

2160 LaserFlow™ Module

Installation and Operation Guide



Part #69-2003-703 of Assembly #60-2004-703
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Revision B, April 2014

Foreword

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

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

If 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.

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.

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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 in the following general warnings.

This product is often installed in confined spaces. Some examples of confined spaces are 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.

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 Sie 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.

2160 LaserFlow™ Module

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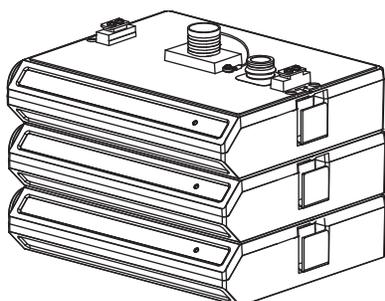
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2160 LaserFlow™ Module

Section 1 Introduction

1.1 Product Description



A 3-module site

The 2160 LaserFlow Module is part of Teledyne Isco's 2100 Series. The 2100 Series systems measure parameters of open channel flow streams.

The 2100 Series system is designed to be modular so it can be expanded to meet data collection needs. By stacking the 2100 Series modules, a single site can measure multiple flow channels, collect redundant data, or add other available measurement capabilities. A site can include remote measurement points as distant as 3300 feet by connecting modules with cables. Even with several remote modules configured as a site, all measurement data can still be retrieved from a single connection.

The 2100 Series System is set up and programmed with Teledyne Isco's Flowlink® software. Flowlink can quickly set up modules, retrieve measurement data, manage the sites, and analyze the data.

The module's flexible data storage memory is able to store the measurements in intervals from 15 seconds to 24 hours. The modules can also be configured for variable rate data storage. Variable rates enable data storage at a different interval when a programmed condition occurs.

The module's program and collected data are stored in Flash memory for security. Flash memory retains data without the concern of power failures or aging backup batteries. Its capacity is more than sufficient for most applications. The data storage memory can hold approximately 158,000 readings – the equivalent of over 270 days of level, velocity, flow rate, ultrasonic signal, Doppler frequency, and input voltage readings at 15 minute intervals. The Flash memory also stores sensor calibration information. A separate Flash memory device inside the module stores the operating firmware.

The rugged 2100 series components are rated IP68. The permanently sealed enclosures are designed to meet the environmental demands of many sewer flow monitoring applications. All connections between modules, sensors, and communication cables lock in place. Each locking mechanism strongly secures the components and provides a watertight seal.

The flow information from the 2160 can be used to pace a Teledyne Isco waste water sampler using the 2100 Series Sampler Interface Cable. A flow pulse is sent out every 100 gallons or 500 liters of flow, depending on how the 2160 is configured.

1.2 2160 Operation Overview

The 2160 measures liquid level and velocity to calculate the flow rate and total flow. Velocity and level are measured by the TIENet™ LaserFlow™ non-contact velocity sensor. Flow rate calculations are performed internally using the measured parameters from the sensor. Additionally, the 2160 can measure its input voltage.

Complete information about setup, installation, and operation of the LaserFlow Sensor is provided in the LaserFlow Sensor's user manual.



Figure 1-1 TIENet 360 LaserFlow velocity sensor

The 2160 is designed to provide durable operation with only a minimal amount of routine maintenance, all of which may be performed in the field. Typically, the 2160 will only require that you replace spent desiccant and batteries.

1.2.1 Input Voltage

The 2160 input voltage measurement is useful when estimating the remaining battery life and determining when the system must be serviced. You can log the Input Voltage readings in data storage to chart power consumption.

2191 Battery module

The 2191 Module requires two 6V lantern-type batteries. The following batteries may be used in the battery module:

- Commercially available 6VDC alkaline lantern batteries
- Rechargeable 6VDC lead-acid battery in a lantern-style case. This 5.0 ampere-hour battery can be ordered from Isco.

The Battery Module's only role is to supply DC power, yet it still supports communications between other modules. The upper and lower connectors pass along communications between modules attached above and below.

You can stack Battery Modules to increase the power available to a module or a stack of modules.

1.3 Component Identification

The components of the 2160 and 2191 Battery Module are shown in Figures 1-2 and 1-3. (For details about the LaserFlow sensor, refer to the LaserFlow user manual.) Items referenced in the figures are summarized in the tables below.

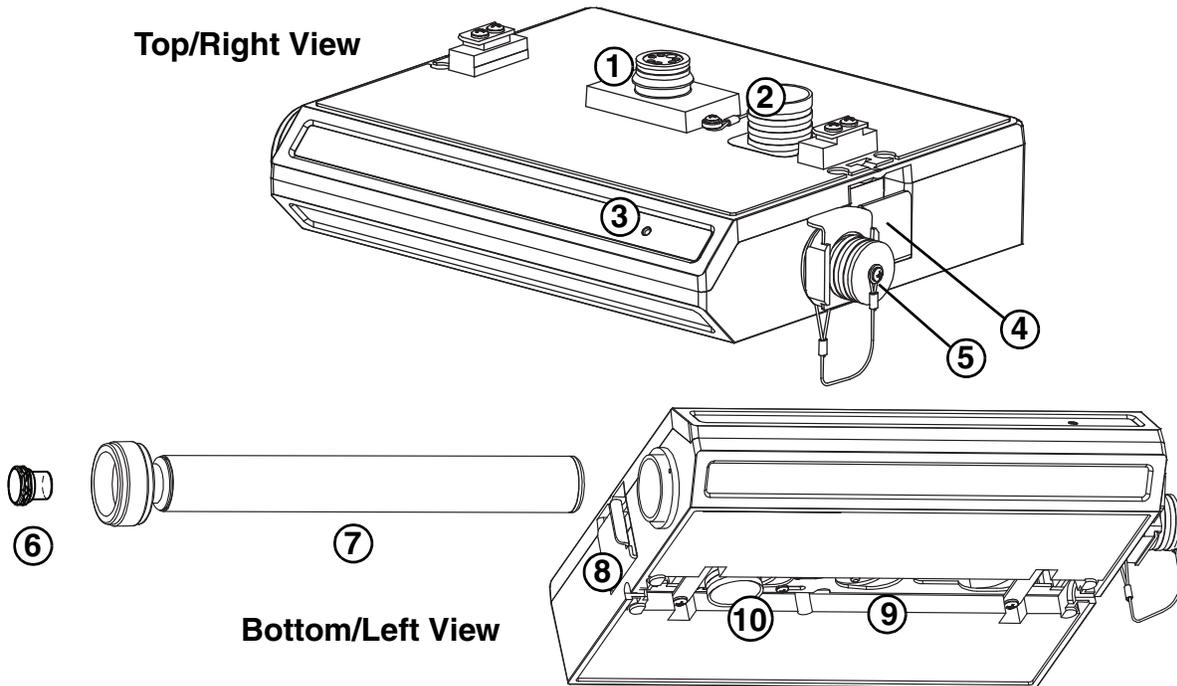


Figure 1-2 Controls, Connectors, and Indicators – 2160 Module

Table 1-1 Components – 2160 Flow Module		
Item No.	Name	Description
1	Communication Connector	Upper communication port. The connection transfers data and 12 VDC power to other modules. The port is also used to connect to a PC running Flowlink software.
2	Connector Cap	Insert into unused communication connectors to terminate the network and protect them from moisture damage. When communication connectors are in use, the caps must be stowed as shown in Figure 1-2 to protect the terminating components inside the cap.
3	Communication Indicator	Illuminates when the module is active. With Flowlink, a user can turn on this light-emitting diode (LED) to identify the module at a multiple-module site.
4	Latch Release	Push in to release the module from a stack.
5	Sensor Receptacle	Port used to attach the USLS Sensor. Insert the protective cap when not in use.
6	Hydrophobic Filter	Prevents moisture from entering the case.
7	Desiccant Cartridge	Container holding desiccant that dries the internal air.
8	Latch	Push in to lock the module in a stack.
9	Communication Connector	Lower communication port. The connector transfers data and 12 VDC power to other modules.
10	Connector Plug	Insert into the interface connector when the connector is not in use to protect it from damage.

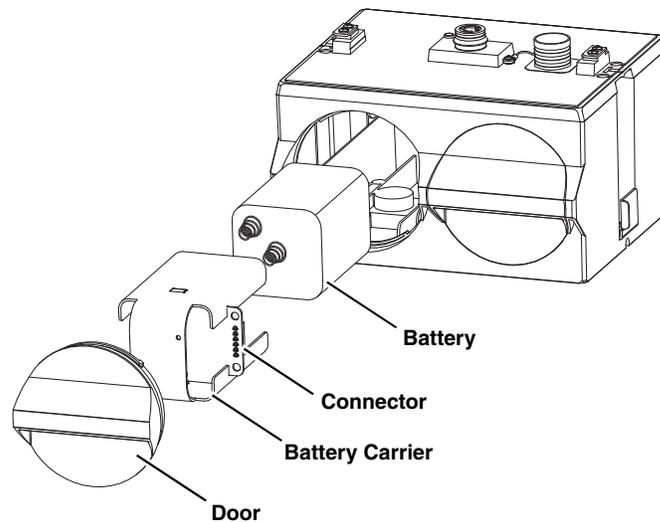


Figure 1-3 2191 Battery Module key components

1.4 Latches

Latches must be operated to stack and unstack the modules. Take a moment to familiarize yourself with operating the latches. The latch is operated by pushing on one of the sides — the right side to unlock, and the left side to lock. Both latches are flush to the module's sides in the locked position.

CAUTION

The latch can be damaged by applying too much force. Never press on both sides at the same time. Do not force the latch if it is obstructed. While some degree of pressure must be applied to slide the latch, the ends of the latches should never bend more than 1/8".

Figure 1-4 shows how to unlock the latch. You must unlock the latch to place the module on top of a stack. Otherwise, the latch is normally locked. Locate the latch release on the right side of the module. Push in to slide the latch toward the left of the module.

Latches will “click” when they are fully locked and unlocked.

Module stacking is described in more detail in Section 2.5.3.



Figure 1-4 Unlocking the latch

1.5 Communication Connectors

Any communication connector not in use should always be capped. The cap seals the connector to prevent corrosion, prevent moisture from entering the unit, and improve communications.

When a communication connector is in use, store the cap on the holder next to the connector (Figure 1-5). The communication connector will be sealed by its mating connector.

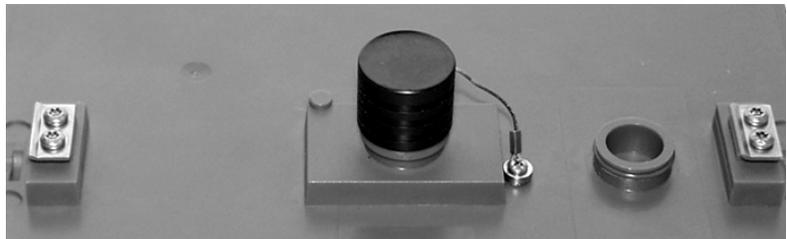
 **CAUTION**

Caps **PUSH ON** and **PULL OFF**. Do not rotate the caps to remove them from the connectors.

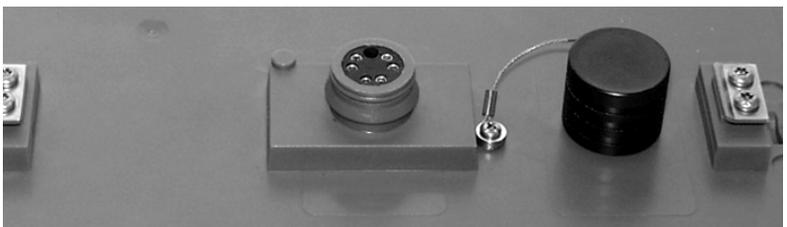
 **Note**

For modules to correctly stack and lock together, protective caps between the modules must be stored on the holders, as shown in Figure 1-5.

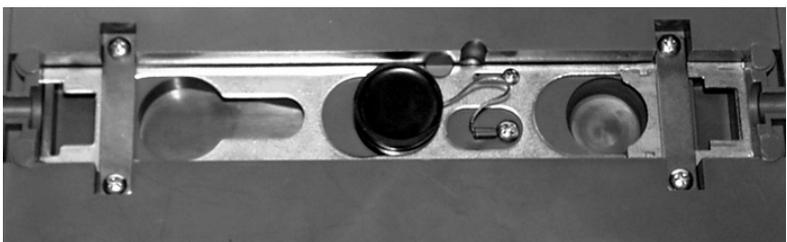
Upper connector, capped



Upper connector, uncapped



Lower connector, plugged



Lower connector, unplugged

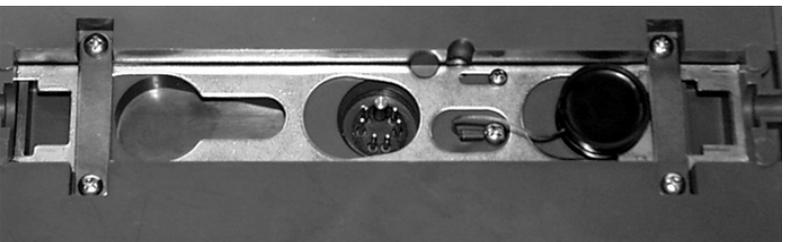


Figure 1-5 Connector sealing and Cap storage

1.6 Technical Specifications

The following tables provide technical information about the 2160 Module and its related components. Physical dimensions are also provided in Figure 1-6. For communication connector pin functions, refer to Figure 1-7 and the table that follows it.

