750 Area Velocity Module

Installation and Operation Guide

Part #60-9003-465

Revision E, January, 2003

Isco, Inc.

Foreword

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

Although 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 email the Isco Customer Service Department for assistance. Contact information is provided below. 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.

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

Contact Information

Phone:	(800) 228-4373	(USA, Canada, Mexico)
	(402) 464-0231	(Outside North America)
Repair Service:	(800) 775-2965	(Analytical and Process Monitoring Instruments)
	(800) 228-4373	(Samplers and Flow Meters)
Fax:	(402) 465-3022	
Email address:	info@isco.com	
Website:	www.isco.com	
Return equipment to:	4700 Superior Street, Lincoln, NE 68504-1398	
Other correspondence:	P.O. Box 82531, Lincoln, NE 68501-2531	

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:

⚠ WARNING

Liquids associated with this instrument may be classified as carcinogenic, biohazard, flammable, or radioactive. Should these liquids be used, it is highly recommended that this application be accomplished in an isolated environment designed for these types of materials in accordance with federal, state, and local regulatory laws, and in compliance with your company's chemical/hygiene plan in the event of a spill.

⚠ AVERTISSEMENT

Eviter de répandre des liquides dangereux. Les liquides qui sont analysés dans cet instrument peuvent être cancérigènes, hasards biologiques, inflammables, ou radioactifs. Si vous devez utiliser tels liquides, il est très recommandé que vous le faites à l'intérieur d'un environnement isolé conçu pour tels liquides. Cet environnement isolé devrait être construit selon les règlements fédéraux, provinciaux, et locaux, aussi que le plan de votre compagnie qui concerne l'évènement d'un accident avec les matières hasardeuses.

⚠ WARNING

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

⚠ AVERTISSEMENT

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

⚠ WARNING

If this system uses flammable organic solvents, Isco recommends that you place this system in a well-ventilated environment, designed for these types of materials. This environment should be constructed in accordance with federal, state, and local regulations. It should also comply with your organization's plan concerning chemical and

hygiene mishaps. In all cases use good laboratory practices and standard safety procedures.

⚠ AVERTISSEMENT

Ce système peut utiliser des dissolvants organiques inflammables. Pour réduire le péril qui peut être causé par l'accumulation des vapeurs explosives, Isco recommande que vous installez ce système dans un environnement bien-aéré qui est conçu pour les matières hasardeuses. Cet environnement devrait être construit selon les règlements fédéraux, provinciaux, et locaux. Aussi, il devrait se conformer au plan de votre organisation qui concerne les mésaventures de l'hygiène ou de chimique. En tout cas, utilisez toujours de pratiques bonnes de la laboratoire et des procédures standardes de la sûreté.

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.

750 Area Velocity Module

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750 Area Velocity Module

Section 1 Introduction

1.1 Overview

The Model 750 Area Velocity Module is one of Isco's interchangeable modules for the 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.

The Technical Specifications for each sensor can be found in Tables 1-2 and 1-3.

⚠ WARNING

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 Technical Specifications

The technical specifications for the 750 module and Standard and Low Profile probes are listed in the following tables.

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: ±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 Extended Range	2.1 lbs (.96 kg) 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
Cable Length Standard Range Extended Range	25 ft (7.6 m) 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 Extended Range	 0.05 to 10.0 ft (0.015 to 3.05 m) 0.05 to 30.0 ft (0.015 to 9.14 m)

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

Table 1-3 Technical Specifications for the Low Profile AV Sensor (Continued)	
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.

1.3 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.

1.4 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.

1.4.1 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.

1.4.2 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.

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 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 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.

2.2 Programming Notes

You should 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 2-1 through 2-3. These figures outline the steps for module programming and calibration. For 6712 programming and general programming information, see the sampler manual.

2.2.1 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.

2.3 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.

