case board reference port 2-8
2-10 Position and secure the cable 2-8
2-11 Sensor Installed on a Spring Ring 2-11
2-12 Scissors Ring adjustment 2-13
3-1 Character grid 3-2
3-2 Menu Tree: 350 Configuration 3-3
3-3 Configuring level and velocity measurement 3-4
3-4 Measurement setup: Advanced settings for 350 AV sensor 3-5
3-5 350 Level adjustment screen 3-6
4-1 Desiccant indicating saturation 4-2
4-2 Removing the external desiccant cartridge 4-2
4-3 Opening the desiccant cartridge chambers 4-3
B-1 Signature flow data: Selecting the .ddp file(s) B-1
B-2 Signature flow data: Importing the .ddp file B-2
B-3 Identifying error codes in the 360 Velocity data set B-3

TIENet® Model 350 Area Velocity Sensor

Section 1 Introduction

The Teledyne ISCO TIENet 350 Area Velocity Sensor measures flow stream average area velocity and liquid level. The Signature® Flow Meter uses this information to calculate the flow rate and total flow of the stream. To operate with the 350 sensor, the Signature requires software version 1.18 or later.

1.1 Description

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

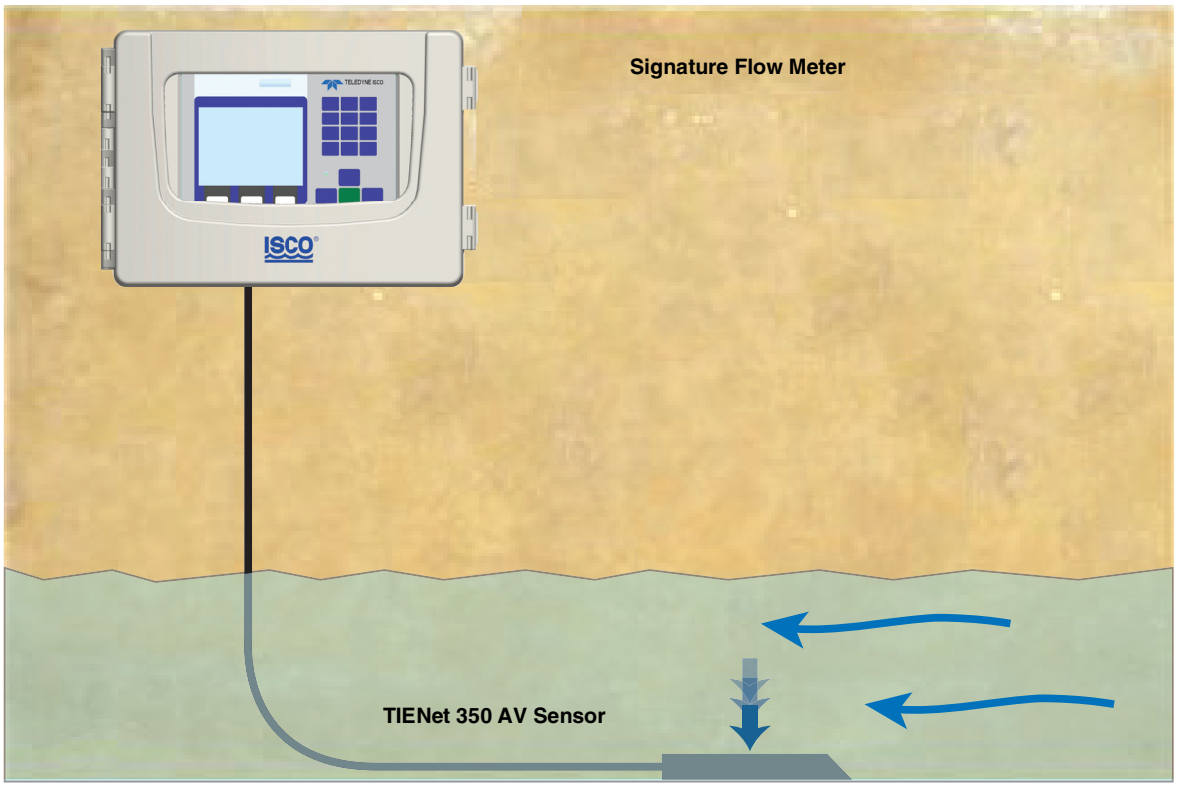
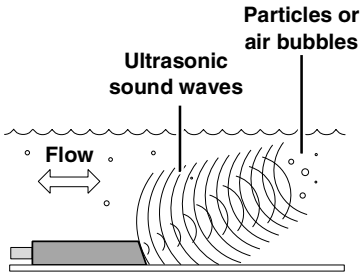


Figure 1-1 Basic Signature monitoring system with 350 (mounting hardware not shown)

The 350 AV sensor is available with a 10m, 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.

Figure 1-2 TIENet Model 350 Area Velocity Sensor

1.1.1 350 Velocity Operation



The 350 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 Level Operation

The 350 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 as an RS-485 half-duplex signal.

1.2 Technical Specifications

Table 1-1 350 TIENet Sensor Specifications[a]

Sensor Dimensions	1.9 × 3.3 × 15.2 cm	0.75 × 1.31 × 6.00 in
Standard Cable Length	10, or 23 m	16.4, 32.8, or 75.5 ft
Cable Diameter	10.2mm ±0.254mm	0.402 in ±0.010 in
Minimum Bend Radius	15.24 cm	6 in
Maximum Cabling from Signature Flow Meter	305 m	1,000 ft
Typical Weight w/ 10 m Cable w/ 23 m Cable	 1.68 kg 3.10 kg	 3.70 lb 6.84lb
Body Materials	PDVF	
Cable Materials	UV-Rated PVC	
Temperature Range Operation Storage	 0 to 70 °C -40 to 70 °C	 32 to 158 °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	10.55 m	34.6 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
Range	-1.5 to +6.1 m/s	-5 to +20 ft./s
Accuracy[d]	Velocity Error -5 to +5 ft./s: -1.5 to +1.5 m/s 5 to 20 ft./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 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 Area Velocity Sensor can be installed using ISCO's mounting rings listed below. A Low Profile Carrier is optional when attaching the 350 to a mounting ring (not for use with the Street Level Installation System).

TIENet 350 AV Sensor w/ 10m Cable 60-4354-113
TIENet 350 AV Sensor w/ 23m Cable 60-4354-114
TIENet 350 AV Sensor w/ 2ft Cable & TIENet Plug Connector 60-4354-117

Cord grip fitting, 3/4" NPT, for TIENet cable 209-0073-12
Bulk TIENet Cable, Cut to Length 60-4304-050
TIENet Expansion Box 60-4307-023
TIENet Expansion Box with reference line support 60-4357-018

Signature Flow Meter Exterior desiccator
(required for use with 330 and 350 TIENet devices) 60-4304-092
Silica gel desiccant, 1-lb container 60-2004-233

Low Profile Carrier
(attaches the 350 sensor to a standard-size ring or plate)
(With plastic ties & instructions) 60-3204-029
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.