Table 1-2 Specifications – 2160 Laser Module^a

Size (H×W×D)	2.9 × 11.3 × 7.5 in.	7.4 × 28.7 × 19.1 cm
Weight Alone	2.0 lbs	0.9 kg
Weight w/ 2191 Battery Module	6.0 lbs	2.7 kg
Material	High-impact polystyrene, Stainless steel	
Enclosure (self-certified)	NEMA 4X, 6P	IP 68
Power	7.0 to 16.6 VDC. Typical operating current 25 mA at 12 VDC Nominal, 1.0mA standby.	
	<div style="border: 1px solid black; padding: 5px;"> <input checked="" type="checkbox"/> Note Some other system components, including cables, cannot be connected in systems powered by more than 16.6 VDC. Refer to Section 2.3 for complete information. </div>	
Typical Battery Life ^b (LaserFlow Sensor w/ 2160 module and 2191 Battery Module)	Data Storage Interval 15 minutes	Alkaline Batteries ^b 12 weeks
Program Memory	Non-volatile, programmable flash; can be updated using PC without opening enclosure; retains user program after updating	
Number of Modules	Up to 4, field interchangeable	
Maximum Distance between Remote Modules	3300 ft	1000 m
Maximum Distance between 2160 and LaserFlow Sensor	75 ft	23 m
Wiring between Modules	Twisted pair for communication, pair for power, gauge dependent on distance	
Total Flow Calculations	Up to 2 independent level-to-area and/or level-to-flow rate conversions, net, positive or negative, based on either flow rate conversion.	
Level-to-Area Conversions		
Channel Shapes	Round, U-shaped, rectangular, trapezoidal, elliptical, with silt correction	
Data Points	Up to 50 level-area pairs	
Level-to-Flow Rate Conversions		
Weirs	V-notch, rectangular, Cipolletti, Isco Flow Metering Inserts, Thel-Mar	
Flumes	Parshall, Palmer-Bowlus, Leopold-Lagco, trapezoidal, H, HS, HL	
Manning Formula	Round, U-shaped, rectangular, trapezoidal	
Data Points	Up to 50 level-flow rate pairs	
Equation	2-term polynomial	
Data Storage Memory	Non-volatile flash; retains stored data during program updates	
Capacity	798,000 bytes (up to 158,000 readings, equal to over 270 days of level, velocity, flow rate, ultrasonic signal, Doppler power, and input voltage readings at 15 minute intervals.	

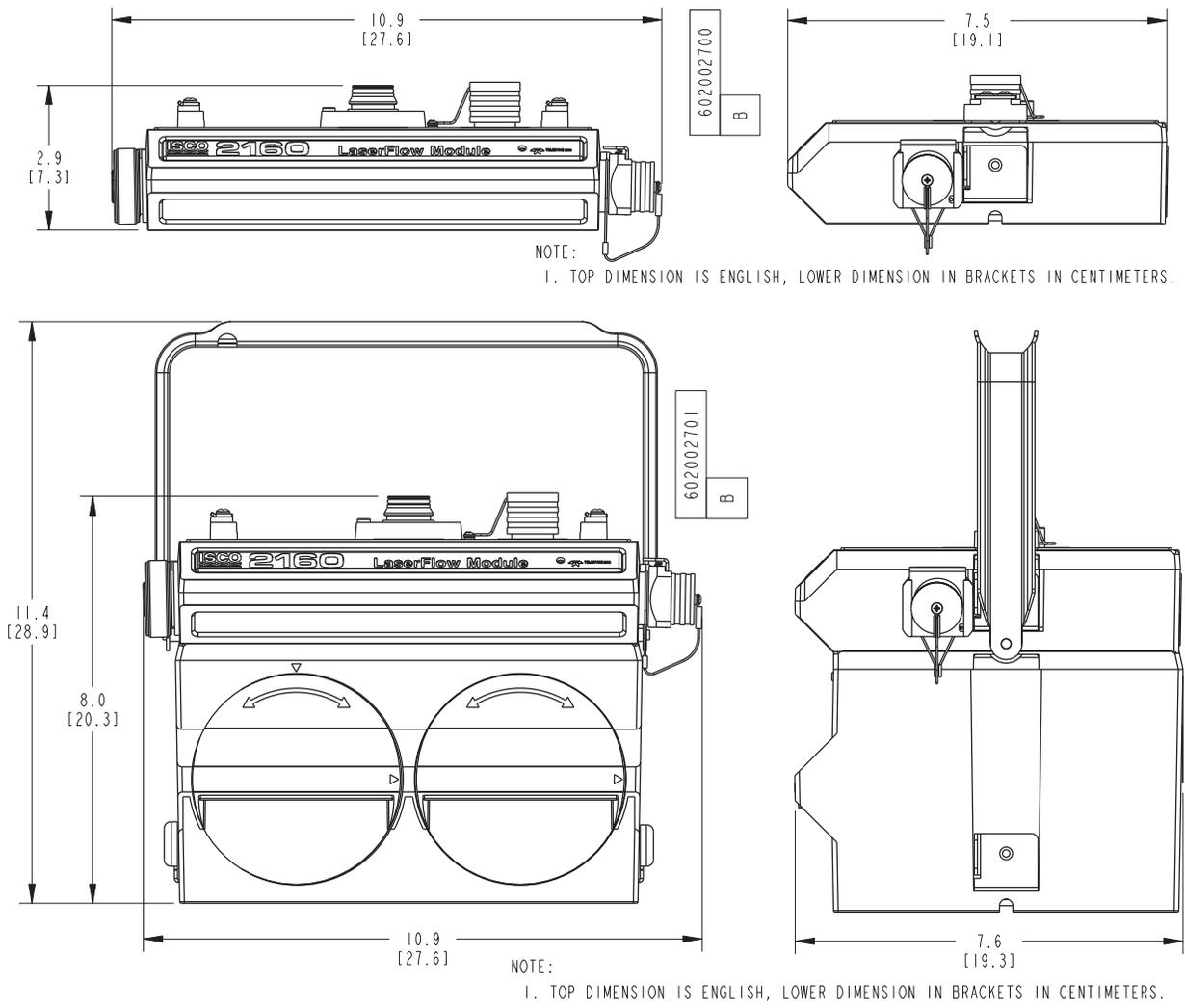
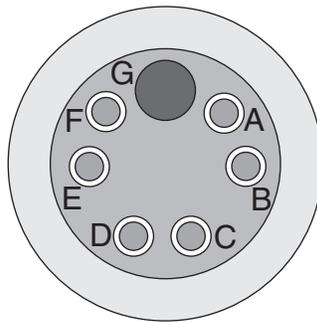


Figure 1-6 2160 LaserFlow Module dimensions:
Alone (top) and with 2191 Battery Module (bottom)



**Communications Port
 (top connector shown)**

Figure 1-7 2160 Module connector pins

Table 1-4 2160 Module Connector Pins		
Pin	Name	Description
A	LONA	Neuron differential transceiver Data A
B	LONB	Neuron differential transceiver Data B
C	VIN+	Positive power supply voltage input (+12 VDC nominal)
D	VIN-	Negative power supply voltage input (0 VDC nominal)
E	RCVUP	PC data receiver RS-232 level input
F	XMTUP	PC data transmit RS-232 level output
G	Key	Aligns connector pins

1.7 Unpacking Instructions

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

 WARNING
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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 advice.

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.

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

Phone:(800) 228-4373
Outside USA & Canada call:
(402) 464-0231

FAX: (402) 465-3022

E-mail: IscoInfo@teledyne.com

2160 LaserFlow™ Module

Section 2 Preparation and Installation

This section covers preparation and installation of the 2160 Laser Module. For complete information about installation of the TIENet™ LaserFlow Sensor and TIENet 350 AV Sensor, refer to their respective user manuals.

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

The 2100 Series 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
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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 2160 Mounting Considerations

Ideal sites are easily accessible for service and data collection, while still providing protection for the 2100 Series devices. The 2100 Series devices are constructed of materials that can withstand harsh environments. However, continual exposure to UV light, or periodic submersion should be avoided to extend the life of the components.

Typically, the module is suspended inside a manhole. Suspending the module near the opening will protect it from the elements, minimize the chance of submersion, and allow it to be easily retrieved without entering the manhole.

2.3 System Power

Table 2-1 lists the maximum voltages for all Isco 2100 instrumentation. Regardless of the capabilities of other components, **never** attempt to connect a module or cable to a system using a power source that exceeds its stated operating range.

Table 2-1 Voltage Specifications for 2100 System Components			
Module or Cable	Earlier Voltage Range	Current Voltage Range	Date of Change
2160	N/A	7-16.6 VDC	N/A
2150	7-16.6 VDC	7-26 VDC	March 2005
2110	7-16.6 VDC		N/A
2101			
2103			
2102	10.2-16.6 VDC		
2108	7-26 VDC		
2105			
RS-232 DB9 Cable (part #60-2004-046)	7-16.6 VDC	7-26 VDC	January 2009
RS-232 USB Cable (part #60-2004-507)	7-26 VDC		N/A
Sampler Interface Cable (part #60-2004-260)	12VDC (from sampler)		N/A (Cable is powered from sampler.)

 **WARNING**

Injury and/or equipment damage can result from connecting modules or cables to a power source exceeding the specified operating voltage range. Check labeling on all modules and cables for voltage ranges.

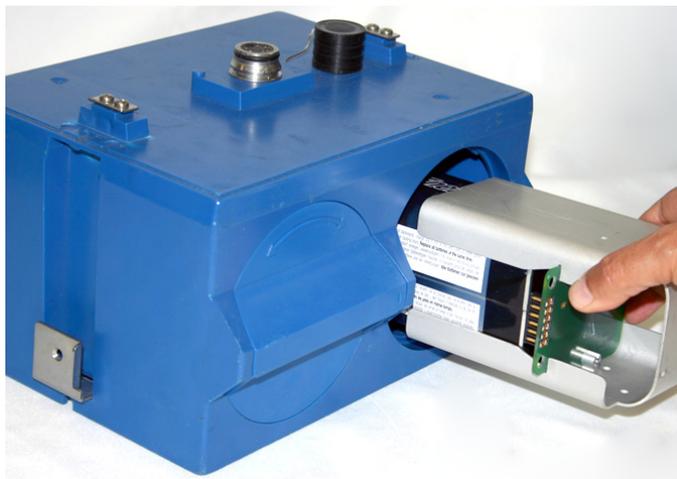
 **Note**

All connected system components should share a common supply ground.

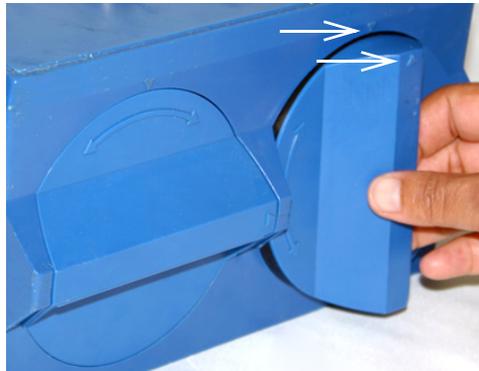
2.4 Installing the Batteries The 2191 battery module requires two lantern batteries. The figures below show a 6 VDC alkaline battery. Rechargeable 6 VDC lead-acid batteries are also available from Teledyne Isco. To install the batteries, follow the instructions in Figure 2-1.



1. Load the lantern battery into the carrier.



2. Insert the carrier and battery into the module. Note the position of the carrier's connector; it must be aligned toward the center of the module.



3. Align the marks indicated and insert the door.



4. Rotate the door 1/4 turn clockwise. Repeat this procedure to install the second battery.

Figure 2-1 Loading the 2191 Battery module

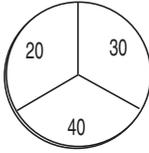
✓ Note

The batteries should always be replaced as a pair. Never mix old and new batteries.

2.5 Installation Procedures

The following sections provide instructions for the installation of the modules and connection of the sensor.

2.5.1 Inspect the Desiccant – Battery Module



A humidity indicator is mounted inside each of the two doors on the battery module. The humidity indicators have regions that display 20, 30, and 40 percent humidity levels. Ideally each region should be completely blue. As the desiccant becomes saturated, the humidity levels will increase and the regions turn pink. When the 40 percent region turns pink, the battery module is no longer adequately protected and the desiccant must be replaced. Refer to Section 5.4 for replacement instructions.

2.5.2 Inspect the Desiccant – 2160 Module

A desiccant cartridge is inserted into the side of the 2160 Module. The cartridge is filled with silica gel beads that will indicate when they are saturated. When dry, the beads are orange. As the desiccant becomes saturated, the humidity levels will increase and the beads turn green. If the entire length of the desiccant cartridge turns green, the interior is no longer adequately protected and the desiccant must be replaced. Refer to section 5.4 for replacement instructions.

2.5.3 Connecting the Modules

The 2100 Series System is modular; you build the system by connecting modules together. The instructions in this section describe how to connect an 2160 to a 2191 in its most basic configuration — by stacking the two modules. Either module may be stacked on the other, but you may find it more convenient if you place the battery module at the bottom of the stack. This keeps the heavier items lower in the stack, making it easier to transport or store.

Other modules may be attached to this stack to increase the site's functions. You can add many modules to the stack as long as each module uses a unique module name (Section 3.2.1), and as long as you observe the power requirements of the extra modules.

Connection Options

Keep in mind that stacking is not the only way to connect modules. The modules may be placed in remote locations and still operate as a single site. If you would like to use remote modules for your application, please consult with the factory or your representative to realize the full potential of your system.

Communication

The computer running **Flowlink** communicates with the modules. With Flowlink, you can name the site, set up its operation, and adjust the level measurement. To assist with servicing, Flowlink will also display input power voltage (indicating remaining battery life) and collect diagnostic reports.

A **communication cable** initially connects the computer and site. The cable supports the data transfers between modules and computer.

To connect the 2160 and 2191, perform the following steps:

1. On the top of the 2191 Battery Module, remove the cap and stow it on the holder. This exposes the communication connector on the 2191.
2. Prepare the battery module's communication connector:
 - a. Inspect the connector. 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. A small amount of lubricant is included in the maintenance kit.

 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. Place the carrying handle on the battery module. (If you are stacking several modules, it is recommended that you position the handle between the top two modules.)
4. Unlock the 2160's latch by pressing in on the latch release (right side).
5. Underneath the 2160, remove the cap from the lower communication connector and stow it in the holder.
6. Lock the latch. Locking the latch correctly seats and aligns the lower cap in its holder.
7. Position the 2160 over the battery module. Align the connectors and lower the 2160 onto the battery module.
8. Unlock the 2160's latch by pressing in on the latch release (right side).
9. Firmly press the modules together and lock the 2160's latch (left side).

