

750 Area Velocity Module

Installation and Operation Guide



Part #60-9003-465
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Revision J, May 8, 2007

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.

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General Warnings

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

Hazard Severity Levels

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

 **CAUTION**

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

 **WARNING**










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

 **DANGER**

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

Hazard Symbols

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

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
	Pinch point. These symbols warn you that your fingers or hands will be seriously injured if you place them between the moving parts of the mechanism near these symbols.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
	Risque de pincement. Ces symboles vous avertit que les mains ou les doigts seront blessés sérieusement si vous les mettez entre les éléments en mouvement du mécanisme près de ces symboles
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sie vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
	Vorsicht Quetschgefahr! Dieses Symbol warnt vor einer unmittelbar drohenden Verletzungsgefahr für Finger und Hände, wenn diese zwischen die beweglichen Teile des gekennzeichneten Gerätes geraten.

750 Area Velocity Module

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750 Area Velocity Module

Section 1 Introduction

1.1 Overview

The 750 Area Velocity Module is one of Teledyne Isco's interchangeable modules for the Avalanche and 6700 Series Samplers. The module enhances sampler operation by providing flow-pacing and additional sampler enable conditions. The sampler also displays the real-time level, velocity, flow rate, and total flow provided by the module. The sampler records this data for later analysis.

The area velocity (AV) sensor detects the average velocity of a liquid as it moves up or downstream. The sensor, equipped with an internal pressure transducer, also measures the level of the flow stream. Three AV sensor models are available:

- Standard range sensor – has a 25 ft (7.6 m) cable and a pressure transducer with a 10 ft (3.05 m) level measurement range.
- Extended range sensor – has a 50 ft (15.2 m) cable and a pressure transducer with a 30 ft (9.14 m) level measurement range.
- Low profile sensor – has a 25 ft (7.6 m) cable and a pressure transducer with a 10 ft (3.05 m) level measurement range. Its smaller size allows velocity measurements at very low liquid depths.

 WARNING
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The 750 module has not been approved for use in hazardous locations as defined by the National Electrical Code. Installation of this module in a hazardous location may cause fire or explosion, resulting in death, personal injury, or property damage. Before installing any device in a dangerous location, review safety precautions in your sampler manual. Check any applicable guidelines, codes, and regulations of federal, state, city, and county agencies.

1.2 Power Sources

We recommend using a Lead-Acid battery or a new 913 or 923 power pack when using the Model 750 Area Velocity Module. A nickel-cadmium battery may not be sufficient to finish a sample routine. For example, a nickel-cadmium battery should be expected to complete five sampling routines of 24 samples, each sample 200 ml, at one sample per hour with a 10 foot suction line and a 5 foot head. But if the routine is changed to flow-paced sampling or enabling the routine with a level, velocity, or flow rate condition, the battery capacity is significantly reduced.

1.3 Principles of Area/Velocity Flow Measurement

Area velocity flow conversion requires three measurements: level, velocity, and channel dimensions. The AV sensor provides the level and velocity measurements. You provide the third measurement, channel dimensions, during module programming.

The flow conversion is best represented as two steps. First, the module calculates the channel cross-section (or area) using the programmed channel dimensions and the level measurement. Next, the module multiplies the channel cross section and the velocity measurement to calculate the flow rate.

1.3.1 Level Measurement

The AV sensor's internal differential pressure transducer measures the liquid level. The transducer is a small piezo-resistive disk that detects the pressures transferred by a stainless steel diaphragm. The outer face of the diaphragm is exposed to the flow stream through the ports at the rear of the sensor. The inner face is exposed, or referenced, to the atmosphere through the internal vent tube that runs the full length of the sensor's cable. The difference between the pressures exerted on the diaphragm is the hydrostatic pressure. The transducer converts the hydrostatic pressure to analog signals. The signals are sent to the module.

Because pressure is proportional to the level of the stream, the module can convert the analog signal to a level measurement. The level measurement, in turn, is applied to the channel cross-section.

1.3.2 Velocity Measurement

The AV sensor measures average velocity by using ultrasonic sound waves and the Doppler effect. The Doppler effect states that the frequency of a sound wave (or other wave) passed from one body to another is relative to both their motions. As the two approach each other, the frequency increases; as they move apart, the frequency decreases.

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

The module compares the frequencies of the sound waves. An increase or decrease in the frequency of the reflected wave indicates forward or reverse flow. The degree of change is proportional to the average velocity of the flow stream.

1.3.3 Alternative Flow Measurement Systems

Because of the characteristics of area/velocity flow measurement, there may be some installations where this method is either unreliable or inaccurate. In these instances, it is worthwhile to consider using an alternate method of flow measurement.

In addition to the 750 Module, Teledyne Isco offers three other types of plug-and-play flow modules in the 700 Series: the 730 Bubbler Module, the 720 Submerged Probe Module, and the 710 Ultrasonic Module.

Information about these flow modules is available from the factory. Call for more information or visit our Web site at www.isco.com.

1.4 Technical Specifications

The following tables contain technical specification for the 750 module, both Standard Sensors, and the Low-Profile Sensor.

General notes:

- All weights may vary by ± 0.2 lb (0.1 kg).
- All lengths may vary by ± 0.25 inches (0.64 cm)

Table 1-1 Technical Specifications for the 750 Area Velocity Module

Weight	0.9 lbs (.4 kg)
Sensor Dimensions	4.9 × 5.7 × 2.0 inches (12.4 × 14.5 × 5.1 cm)
Material	Polystyrene
Operating Temperature	0° to 140°F (-18° to 60°C)
Storage Temperature	-40° to 140°F (-40° to 60°)
Enclosure Rating	NEMA 4X and 6, IP67
Power	9 to 14 VDC provided by the sampler
Memory	Nonvolatile ROM (Flash). Can be field updated through the sampler.
Level Resolution	0.002 ft (0.0006 m)
Velocity Resolution	0.024 ft/s (0.0073 m/s)
Velocity Accuracy	-5 to +5 ft/s: ± 0.1 ft/s (-1.5 + 1.5 m/s: ± 0.03 m/s) 2% of reading) (1.5 to 6.1 m/s: $\pm 2\%$ of reading)
Readings	Programmable through the sampler at 1, 2, 5, 10, 15, and 30 minute intervals. All readings are stored in the sampler.

Table 1-2 Technical Specifications for the Standard AV Sensor

Weight Standard Range	2.1 lbs (.96 kg)
Extended Range	3.9 lbs (1.8 kg)
Sensor Dimensions	Length: 6.6 inches (6.8 cm) Width: 1.6 inches (4.1 cm) Height: 1.2 inches (3.0 cm)
Nose Angle	35° from horizontal

Table 1-2 Technical Specifications for the Standard AV Sensor (Continued)

Cable Length Standard Range	25 ft (7.6 m)
Extended Range	50 ft (15.2 m)
Materials	Sensor: Polybutadiene-based polyurethane, stainless-steel Cable: Polyvinyl chloride (PVC) chlorinated polyvinyl chloride (CPVC)
Operating Temperature	32° to 160°F (0° 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	
Standard Range	0.05 to 10.0 ft (0.015 to 3.05 m)
Extended Range	0.05 to 30.0 ft (0.015 to 9.14 m)
Maximum Allowable level	
Standard Range	20 ft (6.1 m)
Extended Range	40 ft (12.2 m)
Level Measurement Accuracy	
Standard Range	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)
Extended Range	0.05 to 15.0 ft: ± 0.03 ft (0.015 to 4.57 m: ± 0.009 m) 0.05 to 21.0 ft: ± 0.09 ft (0.015 to 6.40 m: ± 0.027 m) 0.05 to 30.0 ft: ± 0.30 ft (0.015 to 9.14 m: ± 0.090 m)
	@ 77°F (25°C). Includes non-linearity, repeatability, and hysteresis. Does not include temperature coefficient.
Compensated Temperature Range	32° to 100°F (0° to 38°C)
Temperature Coefficient	
Standard Range	0.05 to 4.0 ft: ± 0.005 ft/°F (0.015 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)
Extended Range	0.05 to 30.0 ft: ± 0.008 ft/°F (0.015 to 9.14 m: ± 0.0044 m/°C)
	Maximum error over compensated temperature range, per degree of temperature change.
Velocity Measurement Method	Doppler Ultrasonic
Frequency	500 kHz
Typical minimum depth for velocity measurement	0.25 ft (75 mm)
Range	-5 to +20 ft/s (-1.5 to +6.1 m/s)

