4120 Flow Logger

Installation and Operation Guide





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Foreword

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

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

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

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

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

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

Customer Service				
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Contact Information

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:

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

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

Hazard Severity Levels

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

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.

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

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

4120 Flow Logger

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4120 Flow Logger

Section 1 Introduction

The 4120 Flow Logger is a flow-monitoring instrument that measures the level and flow rate of an open-channel flow stream. The 4120 consists of a portable case to which the Isco Submerged Probe is connected. The probe, equipped with an internal pressure transducer, measures the level of a flow stream. A strap at the top of the case suspends the 4120 from a manhole ladder or other support.

The 4120 depends on an IBM-compatible computer running Flowlink, Isco's flow-data management software, for programming and calibration. To program the 4120, simply connect it to a computer running Flowlink and program the 4120 from the computer's keyboard. You can enter settings for sampler pacing and enable controls and set up the 4120's memory to store level, flow-rate, sampler, and rainfall data. Flowlink also retrieves stored data, transferring it from the 4120's memory to the computer. Stored data can also be downloaded for later viewing using Isco's hand-held 581 Rapid Transfer Device.

Sampler controls – The 4120 paces samplers for flow-paced and trigger-paced sampling. It has a number of sampler-enable controls that start and stop the sampler when the 4120 detects programmed level, flow rate, or rainfall measurements.

Internal memory for data storage – The 4120 stores level, flow-rate, rainfall, and sample-event data in 230 kilobytes of non-volatile, battery-backed RAM (Random Access Memory).

Low power consumption – A fully-charged 12-volt alkaline battery will power a 4120 (programmed to take readings at 15-minute intervals) for approximately 6 months without recharging or replacement. You can expect to obtain a battery life of about 3 months with 947 Lead-Acid Batteries.

A variety of power sources – Power the 4120 with two 6-volt alkaline lantern batteries, an Isco 947 Lead-Acid Battery, the Isco 954 Solar Panel and an Isco 946 Lead-Acid Battery, or an Isco sampler.

Battery protection and battery-life monitoring – The 4120 monitors battery use for all battery types and reports the remaining battery life to Flowlink. A shut-down feature turns off the 4120 before a lead-acid battery discharges completely. This protects the battery as well as the integrity of your data.

1.1 Features

Optional 4200T Modem – A factory-installed option, the 4200T Modem is a full duplex, auto-answer modem with dial-out capabilities and a speech synthesizer. It lets Flowlink program the logger to deliver voice messages to as many as five telephone numbers when it detects user-definable alarm conditions.

The 4200T works with standard voice-grade telephone lines. You must have a touch-tone line to use the its dial-out alarm feature. Additional information about dial-out alarms and the modem is in Flowlink's Help section.

Mote

The modem is disabled when an interrogator cable is connected to the flow logger's interrogator port. It cannot receive incoming calls, and the alarm dialout will be rendered inoperative, while this cable is connected. **Disconnect the interrogator cable in order to use the 4200T modem.**

Flash memory for easy software upgrades – As Isco adds software features to the 4120, upgrade your unit by connecting a computer and downloading the new software. For more information about software upgrades, see Using Flash Update on page 4-13.





1.2 Compatible Isco Equipment

- The 4120 Flow Logger is compatible with:
 - Isco 6700 Series Samplers
 - Isco 3700 Series Samplers
 - Isco 674 Rain Gauge
 - Isco 581 Rapid Transfer Device

	Teledyne Isco provides cables to connect the 4120 Flow Logger to samplers and the 674 Rain Gauge. See Connecting the 4120 to Samplers and Rain Gauges on page 2-15 and Appendix A, Acces- sories List.
1.3 What is in This Manual?	This manual is an installation and maintenance manual for the 4120 Flow Logger and the submerged probe. It contains:
	• A brief description of the 4120's features
	• Installation instructions for the 4120 and for the submerged probe
	Maintenance guidelines
	• Technical specifications for the 4120 and the submerged probe.
	To learn how to program and calibrate the 4120 Flow Logger, see the Flowlink Help section.
1.4 Repairing Your Flow Logger	The 4120 Flow Logger has no user-serviceable parts. If your flow logger requires repair, contact Teledyne Isco's Customer Service department for information on returning it to the factory. Contact information is located in the back of this manual.
1.5 Technical	The following tables contain technical specifications for the Isco

Specifications 4120 Flow Logger and Submerged Probe.

Table 1-1 Technical Specifications for the 4120 Flow Logger	
Dimensions 10.5 x 9.0 x 6.0 inches (26.7 x 22.9 x 15.2 cm)	
Weight	8 lbs (3.6 kg), without batteries
Operating Temperature	0° to 140° F (-18° to 60° C)
Storage Temperature	-40° to 140° F (-40° to 60° C)
Enclosure	Self-certified NEMA 4X, 6
Power	Two 6-volt lantern batteries or one 12-volt Model 947 Flow Logger Lead-Acid Battery
Alkaline Battery Life	6 months with minimum reading intervals of 15 minutes

Table 1-2 Materials Used in the 4120 (see Figure 1-2)		
1	Case and Battery Compartment Door	Polystyrene
2	Connector Panel	Noryl
3	Labels	Polyester (not shown)
4	Carrying Handle	Plastic
5	Handle Latches	Stainless Steel
6	Handle Latch Retainers	Stainless Steel
7	Connector Caps	Acetyl Plastic
8	Suspension Hook (not shown)	Stainless Steel

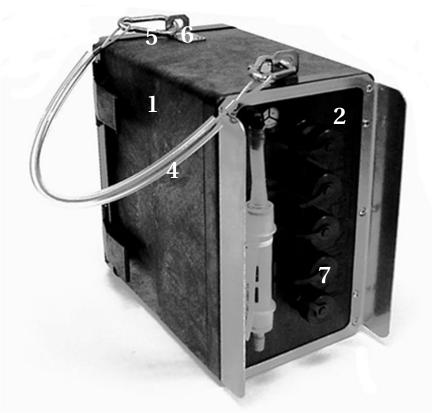


Figure 1-2 Materials Used in the 4120

Table 1-3 Technical Specifications for the Submerged Probe		
Operating Temperature	32° to 160° F (0° to 71° C)	
Storage Temperature	-40° to 160° F (-40° to 71° C)	
Level Measurement Method	Submerged pressure transducer mounted in the flow stream.	
Transducer Type	Differential linear integrated circuit pressure transducer.	
Level Measurement Range	0.1 ft to 10 ft (0.03 m to 3.05 m)	
Maximum Allowable Level	20 ft (6.1 m)	
Level Measurement Accuracy	0.033 to 5.0 ft: ±0.008 ft/ft (0.01 to 1.52 m: ±0.008 m/m) >5.0 ft: ±0.012 ft/ft (>1.52 m: ±0.012 m/m)	
	@ 77° F (25° C). Includes non-linearity, repeatability, and hysteresis, but does not include temperature coefficient.	
Compensated Temperature Range	32° to 100° F (0° to 38° C)	
Temperature Coefficient	0.1 to 4.0 ft: ± 0.005 ft/°F (0.03 to 1.22 m: ± 0.0027 m/°C)	
	4.0 to 10.0 ft: ± 0.007 ft/°F (1.22 to 3.05 m: ± 0.0038 m/°C)	
	Maximum error over compensated temperature range, per degree of temperature change.	

Table 1-3 Technical Specifications for the Submerged Probe (Continued)

Sensor Dimensions	Diameter: 0.875 inches (2.2 cm)
	Length: 5.5 inches (14.0 cm) without nose
	9.5 inches (24.1 cm) with standard nose
	Frontal Area: 0.601 in ² (3.88 cm ²)
Amplifier Box	Watertight enclosure
Cable Length:	25 feet (7.6 m) from sensor to amplifier box
Weight	3 lbs (1.4 kg) Entire probe and cable
Materials	Probe Body: CPVC
	Transducer Diaphragm: Type 316 stainless steel
	Cable: PVC

4120 Flow Logger

Section 2 Installation

2.1 The Basics

Basic installation requires the following:

- 4120 Flow Logger
- The Isco Submerged Probe probe measures depths as great as 10 feet and has a 25-foot cable.
- A power source; see About Power Sources on page 4-6.
- Mounting hardware for the probe (see *Circular Channels*, on page 2-7). You may also need a stud gun to attach the mounting hardware to the wall of the pipe or channel.

You may also need one or more of the following options:

- An Isco Submerged Probe Extension Cable (25 feet);
- A custom-length cable (to 1,000 feet) with an Isco Submerged Probe Quick Disconnect Box for the probe.

Programming and Calibration Require the Following:

- An IBM PC or compatible computer. You can use a desktop or laptop model.
- An Isco 9-pin or 25-pin Computer Connect Cable;
- Isco's Flowlink software.
- 2.1.1 Where Can You Install the 4120? You can install the 4120 Flow Logger in nearly any location. A removable strap at the top of the 4120 case suspends the unit from a manhole ladder or other support. You can install the Submerged Probe in:
 - Round pipes
 - U-channel pipes
 - Rectangular and trapezoidal channels
 - Open-channel weirs and flumes; Any channel or device with a known level-to-flow relationship.

🗹 Note

The Submerged Probe is unsuitable for flow streams with depths less than 0.875 inch (2.22 cm).

The 4120 Flow Logger has not been approved for use in hazardous locations as defined by the National Electrical Code.

Before installing any device in a dangerous location, review safety precautions. (See General Safety Procedures on page D-1.) Check applicable guidelines, codes, and regulations of federal, state, city, and county agencies.

2.1.2 Installation Checklist

Before installing the 4120:

- 1. Check the condition of the desiccators. (Refer to page 4-2 for more information.)
- 2. Install a fresh battery. You can use:
- Two 6-volt alkaline lantern batteries. Lantern batteries are available from Teledyne Isco or local hardware stores.

🗹 Note

Use only alkaline lantern batteries; non-alkaline batteries cannot produce sufficient power under load.

- Isco 947 Lead-Acid Battery. This battery, built especially for the flow logger, is available only from Teledyne Isco.
- Isco 946 Lead-Acid Battery recharged on-site with an Isco 954 Solar Panel.
- Power from an Isco sampler. The 4120 obtains power from the sampler through the cable connecting the 4120 to the sampler.
- A 12-volt DC marine battery can also be used as a power source for the 4120. These batteries require adapter cables and must be mounted outside the 4120's case.

Do not use external power sources that produce more than 13 volts. Excessive voltage will blow the internal fuses, and may cause more serious damage.

- 3. Connect a computer to the 4120 and use Flowlink to:
 - a. Check the remaining battery life
 - b. Set up the pacing and sampler-enable controls
 - c. Enter the flow conversion for the site
 - d. Set up the 4120's memory

2.1.3 At the Installation Site	Be sure you have the correct mounting hardware, including the probe carrier that mounts the probe on an Isco mounting ring.
	Although your initial order will include mounting hardware, you may need additional mounting rings if you move the 4120 from site to site. You may also need a stud gun to attach the ring to the wall of the pipe or channel.
	Physical Installation:
	1. Install the probe upstream from the outflow of the pipe or invert. If you install the probe in a weir or flume, the probe's location varies with the device. Consult the device manufacturer for more information.
	2. Use the strap and hook to suspend the 4120 from a man- hole ladder or other support.
	 Connect the probe's cable to the 4120. With the standard cable, the 4120 must be within 25 feet of the probe. Two extension cables, in 25-foot or 50-foot lengths, are available should you need to locate the 4120 more than 25 feet from the probe. The combined length of the probe's cable and the extension cable should not exceed 75 feet.
	4. Connect a rain gauge or a sampler, if desired.
	5. Connect a laptop computer to the 4120 and calibrate the probe.
2.2 Submerged Probe Operation	The submerged probe consists of a cylindrical body, and a 25-foot (7.6-meter) cable. The probe itself has a removable nose section attached to the rear of body. The rear section contains a differential pressure transducer that senses the hydrostatic pressure produced by the liquid above the probe. The transducer converts pressure to analog signals and sends the signals to the 4120 through an amplifier box approximately 24 feet (7.3 meters) from the probe.
	Because pressure is proportional to the level of the stream, the 4120 can convert the analog signals to level readings. The level readings, in turn, are converted to flow rates with level-to-flow-rate conversion formulas or tables characteristic of the primary device at the site.
2.2.1 How Does the Pressure Transducer Work?	The internal differential pressure transducer detects pressure with a small stainless steel diaphragm that transfers pressure to a small piezo-resistive disk. The outer face of the diaphragm is exposed to the flow stream through the ports around the outside of the probe. The inner face is exposed, or referenced, to the atmosphere through the internal vent tube that runs the full length of the probe's cable.
	The outer face is subjected to the pressure exerted by both the liquid and the atmosphere while the inner face of the diaphragm is subjected only to atmospheric pressure. The difference between the pressures exerted on the diaphragm is the hydrostatic pressure.

