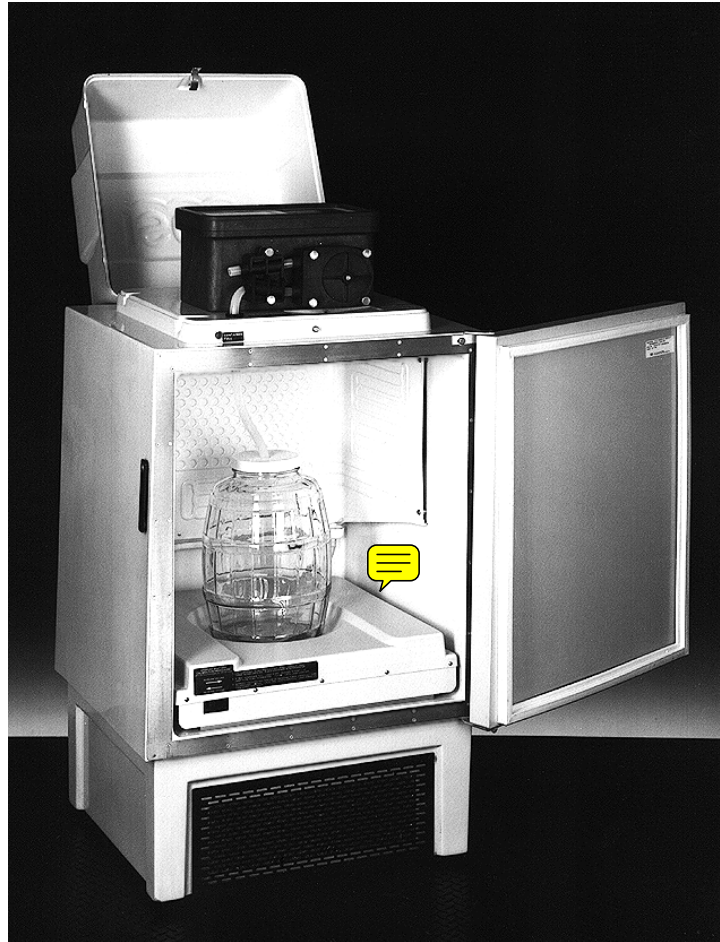


OBSOLETE 6710FR/3730 Refrigerated Sampler

Installation and Operation Guide



Part #60-2733-029 of Assembly #60-3714-031
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Revision Y, January 17, 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.

Contact Information

Customer Service

Phone: (800) 228-4373 (USA, Canada, Mexico)
(402) 464-0231 (Outside North America)
Fax: (402) 465-3022
Email: IscoCSR@teledyne.com

Technical Service

Phone: (800) 775-2965 (Analytical)
(800) 228-4373 (Samplers and Flow Meters)
Email: IscoService@teledyne.com

Return equipment to: 4700 Superior Street, Lincoln, NE 68504-1398

Other Correspondence

Mail to: P.O. Box 82531, Lincoln, NE 68501-2531
Email: IscoInfo@teledyne.com
Web site: www.isco.com

Electrical Requirements

The 3710FR/3730 Refrigerated Sampler is a “definite purpose” device, intended for use **only** with compatible Isco equipment. Do **not** use this product with any other manufacturers’ equipment, or for any other purpose. Use for any purpose not described in this manual could cause personal injury or property damage.

The refrigerator is available in both 120 V \sim and 230 V \sim configurations. The required operating voltage for the refrigerator is listed on the Identification and Serial Number label, placed on the inside of the sample compartment door.

Refrigerators configured for 120 V \sim operation are equipped with a North American NEMA 5-15P plug and is intended for use **only** with 120 V \sim , 60 Hz. The power source should be rated for 30 ampere service.

Refrigerators configured for 230 V \sim operation are equipped with a Continental European CEE 7/7 plug and is intended for use **only** with 230 V \sim , 50/60 Hz. The power source should be rated for 16 ampere service.

Refrigerators in either configuration provide 12.5 V --- at 5 amperes for the sampler controller. This output is from the two-pin military-type connector on the cord on top of the refrigerator. This output is intended for 3700 Series Sampler controllers **only**.



The refrigerator must be installed near a suitable power outlet. Never use an extension cord.



The power outlet must be visible and easily accessible. Unplugging the refrigerator is the only means of disconnecting power.



To minimize the risk of electrical shock, the refrigerator must be connected to an outlet with an electrical ground contact.



The power source must be a dedicated circuit. The line must not power any other devices.



Never operate the refrigerator with the lower front or rear panels removed.



Never operate the refrigerator in an explosive atmosphere.



Do not locate the refrigerator where the lower compartment could become submerged.



Do not lift or carry the refrigerator. Use an appliance carrying device.



Fuses must be replaced with the required size, current, voltage, and blow-time specifications. Refer to the *Replacement Parts List* for the correct part number.

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.

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**

This instrument has not been certified for use in “hazardous locations” as defined by the National Electrical Code.

 **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; this will increase your risk of injury.

 **AVERTISSEMENT**

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

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.

3710FR/3730 Refrigerated Sampler

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3710FR/3730 Refrigerated Sampler

Section 1 Introduction

This section contains an overall description of the sampler and a list of technical specifications.

1.1 3710FR Refrigerated Sampler

The 3710FR consists of a 3730 refrigerator and a 3710 controller mounted on the refrigerator. The 3710FR/3730 Fiberglass Refrigerated Sampler is a programmable liquid sampler designed for composite sampling. It is one of Teledyne Isco's 3700 Series of portable and refrigerated samplers. The extensive sampling capabilities, flexible programming, and durable construction make the 3710FR Sampler ideally suited for general purpose or priority pollutant sampling.

The 3710FR Sampler, although easy to use, offers a number of very sophisticated features. The following sections introduce key features and provide an overview of the unit's sampling capabilities and a variety of interfacing equipment. Examples of interfacing equipment include:

- Isco 4100 Series Flow Loggers, 4200 Series Flow Meters, 2100 Series Flow Modules, 3010 FM Ultrasonic Flow Transmitter, and 3020 Flow Transmitter (collectively called "flow meters" throughout this manual) for flow paced sampling and sampler-enable control.
- Laptop computers that collect, store, or transfer the same data from a sampler in the field to a computer in the office.
- 1640 Liquid Level Sampler Actuator for sampling when a liquid level reaches a predetermined height.

The 3710FR Refrigerated Sampler consists of the 3730 Sampler Refrigerator with the 3710 controller installed on the refrigerator at the factory. The controller is housed in the watertight control box mounted on the top of the refrigerator. However, the refrigerator's lower compartment is not watertight.

The controller consists of a microprocessor with software embedded in a PROM (Programmable Read Only Memory) and supporting electronics. The controller runs the pump, responds to the keypad, and presents information on the display. It governs all automatic sampling according to user-selectable program settings. The controller also provides for manual control of the sampler; for instance, you can run the pump forward with the PUMP FORWARD key or initiate a manual sample with the MANUAL SAMPLE key.

The control panel, containing the 40 character alphanumeric LCD (Liquid Crystal Display) and keypad, is located on the top of the control box. The 23 position keypad is used to enter program

parameters and direct the following controls: on/off, pump reverse, pump forward, stop the pump, start sampling, resume sampling, and display the operating status. A desiccator is installed in the control box to prevent moisture damage to the electronics, pump, and distributor systems.

1.2 3730 Refrigerator

If you want to convert a presently owned 3710 Portable Sampler into a refrigerated unit, or to have both portable and refrigerated options with the same controller, the 3730 Sampler Refrigerator is available. The 3730 includes all the parts necessary to attach the controller from a portable sampler to the refrigerator.

The exterior of the refrigerator is constructed of a fiberglass reinforced polyester with an ultraviolet-resistant gel coat. The interior is made of formed ABS (acrylonitrile-butadiene-styrene) plastic which will not support bacterial growth or retain odors. Both the controller cover and sample compartment may be individually padlocked. The door has a magnetic gasket which seals against a stainless steel bezel.

The refrigerator's solid state thermostat is calibrated at the factory to be accurate at 39°F (4°C). A forced-air condensing coil and front ventilation allow the unit to be positioned close to a wall or in a corner with clearance required only for the controller cover to open. Wrap-around construction of the oversized evaporator plate provides quick and efficient cooling of the sample compartment. Heaters are mounted on the back side of the evaporator plate to keep the sample from freezing in sub-freezing temperatures. Defrosting is automatic under normal operating conditions. The technical specifications of the 3710FR/3730 are found in Table 1-1, on page 1-7.