Table 1-3 Technical Specifications for the Low Profile AV Sensor

Weight	2.1 lbs (.95 kg) including cable and connector
Sensor Dimensions	Length: 6.00 inches (15.2 cm) Width: 1.31 inches (3.3 cm) Height: 0.75 inches (1.9 cm)
Nose Angle	110° from horizontal
Wetted Sensor Material	Epoxy, chlorinated polyvinyl chloride (CPVC), Stainless-steel
Cable Material	Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC)
Cable Length	25 ft (7.6 m)
Maximum Distance (between sensor and module)	75 ft (22.8 m) with optional extension cables. The distance can be extended up to 1000 ft (300 m) with the optional Quick Disconnect Box.
Operating Temperature	32° to 122°F (0° to 50°C)
Storage Temperature	-40° to 160°F (-40° to 71°)
Level Measurement Range	0.033 to 10.0 ft (0.01 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) Accuracy per foot of change from calibrated depth @77°F (25°C). Includes non-linearity and hysteresis.
Temperature Coefficient	±0.0023 ft/°F (±0.0013 m/°C) Maximum error within operating temperature range at zero pressure (per degree of change from calibration temperature).
Maximum Long-term Drift	0.033 ft (±0.010 m)
Velocity Measurement Method	Doppler Ultrasonic
Frequency	500 kHz
Transmission Angle	20° from horizontal
Typical minimum depth for velocity measurement	0.8 ft (25 mm)
Range	-5 to +20 ft/s (-1.5 to +6.1 m/s)
Velocity Accuracy	-5 to +5 ft/s (-1.5 to +1.5 m/s): ± 0.1 ft/s (±0.03 m/s) 5 to 20 ft/s (1.5 to 6.1 m/s): 2% of reading Velocity accuracy for a uniform velocity profile in water with a speed-of-sound of 4850 ft/s.

750 Area Velocity Module

Section 2 Installation and Programming Basics

The 750 can be used in a wide range of applications. In the “Flow Meter” mode of operation, the module will produce sound results if you properly choose an installation site, select an appropriate flow conversion method, and program the module with accurate measurements. Guidelines for each are discussed in the following sections.

If you plan to use the “Level Only” mode of operation, the section Selecting a Flow Conversion Method does not apply.

2.1 Installation Summary

To install the module:

1. Turn the sampler off.
2. Remove the connector cap in the module bay and move it aside.
3. Slide the module into the bay.
4. Push against the module so the connector is fully seated.

To remove the module, turn the sampler off. Press the silver spring button and pull the module from the bay. Replace the connector cap in the module bay.

2.1.1 Installation Checklist

1. Check the desiccant cartridge. Make sure the desiccant is active (blue or yellow in color) and **remove the red cap**.
2. Install the module and turn the sampler on.
3. Install the AV sensor in the channel.
4. Connect the AV sensor cable to the module.
5. Program the sampler and calibrate the module’s level reading.
6. Set up the sampler. See details in the sampler manual.
7. Run the program.

2.1.2 Installation Considerations

CAUTION

Mounting hardware may have sharp edges. Cuts and abrasions are possible. Injuries from hardware contaminated by sewage may also become infected. To avoid these hazards:

- Wear leather gloves when handling the hardware.
- Clean the mounting hardware between installations.

 **CAUTION**

Tests have shown that the 750 Module is affected by RF radiation such as that from radio and TV station towers that are located nearby. If sporadic changes in water level occur as indicated on the sampler's display, the instrument will have to be relocated. Walkie talkies or cell phones must not be operated within 3 meters (10 feet) of the instrument for the same reason.

- Abusive handling will damage the sensor. Although the sensor will survive normal handling and installation, treat the sensor with reasonable care. The internal components cannot be repaired.
- There is a vent tube inside the cable which must remain open. Do not kink the cable or overtighten the plastic ties while securing the cable.
- Install the Standard and Extended Range AV Sensors in flow streams where the liquid covers the sensor. These sensors detect levels above approximately 0.05 foot (0.6 inch or 15 mm) and velocities in streams with a minimum depth of 2 to 4 inches (50-100 mm).
- Install the Low Profile AV Sensors in streams where the liquid covers the sensor. Low Profile Sensors detect levels above approximately 0.033 feet (0.4 inch or 1.0 cm) and typically can measure velocities in streams as low as 0.08 ft (25 mm). Streams that run consistently below 1 inch are not a good application for the 750 and sensor.
- Velocity measurements depend on the presence of some particles in the stream; either air bubbles or suspended solids. If the stream lacks these particles, it may be necessary to aerate the water upstream from the sensor.
- You can install the sensor above the bottom of the flow stream or along the side of the channel, if the sensor will be continually submerged. The module can be calibrated to measure level with the sensor at nearly any depth. The sensor cannot, of course, measure a liquid level that falls below its position in the flow stream. Installing the sensor above the bottom has several advantages:
 - It avoids heavy concentrations of silt, sand, or other solids.
 - It aids installation in narrow or hard-to-reach locations.
 - It maximizes level resolution over a specific level range.
 - It can avoid obstructions in the flow stream.
- When the sensor is installed above the bottom of the channel, a "Zero Level Offset" must be entered during

programming. For more information, refer to Section 2.9, Offsets.

- Route and secure the sensor cable so that it does not collect debris or disturb the flow.
- You may use Teledyne Isco's vented 25 foot (7.6 m) extension cables to locate the sensor at greater distances from the sampler. You can combine vented extension cables, as long as the total cable length does not exceed 75 feet (22.8 m).

To locate the sensor more than 75 feet from the sampler and module, use the Area Velocity Sensor Quick Disconnect Box. The disconnect box increases the maximum distance between the module and the sensor to 1,000 feet (305 m).

2.2 Rectangular and Trapezoidal Channels

A flat, anchored mounting plate is a common mounting choice for installing sensors in rectangular or trapezoidal channels. See the *Isco Mounting Rings Installation and Operation Guide* for more information.

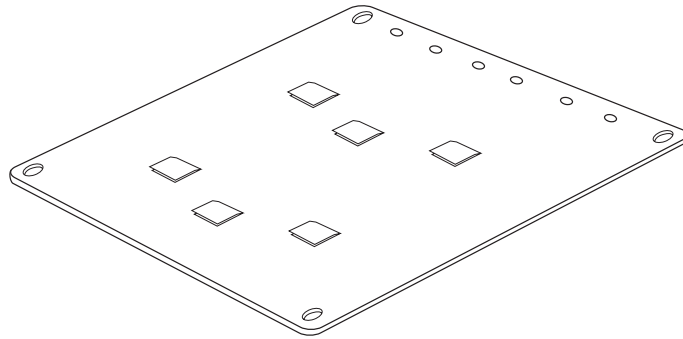


Figure 2-1 Isco Rectangular Mounting Plate

2.3 Mounting Rings for 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 the Sensor 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 **Scissor Rings (Universal Mounting Rings)**. Area velocity sensors can also be installed using primary measuring devices.

2.3.1 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 2-2.

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.

⚠ CAUTION

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.

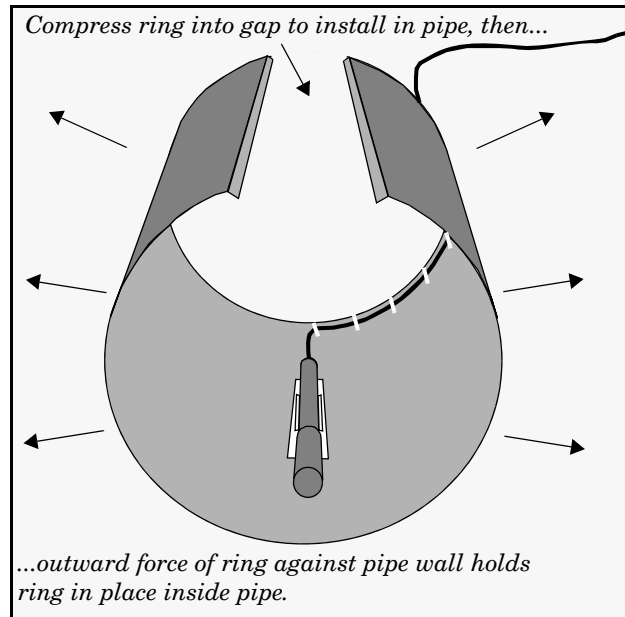


Figure 2-2 Sensor Installed on a Spring Ring

⚠ CAUTION

Make sure the slots on the sensor 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 sensor is not fully pressed onto the mounting ring tabs, it might come loose in the stream, and could possibly be damaged or lost.