The 4120 compares the hydrostatic pressure to atmospheric 2.2.2 Proper Installation **Produces Reliable** pressure. If the vent tube becomes blocked — because the cable is Readings. kinked or the tube fills with condensed water — the transducer is no longer exposed to atmospheric pressure and the pressure readings become unreliable. Proper installation prevents the cable from kinking. A desiccant on the vent line helps prevent moisture from accumulating within the tube and blocking it. The flow logger connector contains a port to accept the vent tube at the end of the probe cable. A tube on the inside of the 4120 continues the vent to the desiccant tube on the 4120's exterior. The following sections describe installation of the submerged probe. The first section presents general mounting considerations common to all submerged probe mounting techniques. The following sections describe probe installation using the two systems available for mounting the submerged probe in pipes or round-bottomed flow streams. For pipes up to 15 inches (38.1 cm) in diameter, spring stainless steel self-expanding mounting rings are available. For pipes larger than 15 inches in diameter, Teledyne Isco offers the Scissors Ring. For use in similarly-sized manhole inverts, you can use the base and extension sections of the Scissors Ring without the scissors section. The straps are held in place by studs installed in the wall of the flow stream using a power-activated stud gun. Submerged probes are also installed in primary measuring devices. **2.3 General Mounting** The location of the probe in the stream is usually dependent on Considerations the flow rate conversion used. For example, if you are using the probe with a primary measuring device (a weir or flume), there is a *specific location* for the probe with each primary device. The Isco Open Channel Flow Measurement Handbook provides much useful information in this regard. If you want to measure flow using a gravity flow equation, such as the Manning equation, you will generally install the probe in the entrance (upstream) pipe of a manhole. If you want to measure flow by calibrating a manhole invert, you would probably locate the probe directly in the manhole invert. In any case, you must determine the appropriate location of the probe, based on the hydraulic characteristics of the site and the method of level-to-flow rate conversion used. You do not have to install the submerged probe at the bottom of the flow stream. Although the bottom is the normal position, the Parameter to Adjust step in the program allows you to mount the probe at any vertical location in the stream, and then adjust the indicated level to match the actual level. (The flow meter can indicate negative levels.) A location other than the bottom of the flow stream may be useful for various reasons: to avoid heavy concentrations of silt, The probe has several ports through which liquid enters the body to contact the pressure transducer. The only way for the probe to malfunction is for all the ports to be completely blocked. Most substances likely to cover the probe are somewhat porous, which still allows the hydrostatic pressure of the flow stream over the probe to reach the transducer.

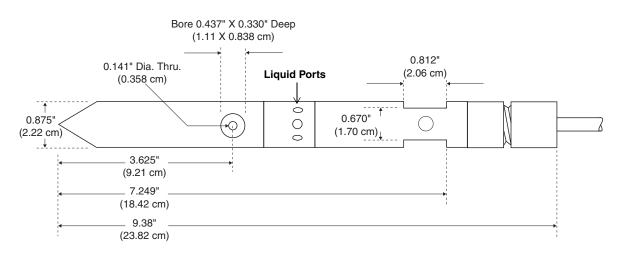


Figure 2-1 Submerged Probe Dimensions

2.3.1 Functionality Under Solids

2.3.2 Minimum Reliable

Detection Level

Consequently, the probe will normally continue to function even when covered with several inches of silt or sand. Note however, that porous solids, such as wood chips or other organic material that may swell considerably when soaked in water, can interfere with the correct operation of the pressure transducer. In extreme cases, swelling material can put enough pressure on the diaphragm of the pressure transducer to deform it. This will ruin the submerged probe by introducing a permanent offset to the pressure transducer.

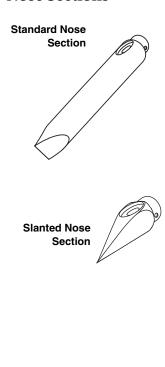
Note

Always install the probe where it will be under water, even if only an inch or so. The probe cannot measure levels that fall below its location in the stream.

It is important to note that there is a practical minimum water level below which the submerged probe cannot reliably measure level. This minimum level is approximately equal to the height of the probe body, 0.1 ft. (1.3 in. or 0.030 m).

Liquid levels lower than this will be below the levels used to calibrate the sensor. The submerged probe level sensor will continue to measure levels less than 0.1 ft.; however, the accuracy of the measurement in this range is not guaranteed. Consequently, you should always use the submerged probe with caution in very low flow situations.

2.4 Submerged Probe Nose Sections



Flume Cap

2.4.1 Attaching the Nose Section

Teledyne Isco provides three nose sections, each designed for specific flow stream conditions.

A complete list of nose sections and their part numbers can be found in Appendix B.

Standard Nose Section – The standard nose section works in any flow stream and will be installed on your probe unless otherwise specified in your order. It is particularly well suited for flow streams with high velocities because its shape overcomes hydraulic problems that develop in these flow streams. At velocities exceeding 5 feet per second (1.5 meters per second), localized low-pressure areas form near the submerged probe, which can result in erroneous level readings. The length of the nose section (3.87 inches or 9.84 cm) minimizes low-pressure areas by allowing the flow stream to stabilize before it reaches the probe's entrance ports.

Slanted Nose Section – Under certain conditions - low flow rates in debris-laden small sewers, for example - the submerged probe may catch and retain the debris, obstructing the flow stream and causing erroneous level readings. To avoid this problem, use the slanted nose section. This nose section has a slanted leading edge that tends to shed debris more readily than the standard nose section.

Use the slanted nose section with caution, however, Under conditions of low flow and high velocity, the slanted nose section may induce a hydraulic "jump" in the flow stream that can cause erroneous level readings.

Flume Cap – The flume cap is a small, blunt cap that replaces the nose section. Most flume manufacturers can supply flumes with a small cavity to accept an Isco probe. The probe cap protects the transducer while minimizing the total length.

After cleaning, reinstall the nose section and tighten the screws. The mounting hole must be aligned with the grounding point.



Figure 2-2 Alignment of Grounding Point

2.5 Circular Channels Consult your Isco Mounting Rings Installation and Operation Guide for detailed hardware information.

The following sections describe sensor installation using the two options available for mounting sensors in pipes or round-bottomed flow streams. For pipes up to 15" (38.1 cm) in diameter, **stainless steel self-expanding mounting rings** (**Spring Rings**) are available. For pipes larger than 15" in diameter, Teledyne Isco offers the **Scissors Rings** (**Universal Mounting Rings**).

2.5.1 Spring Rings To install a spring ring, you compress the ring, slip it inside the pipe, and then allow it to spring out to contact the inside diameter of the pipe. The inherent outward spring force of the ring firmly secures it in place. A typical self-expanding mounting ring (with a probe mounted on it) is shown in Figure 2-3.

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

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

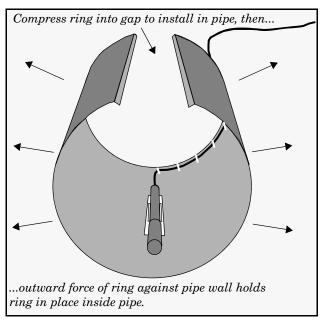


Figure 2-3 Sensor Installed on a Spring Ring

Attaching the Sensor to the Ring

Attach the probe to the ring either by using two 4-40 x $^{3}/_{16}$ " countersink screws or by snapping the optional probe carrier to the ring. This second method of attaching the sensor allows for easy removal in case service is needed later.

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

To complete the sensor-spring ring assembly procedure, attach the sensor cable to the downstream edge of the ring. Follow the cable routing shown in Figure 2-3. Other routing directions may affect measurement accuracy. The cable can actually create a stilling well downstream from the sensor, causing the level to read low. Use the self-locking plastic ties supplied with the ring. Install the ring in the pipe by compressing it. Press inward on both sides and slide the ring into the pipe.

Route the sensor cable out of the stream and secure it in position by placing the ties through the holes in the mounting ring and then locking them around the cable, as shown. To prevent debris from catching on the cable, it is important to attach the cable to the mounting ring so it offers as little resistance to the flow as possible.

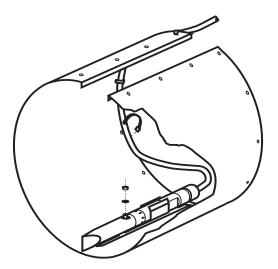


Figure 2-4 Spring Ring Preparation

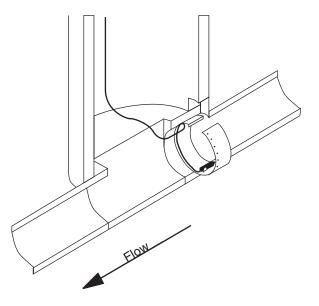


Figure 2-5 Mounting Ring in a Round Pipe

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

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

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

This problem is more prevalent in the larger diameter pipes (10", 12", and 15", and in pipes with smooth inside surfaces, such as plastic pipes). If any of these conditions are present, or if movement of the mounting ring is detected or suspected, you must anchor the ring in place. You can do this by setting screws through the ring into the pipe, or by other appropriate means. If there is a problem with the smaller diameter rings, it may be sufficient to simply increase the outward spring force of the ring by bending it into a less round configuration.

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

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

Each extension, 1, 2, 3, and 4, adds 9.0", 21.5", 31.5", or 41.5", respectively, to the circumference of the ring. Used alone, the base section fits pipe that is approximately 16" to 18" in diameter. The 9.0" (the smallest) extension exists so that in larger pipe sizes, where large variations in circumference can occur, you can use one or two of these extensions to take up or remove slack, to bring the scissors mechanism into a position where it can be effectively tightened.

Mounting ring kits are available for different pipe sizes. A kit is also available for partial pipe applications (see your *Isco Mounting Rings Installation and Operation Guide*). For a listing of part numbers and ordering information, see Appendix B.

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

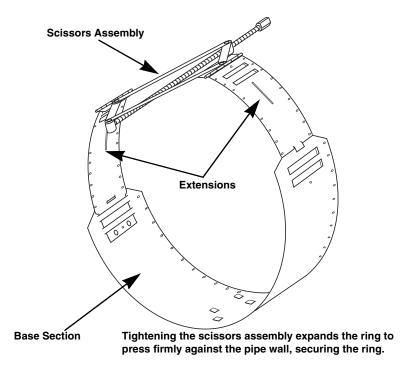


Figure 2-6 Universal Mounting Ring Adjustment

2.6 Other Mounting Techniques

2.6.1 Rectangular and Trapezoidal Channels Many installations require mounting methods other than mounting rings. Some alternative mounting methods are described below. Contact Teledyne Isco for assistance in determining your specific installation needs.

A flat, anchored mounting plate is a common mounting choice for installing sensors in rectangular or trapezoidal channels. You can also install the probe in rectangular channels by bending a mounting ring to fit the channel. Attach the ring to the channel wall with studs. Consult your *Isco Mounting Rings Installation and Operation Guide* for more information.

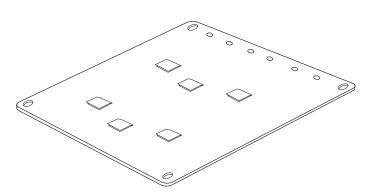


Figure 2-7 Isco Rectangular Mounting Plate

2.6.2	Stilling Wells or Streams with Very Low Velocity	In flow streams with a minimal flow velocity or in a stilling well, simply attach the probe to a weighted plate and submerge the plate in the stream or stilling well.
2.6.3	Securing Probe with a Weighted Plate	In situations with a minimal flow velocity (for example, in a stilling well), you can simply attach the probe to a weighted plate and submerge it in the flow.
2.6.4	Weirs and Flumes	The 4120 Flow Logger is generally used with some type of primary measuring device, such as a weir or flume. The placement of the submerged probe in the primary device is deter- mined by the type of primary device. You can use one of Isco's mounting rings to install the probe in many weirs and flumes. If the mounting ring are not suitable, you must build your own mounting hardware. Figure 2-1 shows the dimensions of the probe for your reference when building your own hardware. Figure 2-8 shows the probe installed in several primary devices. Certain flume manufacturers produce flumes with built-in cav- ities for Isco's submerged probe. Contact the flume manufacturer for details on the special flumes.