1.3 Programmable Features

An intuitive user interface allows the 3710FR Sampler to be programmed for both simple and complex sampling schemes. The LCD prompts you through the programming process by presenting a choice or a question on the sampler's LCD. Programming the sampler is a matter of responding to displayed prompts with the keypad. Two programming modes, basic and extended, are standard with the 3710FR Sampler. The basic programming mode allows you to set up typical sampling routines easily and efficiently. The extended programming mode expands the versatility of the sampler by providing options which allow you to create complex sampling routines.

The LCD not only prompts you through the programming process, but also allows you to closely monitor a sampling routine as it is executed. The LCD displays pertinent information about the routine – for example, the time of the next sample – and notifies you of any problems encountered during the routine. As the routine progresses, the sampler logs (stores) key information about the results of the routine. The results include the start time, any halt and resume times, time of samples, and cause of any missed samples. This information is accessible during a routine or after a sampling routine is finished. You can view this

information from the sampler's display or retrieve it with the Field Printer or a laptop computer running Teledyne Isco's Samplink software.

1.3.1 Flexible Sampling Intervals

The 3710FR is designed for composite sampling. Samples may be collected at user-definable time intervals (time pacing) or at equal flow volume intervals using flow pulse inputs from an external flow meter (flow pacing). The flow interval may be set from 1 to 9999 flow pulses. Sampling can be terminated by a weight table shut-off mechanism or by a user-defined number of samples.

The sampler offers two types of time-pacing: uniform and non-uniform. Uniform time-paced samples may be taken at regular time intervals, a sample every 15 minutes, for example. The interval between samples can be set from 1 minute to 99 hours, 59 minutes in 1 minute intervals. Using the extended programming mode, you can specify up to 999 (or bottle volume dependent) non-uniform time intervals in minutes. For example, you can program the sampler to take the first six samples at 10 minutes intervals, then four more samples at 15 minute intervals, and so on. Nonuniform time intervals can be from 1 to 999 minutes in 1 minute intervals. Nonuniform times can be specified in a clock-time format by entering a time and date for each sample. The sampler will accept up to 99 nonuniform clock times.

Additionally, the Sampling Stops and Resumes feature allows you to create an intermittent sampling schedule. With this extended programming feature, you can sample only during key periods of the day. For example, you may wish to sample only during the hours of 6:00 am to 8:00 am, and 5:00 pm to 7:00 pm. You can enter up to 12 sampling stops and 12 resumes. Sampling stops and resumes can be used with both flow- and time-paced routines and with uniform and nonuniform time intervals.

1.3.2 Accurate Sample Volumes

The sampler can be programmed to take sample volumes of 10 to 9990 milliliters. Equipped with the patented LD90 liquid presence detector, the 3710FR Sampler delivers accurate, repeatable sample volumes in changing head conditions. The LD90 is a *non-wetted* liquid presence detector. It detects virtually any pumpable liquid and because it is non-wetted; sample conductivity, viscosity, temperature, and composition do not affect detection. Although it is not normally necessary, samples can be calibrated, if desired.

1.3.3 Flexible Start Times

A sampling routine can be programmed to use a specific start time and date or a start time delay. The sampler will accept a specific start time and date up to one month after the current date. The start time delay is the period between the time you press the START SAMPLING key and the time the routine starts. It is adjustable from 0 (zero) to 9999 minutes.

1.3.4 Foreign Languages and Metric Units of Measure

The 3710FR Sampler provides displays in French, German, and Spanish. Additionally, the software supports entries in metric units of measure. Samplers using French and German language displays support metric units for suction line and suction head measurements. Metric units include volumes in milliliters, suction head and suction line length in decimeters, and suction line inside diameter (ID) in millimeters. Samplers operating with English displays support either English or metric units for suction line and suction head measurements. (Sample volume units are always entered in milliliters, regardless of the selected language.)

1.3.5 Additional Features

Program storage allows you to store up to three separate programs, eliminating the need to reprogram the sampler for recurrent sampling routines. A program lock is available for protection from unauthorized program alterations. When enabled, a password must be entered before any program settings can be changed, although program settings can be viewed at any time.

1.4 Delivery System

The 3710FR Sampler uses a peristaltic pump for sample collection. The sample liquid is under pumped flow at all times; there are no metering chambers or gravity-fed internal tubing. Each sampling cycle includes an air pre-sample purge and a post-sample purge to clear the suction line both before and after sampling. These features make the 3710FR Sampler ideal for both “suspended solids” and “toxic materials” sampling. Cross contamination between samples is minimized and sites for sediment accumulation in the system are eliminated. Materials in contact with the sample fluid are limited to the strainer, suction line, pump tubing, and collection bottles. The system can be easily and safely cleaned by simply replacing relatively inexpensive lengths of tubing.

Pump speed is approximately 250 RPM which generates a velocity sufficient to obtain representative samples. The pumping rate of 3500 ml per minute is generated when using 3/8 inch ID suction line at 3 ft of head. The line transport velocity, using the same suction line and head, is 2.5 ft per sec. Volumetric accuracy is not significantly affected by pump speed since the delivered volume is based on a patented electronic count of the number of pump revolutions.

1.4.1 Liquid Detector

The LD90 gives the 3710FR Sampler the ability to deliver accurate, repeatable sample volumes regardless of changing head conditions. Typical sample volumes are accurate to within 10% of the programmed volume and repeatable to within ± 10 ml. The detector and a programmable setting provide for automatic rinsing of the suction line when concerns of cross contamination arise. A programmable setting for sampling retries is available. If the suction line becomes clogged and no liquid is detected in the line, the sampler can be programmed to repeat a purge cycle – as many as three times – to clear the clogged line.

- 1.4.2 Pump Tubing and Suction Lines** The pump tubing is Silastic™ medical grade silicon rubber. Liquid is transferred from the source to the pump through either 1/4 or 3/8 inch ID vinyl or 3/8 inch ID PTFE suction tubing. The pump tubing and suction lines are easily replaced, minimizing the need for cleaning. The sampler automatically monitors pump tubing wear: a tubing warning indication is reported on the display when the pump revolution count exceeds a user-specified wear limit.
- 1.4.3 Weight Table Shut-Off** The weight table shut off provides a sampling fail-safe shut-off in case the container is accidentally overfilled. When the container is filled to a selectable, predetermined level, a weight activated control stops the sampling process and a red indicator light illuminates to alert you of the full container.
- 1.4.4 Strainers** The 3/8 inch ID vinyl suction lines are shipped from the factory with our standard weighted polypropylene strainer installed on one end of the suction line and a tubing coupling on the other end.
- Additionally, Teledyne Isco offers two low flow stainless steel strainers for 1/4 inch ID and 3/8 inch ID suction lines.
- For sampling from highly acidic flow streams, a weighted plastic CPVC strainer is available.
- 1.5 Bottle Configurations** Four sample containers are available:
- 9400 ml (2.5 gallon) glass container with PTFE lined cap
 - 9400 ml (2.5 gallon) polyethylene sample container with unlined cap
 - 15,000 ml (4 gallon) polyethylene container with unlined cap
 - 20,800 ml (5.5 gallon) polyethylene container with unlined cap
- 1.6 Power Sources** The 3730 operates from 120 V \sim , 60 Hz power or 230 V \sim , 50 Hz power depending on how the refrigerator was ordered. A 12 V --- power converter, built into the refrigerator, supplies power to the controller.
- In the case of critical sampling, the sampler's controller may be powered by an external battery-backed power pack, as described in Section 2.4, on page 2-5. This allows sampling to continue even if a power failure causes the refrigerator's cooling system to stop functioning.
- 1.7 Interfacing Equipment** A full line of accessories and interfacing items is available to help you adapt the sampler to your specific application; some of the more common items are briefly noted below. Other key accessories are noted throughout this manual, where appropriate. A full list of accessories is found in Appendix B.