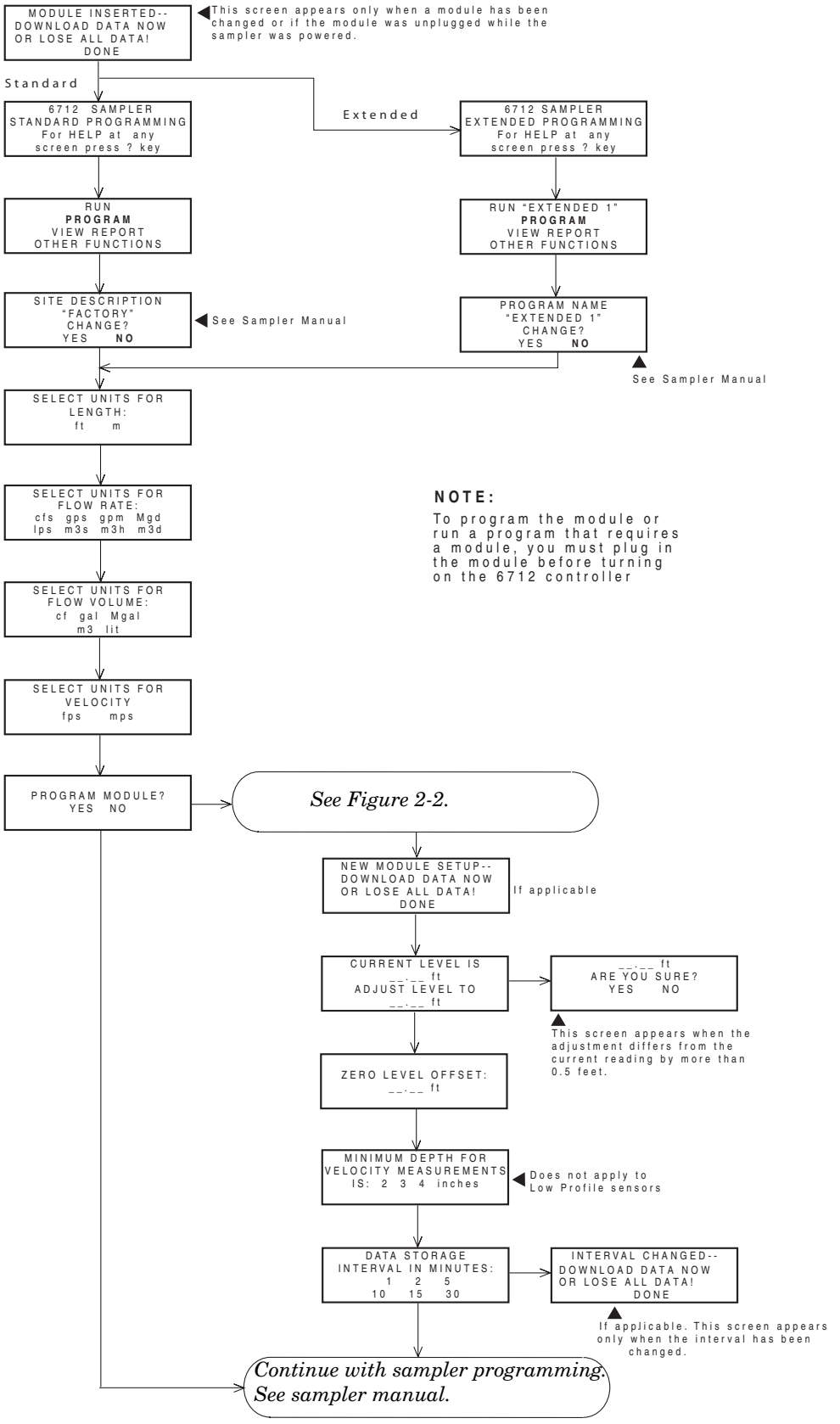


Figure 2-1 6712 