Completing the assembly

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 2-2. 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.

 **CAUTION**

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.

2.3.2 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.

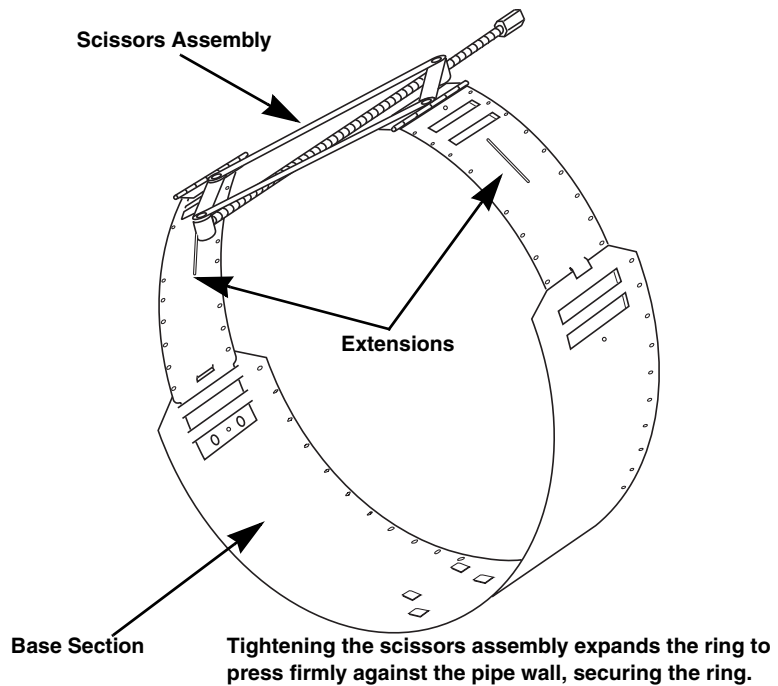


Figure 2-3 Scissors Ring Adjustment

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

2.3.3 Completing the AV Sensor Installation

The AV sensor 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 sensor cable should be handled and mounted with care. Also, if there is any appreciable distance between the point where the sensor cable leaves the mounting apparatus and the location of the flow meter, *be sure* to attach the cable to the flow stream wall to prevent it from vibrating, moving around, tangling, or possibly collecting debris.

 **CAUTION**

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.

2.4 Programming Notes

You must install the module before turning the controller on. When the controller is turned on, it looks for a module. The controller will not recognize a newly installed module if it is not seen during this power-up routine. If you install a module while the controller is already on, turn the controller off and then on again to reconfigure the controller for use with the module.

When the controller is configured with the module, it adds the necessary screens for programming. The screens appear in Figures 2-4 through 2-6. These figures outline the steps for module programming and calibration. For 6712 programming and general programming information, see the sampler manual.

2.4.1 Programmed Enable

When the 750 is installed, additional sampler enable options are available. If programmed for LEVEL ONLY, the additional options are LEVEL and VELOCITY. If programmed for FLOW METER, the additional options are LEVEL, VELOCITY, and FLOW. For more information about programmed enables, see the sampler manual.

2.5 Selecting a Site

The 750 is designed to measure flow in open channels without a primary device. A primary device is a hydraulic structure, such as a weir or a flume, that modifies a channel so there is a known relationship between the liquid level and the flow rate.

The area velocity module’s use is not limited to channels without a primary device. The software also supports installations where you must install the sensor with a primary device.

 **Note**

Primary devices limit the usefulness of the area velocity sensor’s readings. In most cases, levels and velocities near these devices do not represent what normally occurs in the channel. If you must use area velocity flow conversion, or if your interest is the stream’s velocity, do not install the sensor near a primary device. Move the sensor away to where the flow is unaffected.

When the sensor is installed without a primary device, find a section of channel with a minimum of disturbances to the flow. Avoid areas with elbows, outfalls, inverts, junctions, etc., that create turbulence near the AV sensor. The sensor should be located away from these disturbances to a point where the flow has stabilized. For best results, install the sensor where the flow is most uniform. Uniform flow is a condition where the water surface is parallel to the bottom of the channel.

If the sensor is installed in a primary measuring device, its location depends on the type of primary device. Most primary devices have a specific place for the head (level) measurement device. For more details about the location of the head measuring point, refer to the *Isco Open Channel Flow Measurement Handbook*, or to information provided by the manufacturer of the primary device.