1.7.1 Isco Flow Meters

The 4200 Series Flow Meters, 2100 Series Flow Modules, and 4100 Series Flow Loggers, and UniMag Closed-Pipe Flow Meters, are collectively called “flow meters” in this manual. The 3710FR Sampler will accept flow pulses from all Isco Flow meters for flow-paced sampling. Teledyne Isco’s 4200 Series Flow Meters and 4100 Series Flow Loggers are equipped with a sampler enable feature. Isco Flow meters can inhibit a 3710FR Sampler until the level of the flow stream reaches a predetermined height or “set point”; when that height is reached, the flow meter enables the sampler and starts the sampling routine. If the level of the stream falls below the set point, the flow meter can disable the sampler and halt the routine.

4100 Series Flow Loggers and 4200 Series Flow Meters can monitor rainfall. The flow meter can be programmed to enable the sampler when the measured amount of rainfall reaches a predetermined set point.

Set points or pairs of set points — pairs can be level and rainfall rates, level and elapsed time, rainfall and elapsed time, and so on — form the *sampler enable control condition*. A control condition is simply the set of parameters defining the conditions in which a flow meter will enable the sampler. For example, a flow meter can be programmed with a control condition which is satisfied when the flow meter detects $\frac{1}{4}$ inch of rainfall in 15 minutes. While level control conditions can be entered directly at the flow meter front panel, most control conditions must be downloaded to the flow meter from an IBM® compatible computer running Teledyne Isco’s Flowlink® software.

In addition to enable control conditions, Teledyne Isco’s flow meters provide an internal memory module. When programmed with the Flowlink software, the flow meters store level or flow rate readings, rainfall measurements, and sample event data from the samplers. The stored data, which expands the information available from the sampler’s results displays, can be retrieved with a computer running the Flowlink software. For more information on sampler enable control conditions and data retrieval, refer to the Flowlink Help files.

1.7.2 Samplink for Sampling Data Retrieval

Teledyne Isco provides an additional interfacing product that collects data from the sampler’s memory. Samplink runs on a laptop computer that can be taken to the sampling installation to collect the data by connecting to the port on the side of the sampler controller, labeled PRINTER. Samplink collects the data and formats it into two files: a text file and a Flowlink compatible sample event file. The text file can be loaded into a word processor for editing. Samplink’s text file contains the same two reports produced by the Field Printer. The first report contains sampler status information and program settings. The second report contains the sampling results. Because the text file is pre-formatted into report form, you can use DOS printing commands to print the file without editing with a word processor.

☑ Note

The Isco Field Printer has been discontinued and is no longer sold.

The sample event files are identical to those created by Flowlink when it retrieves sample event data from Teledyne Isco's flow meters and flow loggers. Because these files are fully compatible with Flowlink, Flowlink can use the files in its sampling reports and graphs.

1.7.3 Non-Isco Flow Meters

You can connect certain non-Isco Flow meters directly to a 3700 for flow-paced sampling. The flow meter must have an isolated contact closure of at least 25 milliseconds to provide acceptable flow pulses to the sampler. The frequency of the contact closure must be directly proportional to total flow.

If the flow signal is not compatible with Teledyne Isco's standard, Teledyne Isco offers special interfacing devices. See Sections 4.1.2 and 4.1.3.

1.7.4 Liquid Level Actuator

Teledyne Isco's Liquid Level Actuator is used to provide level sensitive control of the sampler. The actuator can be used as an alternative to a flow meter.

1.8 Technical Specifications, Controls, and Connectors

The technical specifications, controls, and connectors of the 3710FR/3730 are listed in the following tables. Refer to Figure 2-7, on page 2-8, for a pictorial view of the controls and connectors.

Table 1-1 3710FR/3730 Technical Specifications

Physical Specifications	
Physical Size	Height: 47 inches (119 cm) Width: 26 inches (66 cm) Depth: 26 inches (66 cm)
Dry weight	175 lb (80 kg)
Shipping weight	200 lbs (91 kg)
Operational Temperature Range	-20°F to 120°F (-29°C to 49°C)
Storage Temperature Range	0° to 140° F (-20° to 60° C)
Control Box Only (does not include refrigerator)	Self Certified NEMA 4X and 6 ratings (Submersible, watertight, dust-tight, and corrosion resistant)
Temperature set point accuracy	± 1.8°F (1°C) at 39°F (4°C)
Pull-down time	15 minutes, typical (from 75°F [24°C] to 39°F [4°C])
Recovery time	5 minutes, typical (door open 1 minute with unit operating at 39°F [4°C], 75°F [24°C] ambient)
Installation category	II
Pollution degree	2

Table 1-1 3710FR/3730 Technical Specifications (Continued)

Power Specifications	
Sampler Controller Power Requirement	12 V ⁻⁻⁻ AC power converter Sampler standby current 10 mA, maximum
Voltage	120 ±10% V _~ , 60 Hz (230 ±10% V _~ , 50 Hz available)
Current: Running Starting Stalled compressor	3.5 amp, typical 120 V _~ . (1.75 amp, typical 230 V _~) 15 amp, typical 120 V _~ . (7.5 amp, typical 230 V _~) 20.7 amp, maximum 120 V _~ . (10.4 amp at 230 V _~)
Controller Internal 3V Lithium Battery Capacity	5 years, minimum (maintains internal logic and program settings)
Refrigeration System	
Compressor	¹ / ₆ HP Tecumseh AE1343A for refrigerators with serial numbers before 11901-001 ¹ / ₅ HP Tecumseh AE1360Y for refrigerators with serial numbers beginning with 11901-001
Refrigerant	R-12, 8.5 oz. charge for refrigerators with serial numbers before 11901-001 R-134a, 7.5 oz. charge for refrigerators with serial numbers beginning with 11901-001
Pump and Tubing	
Suction Tubing (intake)	3 to 99 foot lengths of: ¹ / ₄ inch ID vinyl ³ / ₈ inch ID vinyl ³ / ₈ inch ID PTFE lined
Suction Lift	26 feet (7.9 m), maximum
Pumping Rate (at 3 feet of head)	¹ / ₄ inch ID suction tubing: 3000 ml/minute ³ / ₈ inch ID suction tubing: 3500 ml/minute
Line Transport Velocity (at 3 feet of head)	¹ / ₄ inch ID suction tubing: 5.1 ft/sec ³ / ₈ inch ID suction tubing: 2.5 ft/sec
Clock	
Real Time Clock Accuracy	1 minute/month, typical
Sample	
Sample Volume Accuracy	Accuracy with the liquid detector enabled and automatic compensation for head: typically, the greater of ± 10% or ± 20 ml, over a head range of 1 to 12 feet and sampler supply voltage of 10 to 13 volts.
Sample Volume Repeatability	± 10 ml, typical
Sample Frequency	Selectable from one minute to 99 hours, 59 minutes in 1 minute increments between consecutive samples, or from 1 to 9999 flow pulses in single pulse intervals. Up to 999 nonuniform times may be entered in minute intervals or up to 99 times as specific clock times.
Flow Meter Signal	
Flow Meter Signal Requirements	5 to 15 volt DC pulse or isolated contact closure of at least 25 milliseconds duration. (4-20 mA or pulse duration signal may be converted with optional interface unit).

Table 1-2 Controls and Connectors		
Control	Setting	Function
Thermostat	WARMER, COOLER, 4°C (39°F)	selects the sample temperature
Connector	Type	Function
12V DC	2-pin female mounted	12V DC power supply for sampler
Printer	6-pin female panel mounted	Connects 3710FR to Isco Field Printer or laptop computer
Flow Meter	6-pin male panel mounted	Connects 3700FR to external flow meter
120 or 230 VAC	3-pin grounded male line cord	Supplies line voltage for the unit
Sampler	6-pin female cable mounted	Connects shut-off cable from the weight table and the flow meter to the sampler's controller.
Indicator	Type	Function
Bottle Full Light	Red light	Indicates that composite sample has reached the predetermined volume and sampling has stopped.

Note

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

3710FR/3730 Refrigerated Sampler

Section 2 Setup and Operating Procedures

This section provides the information necessary for everyday operation of the refrigerator. Included are sections covering setup, operation of the refrigerator, and automatic refrigerated sampling.

2.1 Summary

The following sections detail the preparations made before using the refrigerator. To place the sampler into operation:

Note

Read the *Safety Summary* posted at the front of this manual. It outlines the electrical requirements and provides instructions for safe operation.