Programming: 750 Module Screens

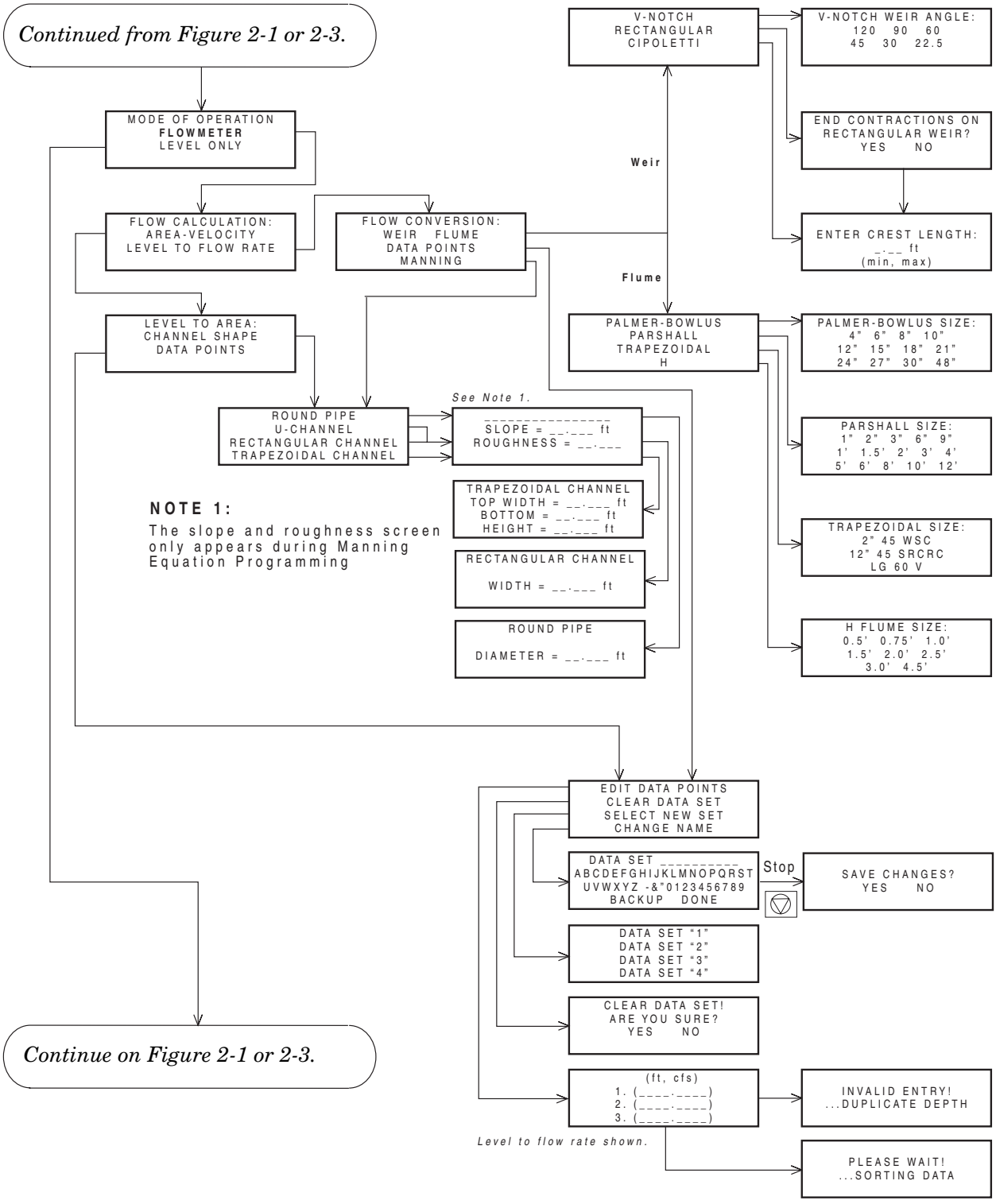