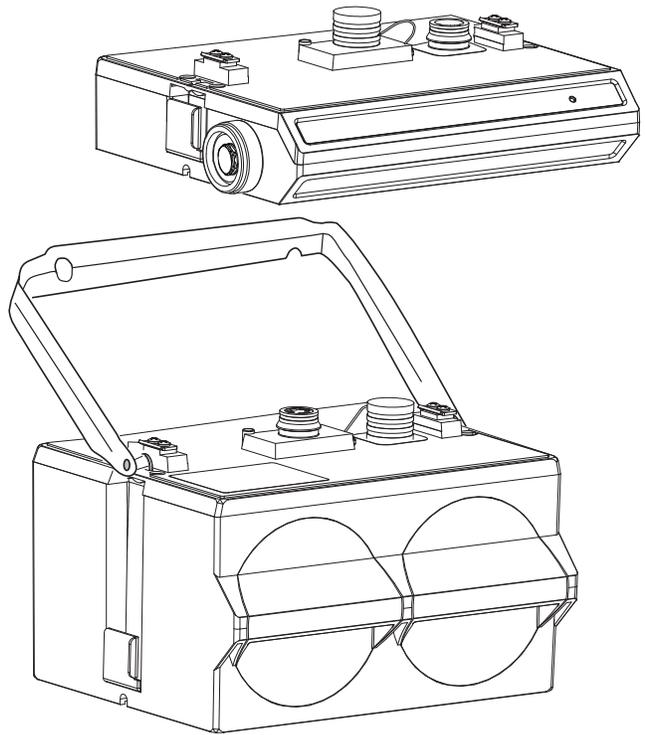


Figure 2-2 Align and secure the module stack

The Communications indicator will blink during the start-up routine to indicate the 2160 is operating.

✓ Note

Unused communication ports on the top and bottom of the stack must be capped. The connector caps terminate the communication lines and protect the pins.

2.5.4 Connecting the LaserFlow Sensor

The sensor cable attaches to the sensor receptacle on the 2160. To connect the LaserFlow (refer to Figure 2-3):

1. Remove the protective caps:
 - a. On the 2160, push down on the sensor release while pulling the protective cap from the receptacle.
 - b. On the sensor cable, pull the cap from the end of its plug.
2. Prepare the LaserFlow 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.
4. Connect the two caps together.

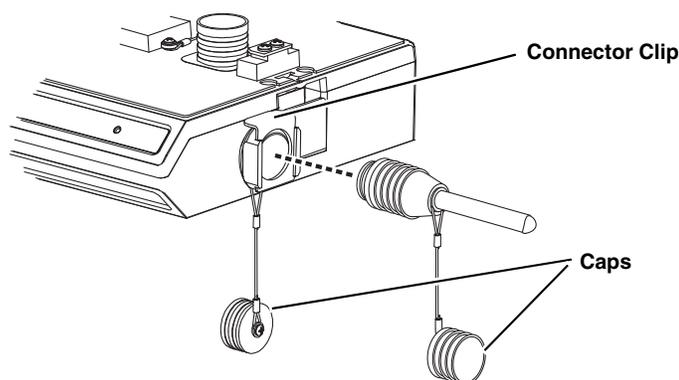


Figure 2-3 Connecting the LaserFlow sensor

Note

Teledyne Isco has options for support of 350 AV sensor reference air moisture protection. For more information, contact the factory.

2.6 Final Installation Check

The modules should be secured at the site. This prevents damage caused by accidental falls and being swept away if the channel is flooded. In manholes, the modules are often secured to a ladder rung, or suspended from a bar. Teledyne Isco’s Customer Service Department or your local representative can assist you with installation options.

The Isco Spreader Bar is commonly used to suspend the modules in a manhole. Spreader bars are adjustable to fit openings from 22.5 to 48 inches (60 to 120 cm).

As you complete the installation, the following should be checked before leaving the site unattended:

1. The modules should be positioned to minimize the risk of submersion.

Note

To protect the 2160, the hydrophobic filter seals off the desiccator when it is exposed to excessive moisture. When sealed,

the filter prevents irreparable damage. This single-use filter must be replaced once it becomes sealed. See Section 5.5.1.

 **CAUTION**

Prolonged submersion may permanently damage the modules and sensors.

2. Ensure that all of the protective caps are in place. Unused upper and lower communication connections must be capped. The caps prevent damage and terminate the communication lines. Caps for any communication connectors that are in use should be properly stowed. Like the module and sensor connections, the protective caps and their O-rings should be cleaned and coated with a silicone lubricant. Damaged O-rings must be replaced.
3. Route all cables carefully without kinks or sharp bends. Keep any excess cable out of the flow to prevent debris from snagging and collecting. Protect them from traffic in the area.

2160 LaserFlow™ Module

Section 3 Programming

3.1 Section Overview

Flowlink Help

This section describes how to set up the operation of a 2160 Module using Isco Flowlink® for software.

Detailed Flowlink instructions are beyond the scope of this manual. Flowlink's operating instructions are available in a Windows Help format. You can access the help topics for an active window by clicking on its *Help* button or by pressing F1 on your computer's keyboard. You can also access Help topics from a Contents and Index window (HELP>CONTENTS AND INDEX from the Flowlink menu). These instructions are also provided in the Flowlink software user manual, provided in PDF format on your Flowlink CD.

Setup and programming specific to the TIENet LaserFlow and 350 AV Sensors is provided in their respective user manuals.

3.2 Flowlink Connections

Initial connection is made directly between your computer and the site using a serial communication cable. Figure 3-1 shows a connection using Isco's USB Communication Cable.

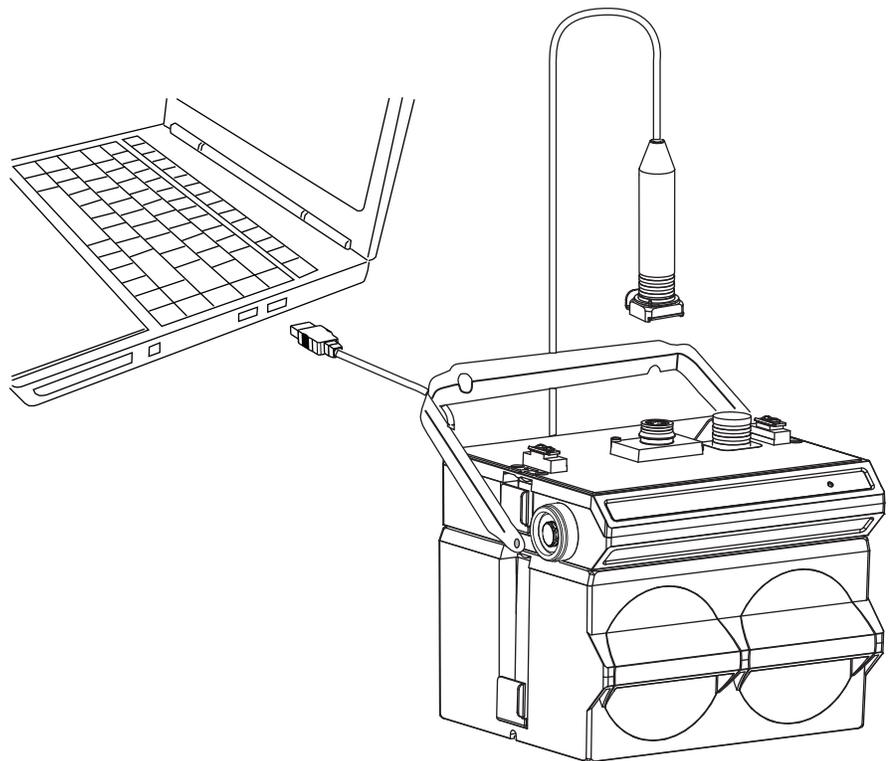


Figure 3-1 Connecting the 2160 to a computer

As a default Flowlink setting, the Quick Connect dialog box opens when you start Flowlink. Or, to open Quick Connect, click the QC icon in the Flowlink toolbar. 

Click on the large *2100 Instruments* button to connect. Flowlink will read the 2100 system information and try to match it with an existing site in the open database. If Flowlink cannot find a match for the connected site, it creates a new site in the database.

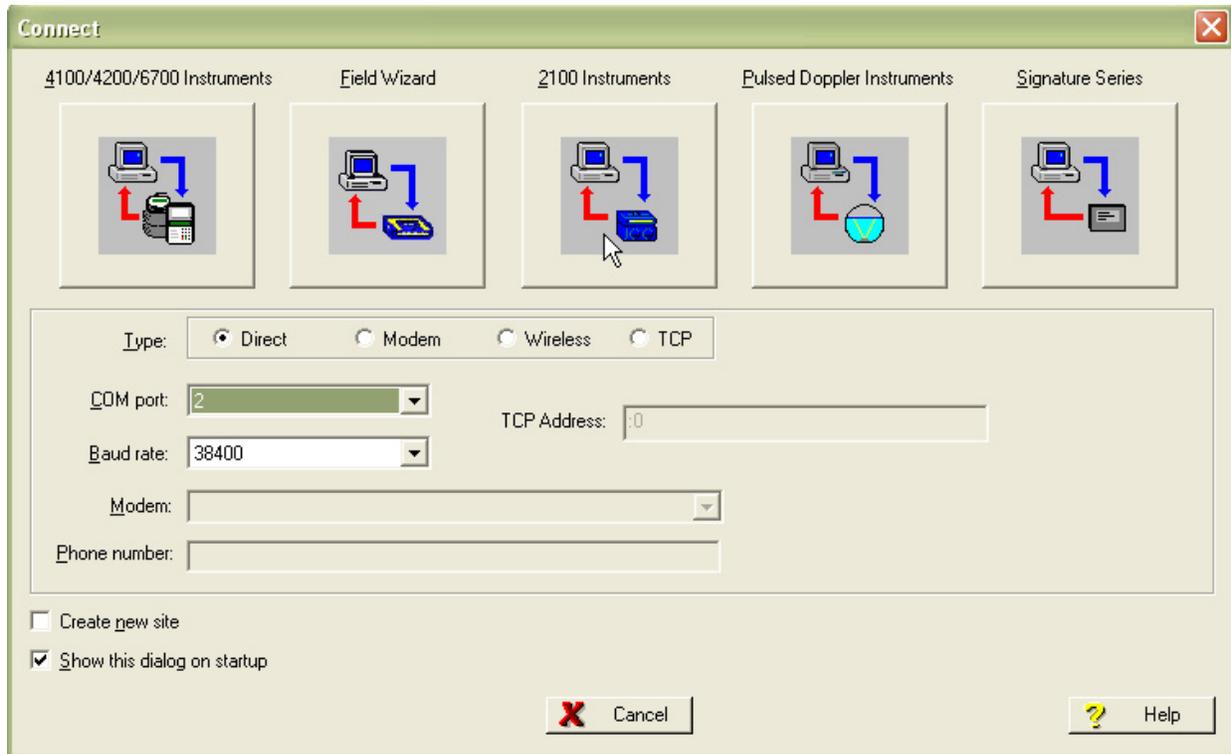


Figure 3-2 Flowlink connect screen

3.2.1 Site Configuration Stability

During the connection process, Flowlink checks the stability of the site's configuration. If there are conflicts with the site configuration, Flowlink presents the *Communication Resolution* window.

There are two common causes of site configuration conflicts. One cause is a Module Name conflict, which may occur when two or more modules at a site use the same module name. The second cause is a Site Name conflict, which occurs when a module added to the site indicates that it belongs to a different site.

The Communications Resolution window lets you choose how the modules should be reconfigured and which Site Name should be retained. To resolve the conflicts, select the actions that should be taken and click the OK button. Be aware that some actions will delete all data from the module.

3.2.2 Site Name

2100 modules are shipped with default names so that they can immediately begin to communicate with Flowlink. You can change the Site name to a more descriptive name on the *Site Info* tab in Flowlink. Keep in mind that the name must be unique among the other Site names in the open Flowlink database.

Site names can be up to 20 characters long. Any character may be used in the name except:

/	forward slash	\	back slash
:	colon	*	asterisk
?	question mark	"	double-quote
<	left angle bracket	>	right angle bracket
	bar	&	ampersand

3.2.3 Module Name

2100 modules are shipped with default names so that they can immediately begin to communicate with Flowlink. You can change a Module name to a more descriptive name on the *Devices* tab in Flowlink. Keep in mind that the name must be unique among the other Module names connected at that site.

To help you match up a single module in a stack with its module name in Flowlink, the *Devices* tab includes an *Identify* button. To identify a module, highlight the Module Name, then click the *Identify* button. The module will turn on its front-panel light so that you can identify which module at the site corresponds with the highlighted Module Name.

Module names can be up to 20 characters long. Any character may be used in the name, except for those noted under *Site Name*, Section 3.2.2.

3.3 Program Settings

While connected, Flowlink displays the Site window. This window contains all of the program settings that control the site's operation. The settings are entered using eight tabs: Site Info, Devices, Measurements, Data, Flow Rate, Modbus, TIENet, and a variable tab used to set up the different measurement types.

Data Storage Settings

You should also check the Data Storage Rates while you are reviewing the program settings. You can view the storage rates on the Data tab to ensure that pertinent types of data are being stored, and that the rates will provide a sufficient amount of data for your application. Refer to Section 3.3.1 for instructions on how to modify the data storage rates.

General Settings

Once the site's configuration has been resolved, the Site and Module Names may be changed to help you better manage the sites and data collection. Giving sites descriptive names such as "12th and Main Streets" can help you easily recognize the measurement locations, instead of generic terms such as "Site 1." Site and Module Names are discussed in Sections 3.2.2 and 3.2.3.

Changing a Setting

After modifying a setting, click Apply (F9). Flowlink sends the change to the module and updates the site's settings in its database.