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

Phone:800 228-4373or402 464-0231
FAX: 402 465-3022

E-mail: isco.orders@teledyne.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 Area Velocity Sensor

Section 2 Installation

The Signature Flow Meter 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 (maximum length of 305 meters or 1,000 feet). Proper installation of the 350 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.

2.2 Reference Line Support

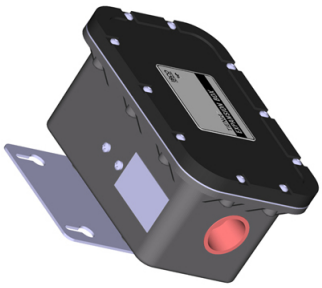
The optional water-tight Signature Expansion Box enables a variety of configurations for adding length, as well as connecting multiple devices at once. The Expansion Box connects to a TIENet™ terminal strip in the Signature, and contains three additional strips inside, as well as a TIENet connection for an option card.

Adding Length Between Signature and Sensors

Distance can increased by installing the Expansion Box closer to the field-mounted TIENet device(s) and adding a custom-length TIENet cable between the box and the Signature. The maximum recommended distance between system components is 305 meters (1,000 feet). Longer distances may result in signal degradation and drops in voltage.

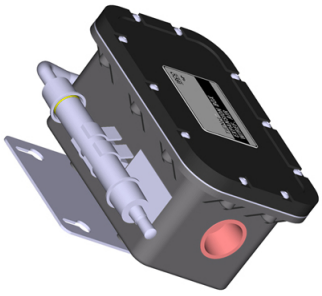
Distance of 100 Feet or Less

The un-vented TIENet expansion box can be used if the total distance is 30.5 meters (100 feet) or less. The Signature's air system will normally supply adequate desiccated air through the TIENet cable air line to the interior of the expansion box. This means the 350 AV sensor is referenced at the Signature's installation location.



Distances Greater than 100 Feet

If the total distance is greater than 30.5 meters (100 feet), or a different reference location is required, the reference air line must be vented outside the expansion box. The TIENet expansion box with reference air is designed for this purpose. The desiccator tube mounted on the side vents dried air to its interior.



2.3 Preparing the Signature Flow Meter

In order to operate with the 350 AV sensor, the Signature must have an external desiccator installed.

2.3.1 External Desiccator

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

Signature bubbler systems will already have a desiccator installed. If you are adding a 350 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.

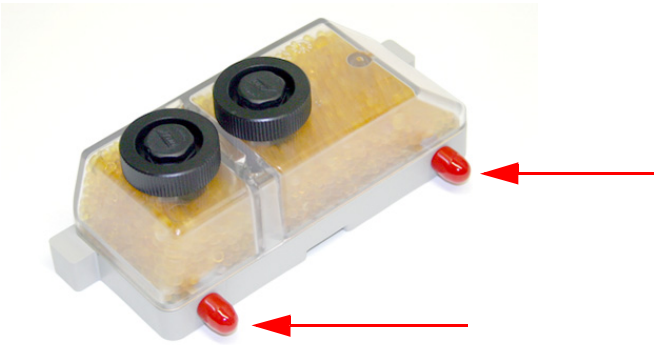


Figure 2-1 Remove red caps before installing external desiccant cartridge

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.

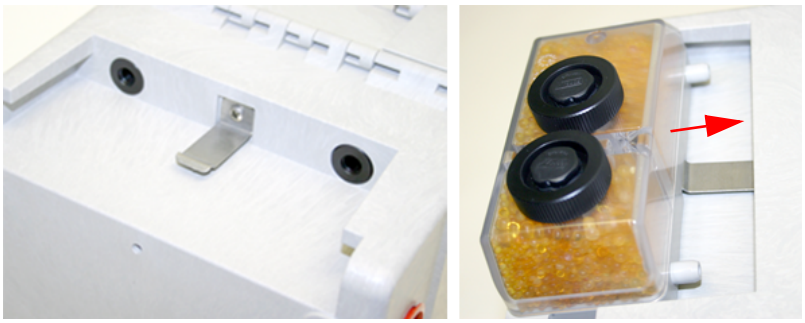


Figure 2-2 Installing the external desiccant cartridge

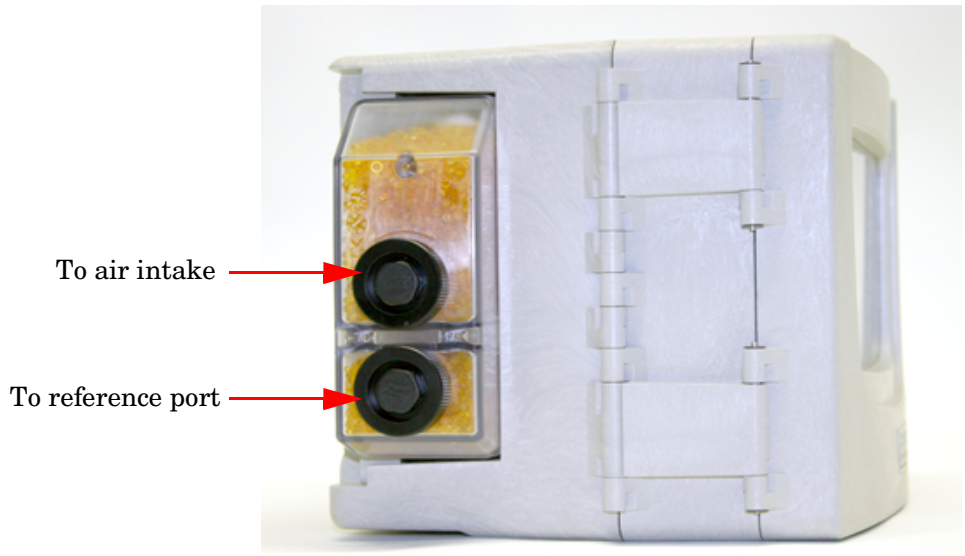


Figure 2-3 External desiccator, installed

The desiccant cartridge requires periodic maintenance. Refer to Section 4.3 *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 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 (Part #209-0167-49)
- 0.25 x 0.125 silicone tubing (Part #60-2003-104: 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 2-4).