1. Install the sampler. Although the suction line can extend to a liquid source up to 99 feet from the sampler, note that the maximum lift for the peristaltic pump with either the PTFE or vinyl line is 26 feet. When installing the sampler, be sure the head — the vertical distance between the level of the liquid source and the pump — is no greater than 26 feet. The pump will not be able to deliver samples for heads of 26 feet or greater.
2. Do not install the refrigerator in a location where the lower compartment could become submerged.
3. Be sure the sampler is connected to a 120 V \sim (230V \sim) power source. Turn the refrigerator on.
4. Attach the suction line.
5. Place the suction line inlet properly in the liquid source.
6. Connect the sampler to a flow meter, if required.
7. Program the sampler. Guidelines for programming the sampler are in Section 3.
8. Calibrate the sample volume, if desired. (Section 3.9.11, on page 3-31, contains calibration instructions.)
9. Calibrate the weight table. See Section 2.7.2, on page 2-7.
10. Start the sampling routine.

2.2 Suction Line

The suction line is the piece of tubing that extends from the sampler's pump tubing intake, at the top of the liquid detector, to the liquid source. There are three standard suction lines available: plasticized vinyl tubing in $\frac{1}{4}$ -inch (0.64 cm) or $\frac{3}{8}$ -inch (0.94 cm) inside diameters, or FEP PTFE with a polyethylene cover in $\frac{3}{8}$ -inch inside diameter. The polyethylene cover over the

0.02 inch (0.051 cm) wall PTFE tubing prevents the PTFE liner from kinking or collapsing in service and protects it from abrasion and other damage.

The vinyl suction tubing contains a very low PPM (parts per million) level of phenols. If this affects your samples, use the PTFE suction line.

Both vinyl and PTFE lines can be cut to any length from 3 to 99 feet in 1 foot increments. Cut the suction line in whole foot increments: lengths of 4 ft, not 3.5 ft. The controller will accept only whole numbers as suction line lengths. To insure the accuracy of the sampler, the suction line length entered must equal that of the actual line measurement. When programming the sampler, you must enter the inside diameter, type, and length of suction line used.

Cut the line to the shortest length feasible: this aids the downhill routing. Avoid loops of coiled suction line which may hold residual amounts of liquid which would cross contaminate sample volumes. A shorter suction line will also extend battery life and pump tube life because a shorter pumping cycle will be needed to deliver the sample volume.

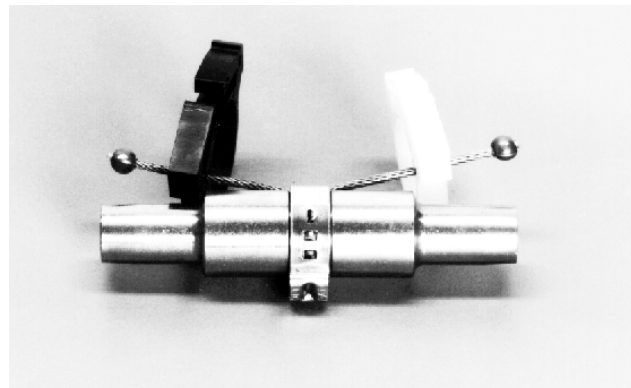


Figure 2-1 Tube Coupling

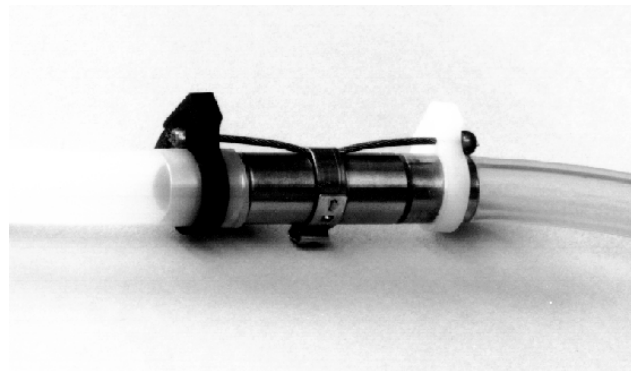


Figure 2-2 Tube Coupling With Suction Line and Pump Tube Connected

2.2.1 Attaching the Vinyl Suction Line

Vinyl suction line is attached to the pump tubing with the tube coupling as illustrated in Figures 2-1 and 2-2. Two couplings are available, one for each size of vinyl line.

Each coupling has two color coded nylon clamps attached to the stainless steel ferrule. The black clamp secures the pump tube to the coupling.

The white clamp secures the suction line. To attach the line or tubing to the coupling, push it onto the appropriate side of the ferrule and tighten the clamp by squeezing the finger pads together. To loosen a clamp, twist the two sides of the clamp until the teeth disengage.

2.2.2 Attaching the PTFE Suction Line

The PTFE line is attached to the pump tubing by inserting the line into the pump tubing and securing it with a suitable clamp.

2.2.3 Routing the Suction Line

Route the suction line from sampler to sampling point so that it slopes continuously downhill. This helps drain the suction line when the peristaltic pump purges the line and minimizes the possibility of cross contamination. When the sampler is used in below freezing temperatures, there is a risk of the suction line being frozen. A suitably warm sampling source can usually prevent this, provided there are no loops in the suction line. Some situations may require more protective measures, such as insulation of the suction line, or heat tape. Thoroughly draining the suction line minimizes the possibility of frozen liquid clogging the line.

2.3 Strainers

The $\frac{3}{8}$ inch ID vinyl suction lines are shipped from the factory with our standard weighted polypropylene strainer (Figure 2-3) installed on one end of the suction line and a tubing coupling on the other end.

Additionally, Teledyne Isco offers two low flow stainless steel strainers (Figure 2-4) for $\frac{1}{4}$ inch ID and $\frac{3}{8}$ inch ID suction lines.

For sampling from highly acidic flow streams, a weighted, CPVC plastic-coated strainer is available (Figure 2-5).

The use of the strainer is optional. When heavy suspended solids are involved and flow stream velocities are significant, some field investigation results indicate that more representative samples are obtained without the strainer.

You can purchase bulk suction line without strainers. Refer to the *Accessories List* in the back of this manual. The strainer prevents solid particles larger than a specific diameter from entering and clogging the suction line. Teledyne Isco recommends its use for bottom sampling or sampling from streams containing large solids. The $\frac{1}{4}$ -inch strainers supplied for use with the $\frac{1}{4}$ -inch ID suction line have $\frac{15}{64}$ -inch (0.56 cm) diameter holes. The $\frac{3}{8}$ -inch strainers supplied for use with the vinyl or PTFE $\frac{3}{8}$ -inch ID suction line have $\frac{23}{64}$ -inch (0.9 cm) diameter holes.

2.3.1 Intake Placement

The proper placement of the sampler intake assures the collection of representative samples. Place the intake in the main flow, not in an eddy or at the edge of flow. The vertical position of the intake in the flow is important. An intake at the bottom may result in excess heavy solids and no floating materials, while placement at the top may result in the opposite.

The suction line tends to float in deep flow streams, dislodging the line and strainer. The following chart shows the maximum depths you can submerge the lines and strainers without risks of flotation. At depths exceeding the safe depths, anchor the line and strainer securely.

Table 2-1 Strainers			
Strainer	Vinyl 1/4-inch (6 mm)	Vinyl 3/8-inch (9 mm)	PTFE 3/8-inch (9 mm)
Standard Weighted Polypropylene	—	22 feet (6.7 m)	15 feet (4.5 m)
Stainless Steel Low Flow	14 feet (4.3 m)	22 feet (6.7 m)	15 feet (4.5 m)
CPVC	—	4 feet (1.2 m)	4 feet (1.2 m)