🗹 Note

Always install the submerged probe pointing toward normal flow at the head-measuring point of the device. The location of the measuring point varies with each device. Refer to Table 2-1 and to the *Isco Open Channel Flow Measurement Handbook*.

Table 2-1 Locating the Head-Measuring Point	
Device	Head-Measuring Point
Weirs	Upstream from the weir plate by at least 3 times the maximum head.
Parshall Flumes	¹ /3 of the way into the converging section.
Palmer-Bowlus Flumes	Upstream from the flume entrance by half the pipe diameter.

🗹 Note

When installing the probe with custom hardware, remember to attach the probe securely to the side or bottom of the flow stream and tie the cable down so that it does not collect debris.

For many primary measuring device installations, the submerged probe mounting rings or base sections discussed previously may be used to mount the probe at the appropriate location. In many installations, though, the mounting rings or bases may not be suitable.

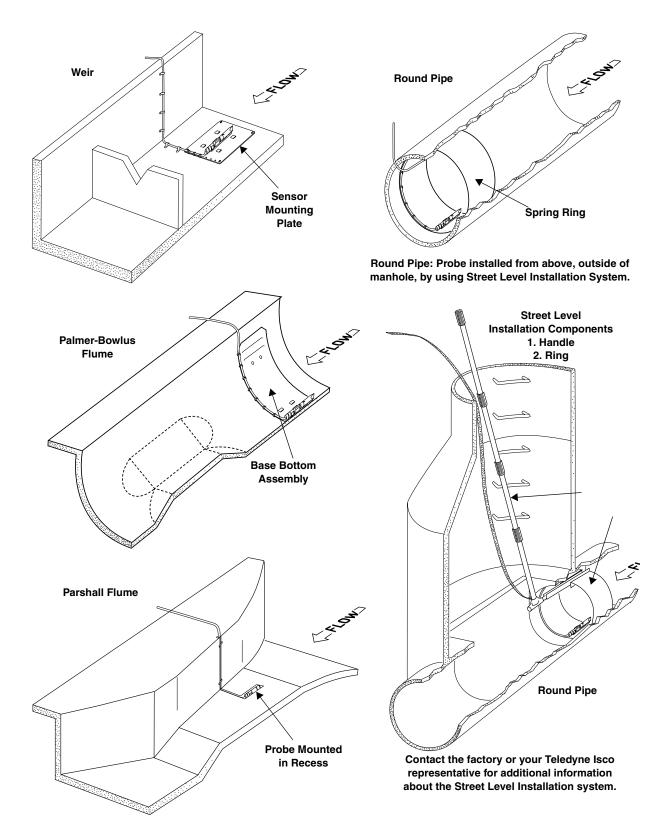


Figure 2-8 Typical Primary Device Installations

Mounting hardware may have to be fabricated locally to allow the level sensor to be mounted at the correct location in the primary device. The only requirements for custom mounting hardware are:

- The probe must be securely attached to the side or bottom of the flow stream.
- The cable must be tied down and led out of the flow stream in an orderly manner.
- The hardware be made from corrosion-resistant materials.

It should be noted that the mounting rings may be used to install the probe in rectangular channels by simply putting right angle bends in them at the appropriate locations. It should be noted that certain flume manufacturers produce flumes with built-in cavities designed specifically for use with Isco submerged probe level sensors. Typically, these are Parshall or Palmer-Bowlus flumes. Contact the manufacturer for details on these flumes.

the Probe The submerged probe installation is finished by coiling any excess sensor cable and securing it using cable clamps or other means. The reference tube inside the cable can be restricted or blocked if the cable is kinked, sharply bent, or otherwise pinched. The probe cable should be handled and mounted with care. Also, if there is any appreciable distance between the point where the probe cable leaves the mounting apparatus and the location of the flow meter, be sure to attach the cable to the flow stream wall to prevent it from vibrating, moving around, tangling, or possibly collecting debris.

Under no circumstances should you leave any extra length of sensor cable dangling freely in the flow stream where it could trap debris or become tangled.

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

Observe general safety procedures when entering any manhole. See "General Safety Procedures" in the back of the manual for more information on general hazards and necessary precautions.

2.7 Completing the Probe Installation

2.8 Connecting the 4120 to Samplers, Rain Gauges, and the RTD

The 4120 Flow Logger is compatible with the Isco 3700 and 6700 Series, 4700, and Avalanche samplers, the Isco Model 674 Rain Gauge, and the Isco 581 Rapid Transfer Device.

A number of cables are available to connect the 4120 to samplers and rain gauges. To connect the sampler to the 4120, attach the cable to the sampler's flow meter connector and the 4120's sampler connector. To select the right cable, refer to the diagram in Figure 2-16.

The 674 rain gauge comes with its own cable, attached to the base. Isco provides a cable to connect non-Isco rain gauges to 4100 Series flow loggers. See the Accessories List in Appendix A.

The Isco 581 RTD requires no cable. It plugs directly into the 4120's Interrogator port and automatically downloads all stored data. While the data is being downloaded, the RTD's green LED will flash steadily. It will stop flashing and remain constant when the download is complete. To save power, be sure to remove the RTD from the 4120 when the download is finished.

Later, the RTD can be connected to your PC for data transfer through the RTD's power cable.

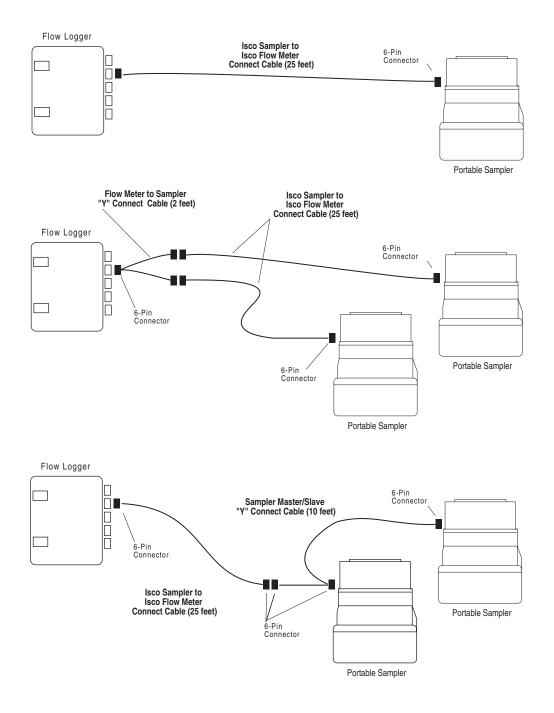


Figure 2-9 Connecting Samplers to the 4120

2.9 Qu	ick Disconnect Box	Use the Quick Disconnect Box when you need to mount the 4120 more than 75 feet from the sensor. You can mount the Quick Dis- connect Box as far as 1,000 feet (262 meters) from the 4120, but no more than 75 feet (20 meters) from the sensor's flow-stream installation. You can combine the sensor with the extension cables and Quick Disconnect Box as shown in Figure 2-10. Use the disconnect box when you need to vent the sensor at
		 another location than the 4120. For example, consider the following situation. Although the primary device is in a manhole, the most convenient location for the 4120 is a nearby building. However, the building's air-handling system produces fluctuations in the air pressure. If the sensor is connected directly to the 4120 and therefore vented through the 4120, the fluctuating air pressure will distort the level and flow readings. Instead of using the 4120 to vent the sensor, mount the Quick Disconnect Box outside the building or in the manhole and vent the sensor through the box.
2.9.1	Connecting the Quick Disconnect Box to the 4120	The Quick Disconnect Box consists of a sealed Noryl [®] enclosure (NEMA 4x, 6) with a removable lid and a mounting bracket. The Quick Disconnect Box has a male 9-pin connector for attaching the sensor cable on one end of the box and a ¹ /2-inch (1.3-centi- meter) NPT hole on the opposite side for custom-length cable. Connect the Quick Disconnect Box to the 4120 with a custom-length cable that Teledyne Isco cuts to order for each cus- tomer. The cable can be as long as 1,000 feet and is supplied with a connector. This connector attaches the cable to the 4120's sensor connector. The wires at the opposite end of the cable connect to the ter- minals inside the Quick Disconnect Box. If you use cable without conduit, use a cord-grip fitting to seal the box. Cord-grip fittings are available from Teledyne Isco. You can use these fittings with cable or with flexible conduit. See the Accessories List in Appendix A to select the right fitting for your cable. If you use rigid conduit, be sure to seal the box with a sealed, ¹ /2-inch conduit connector.
2.9.2	Mounting the Quick Disconnect Box	 Locate the Quick Disconnect Box so that the sensor cable and its interior vent tube are not kinked or bent when con- nected to the box. Mount the Quick Disconnect Box on a solid surface. The box has a mounting bracket with two keyholes on 3-inch (7.7-centimeter) centers. Remove the top of the box. Figure 2-12 shows you how to assemble the cord-grip fit- ting. Thread the cable through the fitting until there is enough lead wire to connect the cable to the barrier block noted in Figure 2-11. If you use conduit, thread the lead wires through the conduit before threading it through a compres-

sion fitting attached to the disconnect box. Be sure to seal the conduit and connector.

- 5. Attach the lead wires as shown in Figure 2-11.
- 6. Replace the top of the box.
- 7. Connect the sensor cable (or extension cable) to the box.

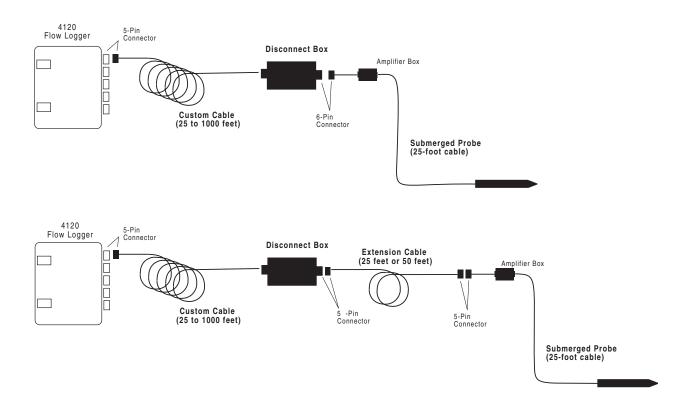


Figure 2-10 Cable Connections and the Quick Disconnect Box

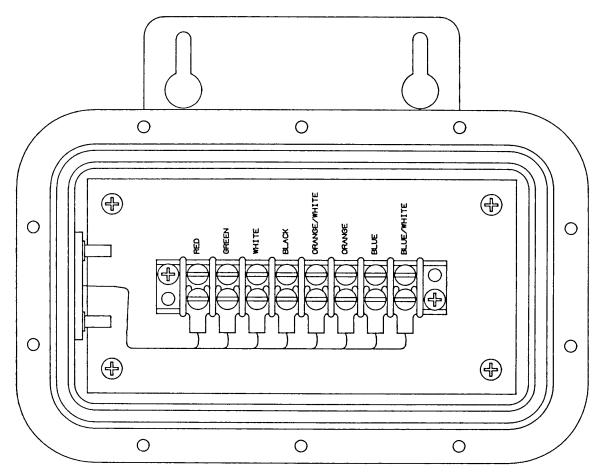


Figure 2-11 Connecting the Custom-Cable Leads to the Disconnect-Box Barrier Block

COLOR	BLOCK POSITION
Red	1
Green	2
White	3
Shield	4
Black	5

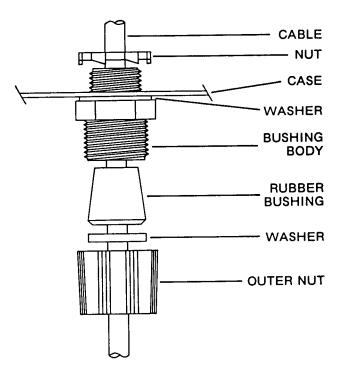


Figure 2-12 Cord-Grip Fitting

Section 3 Programming the 4120

3.1 About the 4120's	To program the 4120, connect the 4120 to a computer and enter the 4120's program with Flowlink. Flowlink provides all pro- gramming instructions for the flow logger. For a summary of Flowlink's functions refer to Table 3-1. More information about programming the flow loggers is in Flowlink's Help section. The 4120's memory contains 230 KB of nonvolatile,
Memory	battery-backed RAM (Random Access Memory) which Flowlink divides into storage areas called partitions. Although the amount of data stored in each partition varies according to the type of data and the partition size, a 230 KB divided into three, equally sized partitions stores:
	 More than 400 days of level, flow-rate, or rainfall data at 15-minute intervals;
	• 5,000 sample-event readings.
3.2 Sampler Enabling and Sampler Pacing	The 4120 offers two types of sampler control: sampler enable and sampler pacing. A 4120 programmed to enable or disable a sampler compares level, flow, time, or rainfall measurements to a set point, usually the reading measurement at which the 4120 is to enable or disable the sampler. Thus, a set point can be:
	• At a specific time and date
	• When the flow stream's level or flow rate passes a set point (for example, a level measurement of 0.3 foot)
	• When the amount of rainfall exceeds a set point (1 inch of rain collected in 30 minutes)
	Although you can program the 4120 to enable the sampler on a single data type's set point, you can also combine most data types with three logical operators: AND, OR, and NOT. Refer to Table 3-2. Using the operators, a flow logger can enable a sampler when reading two set points (level AND rainfall) or either set point (level OR rainfall).
	The second type of sampler control, sampler pacing, determines how often the sampler will take a sample. The flow logger offers both flow-pacing and trigger-pacing.
	To learn more about flow logger memory, sampler enabling, and sampler pacing, refer to Flowlink's Help section.