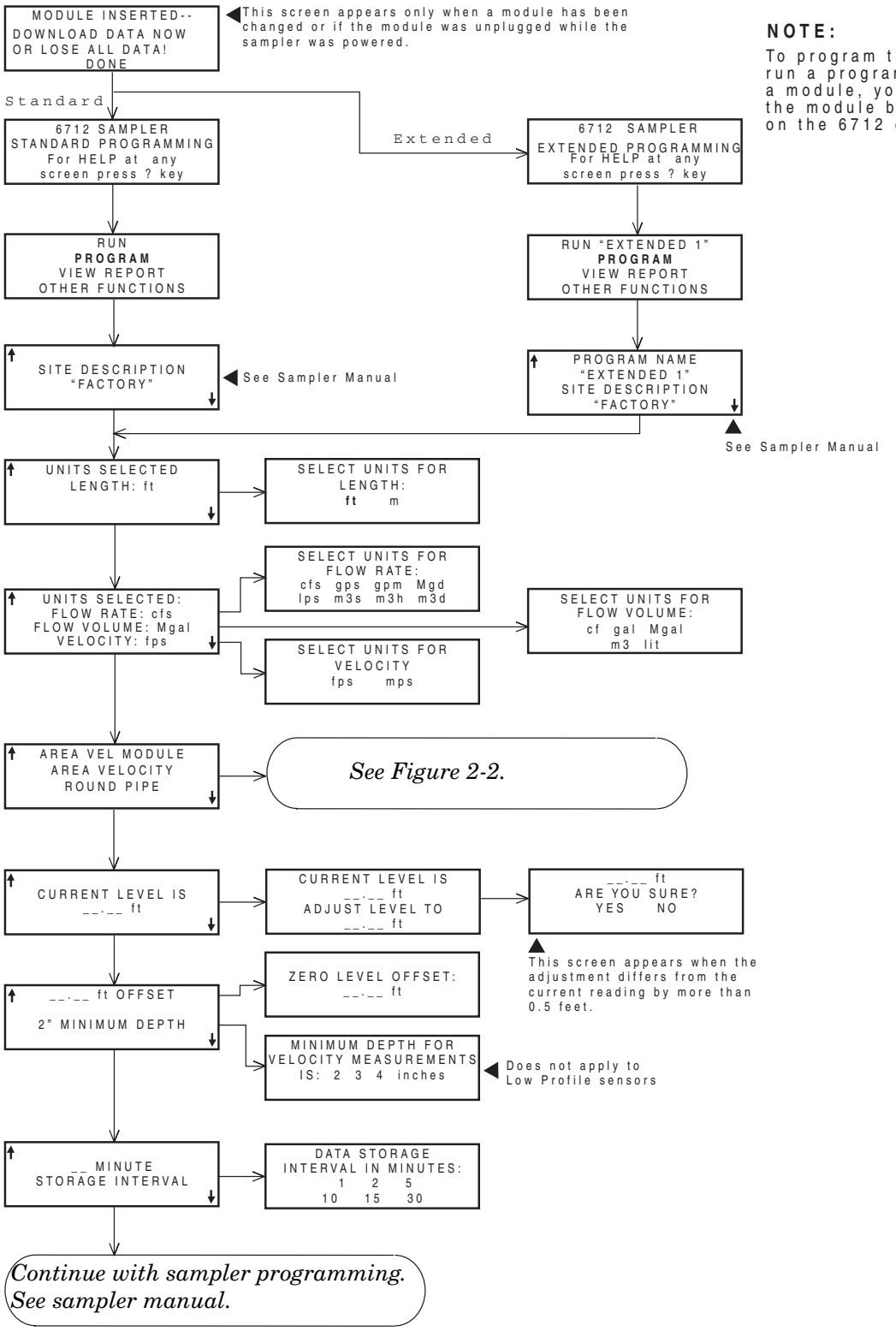