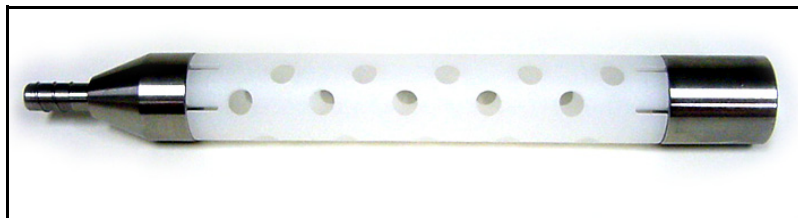


Figure 2-3 Standard Weighted Polypropylene Strainer

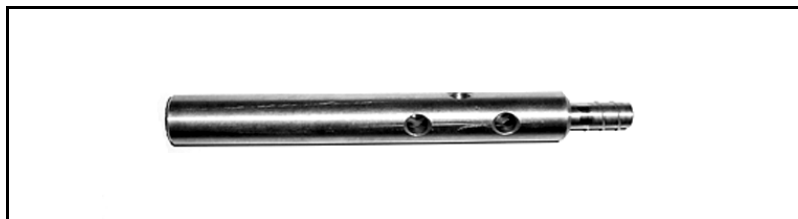


Figure 2-4 Stainless Steel Strainer

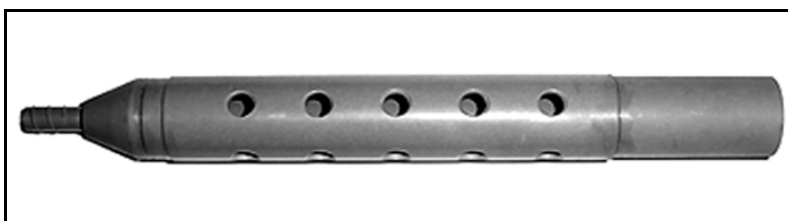


Figure 2-5 CPVC Weighted Strainer

If the strainer is not used, a short piece of thin walled aluminum tubing may be attached to the end of the suction line and the tubing anchored in the flow stream so that the inlet is oriented upstream. The thin wall will provide minimum disturbance of the flow stream and aluminum ions are usually not of concern in analysis. Whether the strainer is used or not, the pre-sample purge cycle should be sufficient to remove any debris which may collect over the strainer or tubing entrance between sampling events.

2.4 Connection to a Power Source

The 3730 operates on 120 V \sim , 60 Hz power (230 V \sim , 50 Hz). To provide power for the refrigerator and controller, plug the refrigerator's line cord into an appropriate source.

Note

Read the *Safety Summary* posted at the front of this manual. It outlines the electrical requirements and provides instructions for safe operation.

A 12 V --- power converter, built into the refrigerator, supplies power to the controller. A 3V lithium battery, with a minimum service life of 5 years, maintains the controller's real time clock and program settings when power is disconnected. The sampler's controller may be temporarily powered by an external 12 V --- battery-backed power pack when AC power is not available. Simply disconnect the power cable and attach the power-pack connector to the sampler's power connector. Refer to the *Power Products Guide* for more information on external power sources for the controller.

2.5 Connection to a Flow Meter

To permit flow proportional sampling, the sampler's controller must be connected to an external flow meter. This connection is made to the flow meter connector (shown in Figure 2-7) located on the thermostat/wiring housing assembly. A small port is provided on the right side of the control base for routing the flow meter cable. Refer to Section 4 for information on interfacing devices required to interface the sampler with non-Isco Flow meters.

2.6 Operation of the Refrigerator

To operate the refrigerator, turn the thermostat knob, shown in Figure 2-7, to the desired sample temperature. The interior air temperature should reach the set value within 10 to 15 minutes. The refrigerator's thermostat is calibrated in sample temperature. That is, if the temperature is set at 4°C (39°F), the temperature of the sample after being in the refrigerator will be 4°C ± 1°C, although the refrigerator air temperature may vary more than this due to the nature of the refrigeration cycle.

Note

If the thermostat knob is turned to the lowest setting, the sample may freeze.

2.6.1 Automatic Defrosting

Under normal conditions, you should not need to defrost the refrigerator manually. The evaporator plate temperature always cycles from below freezing (when the compressor is running) to above freezing (when the compressor is off) during the normal refrigeration cycle. The refrigerator is equipped with a drip tray and a drain tube to route defrost water to a pan in the base of the refrigerator. Water in the pan is evaporated by the warm air from the condensing system.

The refrigerator compressor may not start immediately when the refrigerator is plugged in or the thermostat is turned to a lower setting. This is due to one of two things: either the compressor overload relay is operating or the evaporator plate is still defrosting. After a short time, the compressor will start and initiate the cooling cycle.

2.7 Set Up for Automatic Sampling

Before the unit is ready to be set up for automatic sampling, check that:

1. The control box has been attached to the refrigerator (when necessary).
2. The refrigerator has been connected to a power source.
3. The controller has been connected to an external flow meter (if used).
4. The suction line has been attached to the pump tubing.
5. The weight table shut-off point has been adjusted as described in Section 2.7.2.
6. An empty sample container has been properly located on the weight table and the pump tube inserted approximately 2 inches into the hole in the container's lid.
7. The thermostat has been adjusted to the desired sample temperature.

2.7.1 Locking

After the sampler has been programmed as desired and the sampling program started, the cover should be closed and latched in place. Locking holes are provided in the controller cover latch and on the refrigerator door to accept padlocks to prevent unauthorized tampering.

2.7.2 Automatic Sampler Shut-Off

The refrigerator has an adjustable, weight activated sample container table to automatically shut-off the sampling process when the sample container is filled to a predetermined level. When the container is filled to the preset level, sampling stops and the LCD displays alternating messages; the message, "DONE," will alternate with the message, "FLOAT/WEIGHT TRIPPED."

Calibrating the automatic shut-off mechanism requires three steps.

1. Refer to Figure 2-6. Fill the container with liquid to the desired shut-off level. Leave at least three inches unfilled. Place the container in its normal position in the bottom of the refrigerator.
2. If the red CONTAINER FULL lamp on the outer front of the refrigerator is off, proceed to step 3. If the lamp is on, turn the black thumb wheel on the front of the weight table to the right until the lamp goes out.
3. Do not touch any part of the weight table. Carefully turn the black thumb wheel to the left until the CONTAINER FULL lamp goes on.

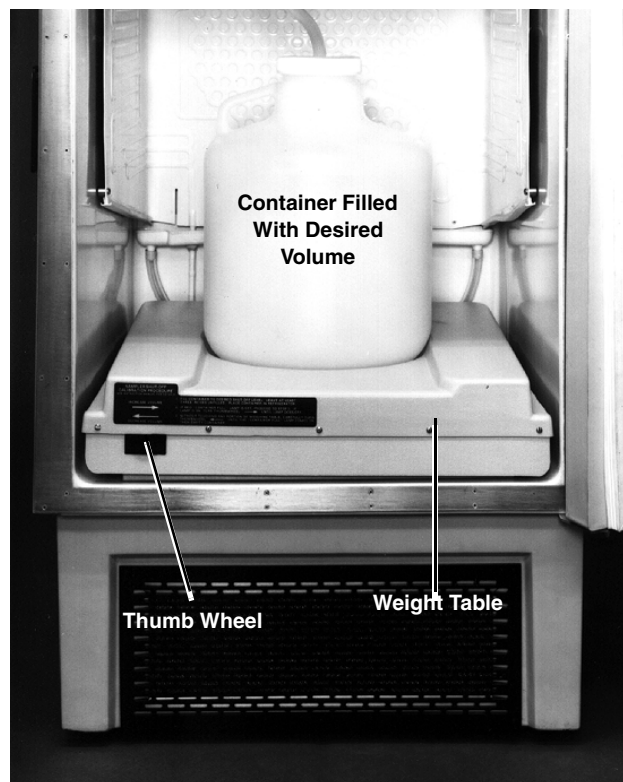


Figure 2-6 Sampler Shut-off Calibration

3710FR/3730 Refrigerated Sampler
 Section 2 Setup and Operating Procedures



Figure 2-7 Flow Meter Cable Connection and Suction Line Port

3710FR/3730 Refrigerated Sampler

Section 3 Programming Guidelines

3.1 Introduction

This section discusses the sampling features of the 3710FR in detail and covers the procedures used to program the sampler.

We recommend you have a sampler with you when you read this section. The most effective way to learn how to program the 3710 Sampler is to read this section, get a sampler, and experiment. A few minutes in the office or laboratory spent in actually programming the sampler and observing its operation usually proves to be a worthwhile investment of time.

If you are already familiar with the sampling capabilities of the 3710 Sampler, you may prefer to begin with Section 3.5. This section introduces the specifics of programming the sampler.

3.2 Description of Sampling Operations

This information serves to acquaint you with the 3710FR Sampler's operation. It introduces you to the types of sampling performed by the sampler and the terminology used to describe those capabilities.

3.2.1 Sample Events and the Sampling Cycle

A sample event is the process of taking a sample. It includes the full sampling cycle. Although the cycle varies according to the program settings which define the sampling routine, the cycle described here follows the typical sequence. This information is presented here to provide you with a frame of reference for the remainder of this section.