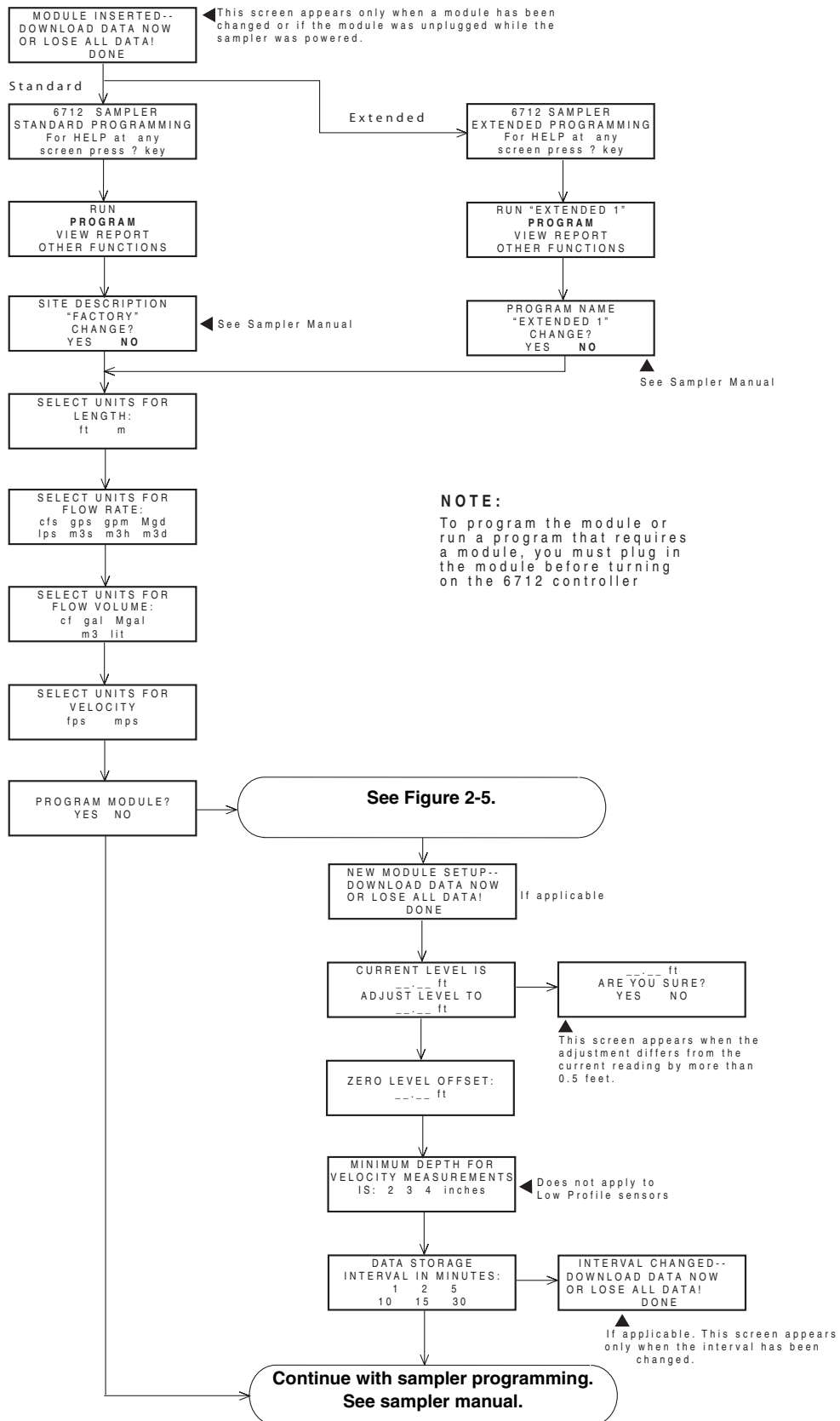


Figure 2-4 6712 Programming: 750 Module Screens

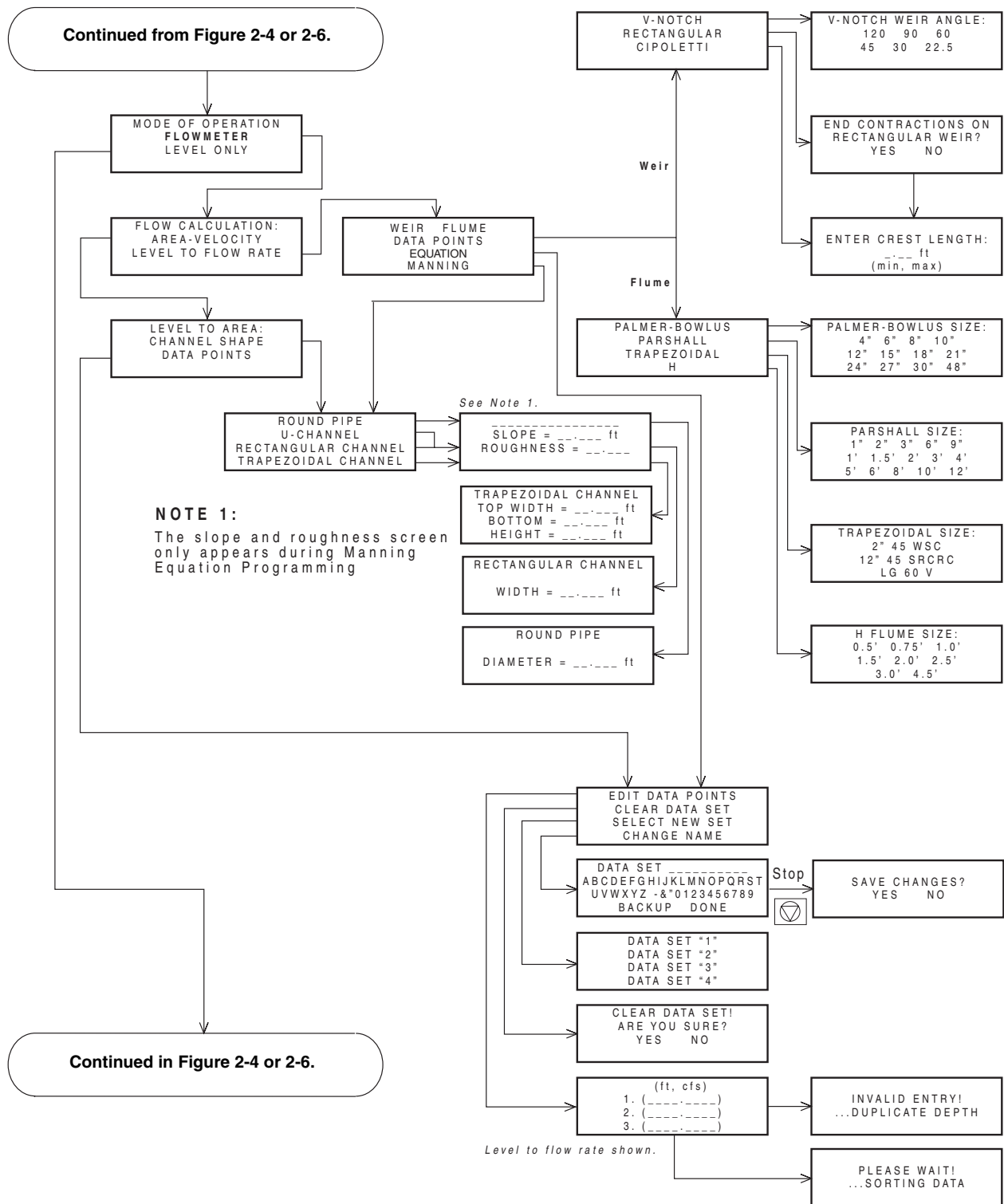
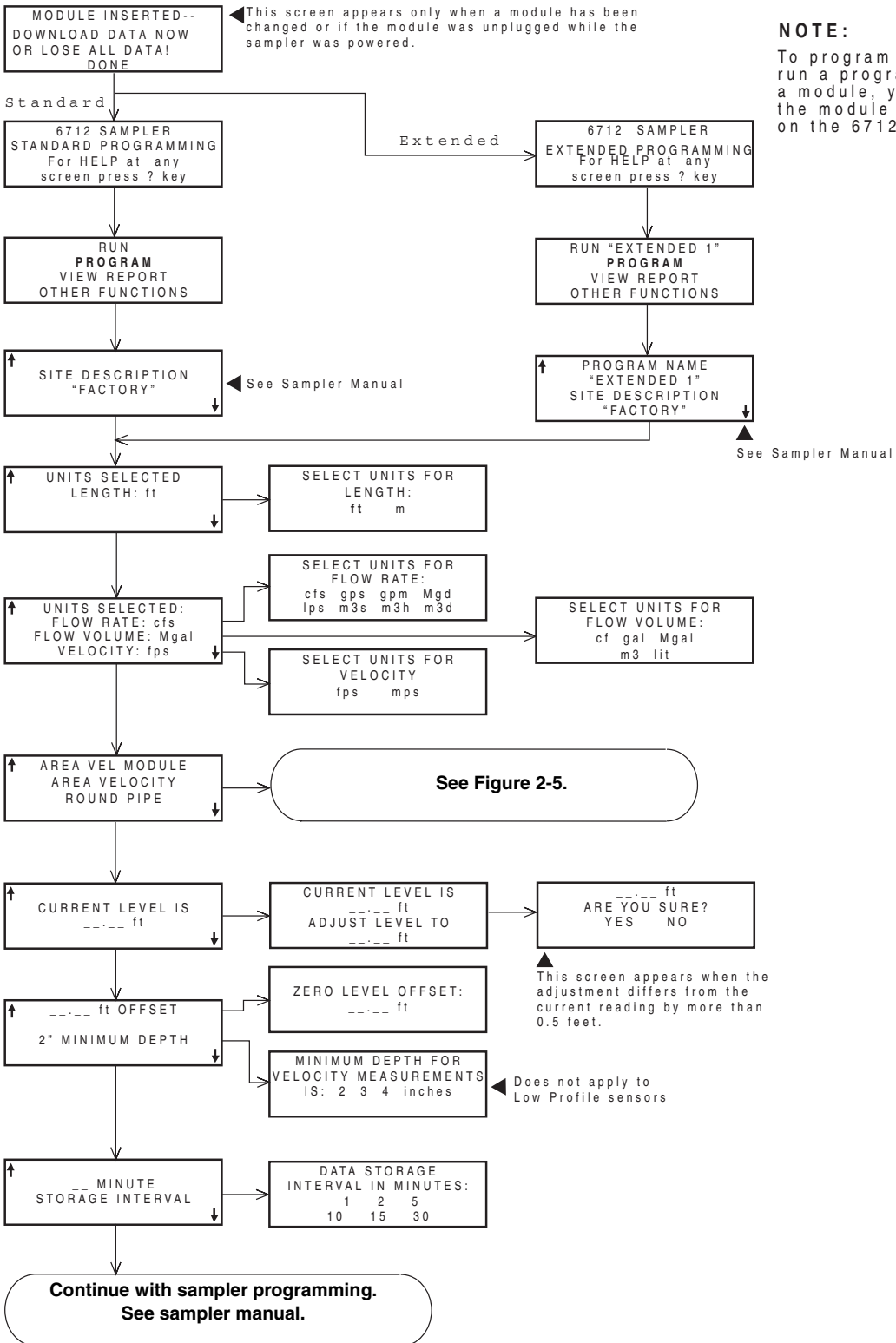


Figure 2-5 6712 Programming: 750 Module Setup Screens



NOTE:

To program the module or run a program that requires a module, you must plug in the module before turning on the 6712 controller

Figure 2-6 6712 Programming: 750 Module Quick View Screens

2.6 Selecting a Flow Conversion Method

The 750 is capable of determining flow rates using either area velocity conversion or level-to-flow rate conversion. A list of available flow conversions appears in Table 2-1, Flow Conversion Methods.