Figure 2-2 6712 Programming: 750 Module Setup Screens



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 2-3 6712 Programming: 750 Module Quick View Screens

2.4 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
	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
	Level-to-Flow Rate Data Points	User-developed tables for level-to-flow rate	3 to 50 data points

2.4.1 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.

2.4.2 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.

2.5 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 2 3/4-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%!

2.6 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.

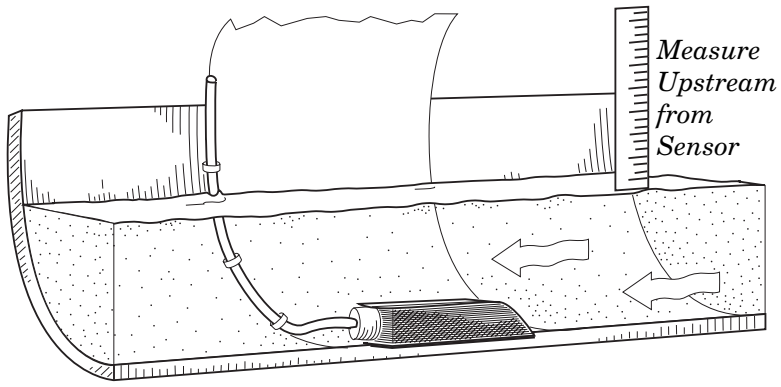


Figure 2-4 Ideal Conditions - Uniform Flow

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 2-5 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.

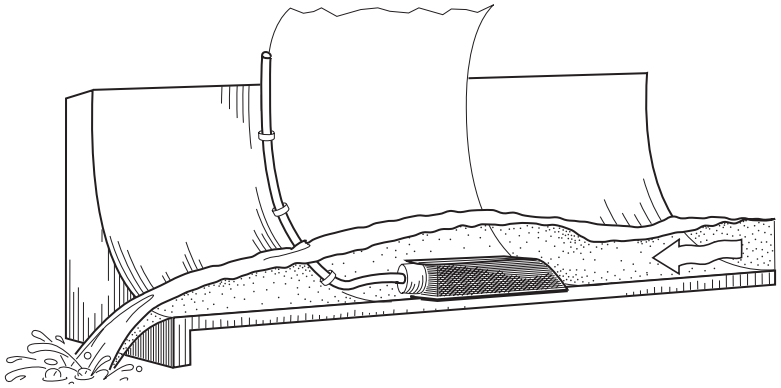
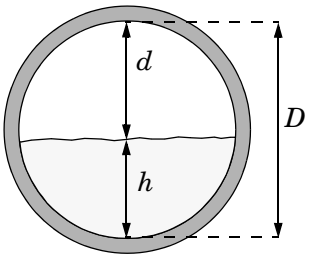


Figure 2-5 Poor Conditions - Disturbed Flow



Level (h) = D – d

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).

2.7 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 2-6. 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).

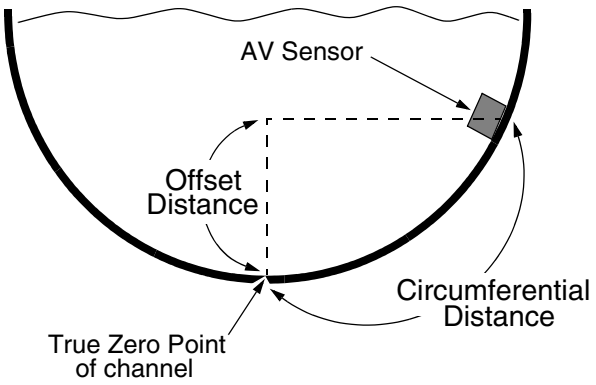


Figure 2-6 Offset Measurements

2.8 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.

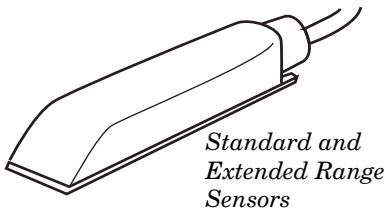
To use **Level-to-Flow** data points, you must enter at least three data points. Each data point entry contains two values – a level and the corresponding flow rate for that level.