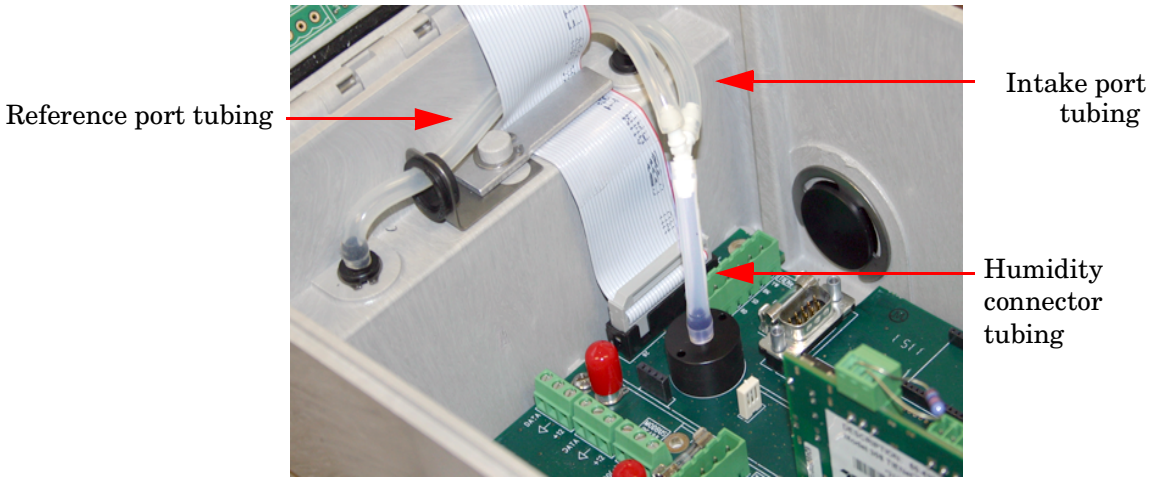


Figure 2-4 Tubing configuration for optimal drying power

2.4 Connecting the Cable

External TIENet devices such as the 350 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

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.

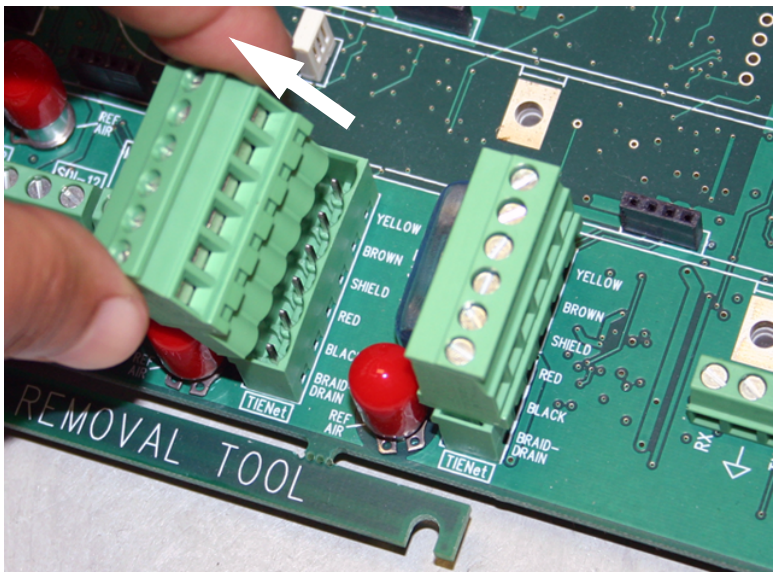


Figure 2-5 TIENet Device terminal strips

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.

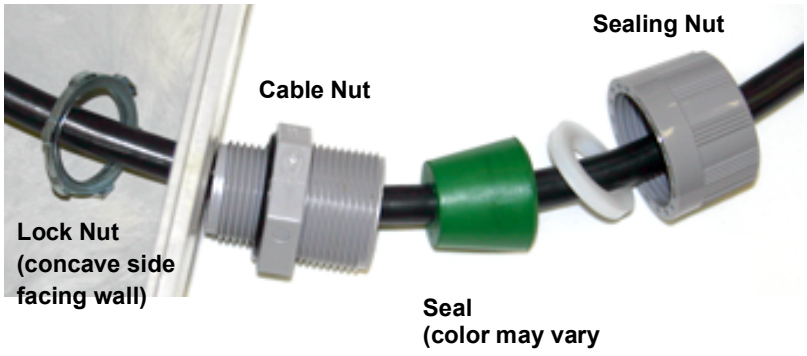


Figure 2-6 Installing cable with a cord-grip fitting

4. Attach the wire ends to the terminal strip as shown in Figure 2-7, then press the terminal strip back down into its socket on the case board, as shown in Figure 2-8, 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.

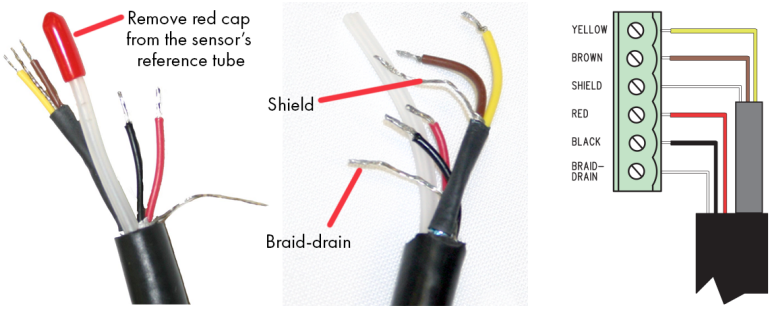


Figure 2-7 TIENet Device terminal connections

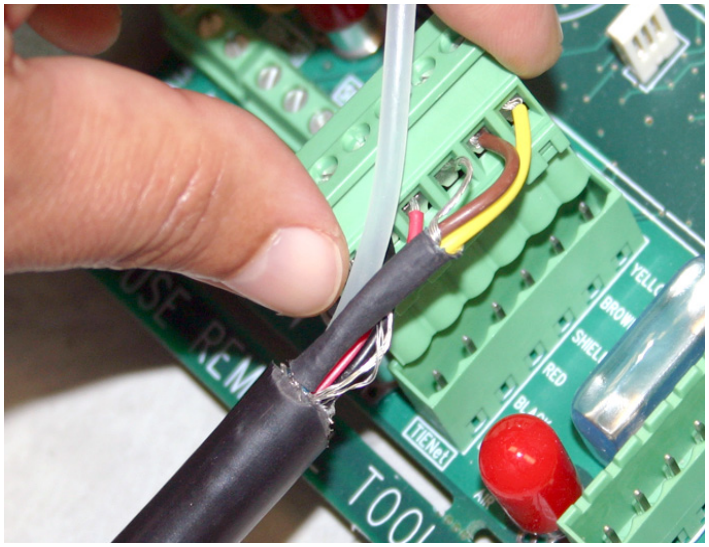


Figure 2-8 Attach wired terminal strip to case board socket

5. Insert the reference tubing into the REF AIR port on the case board, pushing it down inside the silicon tubing. Becareful 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 sensor

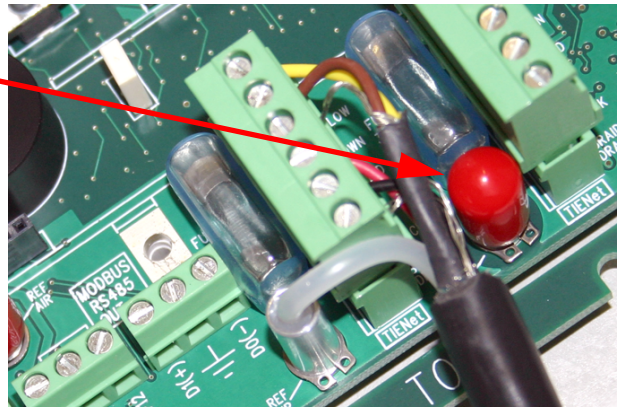


Figure 2-9 Insert the cable reference tubing into the case board reference port

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 2-10).