Table 3-1 Flowlink Tasks		
Programming Instructions	Data Management	
Sampler pacing	Battery life	Data retrieval
 Sampler enable controls Memory setup: number of partitions type of data interval between readings 	 Flow-stream status: totalized flow current level flow rate Sampler enabled or disabled 	 Reports Graphs Data editing Import/export data
Level calibrationLevel-to-flow conversion	Memory status4120 clock4120 software version	in ASCII format

Table 3-2 Sampler-Enable Data Types and Logical Operators		
Data Type or Condition	Data Type or Condition Set Point	
Always ON	None (The Flow Logger will use this condition unless you specify otherwise.)	No
Always OFF	None	No
Level	Level reading	Yes
Flow	Flow rate	Yes
Time	Start time	Yes
Rainfall	Total rainfall measured in a specific period	Yes

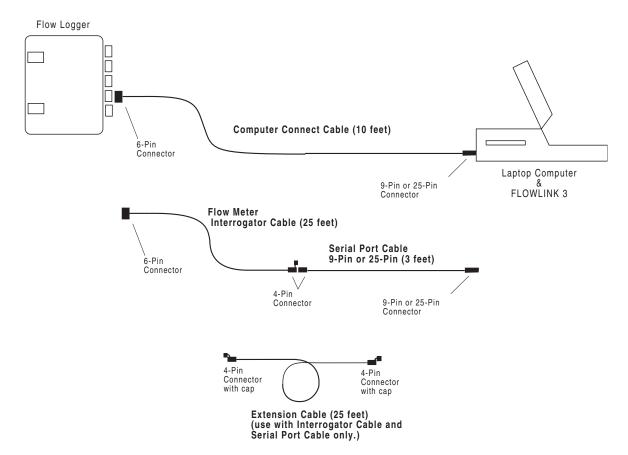


Figure 3-1 Connecting the 4120 for Programming

Section 4 Maintenance

To keep the 4120 in operating condition, observe the following:

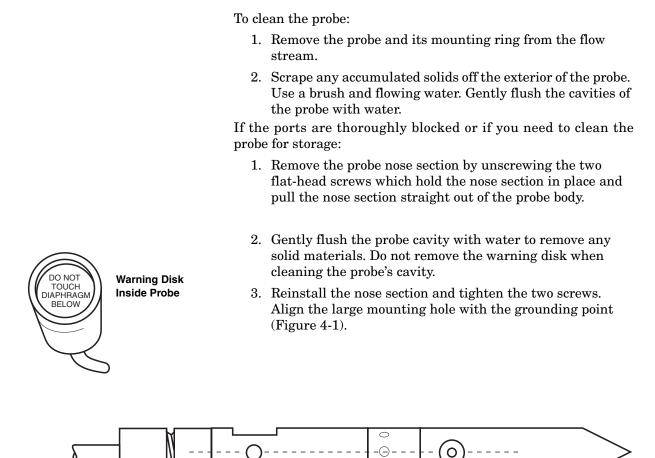
- Keep all unused connectors capped. This prevents moisture and the chemicals found in harsh environments from damaging the pins in the connectors.
- Clean the flow logger and the submerged probe regularly.
- Check the condition of the desiccant regularly, and regenerate the desiccant when necessary. (See Recharging and Replacing the Desiccant on page 4-2.)
- Inspect the paper humidity indicator. If it is pink in color, return the unit to Teledyne Isco. There may be a problem with the case.
- Replace or recharge the batteries as required. (See About Power Sources on page 4-6. For information on recharging Isco batteries, refer to the Isco Power Products Guide.)

The Submerged Probe requires occasional cleaning. (The amplifier box requires no maintenance.) Because the probe body offers a streamlined profile to the flow, solid materials rarely collect on the probe. However, remove debris from the flow stream near the probe periodically to maintain the hydrostatic conditions on which the level-to-flow rate conversion is based.

The probe functions even when covered with silt, sand, or other solid materials. Occasionally, however, organic materials such as saw dust, wood chips, or snails may become jammed inside the probe. This material expands and exerts pressure on the diaphragm. This can damage the diaphragm, permanently disabling the probe. If all liquid ports in the probe become blocked, or if the diaphragm cavity is packed with material, clean the probe. This not only protects the probe from damage, but ensures that the probe responds to the hydrostatic pressure above the probe instead of the pressure created by the swollen material inside the probe.

The stainless-steel diaphragm on the face of the probe's pressure transducer is extremely vulnerable to pressure. Damage to the diaphragm permanently disables the probe. A small warning disk in front of the transducer protects the diaphragm. DO NOT remove the disk.

4.1 Cleaning the Submerged Probe



Grounding Point Mounting Hole (Countersunk Side)

Figure 4-1 Grounding Point on Submerged Probe

4.2 Recharging and Replacing the Desiccant	Because it is frequently installed in humid environments, the 4120 Flow Logger uses desiccators to prevent moisture damage to its components. A desiccant bag protects the electronics compartment. A desiccant cartridge is located inside the battery compartment. A desiccant tube on the exterior of the case dries the probe's vent tube to prevent condensed moisture from blocking the tube.
4.2.1 Recharging the Desiccant Bag	A paper humidity indicator on the side of the case, labeled "INTERNAL CASE HUMIDITY," shows the relative humidity in the compartment. The desiccant should be recharged when the area marked "30" turns pink.

🗹 Note

Teledyne Isco does not recommend recharging the desiccant bag yourself because you must open the case, breaking the NEMA 6 seal that prevents moisture and corrosive atmospheres from destroying the circuitry. Instead, if you think the desiccant bag requires recharging, contact Customer Service for assistance. Excessive humidity in the case may indicate that the case or case seal requires repair.

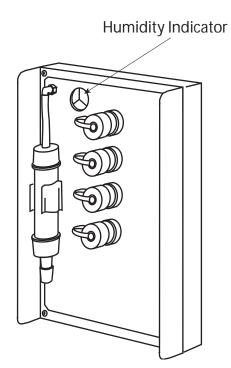


Figure 4-2 Location of Humidity Indicator Window

🗹 Note

Anhydrous calcium sulfate and silica gel are both regenerated with heat but require different temperatures. Calcium sulfate requires temperatures of 400° to 450° F; silica gel requires temperatures of 212° to 350° F.

Desiccant may produce irritating fumes when heated. (Material Safety Data Sheets for both chemicals are in Appendix C.) Leave the room while heating the desiccant. Important Guidelines to Follow:

- Always use a vented, circulating forced air, convection oven in a well-ventilated room.
- DO NOT use a microwave oven to recharge the desiccant cartridge. Heating the metal cartridge case in a microwave oven will damage the oven.
- Use the recommended temperature. Avoid heating the desiccant at higher than recommended temperatures.
- Avoid heating the desiccant longer than necessary.

4.2.2 When to Recharge the Desiccant Cartridge The metal desiccant cartridge, located in the battery compartment, has an inspection window that shows the silica gel desiccant inside. The desiccant is blue or yellow when dry. Recharge the desiccant cartridge when the particles turn pink or green.

> The desiccant cartridge requires periodic recharging to dry it after it becomes saturated with moisture. After repeated recharging, it eventually requires replacement. Table 4-1 shows you how to recharge the desiccant cartridge and when to replace it.

4.2.3 When to Recharge the Desiccant in the Tubes Both the 4120 Flow Logger and the Quick Disconnect Box dry the probe's vent tube with a desiccant tube. Inspect the desiccant tube frequently. Constantly exposed to humid air, the desiccant will become saturated quickly. If the desiccant is unable to dry the vent tube and the tube becomes blocked with moisture, the level readings will be unreliable. Prolonged interior moisture can permanently damage the 4120 and the probe.

Two types of desiccant may be used in the tubes: anhydrous calcium sulfate $(CaSO_4)$ and silica gel (SiO_2) .

Calcium sulfate looks like rough chips of tinted plaster and changes from blue when dry to rose-red when saturated. Regenerate the calcium sulfate desiccant before all the desiccant in the tube turns rose-red.

Isco uses two types of silica gel:

- One chemical looks like small beads or pellets, blue-black when dry, but pale pink to transparent when saturated.
- The other chemical looks like coarse sand, yellow when dry, dark green when saturated.

Regenerate silica gel before all the desiccant in the tube turns pink or green.

The desiccant in the tube requires periodic recharging to dry it after it becomes saturated with moisture. After repeated recharging, it eventually requires replacement. Table 4-1 shows you how to recharge the desiccant in the tube and when to replace it.

Do not put the plastic tube in the oven. It will melt.

	Table 4-1 How to Recharge Desiccators	
	Desiccant Cartridge	Desiccant Tube
Location of desiccant		
How to remove desiccator	Open compartment door and slide car- tridge from slot	Snap the desiccant tube from mounting clip and disconnect it.
When to recharge	Desiccant behind inspection window turns PINK or GREEN.	Anhydrous Calcium Sulfate: Before all desiccant in the tube turns ROSE-RED. Silica Gel: Before all desiccant in the tube turns PINK or GREEN
How to recharge	Heat cartridge in a vented, circulating forced air, convection oven in a well-ven-tilated room.	Pour desiccant particles into shallow pan. Heat particles in a vented, circulating forced air, convection oven in a well-venti- lated room.
Oven temperature	300° F (150° C)	Anhydrous Calcium Sulfate: 400° - 450° F (204° - 232° C) Silica Gel: 300° F (150° C)
How long to heat	3 hours	Anhydrous Calcium Sulfate: 1 to 2 hours Silica Gel: 3 hours
When desiccant is recharged	Desiccant behind the inspection window turns BLUE or YELLOW	Desiccant particles turn BLUE or YELLOW
When to replace	The desiccant particles no longer turn blue when recharged.	The desiccant particles no longer turn blue or yellow when recharged.

The filters in the ends of the desiccant tube prevent desiccant particles from entering the vent line. When they become soiled, wash with dish soap and water, then allow them to dry.