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

2.9 Minimum Depth for Velocity Measurements

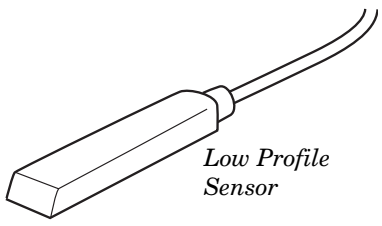
The Minimum Depth is the minimum level of liquid above the bottom of the sensor that is required to obtain a valid velocity reading. The depth varies with the velocity of the flow stream; in the same stream at higher velocities, the depth is greater. Velocity readings taken at too-shallow levels may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

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 Sensor

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.

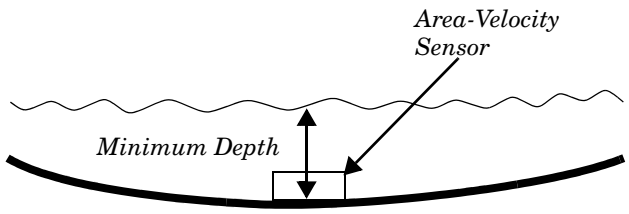


Figure 2-7 Determining Minimum Depth

2.10 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

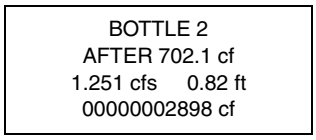
Tests have shown that the 750 Module is affected by RF radiation such as that from radio and TV station towers that are located nearby. If sporadic changes in water level occur as indicated on the sampler's display, the instrument will have to be relocated. Walkie talkies or cell phones must not be operated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

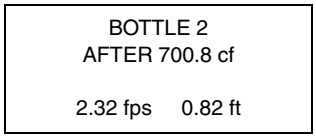
- Abusive handling will damage the sensor. Although the sensor will survive normal handling and installation, treat the sensor with reasonable care. The internal components cannot be repaired.
- There is a vent tube inside the cable which must remain open. Do not kink the cable or overtighten the plastic 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

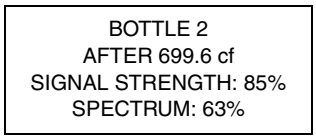
below 1 inch are not a good application for the 750 and sensor.

- 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 2.7, Offsets.
- Route and secure the sensor cable so that it does not collect debris or disturb the flow.
- You may use 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).

2.11 Sampler Run Time Screens







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.

2.12 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.

2.12.1 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.

```
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
```

Settings Report

Summary Report

```
 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

            *---+---+---+---+---+---+*
     19.60  +                       +
            I                       I
            I                    ###I
            I                   ####I
            I                   ####I
     19.55  +                   ####+
            I                   ####I
            I                   ####I
            I                   ####I
            I                   ####I
     19.50  +                   ####+
            I                   ####I
            I                   ####I
            I                   ####I
            I                   ####I
     19.45  +                   ####+
            I                   ####I
            I                   ####I
            I                   ####I
            I                   ####I
     19.40  +                   ####  # +
            I                   ####  # I
            I                   ####  ##I
            I                   ####  ##I
            I                   ####  ##I
     19.35  +                   ####  ##+
            I                   ####  ##I
            I                   ####  ##I
            I                   ##### ##I
            I                   ##### ##I
     19.30  +                   #########+
            *---+---+---+---+---+---+---+*
Hour Ending:       08:     16:     24:
            Units are 'cfs'
```