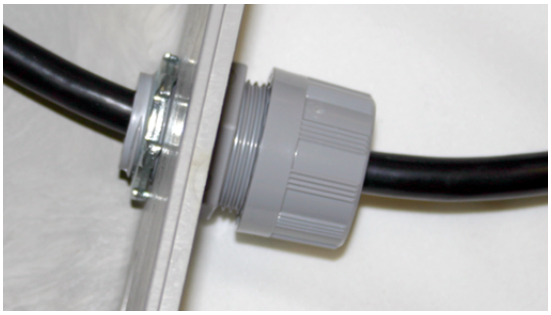


Figure 2-10 Position and secure the cable

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.

2.5 Installing the 350 AV Sensor

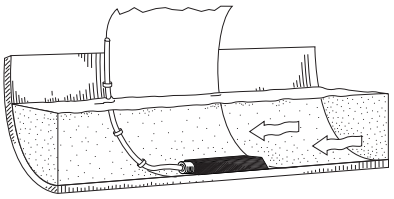
Prior to mounting the sensor in the flow stream, check the displayed level reading. In open air, the reading should be zero. If not, adjust the level to zero from the Level Adjustment screen (refer to "Setting the 350 Ex Level" on page 3-6).

> ☑ ***Note***
>
> If the 350 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.

2.5.1 Installation Considerations

See Section 2.5.2 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 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:

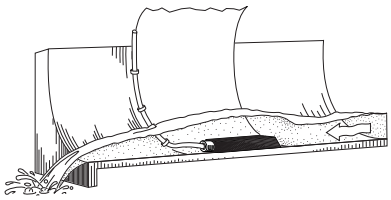


Ideal Conditions - Uni-

Uniform flow - The 350 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 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 sensor.

The example at left shows a few of these poor conditions. The outfall is drawing down the liquid level and the 350 sensor is disturbing the flow. In this example, the 350 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 sensor. Although the 350 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.

2.5.2 Mounting Rings

Consult your Teledyne 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 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 ISCO Mounting Rings Manual on how best to install this device.*

2.5.3 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 2-11.

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 ISCO 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.

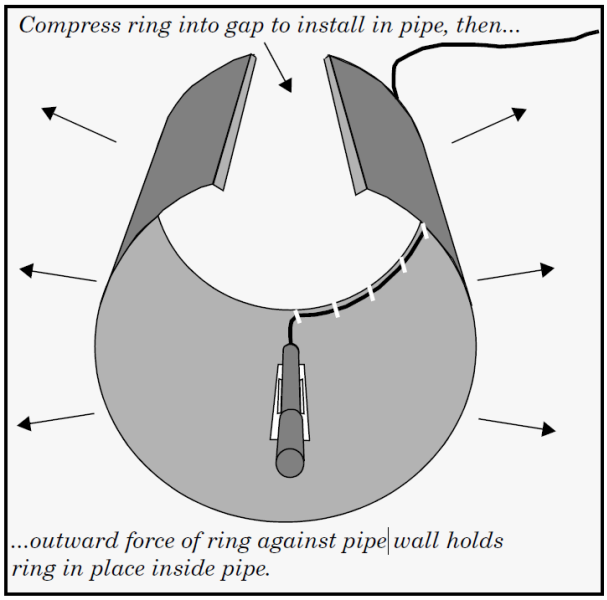


Figure 2-11 Sensor Installed on a Spring Ring

Attaching the Sensor to the Ring

Attach the 350 sensor to the ring either by using two 4-40x$^{3}/_{8}$ countersink 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.

⚠ 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 2-11. 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 2-11.

⚠ 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.

2.5.4 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.

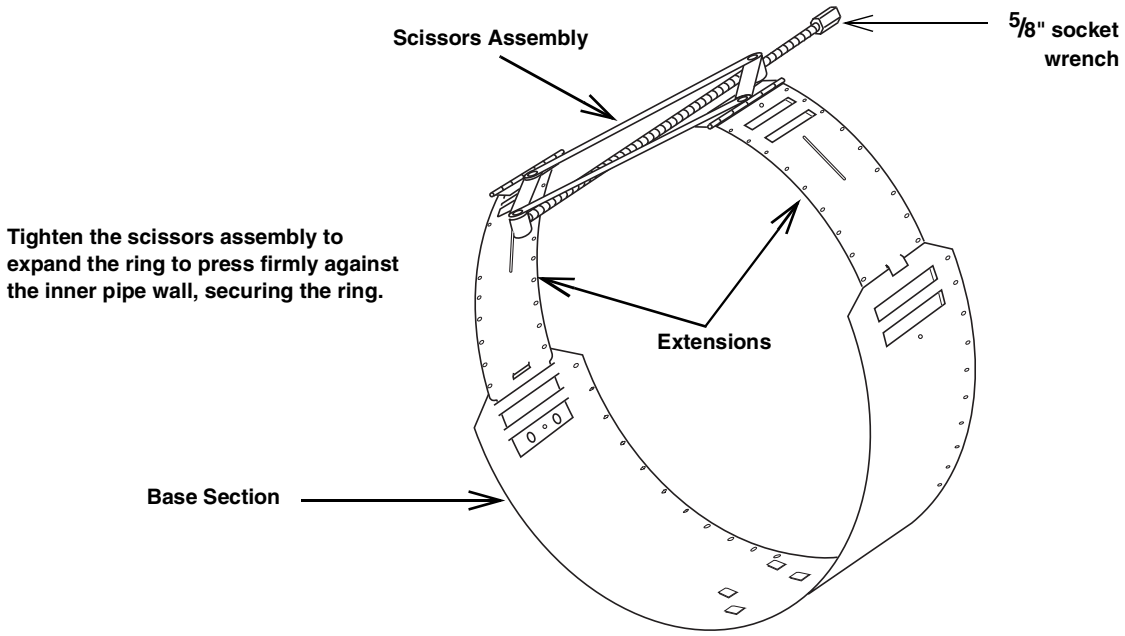


Figure 2-12 Scissors Ring adjustment

☑ *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.