Table 2-1 Flow Conversion Methods

Conversion Type		Device, Formula, or Table	Size or Parameters
Area-Velocity	Channel Shape	Area × Velocity	Round Pipe, U-Channel, Rectangular, Trapezoidal
	Level-to-Area Data Points	User-developed Table	3 to 50 data points
Level to Flow	Weir	V-Notch Weir	22.5, 30, 45, 60, 90, 120 degrees
		Rectangular Weir with end contractions	Crest Length
		Rectangular Weir without end contractions	Crest Length
		Cipoletti Weir	Crest Length
	Flume	Palmer-Bowlus Flume	4, 6, 8, 10, 12, 15, 18, 21, 24, 27, 30, 48 inches
		Parshall Flume	1, 2, 3, 6, 9 inches 1, 1.5, 2, 3, 4, 5, 6, 8, 10, 12 feet
		Trapezoidal Flume	Large 60-degree V 2-inch, 45-degree WSC 12-inch, 45-degree SRCRC
		“H” Flume	0.5, 0.75, 1, 1.5, 2, 2.5, 3, 4.5 feet
	Equation	$Q = a \times H^{b+c} \times H^d$	Q = flow H = head a, b, c, & d = entered values
	Level-to-Flow Rate Data Points	User-developed tables for level-to-flow rate	3 to 50 data points
	Manning Equation	Round Pipe	Slope, Roughness, Diameter
		U-Channel Pipe	Slope, Roughness, Width
		Rectangular Pipe	Slope, Roughness, Width
Trapezoidal		Slope, Roughness, Bottom Width, Top Width	

2.6.1 Flow Conversion Without a Primary Device

There are several conversion options if you install the sensor in a channel without a primary device. The method you choose depends on the channel shape or the amount of information available to define the channel's characteristics.

Area velocity flow conversion is the method of choice for round pipe, U-channel, rectangular, and trapezoidal channels. Non-standard channels can still use area velocity flow conversion, but

you must provide at least three level-to-area data points. The data points define the cross-sectional area of the channel at various levels.

2.6.2 Flow Conversion With a Primary Device

The software supports level-to-flow conversion for many common weirs and flumes. Refer to Table 2-1. If your primary device is not listed, use a level-to-flow rate data set. A data set requires at least three data points to specify the level-to-flow rate relationship of your device. This information is normally available from the manufacturer of the primary device.

The software also supports level-to-flow conversion using the Manning formula. To use the Manning formula you must be able to provide the channel slope, a roughness coefficient, and a channel diameter or width. For more information on the Manning formula, refer to the *Isco Open Channel Flow Measurement Handbook*.

2.7 Measurements for Programming

At a minimum, module programming requires a level measurement and a zero level offset. The standard and extended range AV Sensors will also require a minimum depth for velocity measurement. Depending on the selected flow conversion method, you may also need to enter channel dimensions or data points.

The accuracy of the values you enter during programming directly affect your flow conversion results. These values can include the level adjustment, channel dimension measurements, zero level offset, and data points. All subsequent module calculations will be based upon these values.

Significant errors may be introduced if your measurements are inaccurate. We recommend that you take actual measurements from the installation site - do not use nominal values. The example below illustrates the importance of accurate measurements.

Example:

Nominal Pipe Diameter: 10 inches

Actual Pipe Diameter: 10.25 inches

Level Measured Near Outfall: 2.75 inches

Correct Level Measurement: 3 inches

During programming, you enter 10 inches for the round pipe diameter - from the pipe manufacturer's specification. You also enter the 2³/₄-inch level measurement taken behind the sensor near an outfall. Although each value has only a ¹/₄-inch error, the cumulative flow measurement error may exceed 14%!

2.8 Levels and Channel Dimensions

Channel dimensions and level measurements can vary at different points along the channel. It is important to use measurements from the same point that the AV sensor reads the velocity and level. An ultrasonic sound wave is transmitted in a cone-shaped pattern from the front of the sensor. Your level measurement should be taken at a point inside the ultrasonic cone. Since this cone cannot be seen, a general rule is to measure in front of the sensor along the channel centerline at a distance equal to the liquid depth. For example, if the stream is one foot deep, take the level and channel dimension measurements one foot upstream from the sensor. If the flow at this point is turbulent, consider relocating the sensor.

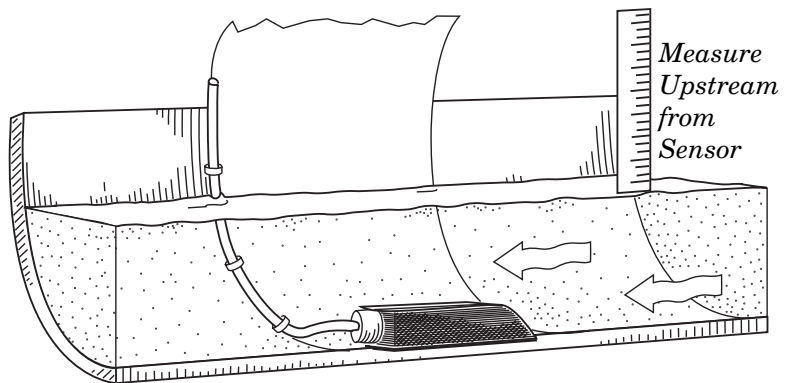


Figure 2-7 Ideal Conditions - Uniform Flow

Do not measure the level and channel dimensions right at the sensor, as the sensor and the mounting ring may cause a slight "jump" or localized rise in the level. At very low levels and high velocities, this jump in the liquid surface may become quite significant. Figure 2-8 shows very poor area velocity measurement conditions. The outfall is drawing down the liquid level and the sensor is disturbing the flow. In this example, the sensor should be moved forward to avoid the drawdown near the outfall. If the jump still exists, average several level measurements or measure the level with the sensor and mounting hardware out of the stream.

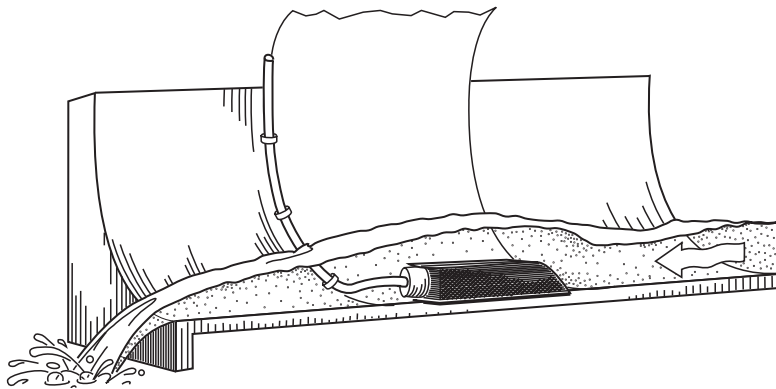
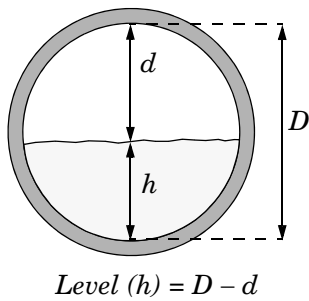


Figure 2-8 Poor Conditions - Disturbed Flow



In round pipes it is possible to measure the level without disturbing the stream surface. This method is preferred. Refer to the diagram in the margin. First measure the inside diameter of the pipe (D). Then measure the airspace (d) from the liquid surface to the peak of the inside diameter. Average this measurement if the surface is not calm. The level measurement that you enter (h) is calculated by subtracting the distance above the liquid (d) from the diameter (D).

2.9 Offsets

Sensors are sometimes offset to avoid heavy concentrations of silt, or to maximize the level resolution over a specific range. During module programming, you enter an offset measurement. Refer to Figure 2-9. Enter a value for the vertical distance the sensor is installed above the true zero level of the stream. For example, if the sensor is mounted on the side of the pipe one foot higher than the true zero level (the bottom center of the pipe), the Zero Level Offset is one foot. If the sensor is mounted at the bottom of the channel, enter zero.