Combined Report

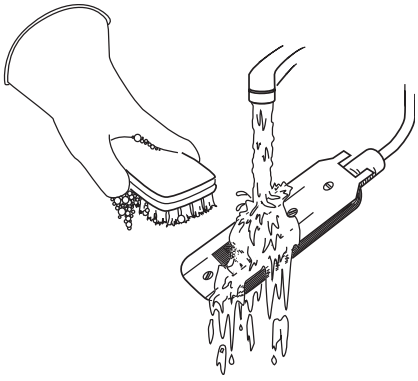
```
SAMPLER ID# 2215220899  08:56 22-FEB-03
 AREA-VEL MODULE: 1365
********** COMBINED RESULTS **********
   SITE: FACTORY
Program Started at 16:36 FR  21-FEB-03
Nominal Sample Volume =  200 ml

                          FLOW          TOTAL
                          RATE           FLOW
SAMPLE  BOTTLE TIME        cfs           Mgal
------- ------ ----  ------ -------------
     1      1   16:44  35.34     000.075006
     1      2   16:53  28.27     000.149821
     1      3   17:02  21.20     000.224477
     1      4   17:09  35.34     000.299454
     1      5   17:19  35.34     000.374269
     1      6   17:28  28.27     000.448872
     1      7   17:36  10.01     000.523683
     1      8   17:44  35.34     000.598452
     1      9   17:53  28.27     000.673267
     1     10   18:02  21.20     000.748082
     1     11   18:10  2.062     000.822872
     1     12   18:19  35.34     000.897662
     1     13   18:28  28.27     000.972477
     1     14   18:37  21.20     001.047398
     1     15   18:44  35.34     001.122110
     1     16   18:54  35.34     001.197002
     1     17   19:03  28.27     001.271764
     1     18   19:11  10.01     001.346536
     1     19   19:19  35.34     001.421397
     1     20   19:28  28.27     001.496106
     1     21   19:37  21.20     001.570922
     1     22   19:45  2.062     001.645719
     1     23   19:54  35.34     001.720660
     1     24   20:03  28.27     001.795369
-----------------------------------------
```

Figure 2-8 Report Examples

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.

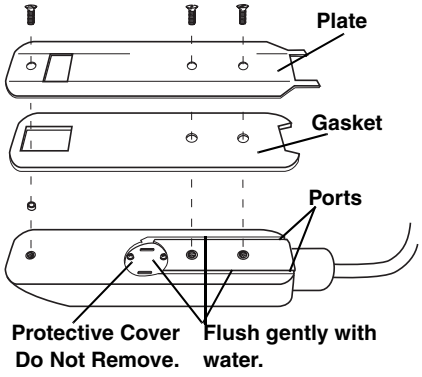


If the flow stream carries a great deal of debris, beware of organic materials that may collect inside the sensor. This material swells as it becomes saturated with water and may exert pressure on the transducer diaphragm inside the sensor. This can damage the diaphragm and permanently disable the sensor.

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.***

3.1 Cable Inspection

Periodically inspect the AV 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

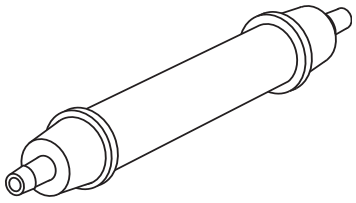
Do not allow the connector end of the probe cable to fall into water, or leave it disconnected without the plastic cap in place. Failure to do so can result in permanent internal water damage to both probe and module.

If the AV 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.

3.2 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 when saturated. Pink 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 attempts to duplicate the problem have been unsuccessful, we still urge you to use caution. Material Safety Data Sheets are in the back of this manual.

To reactivate the desiccant, pour the desiccant out of the cartridge into a heat resistant container. Never heat the plastic cartridge; it will melt. Heat the silica gel in a vented convection oven at 212° to 350° F (100° to 175° C) for two to three hours, or until the blue 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 cotton filters in the end caps keep small pieces of desiccant from falling out of the cartridge. When they become soiled, replace them with ordinary cotton balls.

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

3.3 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 Isco's Customer Service Department for information on returning it to the factory.

3.4 How to Get Help

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

Isco Technical Service Department
P.O. Box 82531
Lincoln, Nebraska, 68501 (USA)

Telephone: (402) 464-0231
Toll Free: (800) 775-2965 (Within USA, Canada, and Mexico)
FAX: (402) 464-3001

3.5 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.