1. A sample event is initiated when the interval since the previous sample has expired. For time based intervals, the samples are taken when the internal clock reaches the scheduled time of the sampling event. For flow-paced intervals, the interval is set to the programmed number of pulses received from a flow meter; the sample event begins when the pulses are counted down to zero.
2. The pump rotates in the reverse direction for the pre-sample purge. The pre-sample purge is an air purge of the suction line and inlet which clears the line of any accumulated debris. It also serves to purge residual liquid to avoid cross-contamination of samples.
3. The pump direction changes, pumping in the forward direction to fill the suction line up to the liquid detector.
4. After the suction line has been filled to the liquid detector and liquid has been detected, the sample volume measuring portion of the sampling cycle begins. The pump continues to rotate in the forward direction until the programmed volume of liquid has been delivered to the

sample bottle. (In this manual, the amount of liquid delivered to the bottle is referred to as the “sample volume.”)

5. The pump direction again changes, pumping in the reverse direction for the post sample purge. Like the pre-sample purge, the post-sample purge is an air purge of the suction line. After the post-sample purge, the pump then shuts off.
6. The sample interval is reset and the cycle begins again at step 1.

3.3 Types of Samples

The 3710FR Sampler is designed to collect composite samples. As noted in Section 1, the 3710FR Sampler has two programming modes: basic and extended. The basic programming mode is used for conventional routines which include the types of sampling described in this section. A discussion of the types of sampling available through the extended programming mode is placed in Section 3.4. Composite sampling places individual sample volumes into a single container. Composite sample types can be characterized by sample pacing. Sample pacing refers to the interval between samples.

There are two types of sample pacing: time-pacing and flow-pacing. In time-paced sampling, the interval between samples is a time interval. In flow-paced sampling, the interval between samples is a certain volume of liquid which has passed a measuring point in a flow stream. Flow-paced sampling requires a flow meter. (The 3710 Sampler can be interfaced with Isco Flow meters and certain non-Isco Flow meters.) The flow meter measures the flow quantity and sends a pulse for every predetermined flow quantity to the sampler. The sampler totalizes the number of pulses received from the flow meter and collects a sample when the total reaches a programmed number.

3.4 Sampling Available Through the Extended Programming Mode

The extended programming mode expands the variations of sample pacing. The extended features listed below are used in more complex sampling routines. Note, however, that the sampling capabilities described previously in Section 3.3 are available in both the basic and the extended programming modes.

3.4.1 Nonuniform Time Intervals

The 3710FR Sampler, through the extended programming mode, can pace samples at nonuniform time intervals. With nonuniform time intervals, samples are taken at irregular intervals, rather than at equal intervals.

Nonuniform time intervals are typically used in runoff studies, often in conjunction with an Isco 1640 Liquid Level Actuator. Nonuniform time intervals permit a number of samples to be collected at short intervals after a rainfall or other event occurs and remaining samples to be collected at widening intervals. For example, when the sampler is used with the actuator in a runoff study, the actuator turns the sampler on when the liquid level of the flow stream rises to contact the actuator’s probe. With non-

uniform time intervals, the sampler can collect samples frequently when the flow rate is highest and less frequently as the flow rate decreases.

Nonuniform times can also be used to simulate flow-paced sampling. When the flow rate varies predictably, using nonuniform time intervals allows you to take samples at equal flow volumes. As the flow rate increases, you can take samples at equal flow volumes by *decreasing* the time interval. As the flow rate decreases, you can *increase* the time interval.

When you use nonuniform times, the time interval between each sample event is individually programmable. You can enter nonuniform times in two ways: in minutes or in clock times. The first method, minutes, allows you to enter the number of sample events spaced at intervals defined in minutes: 12 samples at 5 minute intervals, 6 samples at 10 minute intervals, 4 samples at 15 minute intervals, and so on. You can also enter a specific clock time and date for each sample event: sample event 1 at 6:00 on April 20, sample event 2 at 6:30 on April 20, sample event 3 at 7:15 on April 20. You can specify up to 999 sample events spaced in nonuniform minutes, or up to 99 events specified as clock times. (If a routine requires a large number of nonuniform times, you can save the routine with the program storage feature so that you do not have to re-enter the nonuniform times again.)

3.4.2 Stops and Resumes

The Sampling Stops and Resumes feature, available in the extended programming mode, allows you to create an intermittent sampling schedule. You can program the sampler to stop the routine at a specific time. The routine can then be resumed later. Up to 12 stop times and 12 resume times can be entered. Stops and resumes can be used with time-paced and flow-paced routines and with routines programmed for nonuniform time intervals.

3.5 Programming Introduction

The sampler's programming process is self-prompting. Prompts displayed on the LCD step you through the programming sequence in a logical order, indicating the needed value or option. For example, the sampler will prompt you to enter settings for the interval between samples (select either time-paced or flow-paced intervals); sample volume in ml; and other operating controls. These settings can be changed at any time.

The sampler will accept only appropriate values for the program settings and will reject any unacceptable values. If the unit is turned off or power is disconnected, the settings are retained in the sampler's memory by the lithium battery.

3.5.1 Operating States

There are three operating states: the standby state where the sampler is waiting for your instructions, the run state where the sampler is running a sampling routine, and the interactive state used to program the sampler. Each state serves a different purpose and is discussed separately.

3.5.2 Standby State

In the standby state, the sampler is waiting for your instructions. From standby, you can start a sampling routine, placing the sampler in the run state. You can also access the interactive state. The standby state is discussed in greater detail on page 63.

3.5.3 Run State

In the run state, the sampling routine is being executed and the sampler is operating under program control. While the sampling routine is executed, the LCD displays a number of messages to communicate the progress of the sampler through the routine. It reports the current time for time-paced routines and the remaining time or pulse count to the next sample. These messages vary according to the sampling routine; a representative set of messages is included with the programming examples placed in Sections 3.6 and 3.7. Table 3-7 also lists run state messages.

As the routine progresses, the sampler creates a log of sampling results that records pertinent information about each sample event. The results include the time and date of each sample, the number of pump counts occurring until liquid is detected for each sample event, and any problems encountered. Results can be retrieved with the Display Status procedure, as explained in Section 3.15. You can retrieve the results in the middle of a routine or when the routine is done. The results remain in the sampler's memory until you start the sampler again. Refer to Section 3.17 for more information on the run state.