2.5.5 Completing the Sensor Installation

The 350 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.

2.6 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.

2.7 Grounding Kit for Surge Protection

Added protection from lightning damage is available with the grounding lug kit. This kit consists of a stainless steel terminal for connecting a grounding conductor, and hardware to fasten it to a sensor mounting ring.

TIENet® Model 350 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 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 is physically added to the system, select Perform Scan so that the flow meter detects it. When the scan is complete, the 350 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 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 ( ).

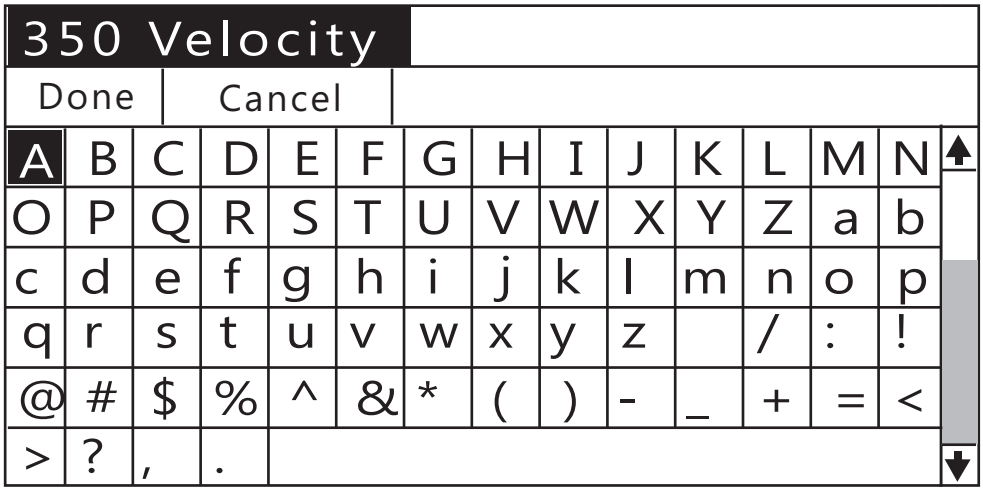


Figure 3-1 Character grid

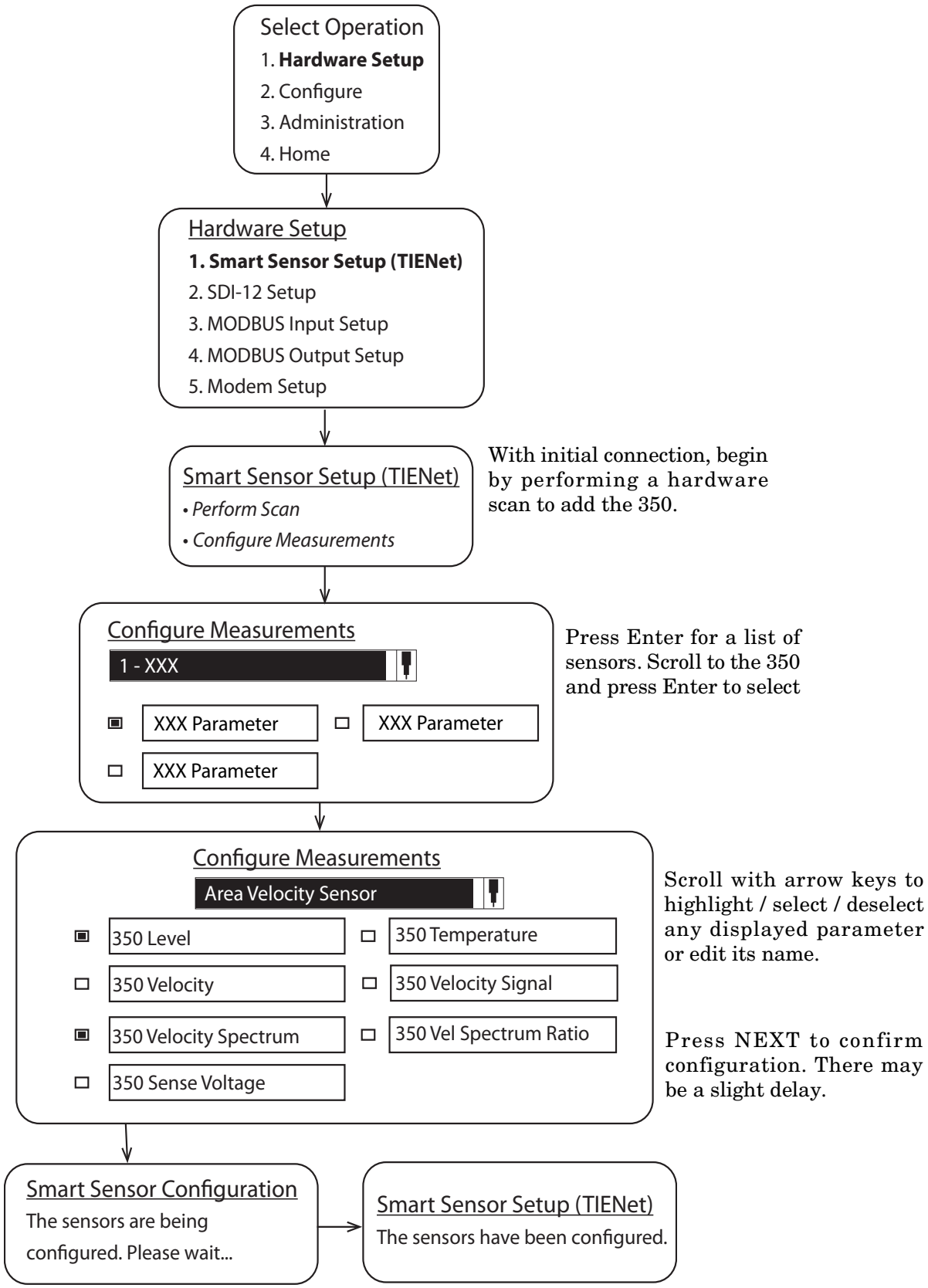


Figure 3-2 Menu Tree: 350 Configuration

3.2 Measurement Setup

From Measurement Setup (Figure 3-3), 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.

3.2.1 350 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.