3.6 Accessories

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

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)

Low Profile Spring Rings

Spring Ring - 6" Dia. 68-3200-016
Spring Ring - 8" Dia. 68-3200-017
Spring Ring - 10" Dia. 68-3200-018
Spring Ring - 12" Dia. 68-3200-019
Spring Ring - 15" Dia. 68-3200-020
(Each spring ring includes plastic ties to fasten the cable)

Standard Scissors Rings

Scissors Ring for 18-26" Pipe. 68-3000-042
Scissors Ring for 26-38" Pipe. 68-3000-043
Scissors Ring for 38-44" Pipe. 68-3000-044
Scissors Ring for 44-48" Pipe. 68-3000-045
Scissors Ring for 60" Pipe 68-3000-046
Scissors Ring for 72" Pipe 68-3000-047
Scissors Ring for 18-60" 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

Low Profile Scissors Rings

Scissors Ring for 18-26" Pipe. 68-3000-053
Scissors Ring for 26-38" Pipe. 68-3000-054
Scissors Ring for 38-44" Pipe. 68-3000-055
Scissors Ring for 44-48" Pipe. 68-3000-056
Scissors Ring for 60" Pipe 68-3000-057
Scissors Ring for 72" Pipe 68-3000-058
Scissors Ring for 18-60" Pipe. 68-3000-059
(Each scissors ring includes a base section, scissors mechanism, extensions, plastic ties, and instructions)
L.P. Base Section (with plastic ties & instructions). 60-3004-185

Street Level Installation System

Multi-section Pole 60-3204-012

(Includes instruction manual. To complete your system, you must also order a Street Level Mounting Ring)

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

L.P. Street Level Mounting Ring for 6" dia. pipe . . . 60-3204-024

L.P. Street Level Mounting Ring for 8" dia. pipe . . . 60-3204-025

L.P. Street Level Mounting Ring for 10" dia. pipe . . 60-3204-026

L.P. Street Level Mounting Ring for 12" dia. pipe . . 60-3204-027

L.P. Street Level Mounting Ring for 15" dia. pipe . . 60-3204-028

Miscellaneous

Sensor Mounting Plate 68-3000-051

(Includes plastic ties and instructions)

L.P. AV sensor carrier 60-3204-029

(adapter to fit the low profile sensor on standard size rings)

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

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_20 = 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 ☐**Stable** ☐**Unstable**	Conditions To Avoid	Moisture and high humidity environments.
Incompatibility (Materials to Avoid)	Water.	
Hazardous Decomposition Products	Carbon dioxide, carbon monoxide, water	
HAZARDOUS POLYMERIZATION ☐May Occur	Conditions To Avoid	None.

*Optional

Section 5 - Health Hazard Data

PRIMARY ROUTES OF ENTRY	☐Inhalation ☐Skin Absorption	☐Ingestion ☐Not Hazardous	**CARCINOGEN LISTED IN**	☐NTP ☐IARC Monograph	☐OSHA ☐Not Listed
HEALTH HAZARDS	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	☐ Local Exhaust	☐Mechanical (General)	☐Special
	☐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.

*Isco One Year Limited Factory Service Warranty **

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 Isco Service Engineer, as may be appropriate.

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

Failure of expendable items (e.g., charts, ribbon, tubing, glassware, seals and filters), or from normal wear, accident, misuse, corrosion, or lack of proper maintenance, is not covered. Isco assumes no liability for any consequential damages.

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

This warranty applies only to products sold under the 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 Isco.

This warranty does not apply to the following products: Process Analyzers, SFX 3560 SFE Extractor, 6100 VOC Sampler.

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

*** This warranty applies to USA customers. Customers in other countries should contact their Isco dealer for warranty service.**

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

Return Authorization

A return authorization number must be issued prior to shipping. Following authorization, 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: Isco, Inc. - Attention Repair Service
4700 Superior Street
Lincoln NE 68504 USA

Mailing address: 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: service@isco.com

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Isco, Inc.
www.isco.com