4.3 About Power Sources	 The 4120 Flow Logger requires a 12-volt DC power source. A number of power sources, two shown in Figure 4-3 and Figure 4-4, are available: Two 6-volt lantern batteries. Use only alkaline lantern batteries or the flow logger will not work correctly. Lantern batteries are available from Teledyne Isco or local hardware stores.
	Note When discarding disposable alkaline batteries or any type of recyclable batteries, please dispose of them safely, observing all local environmental regulations.
	• Isco Model 947 Lead-Acid Battery. This battery, built especially for the flow logger, is available only from Teledyne Isco.
	• Isco Model 946 Lead-Acid Battery recharged on-site with an Isco Model 954 Solar Panel. The battery mounts on the solar panel; it does not fit in the 4120's battery compartment. (See Figure 4-6 and Figure 4-7.)
	• Power from an Isco sampler. The 4120 obtains power form the sampler through the cable connecting the 4120 and the sampler.
	A 12-volt DC marine battery can also be used as a power source for the 4120. These batteries require adaptor cables and must be mounted outside the 4120's case.
	The 4120's battery compartment has a 3-pin connector for the Isco Model 947 Lead-Acid Battery. Install it as shown in Figure 4-3. The three brass contact plates on the back of the com- partment fit the positive and negative contacts of alkaline bat- teries regardless of the batteries' orientation.
	A silicon band seals the battery compartment door when the door is securely latched. Seals around the battery connectors prevent moisture from entering the electronics compartment through the connectors. a desiccant cartridge keeps the battery connectors and contact plates dry when you latch the compartment door.
4.3.1 Battery Protection and Battery Life	Lead-Acid Batteries – Lead-acid batteries can be severely damaged or destroyed if completely discharged. The 4120 pro- tects the battery (and itself) by monitoring the voltage level of the battery. It shuts down when the voltage declines to low levels. This protects not only the battery and the 4120, but, because readings can become unreliable at low voltages, it also preserves the integrity of your data. The 4120 monitors the battery capacity and reports the remaining battery life via Flowlink.

🗹 Note

For information about charging Isco batteries, refer to the *Isco Power Products Guide*.

The 4120 will not lose any data if it shuts down. Readings stored in RAM are protected by a lithium battery that provides power to the RAM when the 4120 is without power; for example, when the 4120 shuts down or when you replace the battery. The lithium battery also maintains the 4120's clock so that you do not have to reset it after battery changes.



Figure 4-3 Installing the Model 947 Lead-Acid Battery

Alkaline Batteries – Place an alkaline battery at each end of the battery compartment, so that the springs contact the brass contact plates at the bottom of the compartment. To complete the circuit, the plates extend form one end of the compartment to the other. A short section of nonconductive tape insulates the plates at the center of the compartment, preventing the batteries form touching the wrong contact plate and creating a short circuit.

If the insulating tape becomes damaged, have it replaced immediately A short circuit in the compartment can severely damage the flow logger's case.



Figure 4-4 Installing Alkaline Batteries

4.3.2 Low Power Consumption

The 4120 Flow Logger consumes very little power. Although the actual power consumed by a flow logger depends on many variables, one is most significant: the frequency of readings.

The frequency of readings determines power consumption because the 4120 shuts down between readings. If you have programmed the flow logger to take frequent readings - at intervals of 5 minutes, for example - you can expect the flow logger to consume about six times more power than a flow logger programmed to take readings every 30 minutes.

Under most conditions, two fully charged, 6-volt alkaline batteries will power the 4120 for as long as 6 months without recharging or replacement when readings are taken at 15-minute intervals. the Model 947 Lead-Acid Battery has about one third that capacity. You can also power the 4120 for longer periods with a lead-acid battery that is recharged daily by a solar panel. Even though you can expect a battery life of 6 months, you should check the remaining battery life regularly. The flow logger reports battery use when connected to a computer running Flowlink. You can use this information to prevent lost readings by scheduling a battery replacement before the current battery becomes completely drained.

Fisco Flowlink 4.14 for Windows - 4120 Flow Logger <u>File Item Actions Database View Utilities Window Help</u>		
	2	
at 120 Flow Logger		
Site: 4120 Flow Logger	Model: 4120	Connected
Basic Info Measurements Site Setup Data Storage Flow Conversio	on Sampler Control Units Dialout Alarms	
General information about the instrument.		
Sensor type: Submerged Flow conversion: Weir, V-Notch, 90 degrees Software revision: 1.49 Instrument ID: 3293509037	Power Type: Alkaline Voltage: 12.5 volts Remaining: 100 %	R
Instrument time: 9/25/02 3:06:10 PM Enter the usual way you connect to this instrument:		Power Supply Information
Iype: © Direct C Modem C £0M port: Default Modem:	Wireless Baud rate: Default	
Disconnect Retrieve Data (F8)	🖌 Apply (F9) 🗶 Cancel	2 Help
For Help, press F1	C:\FL413\Data\Isco.mdb	[NUI

Figure 4-5 Remaining Battery Life Reported in Flowlink

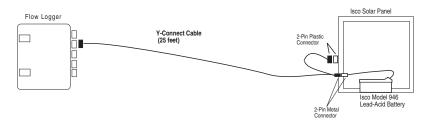


Figure 4-6 Connecting Solar Panels to the 4120

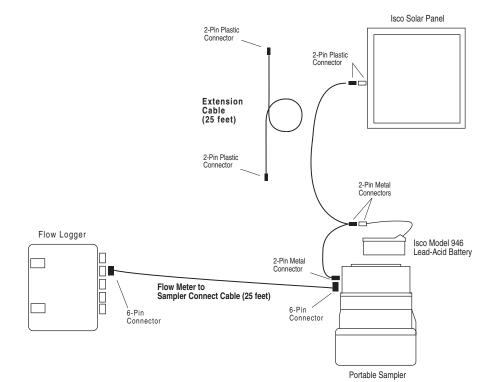
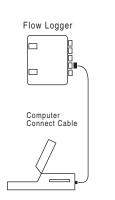


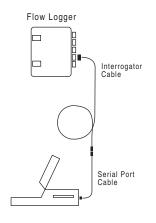
Figure 4-7 Connecting a Solar Panel and a Sampler to the 4120

Flowlink reports the type of battery, the current voltage, and the remaining battery capacity in the Power box. When the flow logger obtains power from an external source, Flowlink reports the battery type as "external."

4.4 How does the Flow
Logger Conserve
Power?The 4120 conserves power by providing power to the circuitry
only under certain conditions. These conditions occur when the
4120 must:

- **Respond to a signal from a tipping-bucket rain gauge.** The 4120 responds to a rain gauge signal only when programmed to store rainfall data or to monitor rainfall readings fro sampler-enable controls.
- **Take a reading.** Flowlink determines the interval between readings (1, 2, 5, 10, 15, 30, 60, or 120 minutes) as part of the 4120's program.





• Send a pacing pulse (an electronic signal) to a sampler. When flow-pacing a sampler, a pulse represents a certain volume of water: 100 gallons; 5,000 cubic feet; or other volume setting entered with Flowlink. When trigger-pacing a sampler, however, a pulse represents one of two possible time intervals. To conserve power, the 4120 must do as many tasks as possible when powered. So, it sends pulses while taking readings. If the 4120 has measured a large volume of water or if the trigger pacing interval is shorter than the reading interval, it may send several flow pulses at once.

Note

For more information about flow pacing and trigger pacing, see the Flowlink Help section.

• **Respond to a computer.** The 4120 responds to a computer when it detects a completed circuit created by connecting a Computer Connect Cable to the flow logger's Interrogator connector. Leaving the cable connected to the flow logger drains power unnecessarily. Teledyne Isco also supplies a pair of cables, the flow Meter Interrogator Cable and the Serial Port Cable, to interrogate flow meters. These cables are compatible with the flow logger. The computer-detecting circuit is in the 4-pin connectors that attach the cables to each other.

🗹 Note

Leaving the Serial Port Cable and the Interrogator Cable attached to each other while the interrogator cable is attached to the flow logger will drain the battery.

• **Respond to Event Marks from a Sampler.** An event mark is an electronic signal sent by the sampler indicating that a sample has been completed. The 4120 responds to an event mark only when programmed to store sample-event data. When it receives an event signal, the 4120 records the time of the event mark and the bottle receiving the sample.

Teledyne Isco provides three power source adaptor cables. The first connects an Isco Model 947 Lead-Acid Battery to the Isco 965 Five Station Battery Charger. Because the Model 947 Lead-Acid Batteries use a different connector than the Isco batteries the charger was originally designed for, use the adaptor to connect the lead-acid batteries to the charger.

The second cable connects the AC Power Pack to the 4120. It attached to the flow logger's sampler connector.

The last cable, the External 12-Volt DC Source Connect Cable, connects the 4120 to a 12-volt, deep-cycle marine battery. The cable has a connector at one end that attaches to the 4120's sampler connector. The opposite end of the cable has one red and

4.5 Adaptor Cables for Alternative Power Sources

one black wire, each attached to a battery clip. Attach the clip at the end of the red wire to the positive terminal of the battery and the clip at the end of the black wire to the negative terminal.

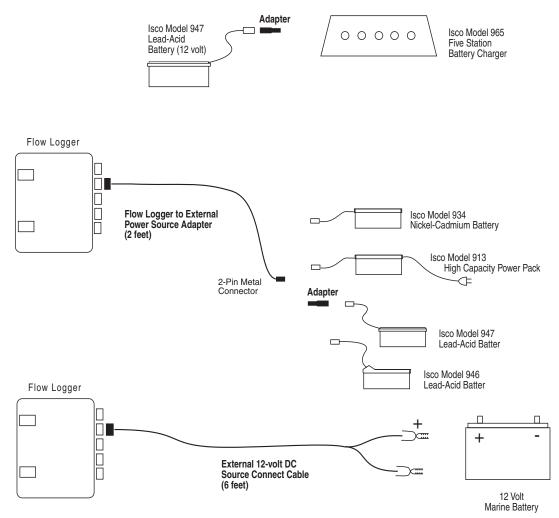


Figure 4-8 Adaptors for Alternative Power Sources

4.6 Fuses

If your flow logger does not seem to be operating correctly, it may have one or two bad fuses, or its circuit board may need repair. The power fuse may be open if the 4120 does not respond when you try to connect through Flowlink. If the other fuse is open, you will still be able to connect and download flow data; however, no rainfall will be logged, and you will not be able to download using an RTD.

Note

Teledyne Isco does not recommend replacing fuses yourself because you must open the case, breaking the NEMA 6 seal that prevents moisture and corrosive atmospheres from destroying the circuitry. Instead, if your flow logger requires repair, contact Customer service for information on returning it to the factory.

	Teledyne Isco, Inc. P.O. Box 82531 Lincoln, NE 68501 Email: IscoInfo@teledyne.com Telephone Within USA: Toll free: (800) 228-4373 Outside USA: (402) 464-0231 Fax: (402) 465-3022 Technical Service: (800) 775-2965
4.7 Using Flash Update	Teledyne Isco manufactures a number of instruments - 4100 Series Flow Loggers, 4200 Series Flow Meters, and 6700 Series Samplers - that use circuitry based on Flash EPROMs. Unlike earlier EPROMs that require UV erasure and were not easily field replaced, the Flash EPROM lets you upgrade the software in the instrument without opening the unit or returning it to the factory. You can now update the software with a disk from Teledyne Isco, an IBM®-compatible personal computer and a connect cable.
	The disk contains UPDATE, a program specifically for flash memories, and a set of software files to update the Flash EPROM.
	Each disk is labeled with:
	• The instrument series number
	• The software revision number for each instrument in the series
	• The part number of the disk
4.7.1 Getting Started	The following instructions assume that:
	• You have had some experience using the computer.
	• You have a Computer Connect Cable. If you do not have the cable, order it from your sales representative or the factory. For more detailed information about hardware requirements, see Table 4-2 on page 4-16.
	• You are familiar with Microsoft® Windows®. FLASH UPDATE uses the standard Windows user-interface for mouse and keyboard commands. If you are unfamiliar with DOS or Windows, please read your DOS or Windows user manuals.
4.7.2 Before Running FLASH UPDATE	The windows in FLASH UPDATE contain all the instructions you need to update the instrument. However, there are a few things to consider before running the program.
	• Updating your instrument erases the data stored in its memory. This includes all readings and most of the program settings. FLASH UPDATE replaces most program settings with factory settings. Before running the program, collect the data and record your program settings. Then, after updating the software, reprogram the instrument.

- If you have Flowlink, Teledyne Isco strongly recommends using it to update 4100 Series Flow Loggers. Flowlink lets you collect the data stored in the instrument before updating the software. It also leaves the program settings in the instrument unchanged, eliminating the need to reprogram them. Then Flowlink updates the software, it uses the update files on the FLASH UPDATE disk and disregards the FLASH UPDATE program. Refer to the Flowlink Help files for more information. Use FLASH UPDATE only if you do not have Flowlink available.
- The instructions in the following section, Running FLASH UPDATE, assume you are running the program from the update disk. However, you may prefer to copy the disk's contents to your hard disk. Before copying the disk, create a new directory for the FLASH UPDATE program and the update files. The program and the update files must be in the same directory. Furthermore, that directory must be the current directory when you run the program.