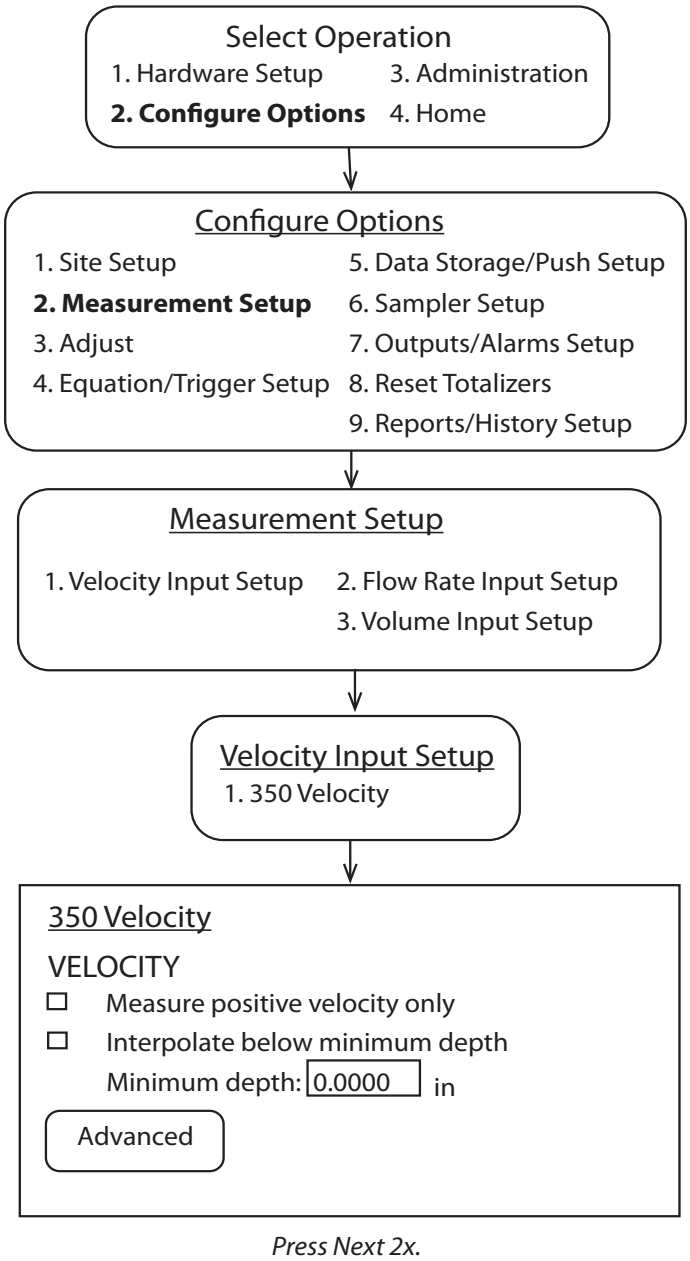


Figure 3-3 Configuring level and velocity measurement

3.2.2 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 3-4).

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).

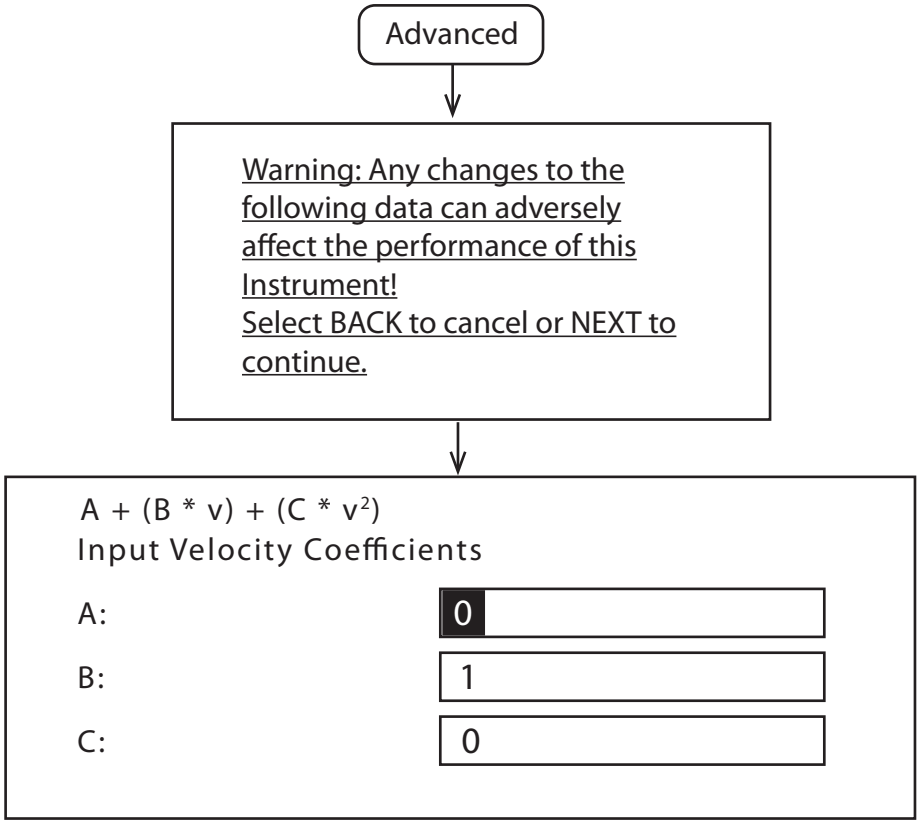


Figure 3-4 Measurement setup: Advanced settings for 350 AV sensor

3.2.3 Setting the 350 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.

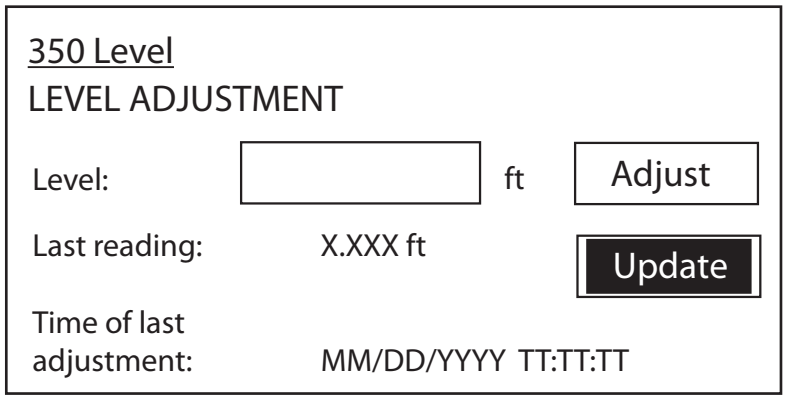


Figure 3-5 350 Level adjustment screen

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**.

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

TIENet® Model 350 Area Velocity Sensor

Section 4 Maintenance

4.1 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.