3.3.1 Data Storage

The interval at which the 2160 stores the readings is called the *Data Storage Rate*. The 2160 is shipped with default storage rates of 15 minutes for level, velocity, flow rate, and ultrasonic signal, and 24 hours for total flow and input voltage readings.

You can modify the data storage rates to log readings at a faster or slower rate. Keep in mind that although the 2160 can store data as fast as one reading every 15 seconds, faster storage rates will shorten battery life, increase memory usage, and lengthen *Retrieve Data* (interrogation) times.

To modify the Data Storage Rates, first click on the *Set Up Data Storage...* button on a measurement tab or from the Data tab. In the *Data Storage Setup* window (Figure 3-3), you configure which types of data are logged and their storage rates.

For each measurement, you can turn the **Primary** storage rate OFF, or select a rate from 15 seconds to once every 24 hours. If the primary rate is turned OFF, the 2160 will not store the measurement (unless a secondary rate is selected). However, the 2160 can still take readings if that measurement type is necessary for a calculation.

Secondary storage rates are used to log data at a different rate when a user-defined condition exists. For example, a secondary rate can be used to increase the level data storage rate when level is greater than or equal to a point of interest. Secondary rates give you the best resolution of data, but only when it is needed. Until the condition is met, the module will conserve power and memory by storing the data at the primary storage rate. Like the primary rate, you can turn the secondary rate OFF, or select a storage rate of 15 seconds to every 24 hours.

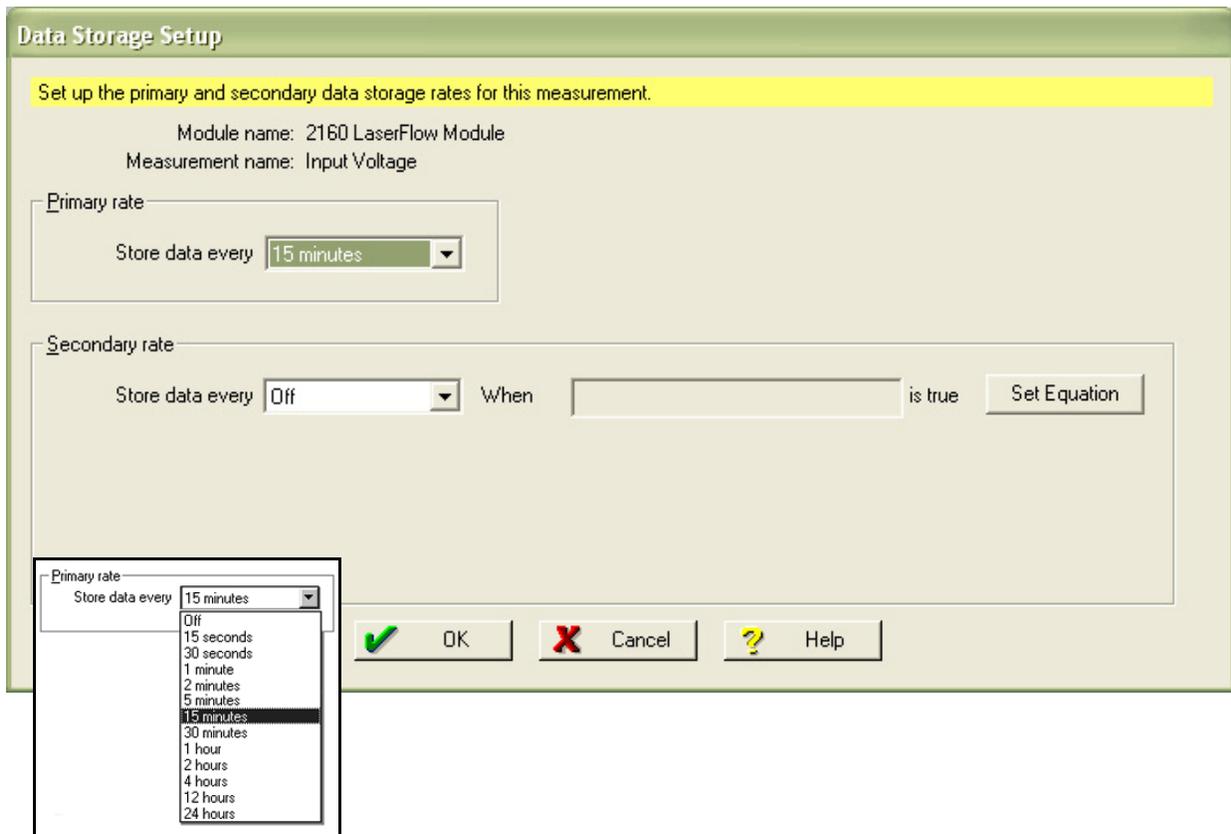


Figure 3-3 Data Storage Setup in Flowlink

Time Resolution

The time resolution of each measurement is one second. That is, readings are taken at the same time as the time stamp, not collected and averaged over a period of time before the stamp.

Rollover Memory

Whether the measurements are stored at the primary or secondary rate, measurements are stored in a *rollover* type of memory. When full, the module overwrites the oldest data with the newest readings.

2160 LaserFlow™ Module

Section 4 Modbus Output Protocol

Sections 4.1 through 4.5 give an overview of the basic capabilities and operation of Modbus output protocol as it applies to Isco 2100 Series flow modules.

For a Glossary of Terms and Common Acronyms, see Sections 4.4 and 4.5.

4.1 Introduction

Modbus is a simple command/response mechanism to read from and write to specific memory locations called *registers*. A register is a holding place for a piece of digital information within the equipment. There are three standard protocols for Modbus: Modbus RTU, Modbus TCP/IP, and Modbus ASCII. The Isco 2100 Series devices use Modbus ASCII protocol, the method discussed in this manual. Modbus ASCII has more liberal communication timing requirements. Modbus communication for the Isco 2100 Series provides a standard protocol that can be used to retrieve real-time data from a single module or stack of modules at a site, or multiple sites, over a wide area. The data can be sent to a central computer for display, data collection, or process control.

Modbus implementation is independent of Flowlink and cannot alter the Flowlink-programmed configuration of the module. Modbus cannot be used to retrieve historical data from a module's memory.

Due to the wide variety of configurations that can be made with Modbus, it is impossible to cover every usable application. This section will discuss the overall capabilities and operation of Modbus.

4.2 Operation

There are many standard, third party Modbus drivers and OPC servers that may be used to link a remote Modbus device, such as a 2100 Series module, to SCADA or process control software, such as Wonderware®¹ or Intellution®². The OPC server communicates with the remote instrumentation and accesses registers. The definition of what information is contained and where (the register number, or address) is decided by the manufacturer (Teledyne Isco).

In a 2100 module, the registers hold, but are not limited to, the current real-time value of the meter's level, velocity, flow, input voltage, temperature, and total flow readings, stored in specified register locations.

-
1. Wonderware® is a registered trademark of Wonderware Software Development Corporation.
 2. Intellution® is a registered trademark of Intellution, Inc.

By accessing these registers you can obtain the current value of whatever parameter you desire. The reading(s) can then be displayed or stored wherever you designate as a destination; for example, a process control computer.

 **Note**

Level, flow, velocity, and temperature data is stored in metric units only.

Not all registers are limited to read-only data storage. You can also use some registers for control purposes. For example, by writing a “1” value to register 24 (“Identify Module” register), you will tell a 2100 module to light the LED on the front of the module.

4.2.1 Establishing Communication

There are several different communications protocols supported in the 2100 series that require auto-baud rate detection. Because of this, each time a modbus connection is made, the module uses a polling mechanism to repeatedly send a command until a response is received. It may take up to 20 command retries before the module has identified the baud rate and a response is received.

4.2.2 Module Addressing

When connecting to a site via a Modbus OPC server, you use a dedicated line of communication to that module or stack from the OPC server, which can be a dedicated communications cable (direct connection) or a dedicated phone number (modem).

When you are using a direct connection, you are dedicating a specified COM port on the computer, and that COM port determines the site to which you are connecting.

When you are using a modem, the dedicated line is defined by the site's phone number.

If you connect more than one 2100 Series module at a site, the Modbus OPC server, while using the shared communication line for all of the modules within the network, must have some way to differentiate between the modules. When sending a command to a specific module, the command has an address field. This allows the server software to talk to, as well as control, the specified module, while ignoring other modules in the same stack or site.

Each module capable of Modbus Protocol communication will automatically create its own specific ASCII address within the site, using:

- The model numbers of the modules
- The user-defined module names

4.3 Configurations

A variety of configurations can be made with Modbus, either through direct connection or through a modem.

In the example shown in Figure 4-1, you are direct-connecting a server PC to two individual 2100 sites through Modbus, using the COM ports on the OPC Server, which are directly connected to the remote sites.

Connection to the module is made through the RS-232 communication port on the top of the module.

✓ Note

For low power operation, we recommend connecting the module(s) to the computer using the straight-through cable, which consumes less power, instead of our standard interrogation cable. Contact the factory for more information.

In Figure 4-1, the OPC Server PC must have two COM ports. Modbus requires one COM port each, for direct connection of each 2160.

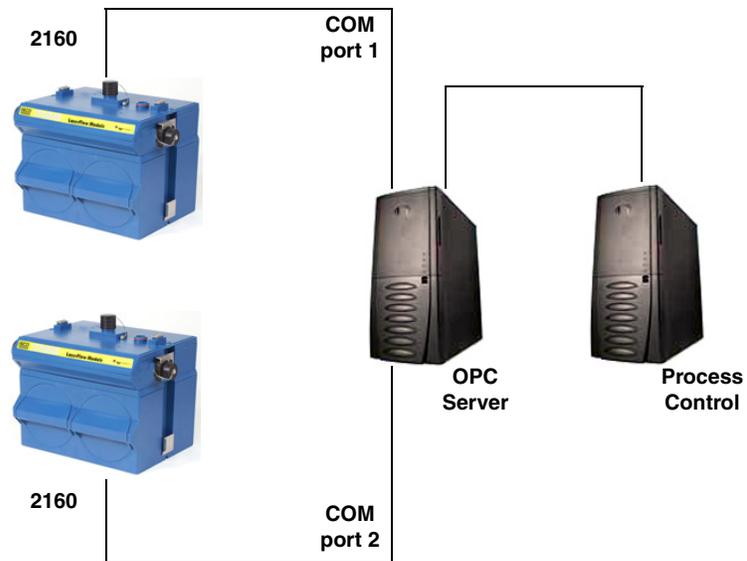


Figure 4-1 Configuration example

The operation sequence for the example above can be summarized in the following steps:

2160:

1. 2160s take readings from probes.
2. 2160s store readings (level, velocity, flow rate, etc.) in their specified registers.

Process Control:

3. The user requests data through Process Control.
4. Process Control asks the OPC server to gather information.

5. OPC connects to the 2160 stack through the cable (direct connection), takes register data from the specified 2160, and populates the OPC server's holding index.
6. Process Control takes data from the OPC server's holding index and gives data to the user.

Note that Process Control can be either manual or automated in this example, and that the OPC server and Process Control may be located physically on the same computer.

4.4 Glossary of Terms

ASCII – Short for American Standard Code for Information Interchange, ASCII is a code that represents English characters with numbers. Most computers represent text with ASCII code, making it possible for one computer or device to share data with another.

2100 modules support Modbus ASCII protocol.

Dedicated Line – A telecommunications path reserved for communication between two specified points and not shared among multiple points.

Modbus Protocol – Modbus Protocol is a messaging structure used to establish master-slave/client server communications between intelligent devices. Modbus is a simple command/response mechanism to read from and write to registers.

OPC – OPC (OLE for Process Control) means open connectivity via open (free for use) standards. It is a series of software standards specifications that fill a need in automation (like printer drivers did for Windows®¹), acting as a translator for data transmission and process control.

The specification defines a standard set of objects, interfaces, and methods for use in process control and manufacturing automation applications to facilitate interoperability. There are hundreds of OPC Data Access servers and clients.

Registers – Registers are locations in memory that have specific data stored for retrieval or are used for control functions. A register is a holding place for a piece of digital information within the equipment. The definition of what is contained and where (the registry number, or address) is decided by the manufacturer (in this case Teledyne Isco).

SCADA – SCADA (Supervisory Control And Data Acquisition) is a computer system for gathering and analyzing real-time data. SCADA systems are used to monitor and control plant operation, or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining, and transportation.

The SCADA system transfers the information (for example, where a leak has occurred in a pipeline), back to a central site, alerting the home station of the leak, performing necessary

1. Windows® is a registered trademark of Microsoft Corporation.

analysis and control (such as determining if the leak is critical), and displaying the information in a logical and organized manner.

SCADA systems can be relatively simple, such as one that monitors the environmental conditions of a small office building, or very complex, such as a system that monitors all the activity in a nuclear power plant or a municipal water system.

4.5 Common Acronyms

ASCII – American Standard Code for Information Interchange
DCS – Distributed Control Systems
MTU – Master Terminal Unit
OPC – Object Linking and Embedding (OLE) for Process Control
PLC – Programmable Logic Controller
RTU – Remote Terminal Unit
SCADA – Supervisory Control And Data Acquisition
TCP/IP – Transmission Control Protocol/Internet Protocol

4.6 Register Specifications

All numbers in the Modbus registers are stored most significant byte first. If the polling device has a byte ordering of least significant byte first (an Intel-based PC, for example), the bytes will need to be reversed after they are received.

The Modbus ASCII address is used to index the data by modules. Modbus ASCII address 1 contains information related to the site. The first register contains a 16-bit integer count of the number of modules that have data to report. The maximum number of modules that can be supported is 4.

Modbus ASCII addresses 2 through the number of the module in the stack (N) minus 1 contain data from the individual modules.

The Modbus ASCII addresses will be sorted by the model number, and then by module name, which is entered by the user through Flowlink. This allows the user to control the ordering of the addresses and easily predict what data will be in specific registers.

Every measured parameter has a corresponding status and measurement time that are updated with each measurement.

The maximum number of supported measurements from all modules in the system is 28.