If you receive several update disks over time, copy the update files and the program when copying the contents of a disk. This ensures that you have a current version of FLASH UPDATE as well as the new update files. Depending on your selection in the preferences window, you may see the window in the margin (left) listing all files in the directory. This window appears only when the directory or disk contains more than one version of the update files and the Preferences option for Show Update File is "All Update Files." (See About Preferences.)

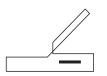
- 1. Connect the Computer Connect Cable to your computer's serial port and the instrument's interrogator connector (marked with the Interrogator icon).
- 2. Insert the update disk in the floppy disk drive.
- 3. Change the DOS prompt to the floppy disk letter prefix.
- 4. At the DOS command line, type: FLASHLD. The first window in FLASH UPDATE will be the Introduction window. Read it carefully before continuing.

FLASH UPDATE has a set of factory settings that appear in Figure 4-9. Change them when your computer requires different settings.

To change preference settings:

1. Click Cancel in the Introduction window.

4.7.3 Running FLASH UPDATE



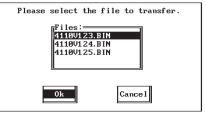
Interrogator Port Icon

4.7.4 About Preferences

- 2. Select Preferences from the Options menu. The notes in Figure 4-9 explain the selections in the window. When you have selected your preferences, select OK.
- 3. Select Update Software from the Options menu, and follow the instructions in each window.



Options Menu



This window appears only

when the directory or disk contains more than one version of the update files and the Preferences option for Show Update File is "all Update Files." It lists the update files in the directory. The first four numbers in the file name are the instrument's model number. The numbers following the "V" are the software version. If several versions appear in the window, select the version with the highest number unless otherwise instructed by Teledyne Isco Technical Service.

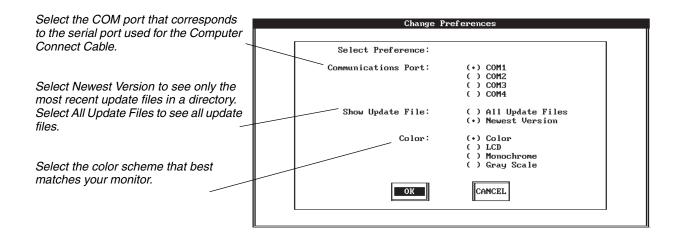


Figure 4-9 Preferences Window

Table 4	-2 Minimum DOS and	Computer Hardware Requirements
DOS	DOS 3.3 or later versions	DOS 5.0 or later versions recommended.
		Microsoft Windows not required.
CPU	80286, 80386, 80486	IBM PC or compatible. 80386 or 80486 recommended.
		(Must operate at 19,200 baud when communicating through the serial port.)
	640 kilobytes RAM (Random Access Memory), minimum	
	Serial port	For connecting the computer to Isco flow meters, flow loggers, or samplers.
Keyboard	Any compatible keyboard	
Hard disk	Not required.	
Floppy disk	3 ¹ /2-inch floppy drive (1.44 mega bytes)	At least one floppy disk drive.
Monitor	LCD, Gray Scale, Color, or Monochrome	IBM CGA, EGA, or VGA compatible.
Mouse	Microsoft [®] -compatible mouse	Optional. Mouse recommended.
Cabling	Isco Computer Connect Cable (9-pin: part #60-2544-044)	For connecting the computer to flow meters, flow loggers, or samplers.
	(25-pin: part #60-2544-040)	

Appendix A Accessories List

The following table contains information about accessories. Accessories can be purchased by contacting Teledyne Isco's Customer ServiceDepartment.

Table A-1 Accessories		
Part Description	Part Number	
Power Sources and Battery Chargers		
6-Volt Alkaline Battery, Disposable, 6 volts; 2 required per flow logger	340-2006-02	
Flow Logger Lead-Acid Battery, Rechargeable, 12 volts; 1 required per flow log- ger. Requires one of the battery chargers listed below. Also requires Flow Logger lead-acid battery charging adapter, part #68-3114-015.	60-3114-011	
Lead-Acid Battery Pack	60-3004-106	
Battery Backed Power Pack (120 VAC), AC power converter/battery charger with built-in battery	60-3004-130	
Battery Backed Power Pack (240 VAC)	60-3004-160	
High Capacity Power Pack (120 VAC)	60-1684-088	
Battery Charger, 120 volts AC, 50/60 Hz	60-3004-059	
Model 965 Five-Station Battery Charger, 120/240 V, with 120 V power cord.	68-3000-965	
Model 965 Five-Station Battery Charger, 120/240 V, with 240 V power cord.	68-2000-966	
5-watt solar panel with pole mount bracket and 25-ft connect cable.	60-5314-478	
40-watt solar panel with mounting brackets	60-5314-347	
90-watt solar panel with mounting brackets	60-5314-399	
Connect Cables		
Computer Connect Cable, 9-pin, 10 ft	60-2544-044	
Computer Connect Cable, 25-pin, 10 ft	60-2544-040	
Flow Logger External 12-Volt DC Source Connect Cable, Connects flow logger to external 12-volt DC source. Terminates in heavy-duty battery clips.	60-3114-016	
Flow Logger External Power Connect Cable	60-3114-002	
Lead-Acid Battery Charging Adapter	60-3114-002	
Solar Panel Connect Cable Only	60-3114-010	
Flow Logger to External Power and Sampler "Y" Connect Cable, Connects a sin- gle flow logger to two Isco sampler-to-flow meter connect cables and to an exter- nal power source.		

Table A-1 Accessories (Continued) Part Description	Part Number
Flow Meter to Sampler "Y" Connect Cable, Connects a single flow logger to an Isco sampler-to-flow meter connect cable.	60-3704-081
Isco Sampler to Flow Meter Connect Cable, 25-foot	60-3004-107
Submerged Probe and Mounting Accessories	
Submerged Probe 10' range with 25' cable	60-3224-002
Standard Nose Section	60-2503-086
Slanted Nose Section	60-2503-097
Flume Probe Cap	60-2503-105
Sensor Carrier	60-3204-005
Isco Open Channel Flow Measurement Handbook	60-3003-041
Spring Ring - 6" Dia.	68-3200-007
Spring Ring - 8" Dia.	68-3200-008
Spring Ring - 10" Dia.	68-3200-009
Spring Ring - 12" Dia.	68-3200-010
Spring Ring - 15" Dia.	68-3200-011
(Each spring ring includes plastic ties to fasten the probe cable.)	1
Scissors Ring for 16" - 23" Pipe	68-3000-042
Scissors Ring for 16" - 36" Pipe	68-3000-043
Scissors Ring for 39" - 43" Pipe	68-3000-044
Scissors Ring for 45" - 49" Pipe	68-3000-045
Scissors Ring for 58 to 63" Pipe	68-3000-046
Scissors Ring for 72" Pipe	68-3000-047
Scissors Ring for 16" - 80" Pipe	68-3000-048
(Each scissors ring includes a base section, scissors mechanism, extensions, plastic ties, and instructions)	
Base Section (Includes plastic ties and instructions)	60-3004-169
Scissors Mechanism	60-3004-170
Probe Extension (Includes mounting hardware)	68-3200-012
Street Level Installation System Multi-Section Pole.	60-3204-012
(Includes instruction manual. To complete your system, you must also order a Street Lev	el Mounting Ring.
Street Level Mounting Ring for 6" diameter pipe	60-3204-014
Street Level Mounting Ring for 8" diameter pipe	60-3204-015
Street Level Mounting Ring for 10" diameter pipe	60-3204-016
Street Level Mounting Ring for 12" diameter pipe	60-3204-017
Street Level Mounting Ring for 15" diameter pipe	60-3204-018
Sensor Mounting Plate (includes plastic ties and instructions)	68-3000-051

Part Description	Part Number
Submerged Probe Quick Disconnect Box	
Quick Disconnect Box	60-3224-003
Watertight Cord-Grip (for 0.19 inch to 0.20 inch diameter cable)	209-0076-05
Watertight Cord-Grip (for 0.25 inch to 0.31 inch diameter cable)	209-0076-04
Watertight Cord-Grip (for 0.31 inch to 0.37 inch diameter cable)	209-0076-03
Watertight Cord-Grip (for 0.37 inch to 0.44 inch diameter cable)	209-0076-06
Watertight Cord-Grip (for 0.44 inch to 0.50 inch diameter cable)	209-0076-07
Watertight Cord-Grip (for 0.50 inch to 0.56 inch diameter cable)	209-0076-08
Desiccant Cartridge Assy	60-9004-105
Rain Gauge (tipping bucket rain gauge with 50-ft cable and con	nector)
Isco Model 674 Rain Gauge 0.01 inch tip	60-3284-001
Isco Model 674 Rain Gauge 0.1 mm tip	60-3284-006
Rain Gauge Connect Cable For Non-Isco Rain Gauges	60-3004-149
Flowlink	·
Flowlink for Windows Software	call factory
Computer Connect Cable, 9-pin, 10 ft	60-2544-044
Computer Connect Cable, 25-pin, 10 ft	60-2544-040
4200T Modem**	factory-installed optic

instruction manual. Requires one of the computer connect cables listed below.

**Contact your sales representative or Teledyne Isco Customer Service.

Appendix B General Safety Procedures

In field installations of 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 4120 has not been approved for use in hazardous locations as defined by the National Electrical Code.

Before any sampler is installed, the proper safety precautions must be taken. The following discussions of safety procedures are only general guidelines. Each situation in which you install a flow meter varies. You must take into account the individual circumstances you are in. Additional safety considerations, other than those discussed here, may be required.

B.1 Practical Safety PrecautionsThe following procedures are those used by Black & Veatch, a respected consulting firm, and are published here by permission.

B.1.1 Hazards

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.

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. orced 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.

B-1

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.

B.1.2 Planning Advance planning should include arrangements for test equipment, tools, ventilating equipment, protective clothing, traffic warning devices, ladders, safety harness, and adequate number of personnel. Hasty actions may result in serious injuries. Time spent in the manhole should be kept to a minimum.

B.1.3 Adverse Atmospheres [Refer to Table B-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 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.

B.1.4 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 emer- gency.
		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.
B.1.5	Traffic Protection	In addition to traffic cones, markers, warning signs, and barri- cades, 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.
B.1.6	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.
B.1.7	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 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 exer- cised 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.
B.1.8	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.

B.1.9 Emergencies	Every member of the crew be followed in cases of an chief to have a list of eme nearest hospital and am station, and rescue or gene	emergency. It is rgency phone nu bulance service	the duty of each crew umbers, including the , police precinct, fire
B.1.10 Field Equipment	The following equipment w	vill be available f	for use:
	Blowers Breathing apparatus Harnesses Emergency flashers Rain slickers Gas detectors Waders"	Gloves Hard Hats First aid kits Pick axes Mirrors Safety vests	Traffic cones Coveralls Manhole irons Flashlights Ropes Gas masks
B.2 Lethal Atmospheres in Sewers	The following is an article and published in the Octob WPCF. Dr. Pomeroy is par over a period of nearly 50 hydrogen sulfide and other He has personally worked the earlier years he did so, grave hazards to which he It is gratifying that the su sewers is receiving much r	ber 1980 issue of rticularly well k 0 years, in the codors in sewers in a great many he admits, with exposed himself ubject of hazards	Deeds & Data of the known for his studies, field of the control of and treatment plants. functioning sewers. In little knowledge of the control of the con
	good safety procedures are this subject. It is essential cedures.	-	_
	It is less important to know of sewer atmospheres an general be broadly applica understanding of this subj in print that do not reflect	re, as safety pr able, but there s ject. It is disturk	recautions should in hould be a reasonable
	One of the most common have died from a lack of function very well with su tions. No one worries about 2,100 meters), where the 16.2% (a normal atmosph going there, a person may following exercise. People over the high passes in the oxygen pressure is 13.2% Mt. Whitney, oxygen is eq and to higher peaks as w may climb to the top of M only 6.7%.	oxygen. The hu bstantially redu t going to Santa partial pressure ere is about 21% experience a littl in good health a e Rocky Mountai of a normal atm jual to 12.2%t. M ell. After adequ	uman body is able to ced oxygen concentra- Fe, New Mexico, (elev. e of oxygen is equal to %) oxygen. When first le 'shortness of breath' are not afraid to drive ins. At Loveland Pass, tosphere. At the top of Many hikers go there, tate acclimation, they

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 H_2S . 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 H_2S , 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 H_2S 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 H_2S 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 H_2S 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 H_2S 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 $\mathrm{H}_2\mathrm{S}.$

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 H_2S concentrations, flammable atmospheres, and hazards of physical injuries. Remember that much H_2S 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."