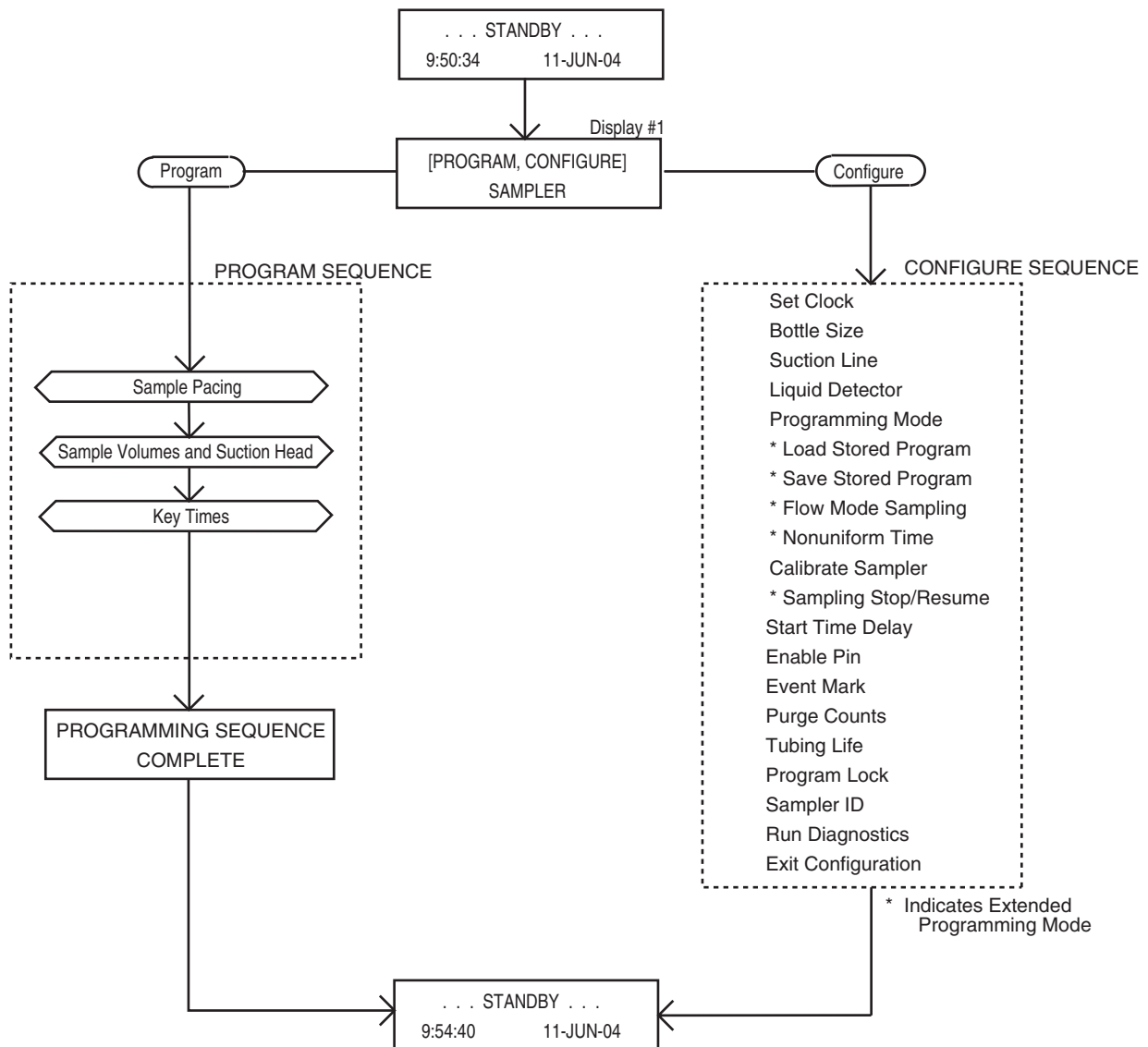


Figure 3-1 Interactive State Structure

3.5.4 Interactive State

The interactive state allows you to program the sampler. The interactive state contains two branches: the program sequence and the configure sequence. Figure 3-1 diagrams the structure of the interactive state. The program sequence is used to define the sampling routine; it allows you to enter the interval between samples, the number of samples, the sample size, and the start time. The configure sequence provides a number of setup options. Some configure options provide equipment specifications: bottle sizes, suction line diameters and lengths, and so on. For example, the 3710FR Sampler can be used with different sized bottles: 2.5 gallon or 4 gallon. You must enter the correct bottle size so that the sampler can calculate the range of sample volumes for a given number of samples. This information is used to prevent

overfilling. Other options allow you to set the sampler's real time clock, calibrate the sampler, or enable the password program protection.

3.6 Programming Procedure

The procedure used to program the sampler follows the steps listed below. Note: Because the configuration settings determine portions of the program sequence and affect the accuracy of the sample, check the configuration settings before programming.

1. Determine the equipment you will be using with the sampler. You will need to know the capacity of the bottle and the inside diameter, type (vinyl or PTFE), and length of the suction line. You will need this information when you verify and revise the configuration settings in step 2.
2. Check the configuration settings. From standby, access the interactive state. Select the configure sequence. Check the configuration settings, revising any settings as needed; select basic or extended programming mode. Return to the standby state.

Example *Checking the Configure Option Settings*, on page 3-17, shows you how to check and revise the configuration settings in the configure sequence. (We recommend you review *Keypad Description* and *Displays* before you work through the programming examples. These sections discuss the functions of the individual keys and how to use the keys when programming the sampler.)

Table 3-1 Configure Option Functions

Configure Option	Availability		Function
	Basic	Extended	
Set Clock	✓	✓	Sets the sampler's real time clock.
Bottle Size	✓	✓	Sets the sampler for portable or refrigerated configuration. Sets the size of the composite bottle.
Suction Line	✓	✓	Sets the type of line (vinyl or PTFE), line diameter ($\frac{1}{4}$ - or $\frac{3}{8}$ -inch), and line length (3 to 99 ft).
Liquid Detector	✓	✓	Enables/disables liquid detector, sets the number of rinse cycles (0 to 3), enables/disables the suction head entry, and sets the number of sampling retries (0 to 3).
Programming Mode	✓	✓	Sets the programming mode: basic or extended.
Load Stored Program		✓	Loads one of up to three previously saved sampling programs.
Save Current Program		✓	Saves current sampling program.
Flow Mode Sampling		✓	Directs sampler to take a sample at the beginning of a flow-paced program.
Nonuniform Time		✓	Directs sampler to accept nonuniform intervals as specific clock times or in minutes.

Table 3-1 Configure Option Functions

Calibrate Sampler	✓	✓	Enables/disables the calibration sequence.
Sampling Stop/Resume		✓	Enables/disables Sampling Stops and Resumes feature.
Start Time Delay	✓	✓	Sets the start time delay (from 0 to 9999 minutes). If no specific start time is entered in the program sequence, the program will use the entered start time delay. The delay is the amount of time which will elapse after the START SAMPLING key is pressed or after the sampler is enabled.
Enable Pin	✓	✓	Enables/disables the master/slave sampling. Directs the sampler to take a sample when disabled and/or enabled by an Isco Flow Meter or Liquid Level Actuator. Allows you to restart the sampling interval when the sampler is enabled.
Event Mark	✓	✓	Allows you to select one of four types of event marks.
Purge Counts	✓	✓	Adjusts the number of pre-sample and post-sample purge counts.
Tubing Life	✓	✓	Displays the pump tubing life information. Resets the tubing life count.
Program Lock	✓	✓	Enables/disables the password protection for input displays.
Sampler ID	✓	✓	Allows you to enter a 10 character ID number for the sampler.
Run Diagnostics	✓	✓	Tests the RAM, ROM, and pump. Allows for re-initialization of certain program and configure settings.

3. Program the sampler. Again, from standby, access the interactive state. Select the program sequence. Enter the program settings for your routine. The sampler will prompt you through the programming process. When the process is completed, the sampler will automatically return to standby.
A more detailed discussion of the programming procedure is placed in Section 3.7. Examples *Time-Paced Sampling*, on page 3-19 through *Calibration*, on page 3-23 demonstrate several types of sampling programs in the basic mode. Extended mode sampling programs can be found in Examples *Extended Time-Paced Sampling Using Stops and Resumes*, on page 3-52 through *Reviewing the Sampling Results*, on page 3-58.
4. Install the sampler, if you have not already done so. (The sampler can be programmed on site or in the office before installation.) If desired, connect the sampler to a flow meter or other interfacing equipment. Start the sampler.
5. As the routine is executed, the displays will report the sampler's progress. The programming examples in this manual conclude with the run state displays you should see for each sampling routine. When the routine is done, the sampler will return to standby.
6. Retrieve the filled sample bottle. If desired, use the *Display Status* procedure, discussed in Section 3.15, to examine the sampling results.
7. If you need to reprogram the sampler, follow this procedure from the beginning. If the sampler's current program is correct, start the sampling routine again.

3.6.1 Following Display Cues Configuring and programming the sampler is as simple as responding to displays on the LCD with the keypad. The sampler will prompt you through many of the entries by presenting a question or a choice on the display. You must respond with the keypad. The LCD and the keypad are located on the 3710 Sampler control panel, shown in Figure 3-2.

A summary of each key's function is placed in Section 3.6.2. For a discussion of the displays presented on the LCD and the way you can use the keypad to interact with the sampler, refer to Section 3.6.6.

3.6.2 Keypad Description Keys are grouped together on the control panel to assist you in identifying related functions. Control keys are used to manually control the sampler; numeric keys are used to enter program values; programming keys are used to monitor the sampler's status and direct programming activities. In this manual, individual keys are indicated in SMALL CAPITAL LETTERS.

The individual key switches that make up the keypad provide tactile and audible feedback to assure you that the key switch has been successfully actuated. When a key switch is pressed, you can feel the deflection of the spring member in the switch; an audio indicator inside the sampler will beep once. The sampler has a 10-keystroke buffer which, in some cases, allows you to "type ahead" of the display.

3.6.3 Control Keys Control keys allow you to turn the sampler on or off, start or resume the currently entered program, and control the sampler manually. The functions of the control keys are listed below.

On/Off – Pressing the ON/OFF key when the sampler is off will turn the sampler on, reactivate the display, and place the sampler in the standby state. Pressing the ON/OFF key (when the sampler is on) will halt all sampling activity and clear the display.