The Modbus registers are assigned within 30 seconds after the 2100 module is powered up. To conserve power for the users who do not use Modbus communications, no Modbus registers will be updated with sensor readings until a Modbus master communicates with the 2100 module.

2160 LaserFlow™ Module

Section 5 Maintenance

5.1 Maintenance Overview

This section explains the maintenance requirements of the 2160 Module.

The 2100 Series system is designed to perform reliably in adverse conditions with a minimal amount of routine service requirements. To keep your system working properly, the following should be checked at regular intervals:

- Battery power (Section 5.3)
- Desiccant (Section 5.4)

Maintenance intervals are affected by many variables. The number of modules powered by a Battery Module and the Data Storage Rate will affect the battery life. Humidity levels obviously affect the service life of the desiccant, and the amount of debris in the stream can drastically alter the channel conditions.

As a guide, a basic system installed in an environment with moderate humidity levels, the maintenance interval should not exceed three months. A basic system is defined as:

- a single 2160 Module and LaserFlow Sensor,
- powered by a fresh pair of alkaline lantern batteries,
- recording readings at the default intervals of 15 minutes.

Experience is often the best tool to use when establishing minimum maintenance intervals for your system. Until you have gained an understanding of the 2160's operation under differing environmental conditions, a weekly maintenance interval is recommended.

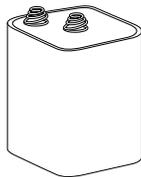
5.2 Maintenance Kits

Teledyne Isco
Customer Service Dept.
P.O. Box 82531
Lincoln, NE 68501 USA
Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3022
E-mail:
IscoInfo@teledyne.com

Many of the parts called out in the *Installation* and *Maintenance* sections of this manual are available in maintenance kits. The 2160 maintenance kit contains O-rings for the connectors and desiccant cartridge, a hydrophobic filter, and a one-pound container of indicating silica gel desiccant. The 2191 maintenance kit contains O-rings for the connectors, gaskets for the battery doors, humidity indicators, and bags of desiccant. You can order the kits by calling Teledyne Isco's Customer Service Department.

5.3 Batteries

Input voltage can be monitored while you are connected to the 2160 with Flowlink. The 2160 also can record Input Voltage readings to closely track the power consumption. Keep in mind that battery discharge rates vary widely depending on the configuration of your system and its operating environment. Batteries should be replaced according to the instructions in Section 2.4.1.

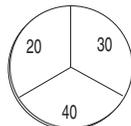


Lantern Battery

The batteries should be replaced with:

- New 6-Volt alkaline lantern batteries
or
- Fully-charged lead-acid batteries.

5.4 Desiccant



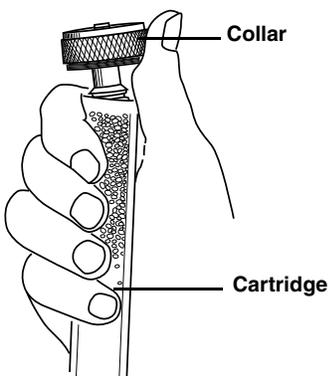
Battery Module
Humidity Indicator

The 2100 System devices use desiccant to protect the internal components from moisture damage. In the 2160, a desiccant cartridge is used to dry the reference air for the sensor. This prevents moisture from plugging the reference line, which would cause the sensor to report erroneous level readings. The cartridge is filled with indicating silica gel that is orange when dry. As the desiccant becomes saturated, the color changes from orange to green. Replace the desiccant before the entire length of the cartridge turns green.

The battery module uses desiccant bags to keep the interior of the case dry. The bags are located inside the battery caps. Attached to the inside face of each cap is a humidity indicator. Humidity indicators have regions that display 20, 30, and 40 percent humidity levels. Ideally, each region should be completely blue. As the desiccant becomes saturated, the humidity levels will increase and the regions turn pink. When the 40 percent region begins to turn pink, the components are no longer adequately protected and the desiccant must be replaced.

5.4.1 Replacing the 2160 Desiccant

The desiccant is contained in a cartridge located on the left side of the 2160. To remove the cartridge, unscrew the collar and slide the cartridge out of the module. The clear tube reveals the silica gel desiccant inside.



To replace the silica gel desiccant:

1. Hold the cartridge upright with the collar at the top.
2. As shown in the margin, push the collar off the cartridge.
3. Empty the saturated silica gel beads or granules.
4. Fill the tube with new or reactivated (see Section 5.4.3) silica gel desiccant.
5. Press the collar onto the tube.
6. Slide the cartridge into the 2160. Tighten the collar to seal the cartridge in place.

5.4.2 Replacing the 2191 Desiccant

A bag of desiccant is located inside each of the battery caps behind a retaining plate. To replace the desiccant:

1. Loosen the two mounting screws that secure the metal retaining plate.
2. Rotate the retaining plate until it is free from the mounting screws.
3. Remove the spent desiccant bag from the cap and replace it with a new or reactivated bag (see Section 5.4.3).
4. Replace the retaining plate and secure it with the screws.

5.4.3 Reactivating the Desiccant

Silica gel beads/granules and bags of desiccant can be reactivated.

 **CAUTION**

Desiccant may produce irritating fumes when heated. Observe the following precautions:

- Use a vented oven in a well-ventilated room.
- Do not remain in the room while the regeneration is taking place.
- Use the recommended temperature. Avoid heating the desiccant at higher than recommended temperatures.

There have been reports of irritating fumes coming from the desiccant during reactivation. While our attempts to duplicate the problem have been unsuccessful, we still urge you to use caution. Material Safety Data Sheets are in the back of this manual.

The desiccant's ability to remove moisture may lessen with each saturation/reactivation cycle, resulting in a need for more frequent service. After several cycles, the desiccant may no longer be effective as it saturates too quickly. At this point, replace the desiccant.

Silica gel

To reactivate the silica gel desiccant, pour the spent desiccant into a heat resistant container. Never heat the cartridge assembly; it will melt. Heat the silica gel in a *vented convection oven* at 212° to 350°F (100° to 175°C) for two to three hours, or until the blue or yellow color returns. Allow the desiccant to cool and store it in an airtight container until ready for use.

Desiccant bags

Bagged desiccant will often include reactivation or recharging instructions on the bag's labeling. Always follow the instructions printed on the bag. If the instructions are not available, the bags may be heated in a *vented convection oven* at 245°F (120°C) for sixteen hours.

5.5 Hydrophobic Filter



209-0093-93

If the 2160 is in a humid location or submerged, a hydrophobic filter prevents water from entering the desiccant cartridge and reference line. Any amount of water will plug the filter and it must be rinsed with clean water and allowed to dry, or replaced so that the reference line for the optional TIENet 350 AV sensor can be reliably ventilated. *Drifting 350 Level readings are often an indication that the hydrophobic filter may be plugged.*

Remove the hydrophobic filter with a $\frac{5}{8}$ " or 16mm socket. Gently screw in the replacement filter.

If the hydrophobic filter frequently requires replacement, consider relocating the modules so that they are better protected.

5.6 Cleaning

The 2160 case may be cleaned with mild detergent and warm water. Before cleaning the module, ensure that all protective connector caps are in place.

The cable and outer surfaces of the LaserFlow sensor may also be cleaned with mild detergent and warm water.

5.7 How to Obtain Service

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

Phone: (866) 298-6174
(402) 464-0231
FAX: (402) 465-3085

E-mail:
IscoService@teledyne.com

The internal components of the 2160 LaserFlow Module are not user-serviceable. The case is completely sealed to protect the internal components. To repair the unit, the case must be broken open and replaced. If you think your module requires repair, contact Teledyne Isco's Technical Service Department.

Corresponding with a Teledyne Isco Technical Service Representative can often resolve the problem without the need to return the item. If the difficulty cannot be resolved you will be issued a Return Authorization Number (RAN) and information on returning it to the factory.

5.7.1 Diagnostics

As a troubleshooting aid, many module functions can generate a diagnostic file. With the assistance of a Teledyne Isco Environmental Product Support (EPS) Representative, the diagnostic files can often be used to isolate a problem.

To view a diagnostic file, connect to the site with Flowlink. View the measurement tab of the suspect function and click on the *Diagnostics...* button. The module then generates the file and sends it to Flowlink where it is displayed as a text report.

Flowlink can also collect all of the diagnostic files while retrieving data. The last available diagnostic files are always kept in Flowlink's database where they can be viewed "off-line" at a later time. To enable Flowlink to automatically collect all diagnostic files while retrieving the data, open the *Utilities>Options* from the menu and check the *Retrieve data gets text reports* box on the 2100 tab.

2160 LaserFlow™ Module

Appendix A Replacement Parts

A.1 Replacement Parts Diagrams and Listings

Replacement parts are called out on the following pages for the 2160 LaserFlow Module and Battery Module. Reference the call-out in the adjacent table to determine the part number for the item.

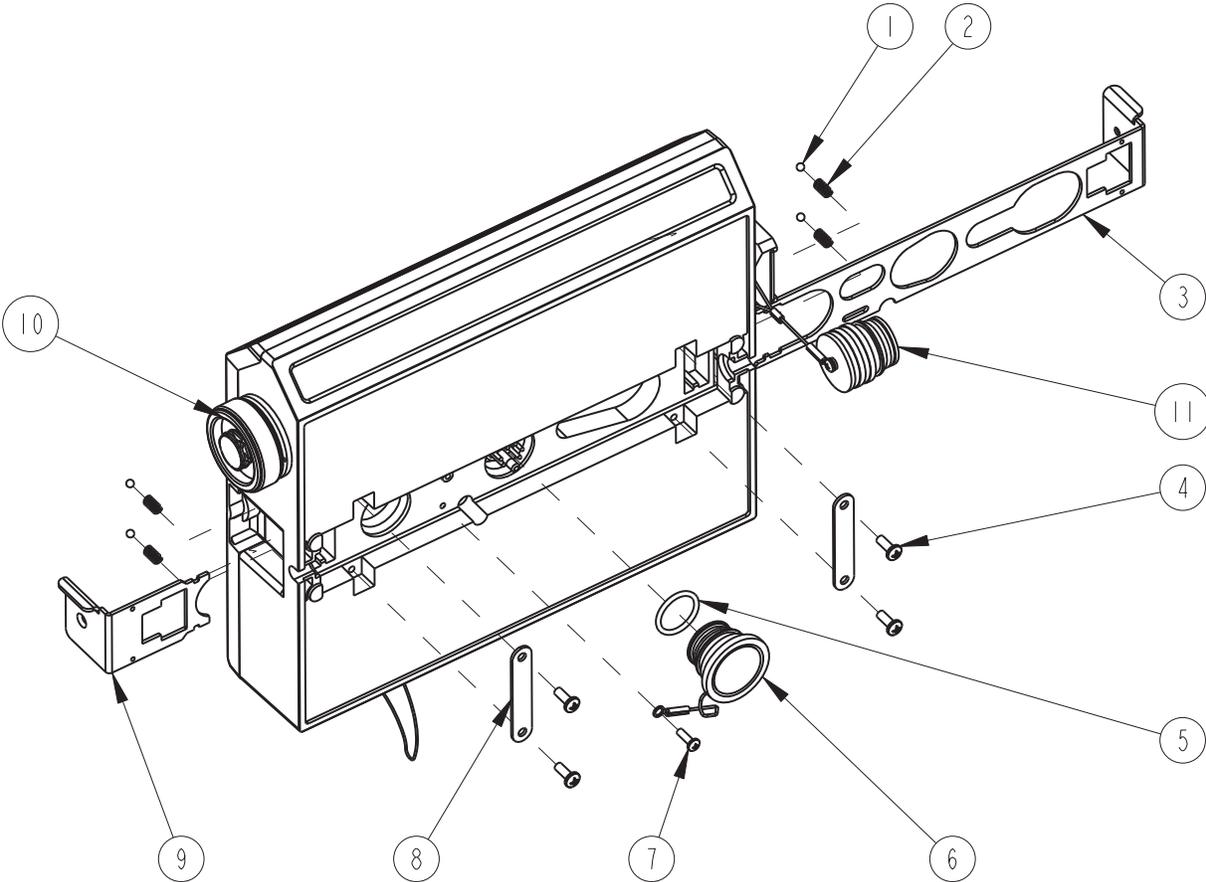
Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