B.3 Hazardous Gases

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

				Table B-1	Hazar	dous Ga	ases			
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. Col- orless with characteris- tic odor.	0.60	Causes throat and eye irritation at 0.05%, cough- ing at 0.17%. Short exposure at 0.5% to 1% fatal.	300 to 500	85	16 25	Near top. Concentrates in closed up- per spaces	Sewers, chemical feed rooms.	Detectable odor at low concentrations
Benzene	C ₆ H ₆	Irritant, colorless anesthetic	2.77	Slight symp- toms 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, color- less, anesthetic. Poisonous.	2.64	Very poison- ous, irritating, vom- iting, convulsions, psychic distur- bance.	_	15	1.3 44.0	At bottom	An insecti- cide	Combustible gas indicator

			Table	B-1 Haza	rdous (Gases (C	Continued	l)		
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 Iower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Carbon Dioxide	CO ₂	Asphyxiant, Col- orless, odorless. When breathed in large quanti- ties, may cause acid taste. Non-flammable. Not generally present in dan- gerous 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 com- bustion, sewer gas, sludge. Also issues from car- bonaceous strata.	Oxygen deficiency indicator
Carbon Monox- ide	СО	Chemical asphyxiant. Col- orless, odorless, tasteless. Flammable. Poisonous.	0.97	Combines with hemoglobin of blood. Uncon- sciousness in 30 min. at 0.2% to 0.25%. Fatal in 4 hours at 0.1%. Head- ache in few hours at 0.02%.	400	50	12.5 74.0	Near top, espe- cially if present with illuminat- ing gas.	Manufac- tured gas, flue gas, products of com- bustion, motor exhausts. Fires of almost any kind.	CO ampoules.
Carbon Tetra-Chl oride	CCl ₄	Heavy, ethereal odor.	5.3	Intestinal upset, loss of consciousness, possible renal damage, respi- ratory failure.	1,000 to 1,500	100		At bottom.	Industrial wastes, solvent, cleaning	Detectable odor at low concen- trations.
Chlorine	Cl ₂	Irritant. Yel- low-green color. Choking odor detectable in very low concentra- tions. Non-flam- mable.	2.49	Irritates respi- ratory tract. Kills most ani- mals in a very short time at 0.1%.	4	1		At bottom.	Chlorine cylinder and feed line leaks.	Detectable odor at low concentra- tions.
Formal- dehyde	CH ₂ O	Colorless, pun- gent suffocating odor.	1.07	Irritating to the nose.	_	10	7.0 73.0	Near bottom.	Incom- plete com- bustion of organics. Common air pollut- ant, fungi- cide.	Detectable odor.
Gasoline	$\begin{array}{c} C_5H_{12}\\ to\\ C_9H_{20} \end{array}$	Volatile solvent. Colorless. Odor noticeable at 0.03%. Flamma- ble.	3.0 to 4.0	Anesthetic effects when inhaled. Rap- idly fatal at 2.4%. Danger- ous 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.	 Combusti- ble gas indi- cator. Oxygen deficiency indicator.**
Hydrogen	H ₂	Simple asphyx- iant. Colorless, odorless, taste- less. Flammable	0.07	Acts mechani- cally to deprive tissues of oxy- gen. Does not support life.	_	_	4.0 74.0	At top.	Manufac- tured gas, sludge digestion tank gas, electroly- sis of water. Rarely from rock strata.	Combustible gas indicator.
Hydrogen Cyanide	HCN	Faint odor of bit- ter almonds. Colorless gas	0.93	Slight symp- toms appear upon exposure to 0.002% to 0.004%. 0.3% rapidly fatal.	_	10	6.0 40.0	Near top.	Insecti- cide and rodenti- cide.	Detector tube

			Table	B-1 Haza	rdous G	lases (C	Continue	1)		
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
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
Hydro- gen Sul- fide	H ₂ S	Irritant and poi- sonous volatile compound. Rot- ten egg odor in small concentra- tions. Exposure for 2 to 15 min. at 0.01% impairs sense of smell. Odor not evident at high concen- trations. Color- less. Flammable.	1.19	Impairs sense of smell, rap- idly as concen- tration increases. Death in few minutes at 0.2%. Exposure to 0.07 to 0.1% rapidly causes acute poison- ing. Paralyzes respiratory center.	200 to 300	20	4.3 45.0	Near bottom, but may be above bottom if air is heated and highly humid.	Coal gas, petro- leum, sewer gas. Fumes from blast- ing under some con- ditions. Sludge gas.	 H₂S Ampoule. 5% by weight lead acetate solution.
Methane	CH4	Simple asphyx- iant. Colorless, odor- less, tasteless, flammable.	0.55	Acts mechani- cally to deprive tissues of oxy- gen. Does not support life.	Probably no limit, pro- vided oxygen percent-age is sufficient for life.	_	5.0 15.0	At top, increas- ing to certain depth.	Natural gas, sludge gas, manu- factured gas, sewer gas. Strata of sedi- mentary origin. In swamps or marshes.	 Combustible gas indicator Oxygen defi- ciency indica- tor.
Nitrogen	N ₂	Simple asphyx- iant. Colorless, tasteless. Non-flammable. Principal constit- uent 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 N ₂ O NO ₂	Colorless Colorless, sweet odor. Reddish-brown. Irritating odor. Deadly poison	1.04 1.53 1.58	60 to 150 ppm cause irritation and coughing. Asphyxiant. 100 ppm dan- gerous. 200 ppm fatal.	50	10		Near bottom.	Industrial wastes. Common air pollut- ant.	NO ₂ detector tube.
Oxygen	02	Colorless, odor- less, tasteless. Supports com- bustion.	1.11	Normal air con- tains 20.8% of O ₂ . Man can tol- erate down to 12%. Minimum safe 8 hour exposure, 14 to 16%. Below 10%, dangerous to life. Below 5 to 7% probably fatal.	_	_		Variable at dif- ferent levels.	Oxygen depletion from poor ventila- tion and absorp- tion, or chemical consump- tion of oxygen.	Oxygen defi- ciency indica- tor.
Ozone	03	Irritant and poi- sonous. Strong electrical odor. Strong oxidizer. Colorless. At 1 ppm, strong sul- fur-like odor.	1.66	Max. naturally occurring level is 0.04 ppm. 0.05 ppm causes irrita- tion of eyes and nose. 1 to 10 ppm causes headache, nau- sea; can cause coma. Symp- toms similar to radiation dam- age.	0.08	0.04		Near bottom.	Where ozone is used for disinfec- tion.	Detectable odor at 0.015 ppm.

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
Sludge Gas	***	Mostly a simple asphyxiant. May be practically odorless, taste- less.	Variable	Will not support life.	No data. Wou vary widely w tion.	ıld vith composi-	5.3 19.3	Near top of structure.	From digestion of sludge.	See compo- nents.
Sulfur Dioxide	SO ₂	Colorless, pun- gent odor. Suffo- cating, corrosive, poisonous, non-flammable.	2.26	Inflammation of the eyes. 400 to 500 ppm imme- diately fatal.	50 to 100	10		At bottom, can combine with water to form sulfurous acid.	Industrial waste, combus- tion, com- mon air pollutant.	Detectable taste and odor at low concen- tration.
Toluene	$\begin{array}{c} C_5H_{12}\\ to\\ C_9H_{20} \end{array}$	Colorless, ben- zene-like odor.	3.14	At 200-500 ppm, headache, nau- sea, bad taste, lassitude.	200	100	1.27 7.0	At bottom.	Solvent.	Combustible gas indicator.
Turpentine	C ₁₀ H ₁₆	Colorless, Char- acteristic odor.	4.84	Eye irritation. Headache, diz- ziness, nausea, irritation of the kidneys.	_	100		At bottom.	Solvent, used in paint.	 Detectable odor at low concentration s. Combustible gas indica- tor.
Xylene	C ₈ H ₁₀	Colorless, flam- mable	3.66	Narcotic in high concentrations. less toxic than benzene.	_	100	1.1 7.0	At bottom.	Solvent	Combustible gas indicator.

Appendix C Material Safety Data Sheets

This appendix provides Material Safety Data sheets for the internal desiccants used in the 4120 Flow Logger.

Specific questions regarding the use and handling of these products should be directed to the manufacturer listed in the MSDS.

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



MATERIAL SAFETY DATA SHEET -- September 28, 1998 SORB-IT[®]

Packaged Desiccant

SECTION I -- PRODUCT IDENTIFICATION

Trade Name and Synonyms:	Silica Gel, Synthetic Amorphous Silica,
	Silicon, Dioxide
Chemical Family:	Synthetic Amorphous Silica
Formula:	SiO ₂ .x H ₂ O

SECTION II -- HAZARDOUS INGREDIENTS

Components in the Solid Mixture

PEL)
ONE,

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

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

SECTION III -- PHYSICAL DATA

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





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

SECTION IV -- FIRE EXPLOSION DATA

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

Flash Point - Nonflammable.

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

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

SECTION V -- HEALTH HAZARD DATA

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

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

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

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

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



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

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

SECTION VI -- REACTIVITY DATA

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

SECTION VII --SPILL OR LEAK PROCEDURES

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

SECTION VIII -- SPECIAL PROTECTION INFORMATION

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

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

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

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





MATERIAL SAFETY DATA SHEET -- September 28, 1998 SORB-IT[®]

Packaged Desiccant

SECTION IX -- SPECIAL PRECAUTIONS

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

* No Information Available

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

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

The information contained herein is based upon data considered true and accurate. However, United Desiccants makes no warranties expressed or implied, as to the accuracy or adequacy of the information contained herein or the results to be obtained from the use thereot. This information is offered solely for the user's consideration, investigation and verification. Since the use and conditions of use of this information and the material described herein are not within the control of United Desiccants, United Desiccants assumes no responsibility for injury to the user or third persons. The material described herein is sold only pursuant to United Desiccants' Terms and Conditions of Sale, including those limiting warranties and remedies contained therein. It is the responsibility of the user to determine whether any use of the data and information is in accordance with applicable federal, state or local laws and regulations.

Material Safety Data Sheet

Indicating Silica Gel

Identity (Trade Name as Used on Label)

Manufacturer	MULTISORB TECHNOLOGIES, INC.	MSDS Number* : M75
:	(formerly Multiform Desiccants, Inc.)	
Address:	325 Harlem Road	CAS Number* :
	Buffalo, NY 14224	
Phone Number	r (For Information): 716/824-8900	Date Prepared: July 6, 2000
Emergency Ph Number:	one 716/824-8900	Prepared By*: G.E. McKedy

Section 1 - Material Identification and Information

Components - Chemical Name & Common Names (Hazardous Components 1% or greater; Carcinogens 0.1% or greater)	%*	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDE D
Silica Gel SiO ₂	98.0	6mg/m ³ (total dust)	10mg/m ³ (total dust)	
Cobalt Chloride	>2.0	0.05mg/m ³ (TWA cobalt metal dust & fume)	.05mg/m ³ (Cobalt, TWA)	
Non-Hazardous Ingredients				
TOTAL	100			

Section 2 - Physical/Chemical Characteristics

Boiling N/A Point	Specific Gravity 2.1 (H ₂ 0 = 1)
Vapor Pressure N/A (mm Hg and Temperature	Melting N/A Point
Vapor N/A Density (Air =1)	Evaporation Rate N/A (=1)
Solubility Insoluble, but will adsorb moisture.	Water Not reactive, but will adsorb moisture.
Appearance Purple crystals, no odor. and Odor	

Section 3 - Fire and Explosion Hazard Data

Flash Point and Methods Used	N/A	Auto-Ignition Temperature	N/A	Flammability Limits in Air % by Volume	N/A	LEL	UEL
	hemical, carbon di	oxide and foam ca	n be used.			1	!
Special Fire Water will generate heat due to the silica gel which will adsorb water and liberate heat. Fighting Procedures							
Unusual Fire and Explosion Hazards When exposed to water, the silica gel can get hot enough to reach the boiling point of water. Flooding with water will reduce the temperature to safe limits.							