Note

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

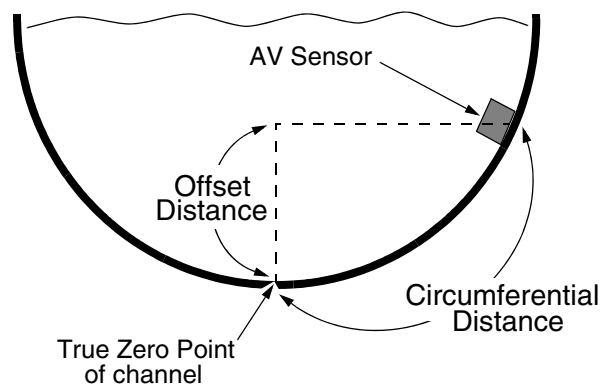


Figure 2-9 Offset Measurements

2.10 Data Points

Data point flow conversion is based on a set of user entered values that define the channel or primary device. A data set is a table of correlating level-to-area or level-to-flow rate data points. The module can interpolate areas or flow rates for all levels using this data set.

The sampler saves up to four different data sets. Each data set holds a minimum of 3 points and a maximum of 50.

The flow conversion accuracy increases with the number of points entered. Keep in mind that you are defining the entire channel shape mathematically; select points that best represent any curves or variations. Compound shapes will need many data points.

The module automatically calculates the maximum head and the flow rate at maximum head. The maximum head is 1.2 times the highest data point entered. For example, the module would calculate a 0.96-foot maximum head if the highest data point was 0.8 feet. The module extrapolates the flow rate at maximum head using the flow curve established by your data set.

To use **Level-to-Area** data points, you must enter at least three data points. Each data point entry contains two values – a level and the cross-sectional area of the channel at that level.

To use **Level-to-Flow** data points, you must enter at least three data points. Each data point entry contains two values – a level and the corresponding flow rate for that level.

Data point entries must use the same units of measure programmed for the sampler's length and flow rate units.

2.11 Minimum Depth for Velocity Measurements

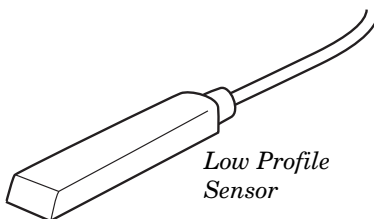
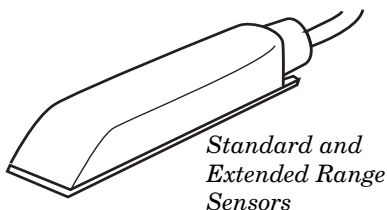
The Minimum Depth is the minimum level of liquid above the bottom of the sensor that is required to obtain a valid velocity reading. The depth varies with the velocity of the flow stream; in the same stream at higher velocities, the depth is greater. Velocity readings taken at too-shallow levels may be inaccurate.

The Minimum Depth setting allows you to program the level below which the module will stop taking velocity readings. When the water level falls below Minimum Depth, the 6712 will display the most recent valid velocity reading, followed by an asterisk (*), and the flow rate will be shown as "0". The asterisk means the velocity information has not been updated; it will disappear when the water rises above Minimum Depth and the module begins to take new readings.

Standard Velocity Sensors – Three selections are available for the Minimum Depth for Standard 10-foot and 30-foot range velocity probes: 2, 3, or 4 inches (50, 75, or 100 mm). In most installations, the 3-inch setting will be the optimum selection. You can use the 2-inch option when the channel produces flows of very low velocity. If, after examining the velocity data, you see a sharp decrease in velocity as the level readings approach Minimum Depth, increase the setting to 3 or 4 inches.

Low Profile Velocity Sensors – For Low Profile probes, the 6712 does not have a menu selection for Minimum Depth. Instead, the Minimum Depth is automatically set to 1 inch.

Probe Identification – When a probe is first connected, the 750 module will not know whether it is a Standard or Low-Profile until it takes a velocity reading. Since the 6712 only retrieves the module status (including probe type) at start-up, it will have to be re-started in order to display the correct probe information.



Measure from bottom of sensor when determining minimum depth setting.

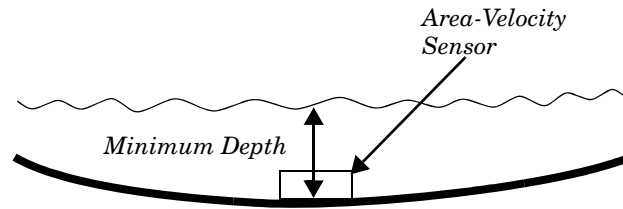


Figure 2-10 Determining Minimum Depth

2.12 Sampler Run Time Screens

```
BOTTLE 2
AFTER 702.1 cf
1.251 cfs  0.82 ft
00000002898 cf
```

```
BOTTLE 2
AFTER 700.8 cf

2.32 fps  0.82 ft
```

```
BOTTLE 2
AFTER 699.6 cf
SIGNAL STRENGTH: 85%
SPECTRUM: 63%
```

While running a sampling program, the sampler displays a variety of messages reporting the program's status. The 750 adds measurement and diagnostic information to these displays. Measurement information includes level, velocity, flow rate, and total flow. The spectrum and signal strength readings are diagnostic aids to help determine if the sensor is operating properly. Percentages near 100 indicate a strong, clear return signal. If both readings are zero, the sensor may not be plugged in, operating, or receiving a signal. Low signal strength or spectrum readings can indicate problems with the sensor, installation, or the characteristics of the flow stream.

The signal strength percentage represents the approximate strength of the return signal. Percentages from 10 to 90 are normal, and percentages from 50 to 90 are typical for sewers. Return signals below 10 percent are weak and the module may have difficulty measuring the stream velocity.

The spectrum percentage represents the approximate amount of noise in the return signal. The typical range of readings for most installations is from 40 to 90 percent. Percentages below 25 indicate a noisy return signal.

2.13 Data Storage

When the sampler is configured for use with the module, a memory partition is reserved. The module readings are stored in this sampler memory partition. For more information on data storage and partition management, see the sampler manual.

2.13.1 Recovering Module Data

The stored module data can be collected or viewed as "reports." Three of the sampler reports contain module information. Refer to the 6712 Sampler Instruction Manual for details on collecting and reading the reports.

Module data is compatible with Flowlink® 3 or 4 software. Flowlink provides additional data reporting options. See the Flowlink Instruction Manual for more information.

Note

An * (asterisk) appears next to the reading if the module was unable to take a reading. If an asterisk appears, the reading displayed is the last available reading.

750 Area Velocity Module
Section 2 Installation and Programming Basics

SAMPLER ID# 2215220899 08:55 22-FEB-03
***** PROGRAM SETTINGS *****

SITE DESCRIPTION:

"FACTORY "

UNITS SELECTED:

LENGTH: ft

UNITS SELECTED:

FLOW RATE: cfs

FLOW VOLUME: Mgal

VELOCITY: fps

AREA-VEL MODULE:

AREA*VELOCITY

ROUND PIPE

0.000 ft OFFSET

3" MINIMUM DEPTH

1 MINUTE

DATA INTERVAL

24, 1000 ml BTLs

10 ft SUCTION LINE

PACING:

FLOW, EVERY

0.075 Mgal

DISTRIBUTION:

SEQUENTIAL

200 ml SAMPLES

NO DELAY TO START

RUN PROGRAM ONCE

Figure 2-11 Report: Program Settings

750 Area Velocity Module
Section 2 Installation and Programming Basics

SAMPLER ID# 2215220899 08:56 22-FEB-03

AREA-VEL MODULE: 1365
SITE: FACTORY

Summary Report for 21-FEB-03 (FR)

Day's Flow: 003.930582 Mgal
Average Flow Rate: 19.46 cfs
20:06 Minimum Flow Rate: 2.456 cfs
20:10 Maximum Flow Rate: 33.16 cfs

Hourly Average Flow Rate
00:00-01:00: NO DATA
01:00-02:00: NO DATA
02:00-03:00: NO DATA
03:00-04:00: NO DATA
04:00-05:00: NO DATA
05:00-06:00: NO DATA
06:00-07:00: NO DATA
07:00-08:00: NO DATA
08:00-09:00: NO DATA
09:00-10:00: NO DATA
10:00-11:00: NO DATA
11:00-12:00: NO DATA
12:00-13:00: NO DATA
13:00-14:00: NO DATA
14:00-15:00: NO DATA
15:00-16:00: NO DATA
16:00-17:00: 19.57 cfs
17:00-18:00: 19.58 cfs
18:00-19:00: 19.58 cfs
19:00-20:00: 19.58 cfs
20:00-21:00: 19.32 cfs
21:00-22:00: 19.30 cfs
22:00-23:00: 19.40 cfs
23:00-24:00: 19.38 cfs