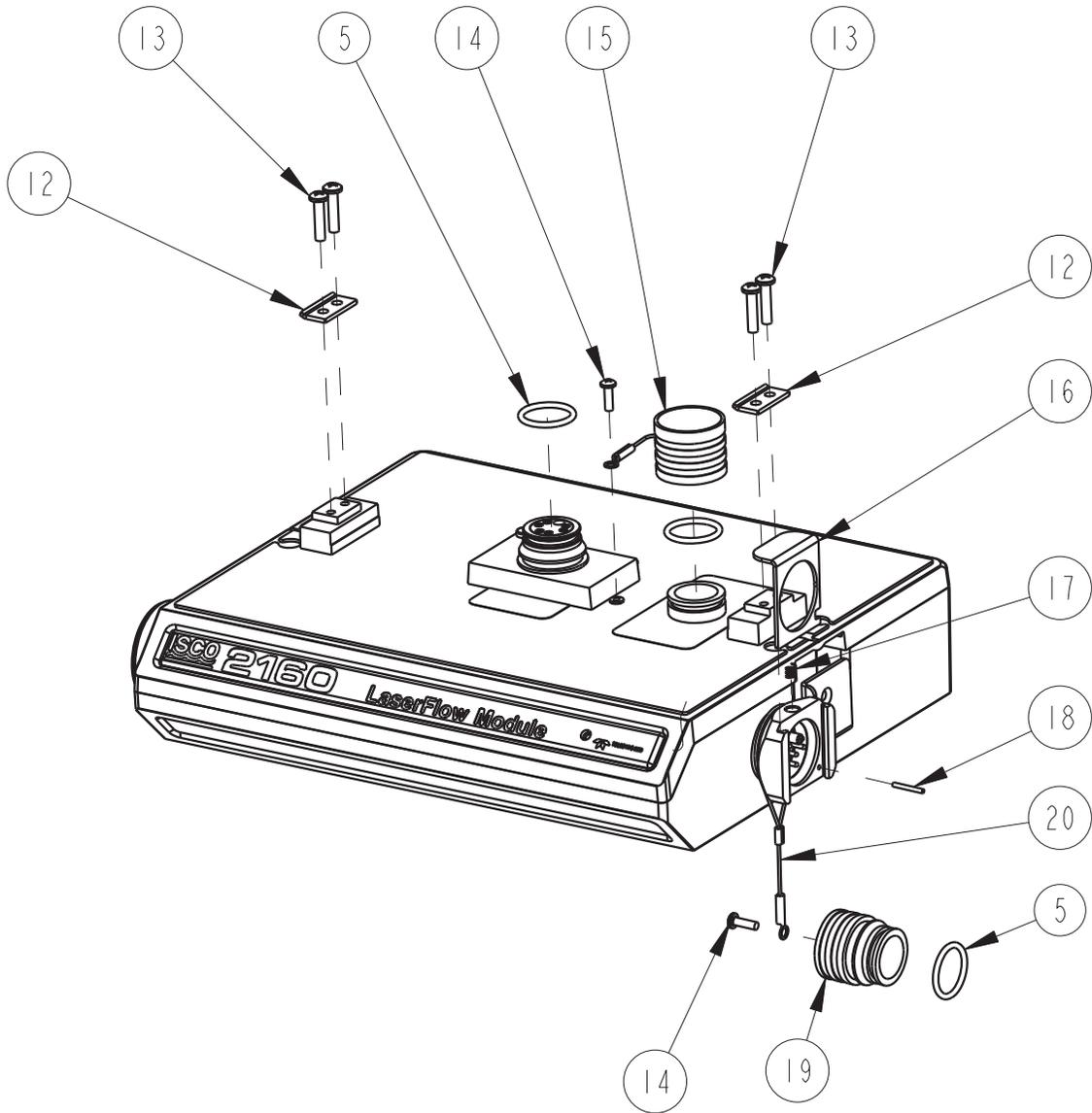
Teledyne Isco
Customer Service Department
P.O. Box 82531
Lincoln, NE 68501 USA

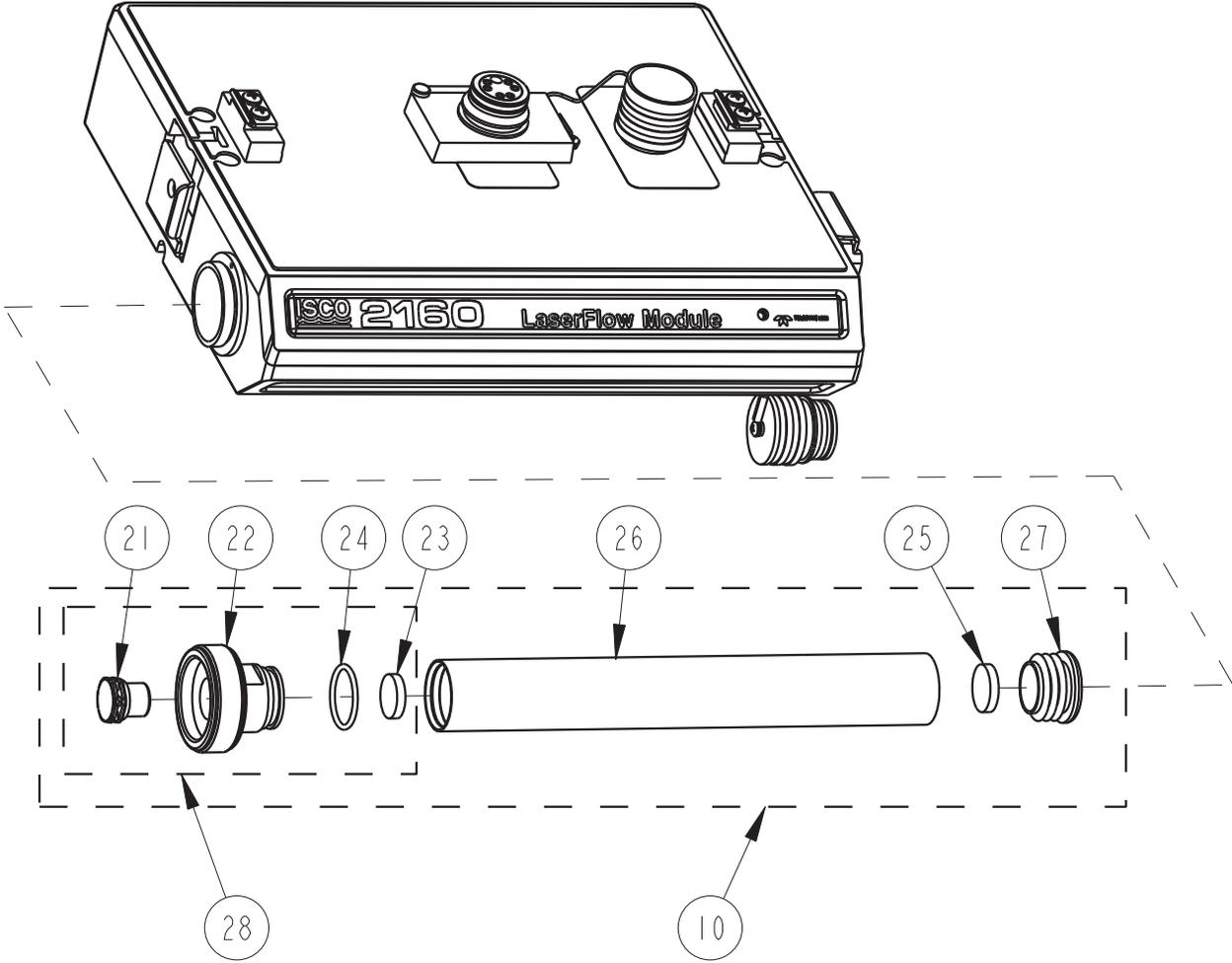
Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3022

E-mail: IscoInfo@teledyne.com

**A.2 2160 LaserFlow
Module**



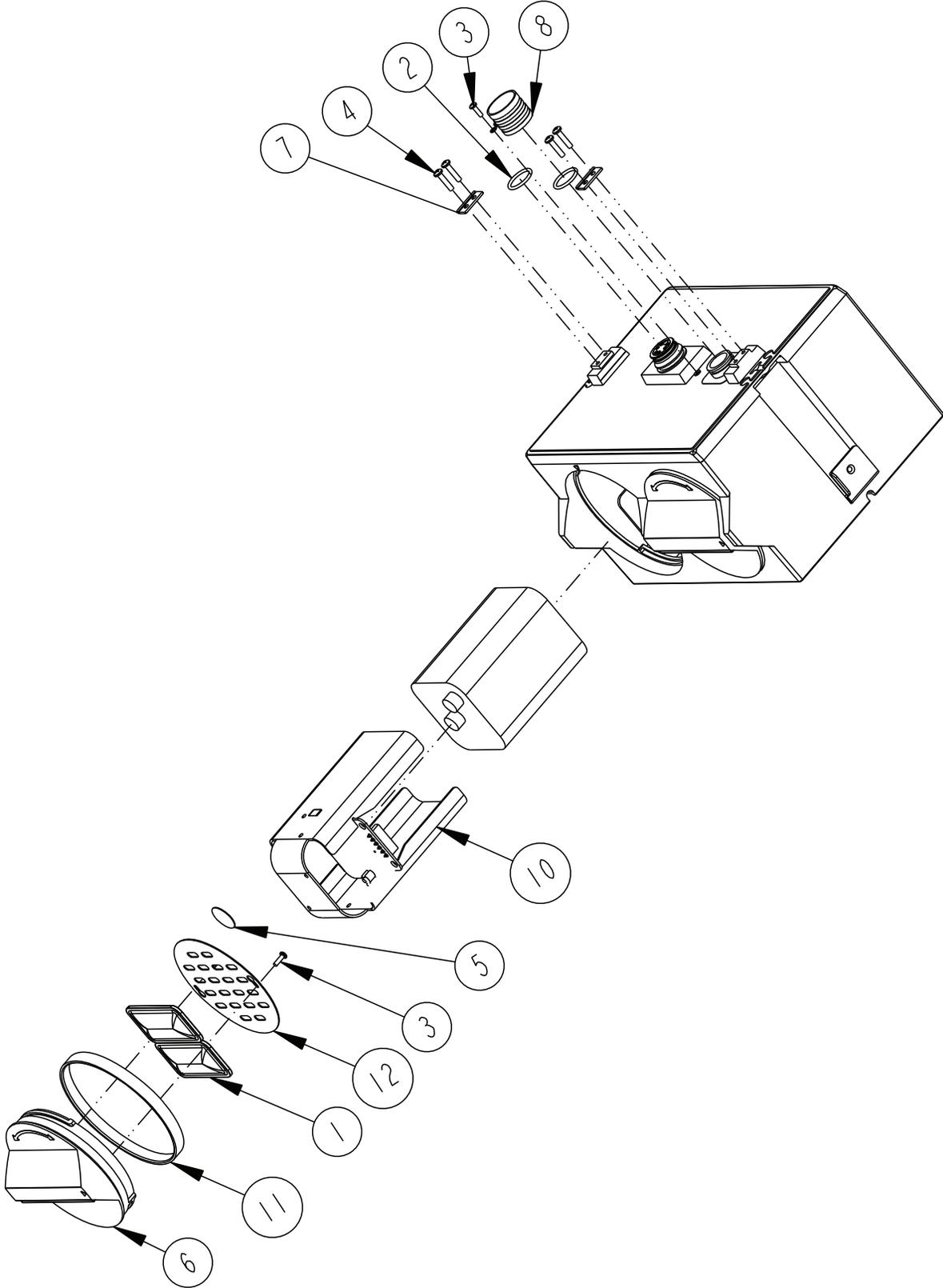




REPLACEMENT PARTS LIST		
TELEDYNE ISCO, INC.		
		602003702
		SHEET: 4 OF 5
		REV:
ITEM NO.	PART NUMBER	DESCRIPTION
1	201900102	BALL .125 DIAMETER 316 SST
2	203011602	COMPRESSION SPRING, .022 DIAMETER WIRE, .031 FREE LENGTH
3	692003190	LARGE LATCH
4	231311206	SCREW, SELF TAP #6 X 3/8 PAN HEAD, PHILLIPS, SST
5	202100669	O RING, .669 ID, .079 CROSS SECTION, BUNA-N RUBBER
6	602004013	PLUG ASSEMBLY FEMALE CONNECTOR (INCLUDES ITEM 5)
7	231611108	SCREW, SELF TAP, #4 X 1/2, PAN HEAD PHILLIPS, SST
8	602003022	LATCH HOLD
9	692003189	SMALL LATCH
10	602004016	DESICCANT ASSEMBLY (includes items 21 thru 27)
11	602004033	PLUG ASSEMBLY (includes items 5, 14, 19 & 20)
12	602003019	NODE CLIP
13	231514920	SCREW, SELF TAP, 6-19 X 5/8 TORX, PAN HEAD, SST
14	231310140	SCREW, SELF TAP, #4 X 3/8, PAN HEAD PHILLIPS, SST
15	602004012	CAP ASSEMBLY, MALE CONNECTOR
16	602003018	CONNECTOR CLIP
17	203011105	COMPRESSION SPRING, .026 DIAMETER WIRE, .31 FREE LENGTH
18	236410408	PIN, SPRING, 1/16 X 1/2 LONG SST
19	602003076	PLUG, FEMALE PROBE
20	692003172	CABLE, FEMALE PROBE PLUG
21	209009393	SCREW IN FILTER
22	602004265	DESICCANT CAP ASSEMBLY
23	692203300	FRIT, .062 DIA.
24	202500017	O RING, .676 ID, .070 CROSS SECTION, BUNA-N RUBBER
25	692203301	FRIT, .670 DIA.
26	602003046	DESICCANT TUBE
NOTE: 1. For current prices and quotations on parts, contact Isco Service Department. 2. This list is subject to change without notice.		

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A.3 2191 Battery Module



2160 LaserFlow™ Module

Appendix B Equipment and Accessories

B.1 How to Order

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

Teledyne Isco

Customer Service Dept.

P.O. Box 82531

Lincoln, NE 68501 USA

Phone: (800) 228-4373

(402) 464-0231

FAX: (402) 465-3022

E-mail: IscoInfo@teledyne.com

B.2 General Equipment

2160 LaserFlow Module	62-2004-001
2191 Battery Module w/ Carrying Handles	62-2004-000
LaserFlow Sensor, 10m Cable w/ TIENet Plug.....	60-4364-001
LaserFlow Sensor, 15m Cable w/ TIENet Plug.....	60-4364-015
LaserFlow Sensor, 23m Cable w/ TIENet Plug.....	60-4364-016
TIENet Expansion Box	60-4307-023
<i>(For AV Reference line support, contact the factory)</i>	
Cord grip fitting, 3/4" NPT, for TIENet cable.....	209-0073-12
Spreader bar for meter suspension	60-3004-110
Adjusts from 22.5 to 48 inches (57 to 122 cm)	
ProHanger SST Bracket for suspending equipment in manhole (up to 24-inch)	69-2003-599
Alkaline Lantern Battery	340-2006-02
Rechargeable 6V Lead-acid Lantern Battery	60-2004-041
Charging Adapter for 6V Lead-acid Lantern Battery.....	60-2004-040
Power adaptor cable for Isco batteries and power packs, 2 ft standard, CE-rated	69-2004-451
USB RS232 Communication Cable	60-2004-507
DB9 RS232 Communication Cable.....	60-2004-046
2100 Module to Module Extension Cable.....	60-2004-056
Sampler Interface Cable	60-2004-260
2108 Analog Output Module.....	68-2000-010
Flowlink for Windows Software.....	CALL

2160 LaserFlow™ Module
Appendix B Equipment and Accessories

2160 Instruction Manual 60-2004-703
LaserFlow Instruction Manual..... 69-4363-043
Teledyne Isco Open Channel Flow Measurement Handbook 60-3003-041
Laser Module Maintenance Kit 60-2059-001
Battery Module Maintenance Kit..... 60-2099-001

2160™ LaserFlow Module

Appendix C Material Safety Data Sheets

C.1 Overview

This appendix to the manual provides Material Safety Data Sheets for the desiccant used by the 2160 LaserFlow Module and 2191 Battery Module.