Table 4-1 Recommended Maintenance Interval (Velocity >1.5/sec)

Action	Recommended Frequency	Reference
Check Desiccant	6 months	Sect.4.3
In Pipe or Channel Cleaning	2 months	Section 4.4
Sensor Cleaning	12 months	Sect 4.5

Table 4-2 Recommended Maintenance Interval (Velocity <1.5/sec)

Action	Recommended Frequency	Reference
Check Desiccant	6 months	Sect. 4.3
In Pipe or Channel Cleaning	Monthly	Section 4.4
Sensor Cleaning	12 months	Sect 4.5

4.2 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 2160 LaserFlow module, the sensor firmware can also be updated using the "Update ISCO Instrument Software" tool included with Flowlink software. Refer to the software help windows for step-by-step instructions.

4.3 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.

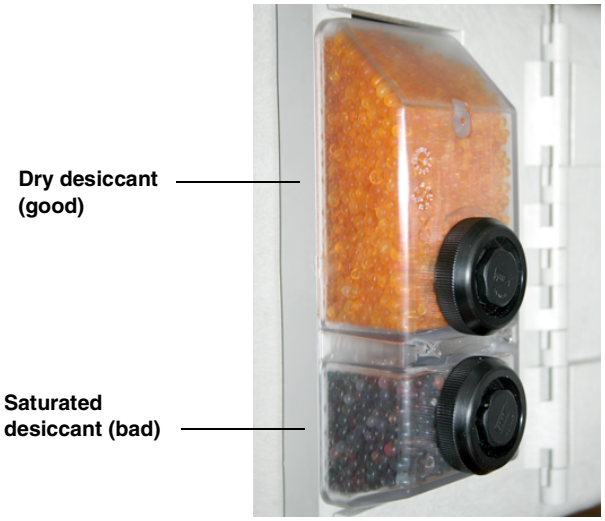


Figure 4-1 Desiccant indicating saturation

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.

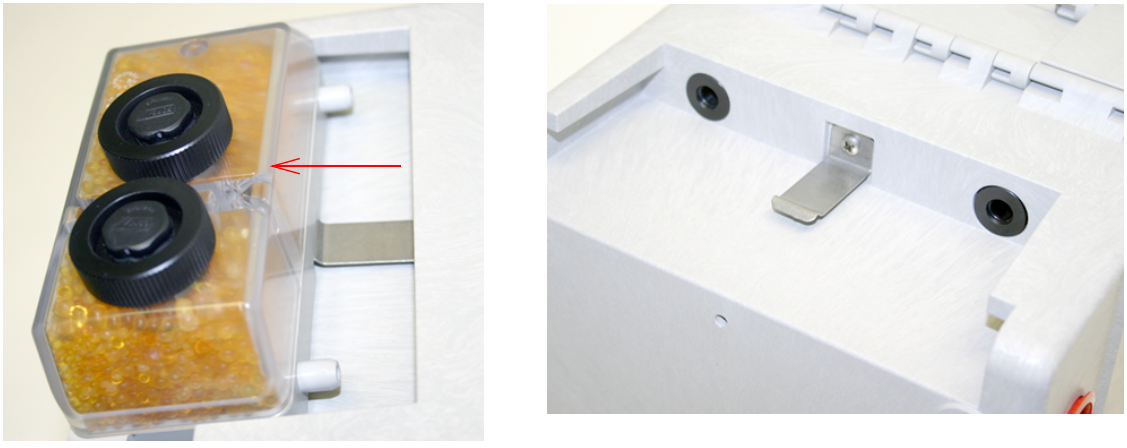


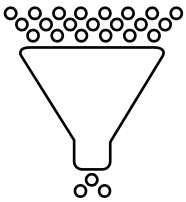
Figure 4-2 Removing the external desiccant cartridge

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.

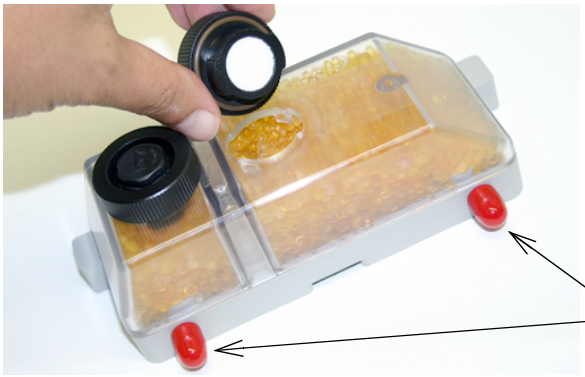


Figure 4-3 Opening the desiccant cartridge chambers

Renewing loose desiccant

To renew the desiccant, spread it in a single layer on a flat metal tray. Place in a vented, circulating forced air, conventional oven in a well ventilated room, and heat at 100 - 175°C (212 - 350°F) for about three hours, or until the color has returned to orange or yellow.

4.4 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.

4.5 Cleaning

The cable and outer surfaces of the 350 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 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 sensor. Keeping the ports clean not only prevents damage, but ensures that the 350 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 two 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 sensor.

4.6 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

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 or (402) 464-0231
FAX:(402) 465-3022

E-mail: isco.orders@teledyne.com

REPLACEMENT PLUG SENSOR CAP KIT FOR
2100 SERIES AND TIENET DEVICES
#60-9004-469

TIENet® Model 350 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 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

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.

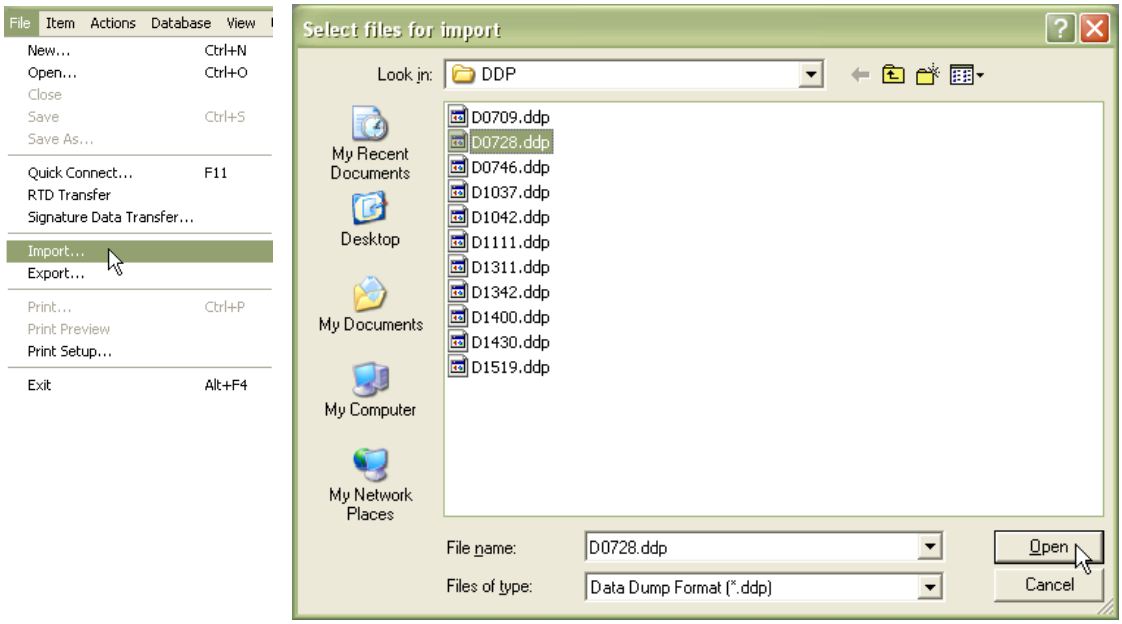


Figure B-1 Signature flow data: Selecting the .ddp file(s)

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.