Section 4 - Reactivity Hazard Data

STABILITY	Conditions	Moisture and	d high humidity environments.
Stable	To Avoid		
Unstable			
Incompatibility	Water.		
(Materials to Avoid)			
Hazardous	Carbon d	ioxide, carbon	monoxide, water
Decomposition			
Products			
HAZARDOUS POLYM	ERIZATION	Conditions	None.
May Occur		To Avoid	

*Optional

Indicating Silica Gel

Page 2

Section 5 - Health Hazard Data

PRIMARY ROL	UTES	Inhalation	Ingestion	CARCINOGEN		DOSHA
OF ENTRY		Skin Absorption	Not Hazardous	LISTED IN	IARC Monograph	Not Listed
HEALTH HAZA	ARDS	Acute	May cause eye, skin ar	nd mucous membrane	e irritation.	
		Chronic	Prolonged inhalation m	ay cause lung damag	le.	
Signs and Sym	nptoms	Drying and irritation	on.			
of Exposure	·	, ,				
Medical Conditi	ions	Asthm	a.			
Generally Aggr	ravated b	y Exposure				
EMERGENCY	FIRST A	ID PROCEDURES - S	Seek medical assistance f	or further treatment, obs	ervation and support if nece	ssary.
Eye Contact	Flush w	ith water for at leas	t 15 minutes.			
Skin	Wash a	affected area with so	cap and water.			
Contact			•			
Inhalation	Remov	e affected person to	o fresh air.			
Ingestion	Drink a	t least 2 glasses of	water.			

Section 6 - Control and Protective Measures

Respiratory Protection (Specify Type)	Use NIOSH approved dust mask or res	pirator.	
Protective Lig	ght cotton gloves.	Eye Protection Safety glasses.	
Gloves			
VENTILATION	Local Exhaust	Mechanical (General)	Special
TO BE USED			
	Other (Specify)		
Other Protective	None.		
Clothing and Equipmen	it		
Hygienic Work Practices	Avoid raising dust. Avoid contact with sl	in, eyes and clothing.	

Section 7 - Precautions for Safe Handling and Use/Leak Procedures

Steps to be Taken if Ma	tterial Sweep or vacuum up and place the spilled material in a waste disposal container. Avoid raising dust.
ls	
Spilled Or Released	
Waste Disposal	Dispose in an approved landfill according to federal, state and local regulations.
Methods	
Precautions to be	Cover promptly to avoid blowing dust. Wash after handling.
Taken	
In Handling and	
Storage	
Other Precautions and/	or Special Keep in sealed containers away from moisture. The silica gel will readily adsorb moisture.
Hazards	

Indicating Silica Gel



MATERIAL SAFETY DATA SHEET

Effective DateMarch 8, 2005MSDS NumberM163

Section 1 – Product and Company Information

Product Name:	Silica gel, indicating, yellow
Product Use:	Desiccant, absorbent
Grades:	Silica gel, indicating
Synonyms:	Amorphous silica gel, SiO ₂ , silicon dioxide (amorphous)
Company;	Multisorb Technologies, Inc.
Street Address:	325 Harlem Road
City, State, Zip, Country:	Buffalo, NY 14224-1893 USA
Telephone Number:	(716) 824 8900 [USA] Monday - Friday (8:00 - 5:00 EDT)
Fax Number:	(716) 824 4091 [USA]
Website / E-Mail :	multisorb.com

Section 2 – Composition / Information on Ingredients

Component Name	CAS Number	% by Weight
Synthetic amorphous silica gel (SiO ₂)	112926-00-8	100
Phenolphthalein	77-09-08	100 ppm

While this material is not classified, this MSDS contains valuable information critical to the safe handling and proper use of this product. This MSDS should be retained and available for employees and other users of this product.

Section 3 – Hazard Identification

Emergency (Overview: A yellow bead or granular material that poses little or no immediate hazard. This material is not combustible.		
Potential He	lth Effects:		
Eyes:	Dust and or product may cause eye discomfort and irritation seen as tearing and reddening.		
Skin:	The product dust may cause drying of the skin. Silica gel may get hot enough to burn skin when it adsorbs moisture rapidly. Use an excess of water to cool the silica gel.		
Ingestion:	Material is not toxic and will pass through the body normally.		
Inhalation:	Slight irritation is possible but none is expected.		
Medical Effects Generally Aggravated by Exposure: Respiratory ailments.			
Chronic Effects/Carcinogenity: May cause eye, skin and mucous membrane irritation and drying.			

Section 4 – First Aid Measures

Eyes:	Rinse the eyes well with water while lifting the eye lids. If irritation persists, consult a physician.	
Skin:	Wash affected area with soap and water.	
Ingestion:	Ingestion is unlikely, this material will pass through the body normally.	
Inhalation:	Remove the affected person to fresh air and get medical attention if necessary.	
Notes to Physician: Not applicable		

Section 5 – Fire Fighting Measures

Flammable Properties:	Not flammable		
Flash Point:	Not applicable	Method:	Not applicable
Flammable Limits:	Not flammable		
Lower Flamn	ability Limit: Not applicable		
Upper Flamm	ability Limit: Not applicable		
Autoignition Temperature: Not applicable			
Hazardous Combustion Products: Not applicable			
Extinguishing Media: Use extinguishing media that is appropriate for the surrounding fire. Silica gel is not combustible.			
Fire Fighting Instructions: Not combustible			
Unusual Fire and Explosion Hazards: None			

Section 6 – Accidental Release Measures

Spill: Sweep or vacuum up and place the spilled material in a waste disposal container. Avoid raising dust. Wash with soap and water after handling.

Section 7 – Handling and Storage

Handling:	Avoid raising dust and minimize the contact between worker and the material. Practice good hygienic work practices.
Storage:	Store in a cool, dry location. Keep in sealed containers away from moisture. The silica gel will readily adsorb moisture.

Section 8 – Exposure Controls/Personal Protection

Engineering Controls:	Use exhaust ventilation to keep the airborne concentrations below the exposure limits.			
Respiratory Protection:	Use NIOSH approved respirator when the air quality levels exceed the TLV's.			
Skin Protection:	Light g	loves will protect against	t abrasion and drying of th	ne skin.
Eye Protection:	Safety glasses.			
Component Name			Exposure Limits	
		OSHA	ACGIH	Other
		PEL	TLV	Recommended
				Limits
Silian gal		TWA 20 monof	$TWA 10 ma / m^3$	NIOSH DEI

 Silica gel
 TWA 20 mppcf (80 mg / m³ % SiO₂)
 TWA 10 mg / m³
 NIOSH REL TWA 6 mg / m³

 Phenolphthalein
 Not Applicable
 Not Applicable
 Not Applicable

Section 9 – Physical and Chemical Properties

Appearance:	Yellow beads or granules	Vapor Density:	Not applicable
Odor:	None	Boiling Point:	4046° F (2230° C)
Physical State:	Solid bead	Melting Point:	3110° F (1710° C)
PH:	Not applicable	Solubility:	Insoluble in water
Vapor Pressure:	Not applicable	Specific Gravity:	2.1

Section 10 – Stability and Reactivity

Stability:StableConditions to avoid:Moisture and high humidity environments.Incompatibility:Water, fluorine, oxygen difluoride, chlorine trifluorideHazardous Decomposition Products:NoneHazardous Polymerization:Will not occur

Section 11 – Toxicological Information

This product and its components are not listed on the NTP or OSHA Carcinogen lists.

Human Toxicology Silica gel is a synthetic amorphous silica not to be confused with crystalline silica. Epidemiological studies indicate low potential for adverse health effects. In the activated form, silica gel acts as a desiccant and can cause a drying irritation of the mucous membranes and skin in cases of severe exposure. Multisorb Technologies Inc. knows of no medical conditions that are abnormally aggravated by exposure to silica gel. The primary route of entry is inhalation of dust.

Section 12 – Ecological Information

Not known to have any adverse effect on the aquatic environment. Silica gel is insoluble and non-toxic.

Section 13 – Disposal Information

Disposal Information If this product as supplied becomes a waste, it does not meet the criteria of a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Materials of a hazardous nature that contact the product during normal use may be retained on the product. The user of the product must identify the hazards associated with the retained material in order to assess the waste disposal options. Dispose according to federal, state and local regulations.

Section 14 – Transportation Information

U.S. Department of Transportation Shipping Name: Not classified as a hazardous material. Not regulated.

Section 15 – Regulatory Information (Not meant to be all inclusive - selected regulations represented)

TSCA Listed: Yes

DSL/NDSL (Canadian) Listed: Yes

OSHA: TWA 20 mppcf ($80 \text{ mg} / \text{m}^3 \% \text{SiO}_2$) for Silica gel

- NIOSH: REL TWA 6 mg / m³ IDLH 3,000 mg / m³ for silica gel Animal tests conducted in 1976 - 1978. 18 month exposure at 15 mg / m³ showed silica deposition in respiratory macrophages and lymph nodes, minimum lung impairment, no silicosis.
- **ACGIH:** TLV 10 mg / m^3 for Silica gel
- **DOT:** Not classified as a hazardous material.

HMIS – Hazardous Materials Identification System

HMIS Rating		
Health	0	
Flammability	0	
Reactivity	0	

0 - minimal hazard, 1 - slight hazard, 2 - moderate hazard, 3 - serious hazard, 4 - severe hazard

This MSDS was prepared by: George E. Mckedy Senior Applications Development Specialist Multisorb Technologies, Inc.

This data and recommendations presented in this data sheet concerning the use of our product and the materials contained therein are believed to be correct but does not purport to be all inclusive and shall be used only as a guide. However, the customer should determine the suitability of such materials for his purpose before adopting them on a commercial scale. Since the use of our products is beyond our control, no guarantee, expressed or implied, is made and no responsibility assumed for the use of this material or the results to be obtained therefrom. Information on this form is furnished for the purpose of compliance with Government Health and Safety Regulations and shall not be used for any other purposes. Moreover, the recommendations contained in this data sheet are not to be construed as a license to operate under, or a recommendation to infringe, any existing patents, nor should they be confused with state, municipal or insurance requirements, or with national safety codes.

4120 Flow Logger

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Teledyne Isco One Year Limited Factory Service Warranty *

Teledyne Isco warrants covered products against failure due to faulty parts or workmanship for a period of one year (365 days) from their shipping date, or from the date of installation by an authorized Teledyne Isco Service Engineer, as may be appropriate.

During the warranty period, repairs, replacements, and labor shall be provided at no charge. Teledyne Isco's liability is strictly limited to repair and/or replacement, at Teledyne Isco's sole discretion.

Failure of expendable items (e.g., charts, ribbon, tubing, lamps, glassware, seals, filters, fittings, and wetted parts of valves), or from normal wear, accident, misuse, corrosion, or lack of proper maintenance, is not covered. Teledyne Isco assumes no liability for any consequential damages. This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

This warranty applies only to products sold under the Teledyne Isco trademark and is made in lieu of any other warranty, written or expressed.

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

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

* This warranty applies to the USA and countries where Teledyne Isco Inc. 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.

In the event of instrument problems, always contact the Teledyne Isco Service Department, as problems can often be diagnosed and corrected without requiring an on-site visit. In the U.S.A., contact Teledyne Isco Service at the numbers listed below. International customers should contact their local Teledyne Isco agent or Teledyne Isco International Customer Service.

Return Authorization

A return authorization number must be issued prior to shipping. Following authorization, Teledyne Isco will pay for surface transportation (excluding packing/crating) both ways for 30 days from the beginning of the warranty period. After 30 days, expense for warranty shipments will be the responsibility of the customer.

Shipping	Address:	Teledyne Isco, Inc Attention Repair Service 4700 Superior Street Lincoln NE 68504 USA	
Mailing	address:	Teledyne Isco, Inc. PO Box 82531 Lincoln NE 68501 USA	
	Phone:	Repair service: (800)775-2965 (lab instruments) (800)228-4373 (samplers & flow meters) Sales & General Information (800)228-4373 (USA & Canada)	
F	Fax:	(402) 465-3001	
k	Email:	iscoservice@teledyne.com Web site: www.isco.com	