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.

MATERIAL SAFETY DATA SHEET



sSORB®



Health	1
Fire	0
Reactivity	0
Personal Protection	E

Section 1: CHEMICAL PRODUCT & COMPANY IDENTIFICATION

Product Name: sSORB®	Supplier: Interra Global Corporation
Chemical Name: Yellow Indicating Silica Gel	800 Busse Hwy, Suite 101
Synonyms: Orange Indicating Silica Gel	Park Ridge, IL 60068
	USA
Emergency Assistance	
USA	+ 1.847.292.8600 Telephone: + 1.847.292.8600
Outside USA	+ 1.847.292.8600 Fax: + 1.847.292.8601

Section 2: COMPOSITION & INFORMATION ON INGREDIENTS

CAS Numbers: 1343-98-2, 77-09-8
Molecular Formula: SiO ₂ · nH ₂ O + C ₂₀ H ₁₄ O ₄

Section 3: HAZARDS IDENTIFICATION

Potential Health Effects
Inhalation: May cause dryness and irritation to mucous membranes, nose and throat. Symptoms may include coughing, sore throat, and wheezing.
Ingestion: No adverse effects expected.
Skin Contact: May cause irritation with dryness and abrasion.
Eye Contact: May cause irritation, redness and pain.
Chronic Exposure: Repeated exposure may cause symptoms similar to those listed for acute effects. Synthetic amorphous silica does not produce silicosis.

Section 4: FIRST AID MEASURES

Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.
Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.
Ingestion: Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Inhalation: If inhaled, remove to fresh air. If breathing is difficult, get medical attention.

Section 5: FIRE & EXPLOSION DATA

Fire: Not considered to be a fire hazard.
Explosion: Not considered to be an explosion hazard.
Fire Fighting Media and Instructions: Use any means suitable for extinguishing surrounding fire.
Special Remarks: Use protective clothing and breathing equipment appropriate for surrounding fire.

MATERIAL SAFETY DATA SHEET

Section 6: ACCIDENTAL RELEASE MEASURES

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container. Use respiratory protection and eye protection.

Large Spill: Use a shovel to put the material into a convenient waste disposal container. Vacuuming or wet sweeping may be used to avoid dust dispersal. Use respiratory protection and eye protection.

Section 7: HANDLING & STORAGE

Storage: Keep container tightly closed. Suitable for any general chemical storage area. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

Section 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls: Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Respirator (NIOSH Approved). Gloves.

Section 9: PHYSICAL & CHEMICAL PROPERTIES

Physical state:	Solid	Boiling Point:	2230C (4046F)
Color:	Yellow/Orange-Dry:Green-Saturatec	Melting Point:	1610C (2930F)
Odor:	Odorless	Vapor Pressure:	Not applicable.
Solubility:	Insoluble	Vapor Density:	Not applicable.
Specific Gravity:	2.1 (Water=1)	Evaporation Rate:	Not available.
pH :	3 - 8 (in 5% slurry)	% Volatiles by volume @ 21C (70F):	0

Section 10: STABILITY & REACTIVITY

Stability: The product is stable.

Hazardous Decomposition Products: Oxides of carbon and silicon may be formed when heated.

Hazardous Polymerization: Will not occur.

Incompatibility with powerfull oxiders: Reacts with hydrogen flouoride, fluorine, oxygen difluoride, chlorine trifluoride, strong acids, strong bases, and oxidizers.

Conditions to Avoid: Moisture, extreme heat, and incompatibles.

Section 11: TOXICOLOGICAL INFORMATION

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available.

LC50: Not available.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity: This material is not expected to be toxic to aquatic life.

Section 13: DISPOSAL CONSIDERATIONS

Waste Disposal: Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: TRANSPORT INFORMATION

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

MATERIAL SAFETY DATA SHEET

Section 15: OTHER REGULATORY INFORMATION

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Section 16: OTHER INFORMATION

References: Not available.

Other Special Considerations: Not available.

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Last Updated: 08/20/2012 12:15 PM

The purpose of this Safety Data Sheet is to describe the products in terms of their safety requirements. The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Interra Global Corporation be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Interra Global Corporation has been advised of the possibility of such damages.

2160 LaserFlow™ Module

Appendix D Safety Information

D.1 Safety Considerations

In field installations of Teledyne Isco wastewater samplers and associated equipment, the safety of the personnel involved should be the foremost consideration. The following sections provide safety procedures for working in and around manholes and sewers. The first section offers general safety advice. The second section deals with the special problem of hazardous gases found in sewers.

The 2160 has not been approved for use in hazardous locations as defined by the National Electrical Code.

D.2 Practical Safety Precautions

The following procedures are those used by Black & Veatch™¹, a respected consulting firm, and are published here by permission.

Field personnel must keep safety uppermost in their minds at all times. When working above ground, rules of common sense and safety prevail. However, when entering manholes, strict safety procedures must be observed. Failure to do so could jeopardize not only your own life, but also the lives of other crew members.

D.2.1 Hazards

There are many hazards connected with entering manholes. Some of the most common hazards are:

Adverse Atmosphere – The manhole may contain flammable or poisonous gases or the atmosphere may be deficient in oxygen. forced ventilation may be necessary.

Deteriorated Rungs – Manhole steps may be corroded and not strong enough to support a man. It may be difficult to inspect the rungs because of poor lighting.

Traffic – Whenever manholes are located in the traveled way, barricades and warning devices are essential to direct traffic away from an open manhole.

Falling Objects – Items placed near the manhole opening may fall and injure a worker in the manhole.

Sharp Edges – Sharp edges of items in or near a manhole may cause cuts or bruises.

Lifting Injuries – Unless proper tools are used to remove manhole covers, back injuries or injuries to hands or feet may result.

D.2.2 Planning

Advance planning should include arrangements for test equipment, tools, ventilating equipment, protective clothing, traffic warning devices, ladders, safety harness, and adequate

1. Black & Veatch™ is a registered trademark of Black & Veatch Holding Company.

number of personnel. Hasty actions may result in serious injuries. Time spent in the manhole should be kept to a minimum.

D.2.3 Adverse Atmospheres

[Refer to Table D-1, Hazardous Gases, at the end of this appendix.] Before workers enter a manhole, tests should be made for explosive atmosphere, presence of hydrogen sulfide, and oxygen deficiency. Combustible or toxic vapors may be heavier than air, so the tests on the atmosphere must be run at least $\frac{3}{4}$ of the way down the manhole.

Whenever adverse atmosphere is encountered, forced ventilation must be used to create safe conditions. After the ventilating equipment has been operated for a few minutes, the atmosphere in the manhole should be retested before anyone enters the manhole.

When explosive conditions are encountered, the ventilating blower should be placed upwind to prevent igniting any gas that is emerging from the opening. When a gasoline engine blower is used, it must be located so that exhaust fumes cannot enter the manhole.

If testing equipment is not available, the manhole should be assumed to contain an unsafe atmosphere and forced ventilation must be provided. It should never be assumed that a manhole is safe just because there is no odor or the manhole has been entered previously.

D.2.4 Entering Manholes

Since the top of the manhole is usually flush with the surrounding surface, there may not be anything for the person who is entering the manhole to grab on to steady himself. Persons who are entering manholes should not be permitted to carry anything in their hands as they enter the manhole, to ensure that their hands will be free to hold on or grab if they slip. A good method for entering a manhole is to sit on the surface facing the manhole steps or ladder, with the feet in the hole and the arms straddling the opening for support. As the body slides forward and downward, the feet can engage a rung, and the back can rest against the opposite side of the opening. If there is any doubt about the soundness of the manhole steps, a portable ladder should be used.

A person should never enter a manhole unless he is wearing personal safety equipment, including a safety harness and a hard hat. Two persons should be stationed at the surface continuously while anyone is working inside a manhole, to lift him out if he is overcome or injured. One man cannot lift an unconscious man out of a manhole. The persons stationed at the surface should also function as guards to keep people and vehicles away from the manhole opening. To avoid a serious injury, a person should not be lifted out of a manhole by his arm unless it is a dire emergency.

When more than one person must enter a manhole, the first person should reach the bottom and step off the ladder before the next one starts down. When two men climb at the same time, the upper one can cause the lower one to fall by slipping or stepping on his fingers.

D.2.5 Traffic Protection

In addition to traffic cones, markers, warning signs, and barricades, a vehicle or a heavy piece of equipment should be placed between the working area and oncoming traffic. Flashing warning signals should be used to alert drivers and pedestrians. Orange safety vests should be worn by personnel stationed at the surface when the manhole is located in a vehicular traffic area.

D.2.6 Falling Objects

All loose items should be kept away from the manhole opening. This applies to hand tools as well as stones, gravel and other objects.

D.2.7 Removing the Covers

Manhole covers should be removed with a properly designed hook. Use of a pick ax, screwdriver, or small pry bar may result in injury. A suitable tool can be made from $\frac{3}{4}$ -inch round or hex stock. Two inches of one end should be bent at a right angle and the other end should be formed into a D-handle wide enough to accommodate both hands. Even with this tool, care must be exercised to prevent the cover from being dropped on the toes. The 2-inch projection should be inserted into one of the holes in the cover, the handle grasped with both hands, and the cover lifted by straightening the legs which have been slightly bent at the knees.

D.2.8 Other Precautions

Other precautions which should be taken when entering a manhole are:

- Wear a hard hat.
- Wear coveralls or removable outer garment that can be readily removed when the work is completed.
- Wear boots or nonsparking safety shoes.
- Wear rubberized or waterproof gloves.
- Wear a safety harness with a stout rope attached.
- Do not smoke.
- Avoid touching yourself above the collar until you have cleaned your hands.

D.2.9 Emergencies

Every member of the crew should be instructed on procedures to be followed in cases of an emergency. It is the duty of each crew chief to have a list of emergency phone numbers, including the nearest hospital and ambulance service, police precinct, fire station, and rescue or general emergency number.

D.2.10 Field Equipment

The following equipment will be available for use:

Blowers	Gloves	Traffic cones
Breathing apparatus	Hard Hats	Coveralls
Harnesses	First aid kits	Manhole irons
Emergency flashers	Pick axes	Flashlights
Rain slickers	Mirrors	Ropes
Gas detectors	Safety vests	Gas masks
Waders”		

D.3 Lethal Atmospheres in Sewers

The following is an article written by Dr. Richard D. Pomeroy, and published in the October 1980 issue of *Deeds & Data* of the WPCF. Dr. Pomeroy is particularly well known for his studies, over a period of nearly 50 years, in the field of the control of hydrogen sulfide and other odors in sewers and treatment plants. He has personally worked in a great many functioning sewers. In the earlier years he did so, he admits, with little knowledge of the grave hazards to which he exposed himself.

It is gratifying that the subject of hazards to people working in sewers is receiving much more attention than in past years, and good safety procedures are prescribed in various publications on this subject. It is essential that people know and use correct procedures.

It is less important to know just what the hazardous components of sewer atmospheres are, as safety precautions should in general be broadly applicable, but there should be a reasonable understanding of this subject. It is disturbing to see statements in print that do not reflect true conditions.

One of the most common errors is the assumption that people have died from a lack of oxygen. The human body is able to function very well with substantially reduced oxygen concentrations. No one worries about going to Santa Fe, New Mexico, (elev. 2,100 meters), where the partial pressure of oxygen is equal to 16.2% (a normal atmosphere is about 21%) oxygen. When first going there, a person may experience a little ‘shortness of breath’ following exercise. People in good health are not afraid to drive over the high passes in the Rocky Mountains. At Loveland Pass, oxygen pressure is 13.2% of a normal atmosphere. At the top of Mt. Whitney, oxygen is equal to 12.2%. Many hikers go there, and to higher peaks as well. After adequate acclimation, they may climb to the top of Mt. Everest, where oxygen is equal to only 6.7%.

The lowest oxygen concentrations that I have observed in a sewer atmosphere was 13 percent. It was in a sealed chamber, near sea level, upstream from an inverted siphon on a metropolitan trunk. A man would be foolish to enter the chamber. Without ventilation, he might die, but not from lack of oxygen.

It seems unlikely that anyone has ever died in a sewer from suffocation, that is, a lack of oxygen. Deaths have often been attributed to ‘asphyxiation.’ This is a word which, according to

the dictionary, is used to mean death from an atmosphere that does not support life. The word has sometimes been misinterpreted as meaning suffocation, which is only one kind of asphyxiation.

In nearly all cases of death in sewers, the real killer is hydrogen sulfide. It is important that this fact be recognized. Many cities diligently test for explosive gases, which is very important, and they may measure the oxygen concentration which usually is unimportant, but they rarely measure H₂S. Death has occurred where it is unlikely that there was any measurable reduction in the oxygen concentration. Waste water containing 2 mg per liter of dissolved sulfide, and at a pH of 7.0, can produce, in a chamber with high turbulence, a concentration of 300 PPM H₂S, in the air. This is considered to be a lethal concentration. Many people have died from H₂S, not only in sewers and industries, but also from swamps and from hot springs. In one resort area, at least five persons died from H₂S poisoning before the people were ready to admit that H₂S is not a therapeutic agent. Hardly a year passes in the U.S. without a sewer fatality from H₂S as well as deaths elsewhere in the world.

The presence of H₂S in a sewer atmosphere is easily determined. A bellows-and-ampoule type of tester is very satisfactory for the purpose, even though it is only crudely quantitative. When using a tester of this type, do not bring the air to the ampoule by way of a tube, as this may change the H₂S concentration. Hang the ampoule in the air to be tested, with a suction tube to the bulb or bellows.