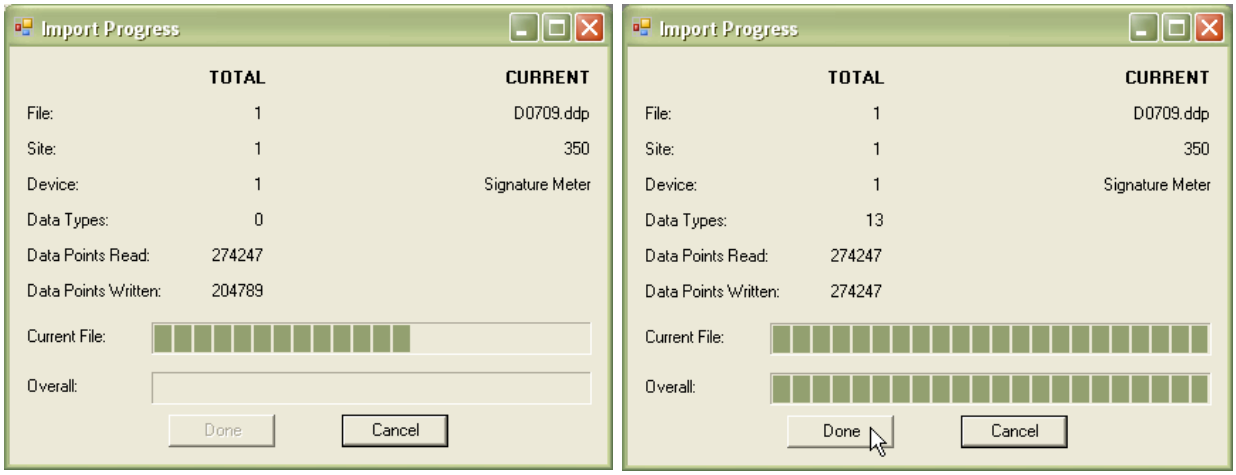


Figure B-2 Signature flow data: Importing the .ddp file

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.

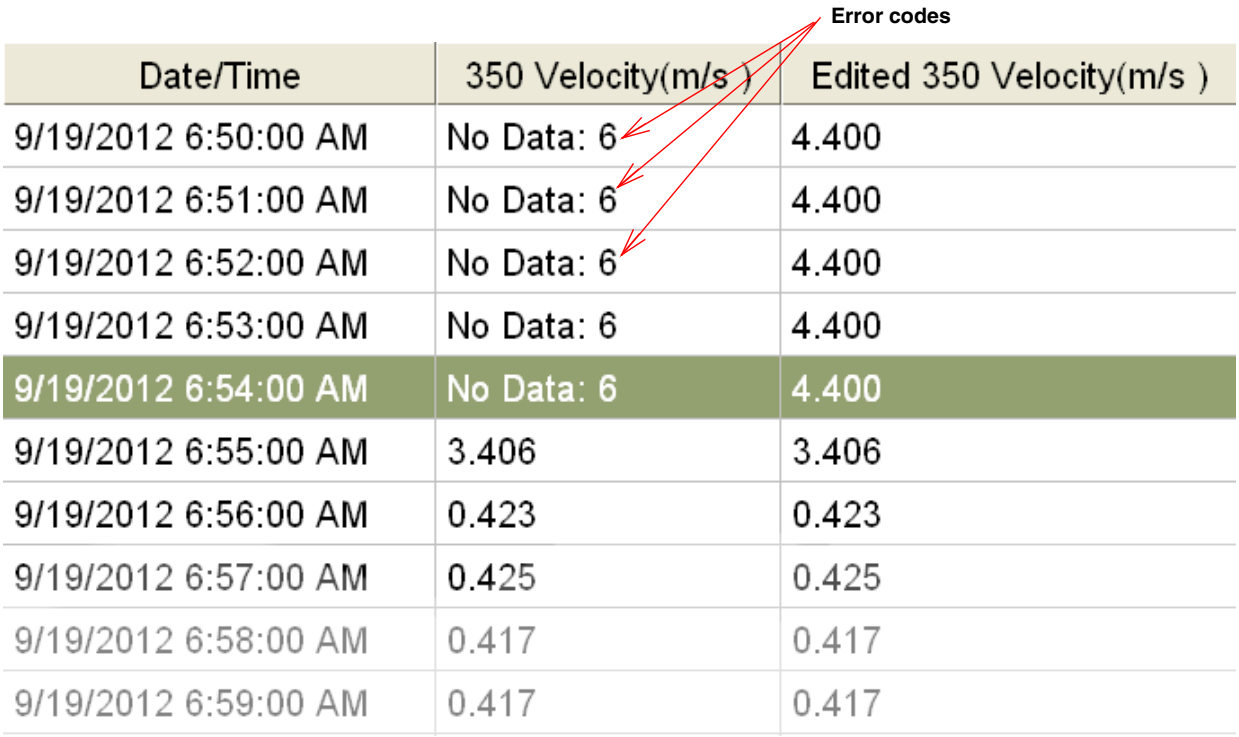


Figure B-3 Identifying error codes in the 360 Velocity data set

Table B-1 Definitions of 350 Velocity Error Codes

Error Code	Definitions
1: Measurement Error	Unable to get valid velocity reading after a specific number of retries.
3: Velocity Filter Error	Unable to get valid velocity spectrum to determine what frequency range is sampled for the velocity reading. This could be an indication of debris or silting.
5: Velocity Gain Error	The average gain required from the amplifier in order to see reflected Doppler information is too high, indicating a weak signal.This could be an indication of fouling of the sensor
6: Velocity level too low	Velocity measurement was attempted while liquid level was less than one inch.
7 w/ non-zero (#.###) Edited Velocity:	Measurement time-out. Edited Velocity will be last valid measurement reported by sensor.
7 w/ zero (0.000) Edited Velocity:	No sensor response to request for Take Reading or Report Measurement.

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	O
显示 Display	X	O	O	O	O	O
接线 Wiring	O	O	O	O	O	X
内部电缆 Internal Cables	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
电磁阀 Solenoid valve	X	O	O	O	O	X

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.