SAMPLER ID# 2215220899 08:56 22-FEB-03

AREA-VEL MODULE: 1365

***** COMBINED RESULTS *****

SITE: FACTORY

Program Started at 16:36 FR 21-FEB-03

Nominal Sample Volume = 200 ml

				FLOW RATE	TOTAL FLOW
				cfs	Mgal
SAMPLE	BOTTLE	TIME			
19.60	+	+	+		
	I			35.34	000.075006
	I	###	I	28.27	000.149821
	I	####	I	21.20	000.224477
	I	####	I	35.34	000.299454
19.55	+	####	+	35.34	000.374269
	I	####	I	28.27	000.448872
	I	####	I	10.01	000.523683
	I	####	I	35.34	000.598452
19.50	+	####	+	28.27	000.673267
	I	####	I	21.20	000.748082
	I	####	I	2.062	000.822872
19.45	+	####	+	35.34	000.897662
	I	####	I	28.27	000.972477
	I	####	I	21.20	001.047398
	I	####	I	35.34	001.122110
19.40	+	####	# +	35.34	001.197002
	I	####	# I	28.27	001.271764
	I	####	## I	10.01	001.346536
	I	####	## I	35.34	001.421397
19.35	+	####	##+	28.27	001.496106
	I	####	## I	21.20	001.570922
	I	####	## I	2.062	001.645719
19.30	+	#####	##+	35.34	001.720660
	I	#####	##+	28.27	001.795369
Hour Ending:		08:	16:	24:	
		Units are 'cfs'			

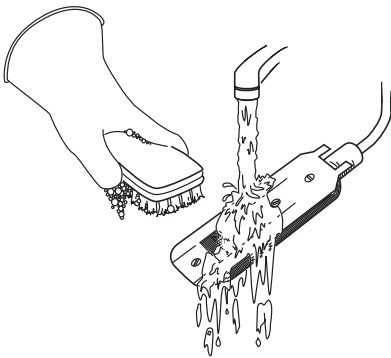
Figure 2-12 Summary Report (left) and Combined Results (right)

750 Area Velocity Module

Section 3 Maintenance

The area velocity sensor and cable require little maintenance. Because the sensor body offers a streamlined profile to the flow, solid materials rarely collect on the sensor. However, clean the channel up- and downstream from the sensor periodically. This maintains the hydrostatic conditions on which the level-to-area conversion is based.

3.1 Cleaning



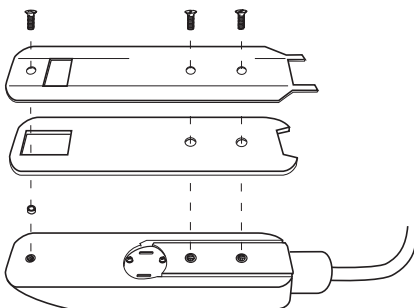
If the flow stream carries a great deal of debris, beware of organic materials that may collect inside the sensor. This material swells as it becomes saturated with water and may exert pressure on the transducer diaphragm inside the sensor. This can damage the diaphragm and permanently disable the sensor.

If the liquid ports in the sensor become blocked, clean the sensor. Cleaning the sensor not only protects it from damage, but assures you that the sensor will respond to the hydrostatic pressure above the sensor instead of the pressure created by swollen material inside.

1. Remove the sensor from its mounting ring or strap.
2. Scrape any accumulated solids off the exterior of the sensor. Use a brush and flowing water.

If the ports are thoroughly blocked or if you need to clean the sensor for storage, continue with steps 3 through 6 for standard and extended range sensors, 5 and 6 for low profile sensors.

3. Remove the mounting plate by unscrewing the three screws that hold the plate in place.
4. Carefully pull the mounting plate and urethane foam gasket away from the sensor.
5. Gently flush the sensor with water to remove any solid materials.
6. The pressure transducer is behind the small, round plate on the bottom of the sensor. *Gently* flush the transducer cavity with water to remove debris. *Do not remove the disk protecting the pressure transducer.*



3.2 Cable Inspection

Periodically inspect the sensor cable and connector for wear caused by abuse or exposure to the elements. A damaged cable can affect the operation of the sensor, particularly if the reference port vent tube inside the cable is collapsed or blocked. In some cases, a damaged connector can be replaced, but damaged cables cannot be spliced or repaired.

 **CAUTION**

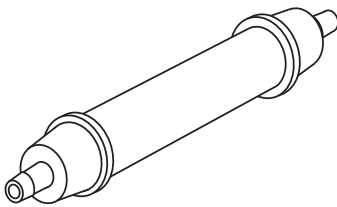
Do not allow the connector end of the probe cable to fall into water, or leave it disconnected without the plastic cap in place. Failure to do so can result in permanent internal water damage to both probe and module.

If the sensor cable is damaged, you must replace the entire assembly, as the sensor, cable, and connector are a factory-sealed unit. Keep the connector clean and dry. In permanent installations, install the cable so that it is not at risk of damage resulting from other activity taking place in the area.

In temporary installations, do not leave cables lying around where they may be run over by heavy equipment. Do not leave extra cable loose in the flow stream where it can trap debris.

In permanent installations, cables repeatedly subjected to abuse will fail and should be installed in conduit for protection. The conduit must be large enough to pass the connector, as you cannot remove or replace it.

3.3 Desiccant Reactivation



Desiccant Cartridge

There is a cartridge on the side of the module to dry the reference air. It contains a silica gel desiccant with a color indicator that changes from blue to pink, or yellow to green, when saturated. Pink or green desiccant cannot remove moisture and must be replaced or reactivated.

 **CAUTION**

Desiccant may produce irritating fumes when heated. Observe the following precautions:
Use a vented oven in a well-ventilated room.
Do not remain in the room while the regeneration is taking place.
Use the recommended temperature. Avoid heating the desiccant at higher than recommended temperatures.

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

To reactivate the desiccant, pour it out of the cartridge into a heat-resistant container. Never heat the plastic cartridge. Heat the silica gel in a vented convection oven at 212° to 350° F (100° to 175° C) for two to three hours, or until the blue or yellow color

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

The foam filters in the end caps keep small pieces of desiccant from falling out of the cartridge. When they become soiled, wash with dish soap and water, then allow to dry.

 **Note**

A saturated desiccator will let moisture into the reference tube. The moisture may block the tube and cause reading errors and internal damage. Also, the air in many installations contains fumes that will form acids in the presence of moisture. These acids may corrode internal components.

3.4 Repair of the Module and Probe

The module has no user-serviceable parts. Its case is completely sealed to protect the internal components. To repair the unit, the case must be broken open and replaced.

The velocity sensor's pressure transducer, the ultrasonic transducers, cable, and the electronic components are encapsulated in plastic resin and are not user-serviceable.

If you think your module or probe requires repair, contact Teledyne Isco's Customer Service Department at 800-228-4373 for information on returning it to the factory.

3.5 How to Get Help

If you need help or have repair questions, contact Teledyne Isco's Technical Service department.

Teledyne Isco Technical Service Department

P.O. Box 82531

Lincoln, Nebraska, 68501 (USA)

E-mail: IscoService@teledyne.com

Telephone: (402) 464-0231

Toll Free: 800-775-2965 (Within USA, Canada, and Mexico)

FAX: (402) 464-3001

3.6 Flash Memory and Software Upgrades

The module has Flash memory to store its software. With Flash technology, you can upgrade your module's software without sending it back to the factory or replacing a chip. To update the module software, install the module in a 6712 sampler. Then connect the sampler power source and turn the sampler on. Connect the sampler to a computer and follow the instructions received with your Flash Update program.

750 Area Velocity Module

Appendix A Replacement Parts and Accessories

The following appendix contains the most commonly ordered parts and accessories for the 750 module, including part descriptions and order numbers.