Lead acetate paper is very useful as a qualitative indicator. It cannot be used to estimate the amount of sulfide, but it will quickly turn black in an atmosphere containing only a tenth of a lethal concentration.

Electrodes or other similar electrical indicating devices for H₂S in air have been marketed. Some of them are known to be unreliable, and we know of none that have proved dependable. Do not use one unless you check it at frequent intervals against air containing known H₂S concentrations. A supposed safety device that is unreliable is worse than none at all.

Remember that the nose fails, too, when it comes to sensing dangerous concentrations of H₂S.

Various other toxic gases have been mentioned in some publications. It is unlikely that any person has been asphyxiated in a sewer by any of those other gases, except possibly chlorine. The vapor of gasoline and other hydrocarbons is sometimes present in amounts that could cause discomfort and illness, but under that condition, the explosion hazard would be far more serious. The explosimeter tests, as well as the sense of smell, would warn of the danger. Pipelines in chemical plants might contain any number of harmful vapors. They, too, are sensed by smell and explosimeter tests if they get into the public sewer. Such occurrences are rare.

The attempt to instill a sense of urgency about real hazards is diluted if a man is told to give attention to a long list of things that in fact are irrelevant.

Be very careful to avoid high H₂S concentrations, flammable atmospheres, and hazards of physical injuries. Remember that much H₂S may be released by the stirring up of sludge in the bottom of a structure. Obey your senses in respect to irritating gases, such as chlorine (unconsciousness comes suddenly from breathing too much). Be cautious about strange odors. Do not determine percent oxygen in the air. There is a danger that the result will influence a man's thinking about the seriousness of the real hazards. Most important, use ample ventilation, and do not enter a potentially hazardous structure except in a good safety harness with two men at the top who can lift you out."

D.4 Hazardous Gases

The following table contains information on the properties of hazardous gases.

Table D-1 Hazardous Gases

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Ammonia	NH ₃	Irritant and poisonous. Colorless with characteristic odor.	0.60	Causes throat and eye irritation at 0.05%, coughing at 0.17%. Short exposure at 0.5% to 1% fatal.	300 to 500	85	16 25	Near top. Concentrates in closed upper spaces	Sewers, chemical feed rooms.	Detectable odor at low concentrations
Benzene	C ₆ H ₆	Irritant, colorless anesthetic	2.77	Slight symptoms after several hours exposure at 0.16% to 0.32%. 2% rapidly fatal.	3,000 to 5,000	25	1.3 7.1	At bottom.	Industrial wastes, varnish, solvents.	Combustible gas indicator
Carbon Bisulfide	CS ₂	Nearly odorless when pure, colorless, anesthetic. Poisonous.	2.64	Very poisonous, irritating, vomiting, convulsions, psychic disturbance.	—	15	1.3 44.0	At bottom	An insecticide	Combustible gas indicator
Carbon Dioxide	CO ₂	Asphyxiant, Colorless, odorless. When breathed in large quantities, may cause acid taste. Non-flammable. Not generally present in dangerous amounts unless an oxygen deficiency exists.	1.53	Cannot be endured at 10% more than a few minutes, even if subject is at rest and oxygen content is normal. Acts on respiratory nerves.	40,000 to 60,000	5,000	— —	At bottom; when heated may stratify at points above bottom.	Products of combustion, sewer gas, sludge. Also issues from carbonaceous strata.	Oxygen deficiency indicator

Table D-1 Hazardous Gases (Continued)

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Carbon Monoxide	CO	Chemical asphyxiant. Colorless, odorless, tasteless. Flammable. Poisonous.	0.97	Combines with hemoglobin of blood. Unconsciousness in 30 min. at 0.2% to 0.25%. Fatal in 4 hours at 0.1%. Headache in few hours at 0.02%.	400	50	12.5 74.0	Near top, especially if present with illuminating gas.	Manufactured gas, flue gas, products of combustion, motor exhausts. Fires of almost any kind.	CO ampoules.
Carbon Tetra-Chloride	CCl ₄	Heavy, ethereal odor.	5.3	Intestinal upset, loss of consciousness, possible renal damage, respiratory failure.	1,000 to 1,500	100	— —	At bottom.	Industrial wastes, solvent, cleaning	Detectable odor at low concentrations.
Chlorine	Cl ₂	Irritant. Yellow-green color. Choking odor detectable in very low concentrations. Non-flammable.	2.49	Irritates respiratory tract. Kills most animals in a very short time at 0.1%.	4	1	— —	At bottom.	Chlorine cylinder and feed line leaks.	Detectable odor at low concentrations.
Formaldehyde	CH ₂ O	Colorless, pungent suffocating odor.	1.07	Irritating to the nose.	—	10	7.0 73.0	Near bottom.	Incomplete combustion of organics. Common air pollutant, fungicide.	Detectable odor.
Gasoline	C ₅ H ₁₂ to C ₉ H ₂₀	Volatile solvent. Colorless. Odor noticeable at 0.03%. Flammable.	3.0 to 4.0	Anesthetic effects when inhaled. Rapidly fatal at 2.4%. Dangerous for short exposure at 1.1 to 2.2%.	4,000 to 7,000	1,000	1.3 6.0	At bottom.	Service stations, garages, storage tanks, houses.	1. Combustible gas indicator. 2. Oxygen deficiency indicator.**
Hydrogen	H ₂	Simple asphyxiant. Colorless, odorless, tasteless. Flammable	0.07	Acts mechanically to deprive tissues of oxygen. Does not support life.	—	—	4.0 74.0	At top.	Manufactured gas, sludge digestion tank gas, electrolysis of water. Rarely from rock strata.	Combustible gas indicator.
Hydrogen Cyanide	HCN	Faint odor of bitter almonds. Colorless gas	0.93	Slight symptoms appear upon exposure to 0.002% to 0.004%. 0.3% rapidly fatal.	—	10	6.0 40.0	Near top.	Insecticide and rodenticide.	Detector tube
Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air = 1	Physiological Effect*	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air.) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing

Table D-1 Hazardous Gases (Continued)

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Hydrogen Sulfide	H ₂ S	Irritant and poisonous volatile compound. Rotten egg odor in small concentrations. Exposure for 2 to 15 min. at 0.01% impairs sense of smell. Odor not evident at high concentrations. Colorless. Flammable.	1.19	Impairs sense of smell, rapidly as concentration increases. Death in few minutes at 0.2%. Exposure to 0.07 to 0.1% rapidly causes acute poisoning. Paralyzes respiratory center.	200 to 300	20	4.3 to 45.0	Near bottom, but may be above bottom if air is heated and highly humid.	Coal gas, petroleum, sewer gas. Fumes from blasting under some conditions. Sludge gas.	1. H ₂ S Ampoule. 2. 5% by weight lead acetate solution.
Methane	CH ₄	Simple asphyxiant. Colorless, odorless, tasteless, flammable.	0.55	Acts mechanically to deprive tissues of oxygen. Does not support life.	Probably no limit, provided oxygen percent-age is sufficient for life.	—	5.0 15.0	At top, increasing to certain depth.	Natural gas, sludge gas, manufactured gas, sewer gas. Strata of sedimentary origin. In swamps or marshes.	1. Combustible gas indicator 2. Oxygen deficiency indicator.
Nitrogen	N ₂	Simple asphyxiant. Colorless, tasteless. Non-flammable. Principal constituent of air. (about 79%).	0.97	Physiologically inert.	—	—	— —	Near top, but may be found near bottom.	Sewer gas. sludge gas. Also issues from some rock strata.	Oxygen deficiency indicator.
Nitrogen Oxides	NO	Colorless	1.04	60 to 150 ppm cause irritation and coughing.	50	10	— —	Near bottom.	Industrial wastes. Common air pollutant.	NO ₂ detector tube.
	N ₂ O	Colorless, sweet odor.	1.53	Asphyxiant.						
	NO ₂	Reddish-brown. Irritating odor. Deadly poison	1.58	100 ppm dangerous. 200 ppm fatal.						
Oxygen	O ₂	Colorless, odorless, tasteless. Supports combustion.	1.11	Normal air contains 20.8% of O ₂ . Man can tolerate down to 12%. Minimum safe 8 hour exposure, 14 to 16%. Below 10%, dangerous to life. Below 5 to 7% probably fatal.	—	—	— —	Variable at different levels.	Oxygen depletion from poor ventilation and absorption, or chemical consumption of oxygen.	Oxygen deficiency indicator.
Ozone	O ₃	Irritant and poisonous. Strong electrical odor. Strong oxidizer. Colorless. At 1 ppm, strong sulfur-like odor.	1.66	Max. naturally occurring level is 0.04 ppm. 0.05 ppm causes irritation of eyes and nose. 1 to 10 ppm causes headache, nausea; can cause coma. Symptoms similar to radiation damage.	0.08	0.04	— —	Near bottom.	Where ozone is used for disinfection.	Detectable odor at 0.015 ppm.
Sludge Gas	—***	Mostly a simple asphyxiant. May be practically odorless, tasteless.	Variable	Will not support life.	No data. Would vary widely with composition.		5.3 19.3	Near top of structure.	From digestion of sludge.	See components.

Table D-1 Hazardous Gases (Continued)

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Sulfur Dioxide	SO ₂	Colorless, pungent odor. Suffocating, corrosive, poisonous, non-flammable.	2.26	Inflammation of the eyes. 400 to 500 ppm immediately fatal.	50 to 100	10	— —	At bottom, can combine with water to form sulfurous acid.	Industrial waste, combustion, common air pollutant.	Detectable taste and odor at low concentration.
Toluene	C ₅ H ₁₂ to C ₉ H ₂₀	Colorless, benzene-like odor.	3.14	At 200-500 ppm, headache, nausea, bad taste, lassitude.	200	100	1.27 7.0	At bottom.	Solvent.	Combustible gas indicator.
Turpentine	C ₁₀ H ₁₆	Colorless, Characteristic odor.	4.84	Eye irritation. Headache, dizziness, nausea, irritation of the kidneys.	—	100		At bottom.	Solvent, used in paint.	1. Detectable odor at low concentration. 2. Combustible gas indicator.
Xylene	C ₈ H ₁₀	Colorless, flammable	3.66	Narcotic in high concentrations. less toxic than benzene.	—	100	1.1 7.0	At bottom.	Solvent	Combustible gas indicator.

* Percentages shown represent volume of gas in air.

** For concentration over 0.3%.

*** Mostly methane and carbon dioxide with small amounts of hydrogen, nitrogen, hydrogen sulfide, and oxygen; occasionally traces of carbon monoxide.

2160 LaserFlow™ Module

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DECLARATION OF CONFORMITY



Application of Council Directive: 2004/108/EC -The EMC Directive
 2012/19/EC- The WEEE Directive
 2006/95/EC – The Low Voltage Directive

Manufacturer's Name: Teledyne Isco

Manufacturer's Address: 4700 Superior, Lincoln, Nebraska 68504 USA
 Mailing Address: P.O. Box 82531, Lincoln, NE 68501
 Phone: +1 (402) 464-0231
 FAX: +1 (402) 465-3799

Equipment Type/Environment: Laboratory Equipment for Light Industrial/Commercial Environments

Trade Name/Model No: 360 Laser Flow Sensor with 2160 Laser Flow Area Velocity Module and 2191 Battery Module

Year of Issue: 2012

Standards to which Conformity is Declared: EN 61326:2006 EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use
 EN 61010-1 2nd edition Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use
 EN60529 Special Protection offered by the Signature's Enclosure: IP-66

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

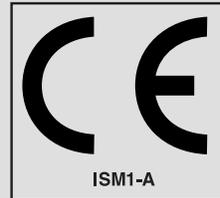
We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of September 21, 2012.

USA Representative

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



Application of Council Directive: 89/336/EEC – The EMC Directive
73/23/EEC – The Low Voltage Directive

Manufacturer's Name: Teledyne Isco, Inc.
Manufacturer's Address: 4700 Superior, Lincoln, Nebraska 68504 USA
Mailing Address: P.O. Box 82531, Lincoln, NE 68501

Equipment Type/Environment: Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No: 2191 Battery Module
Year of Issue: 2001

Standards to which Conformity is Declared: EN 61326-1998 EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use
EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use.

Standard	Description	Severity Applied	Performance Criteria
EN61000-4-2	Electrostatic Discharge	Level 2 - 4kV contact discharge Level 3 - 8kV air discharge	B B
EN61000-4-3	Radiated RF Immunity	80 MHz to 1000MHz 80% AM at 1kHz Level 1 – 10V/m	B
EN61000-4-4	Electrical Fast Transient	Level 1 – 1kV on I/O lines	B
EN61000-4-5	Surge on I/O Lines	1kV common mode, 0.5KV differential mode	B
EN61000-4-6	Conducted RF on I/O lines	150 kHz to 80 MHz, 3V rms, 80% modulated	B
CISPR11/ EN 55011	RF Emissions	Group 1, Class A Industrial, Scientific, and Medical Equipment	

We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of July 1, 2001.

William Foster
USA Representative



William Foster
Director of Engineering
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Lincoln, Nebraska 68504

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60-2002-158
Rev A

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

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

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

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

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

(企业可在此处，根据实际情况对上表中打“X”的技术原因进行进一步说明。)

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

(Manufacturer may give technical reasons to the “X”marks)

环保使用期由经验确定。

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

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

A 为一月，B 为二月，等等。

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

Teledyne Isco One Year Limited Factory Service Warranty*

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

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

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

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

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

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

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

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

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

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

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

Shipping Address: Teledyne Isco - Attention Repair Service
4700 Superior Street
Lincoln, NE 68504 USA

Mailing Address: Teledyne Isco
PO Box 82531
Lincoln, NE 68501 USA

Phone: Repair service: (800) 775-2965 (lab instruments)
(866) 298-6174 (samplers & flow meters)
Sales & General Information: (800) 228-4373 (USA & Canada)

Fax: (402) 465-3001

Email: IscoService@teledyne.com



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