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

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

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

E-mail: IscoInfo@teledyne.com

A.1 Sensors

AV Sensor 10' range (with 25' cable)	60-3254-001
AV Sensor 30' range (with 50' cable)	60-3254-003
Low Profile AV Sensor 10' range (with 25' cable)	60-3254-021

A.2 Standard Spring Rings

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 cable)

A.3 Standard Scissors Rings

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 (with plastic ties & instructions)	60-3004-169
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A.4 Street Level Installation System

Multi-section Pole.	60-3204-012
<i>(Includes instruction manual. To complete your system, you must also order a Street Level Mounting Ring)</i>	
Street Level Mounting Ring for 6" dia. pipe.	60-3204-014
Street Level Mounting Ring for 8" dia. pipe.	60-3204-015
Street Level Mounting Ring for 10" dia. pipe.	60-3204-016
Street Level Mounting Ring for 12" dia. pipe.	60-3204-017
Street Level Mounting Ring for 15" dia. pipe.	60-3204-018

A.5 Miscellaneous

Sensor Mounting Plate	68-3000-051
<i>(Includes plastic ties and instructions)</i>	
L.P. AV sensor carrier	60-3204-029
<i>(adapter to fit the low profile sensor on standard size rings)</i>	
Desiccant Cartridge Assy	60-9004-105
Area velocity sensor extension cable.	60-3254-005
Quick Disconnect Box	60-3254-004
Isco Open Channel Flow Measurement Handbook	60-3003-041

750 Area Velocity Module

Appendix B Material Safety Data Sheets

This appendix to the manual provides Material Safety Data Sheets for the desiccant used by the 750 Area Velocity Module.

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

Material Safety Data Sheet

Indicating Silica Gel

Identity (Trade Name as Used on Label)

Manufacturer : MULTISORB TECHNOLOGIES, INC. (formerly Multiform Desiccants, Inc.)	MSDS Number* : M75
Address: 325 Harlem Road Buffalo, NY 14224	CAS Number* :
Phone Number (For Information): 716/824-8900	Date Prepared: July 6, 2000
Emergency Phone Number: 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 RECOMMENDED
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 Point	N/A	Specific Gravity (H ₂ O = 1)	2.1
Vapor Pressure (mm Hg and Temperature)	N/A	Melting Point	N/A
Vapor Density (Air =1)	N/A	Evaporation Rate (_____ =1)	N/A
Solubility in Water	Insoluble, but will adsorb moisture.	Water Reactive	Not reactive, but will adsorb moisture.
Appearance and Odor	Purple crystals, no 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
Extinguisher Media	Dry chemical, carbon dioxide and foam can be used.						
Special Fire Fighting Procedures	Water will generate heat due to the silica gel which will adsorb water and liberate heat.						
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 <input type="checkbox"/> Stable <input type="checkbox"/> Unstable	Conditions To Avoid	Moisture and high humidity environments.
Incompatibility (Materials to Avoid)	Water.	
Hazardous Decomposition Products	Carbon dioxide, carbon monoxide, water	
HAZARDOUS POLYMERIZATION <input type="checkbox"/> May Occur	Conditions To Avoid	None.

*Optional

Indicating Silica Gel

Section 5 - Health Hazard Data	
PRIMARY ROUTES OF ENTRY	<input type="checkbox"/> Inhalation <input type="checkbox"/> Ingestion <input type="checkbox"/> Skin Absorption <input type="checkbox"/> Not Hazardous
HEALTH HAZARDS	CARCINOGEN LISTED IN <input type="checkbox"/> NTP <input type="checkbox"/> OSHA <input type="checkbox"/> IARC Monograph <input type="checkbox"/> Not Listed Acute May cause eye, skin and mucous membrane irritation. Chronic Prolonged inhalation may cause lung damage.
Signs and Symptoms of Exposure	Drying and irritation.
Medical Conditions Generally Aggravated by Exposure	Asthma.
EMERGENCY FIRST AID PROCEDURES - Seek medical assistance for further treatment, observation and support if necessary.	
Eye Contact	Flush with water for at least 15 minutes.
Skin Contact	Wash affected area with soap and water.
Inhalation	Remove affected person to fresh air.
Ingestion	Drink at least 2 glasses of water.

Section 6 - Control and Protective Measures	
Respiratory Protection (Specify Type)	Use NIOSH approved dust mask or respirator.
Protective Gloves	Light cotton gloves.
Eye Protection	Safety glasses.
VENTILATION TO BE USED	<input type="checkbox"/> Local Exhaust <input type="checkbox"/> Mechanical (General) <input type="checkbox"/> Special <input type="checkbox"/> Other (Specify)
Other Protective Clothing and Equipment	None.
Hygienic Work Practices	Avoid raising dust. Avoid contact with skin, eyes and clothing.

Section 7 - Precautions for Safe Handling and Use/Leak Procedures	
Steps to be Taken if Material Is Spilled Or Released	Sweep or vacuum up and place the spilled material in a waste disposal container. Avoid raising dust.
Waste Disposal Methods	Dispose in an approved landfill according to federal, state and local regulations.
Precautions to be Taken In Handling and Storage	Cover promptly to avoid blowing dust. Wash after handling.
Other Precautions and/or Special Hazards	Keep in sealed containers away from moisture. The silica gel will readily adsorb moisture.

*Optional

Indicating Silica Gel



MATERIAL SAFETY DATA SHEET

Effective Date March 8, 2005
MSDS Number M163

Section 1 – Product and Company Information

Product Name: Silica gel, indicating, yellow

Product Use: Desiccant, absorbent

Grades: Silica gel, indicating

Synonyms: Amorphous silica gel, SiO₂, 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 Health 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/Carcinogenicity: 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 Flammability Limit:** Not applicable
- Upper Flammability 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 gloves will protect against abrasion and drying of the skin.
- Eye Protection:** Safety glasses.

Component Name	Exposure Limits		
	OSHA PEL	ACGIH TLV	Other Recommended Limits
Silica gel	TWA 20 mppcf (80 mg / m ³ % SiO ₂)	TWA 10 mg / m ³	NIOSH REL TWA 6 mg / m ³ IDLH 3000 mg / m ³
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:** Stable
- Conditions to avoid:** Moisture and high humidity environments.
- Incompatibility:** Water, fluorine, oxygen difluoride, chlorine trifluoride
- Hazardous Decomposition Products:** None
- Hazardous Polymerization:** Will not occur

Section 11 – Toxicological Information

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

Animal Toxicology Tests for DOT Hazard classification
(Tests Conducted on finely ground silica gel)
1 - hour LC₅₀ (rat) > 2 mg / l
48 - hour oral LD₅₀ (rat) est. > 31,600 mg / kg
48 - hour dermal LD₅₀ (rabbit) est. > 2,000 mg / kg
Considered an ocular irritant

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 mg / m³ % SiO₂) 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 / m³ for Silica gel

DOT: Not classified as a hazardous material.

Section 16 – Other Information

HMIS – Hazardous Materials Identification System

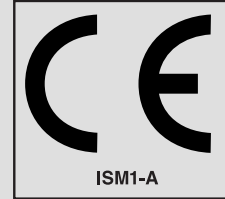
HMIS Rating	
Health	0
Flammability	0
Reactivity	0

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.

DECLARATION OF CONFORMITY



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

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

Equipment Type/Environment: Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No: 750 Area Velocity Probe Module
Year of Issue: 2001

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

Standard	Description	Severity Applied	Performance Criteria
EN61000-4-2	Electrostatic Discharge	Level 2 - 4kV contact discharge Level 3 - 8kV air discharge	B B
EN61000-4-3 *	Radiated RF Immunity	80 MHz to 1000MHz 80% AM at 1kHz Level 1 - 10V/m	A
EN61000-4-4	Electrical Fast Transient	Level 2 - 2kV on ac lines	B
EN61000-4-5	Surge on AC Lines	2kV common mode, 1KV differential mode	B
EN61000-4-6 *	Conducted RF on AC lines	150 kHz to 80 MHz, 3V rms, 80% modulated	B
EN61000-4-11	Voltage Dips/Short Interruptions	0.5 cycle, each polarity/100%	B
CISPR11/ EN 55011	RF Emissions	Group 1, Class A Industrial, Scientific, and Medical Equipment	
EN61000-3-2, 3-3	Harmonic, Flicker		

* Instrument is susceptible to 10V/M from 80MHz to 1000 MHz and 3 VRMS from 150 KHz to 80 MHz
We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of March 6, 2001.

William Foster
USA Representative



Williams Foster
Director of Engineering
Teledyne Isco, Inc.
4700 Superior Street
Lincoln, Nebraska 68504

Phone: (402) 464-0231
Fax: (402) 464-4543

60-9002-069
Rev. A

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)

Fax: (402) 465-3001

Email: iscoservice@teledyne.com **Web site:** www.isco.com