Pump Forward – While in the standby state, pressing the PUMP FORWARD key will cause the pump to run continuously in the forward direction. The pump will run until the STOP key is pressed.

Pump Reverse – While in the standby state, pressing the PUMP REVERSE key will run the pump continuously in reverse. The pump will run until the STOP key is pressed.

Stop – The STOP key will stop the pump any time it is running. When the STOP key is pressed in the run state, the sampling routine will be halted, the sampler will be transferred to the standby state, and the "PROGRAM HALTED" message will be displayed. Pressing the STOP key while in the interactive state will access the display's reference number.

Start Sampling – When in the standby state, pressing the START SAMPLING key will begin the sampling program. When entering a sampler ID, the key will type a space.

Resume Sampling – When “PROGRAM HALTED” is displayed, pressing the RESUME SAMPLING key will cause the sampler to continue with the current sample program at the point at which it was halted. When entering a sampler ID, the key will type a period.

Manual Sample – Pressing the MANUAL SAMPLE key will allow you to take a manual sample. The MANUAL SAMPLE key is valid in the standby state, the run state, and when calibrating the sampler. When entering a sampler ID, the key will type a dash (-).



Figure 3-2 3710 Sampler Control Panel

3.6.4 Program Keys

The four program keys are used to enter program settings. Each key’s function is listed below.

Display Status – While the sampler is in the standby or run state, pressing the DISPLAY STATUS key will allow you to view the program settings or the sampling results.

Exit Program – Pressing the EXIT PROGRAM key while in the program sequence will return the sampler to standby. Pressing the EXIT PROGRAM key while in the run state will halt the program; the message “PROGRAM HALTED” will be displayed.

Clear Entry – When entering a number, the CLEAR ENTRY key can be used to return to the original entry.

Enter/program – The ENTER/PROGRAM key, while in the standby state, will cause the sampler to enter the interactive state. While at an input display, the ENTER/PROGRAM key will accept an

entered value or a blinking option and direct the sampler to proceed to the next step. Input displays are discussed in *Displays*.

3.6.5 Numeric Keys

The numeric keys consist of 10 digit keys, a LEFT ARROW key, and a RIGHT ARROW key. The digit keys are used to enter quantities. The arrow keys are used to move through the configure option list or program options.

Left Arrow – The LEFT ARROW key is used to select one of two or more program options displayed when the sampler is in the interactive state. When more than one numeric entry is displayed – for example, the hours and minutes of a time setting – the LEFT ARROW can be used to step back to a previously entered value. When entering a number, the LEFT ARROW can be used to erase the most recently entered digit. It is also used to step through display status information and configure option list.

Right Arrow – The RIGHT ARROW key is used to select one of two or more program options displayed in an input display. It is also used to step through display status information and configure option list.

3.6.6 Displays

There are two types of displays: displays which communicate information about the sampler's status and displays which request input. In many cases, you must respond to a display with the keypad.

Informational Displays – Informational displays communicate information about the sampler's status. For example, when the sampler completes a sampling program, a display similar to the illustration below appears. It communicates the sampler's status ("DONE"), the number of samples taken (which will vary according to the program), and the current time and date.

```
DONE . . . 48 SAMPLES
10:32:34 14-APR-04
```

Input Displays – Input displays can be identified easily because they contain a blinking word or number. The blinking word or number serves as a prompt for input and is said to be "selected." When the input displays shown below first appear, the word "PROGRAM" and the sample volume entry "250" will be blinking. Blinking words or numbers are represented in illustrations of displays with *italic* characters.

```
[PROGRAM, CONFIGURE]
SAMPLER
```

```
SAMPLES VOLUMES OF
250 ml EACH (10 - 990)
```

Display Numbers – Nearly all input displays have a number assigned to them. The number is used to cross reference the input displays with an explanatory listing found in Appendix D,

or in the *3710 Sampler Pocket Guide*. If you have a question about a given input display, you can easily locate the description of the display.

The display number can be accessed by pressing the STOP key when viewing the input display. To see the display number, press the STOP key, read the number from the display, then look up the corresponding number in Appendix D for information on that display. The display number for the program/configure screen above is “1.”

Displays With Choices – There are two types of input displays: displays which prompt you to make a choice (between time-paced and flow-paced sampling, for example) and displays which prompt for numeric input (sample volume, for example). In displays which prompt you to make a choice, you must select one of up to four alternatives placed in brackets. The display above prompts you to select the program or the configure sequence. The choices, “PROGRAM” and “CONFIGURE,” are placed in brackets.

When an input display prompting for a choice first appears, the blinking word indicates the currently selected choice. If the blinking word is acceptable, press the ENTER/PROGRAM key. If the blinking word is not acceptable, select the preferred choice by pressing the LEFT ARROW or RIGHT ARROW key until the preferred choice is blinking; then press the ENTER/PROGRAM key. The sampler will store the selected choice and advance to the next step.

When the display above appears, the word “PROGRAM” will be blinking. If “PROGRAM” is acceptable, press the ENTER/PROGRAM key. If “PROGRAM” is not acceptable, press the LEFT ARROW or RIGHT ARROW key until “CONFIGURE” is blinking. Then, press the ENTER/PROGRAM key. The ENTER/PROGRAM key directs the sampler to advance to the next step.

Numeric Input Displays – A numeric input display will prompt for input by blinking the currently stored number. (In the display illustrated above, the number “250” will blink to prompt you to enter a value.) If the blinking number is acceptable, it is not necessary to type the number again: pressing the ENTER/PROGRAM key will store the number and advance the program to the next step. To enter a new number, press the appropriate numeric keys, then press the ENTER/PROGRAM key.

The sampler will not accept a number that exceeds the allowable range of values placed in parentheses on the display. In the next illustration, no less than 10 ml and no more than 990 ml can be entered as a sample volume. If an entered number exceeds the range, the sampler will emit a series of beeps and the original number will reappear. An acceptable value must be entered to advance to the next step.

3.6.7 Editing Numbers

The left arrow key and CLEAR ENTRY key can be used to edit numeric entries if they are used *after* you press a numeric key and *before* you press the ENTER/PROGRAM key. The CLEAR ENTRY

key will clear any typed number and the original number will re-appear. The left arrow will erase the most recently typed number.

Some numeric input displays prompt for more than one value. In the illustration below, the prompt asks for five number entries: hours, minutes, day, month, and year. The left arrow key and RIGHT ARROW key can be used to move back and forth between each of the five entries. Individual entries can be changed, as discussed above. Pressing the right arrow or ENTER/PROGRAM key on the *last* entry will store the values and advance to the next display.

HH:MM	DD-MM-YY
12:33	21-MAR-04

3.6.8 Military Times

Times must be entered in military format: to set the sampler's clock to 3:30 PM, enter a time of 15:30. When the display above first appears, the first two digits, "12," will blink. To enter a new time, type in the new hour: "15." Store the hour entry and advance to minutes by pressing the ENTER/PROGRAM key.

If the month or year entry does not need to be changed, accept the entry by pressing the RIGHT ARROW or ENTER/PROGRAM key. The left arrow key can be used to return to a previous position. Pressing the RIGHT ARROW or ENTER/PROGRAM key on the *last* entry, "04," will store the value and advance to the next display.

3.6.9 Exit Program Key

The user can exit an input display by pressing the EXIT PROGRAM key. If you use the EXIT PROGRAM key, the currently stored setting will not change.

3.7 Programming Examples

The following examples demonstrate the steps used to check the configure option settings and program the sampler for several different sampling routines. The programming examples in this manual present each display in the order in which they appear on the sampler. They are designed to provide you with step-by-step procedures and are provided as models for you to use later when programming the sampler for your "real" applications. Each programming example concludes with the run state displays that appear while that routine is being executed. The run state displays can be used to monitor the sampler's progress through a routine.

There are two sets of examples. Examples for the basic programming sequence are provided in Examples *Time-Paced Sampling*, on page 3-19 through *Calibration*, on page 3-23. Because many of the features of the extended programming mode are affected by selections made in the configure sequence, examples for the extended programming sequence follow the *Configure Sequence*. This section discusses each configure option separately. We recommend you become familiar with the basic programming mode procedure and examples before using the extended programming mode. Most of the procedures used in the

extended programming mode duplicate those of the basic programming mode and are not repeated in the section on extended programming procedures.

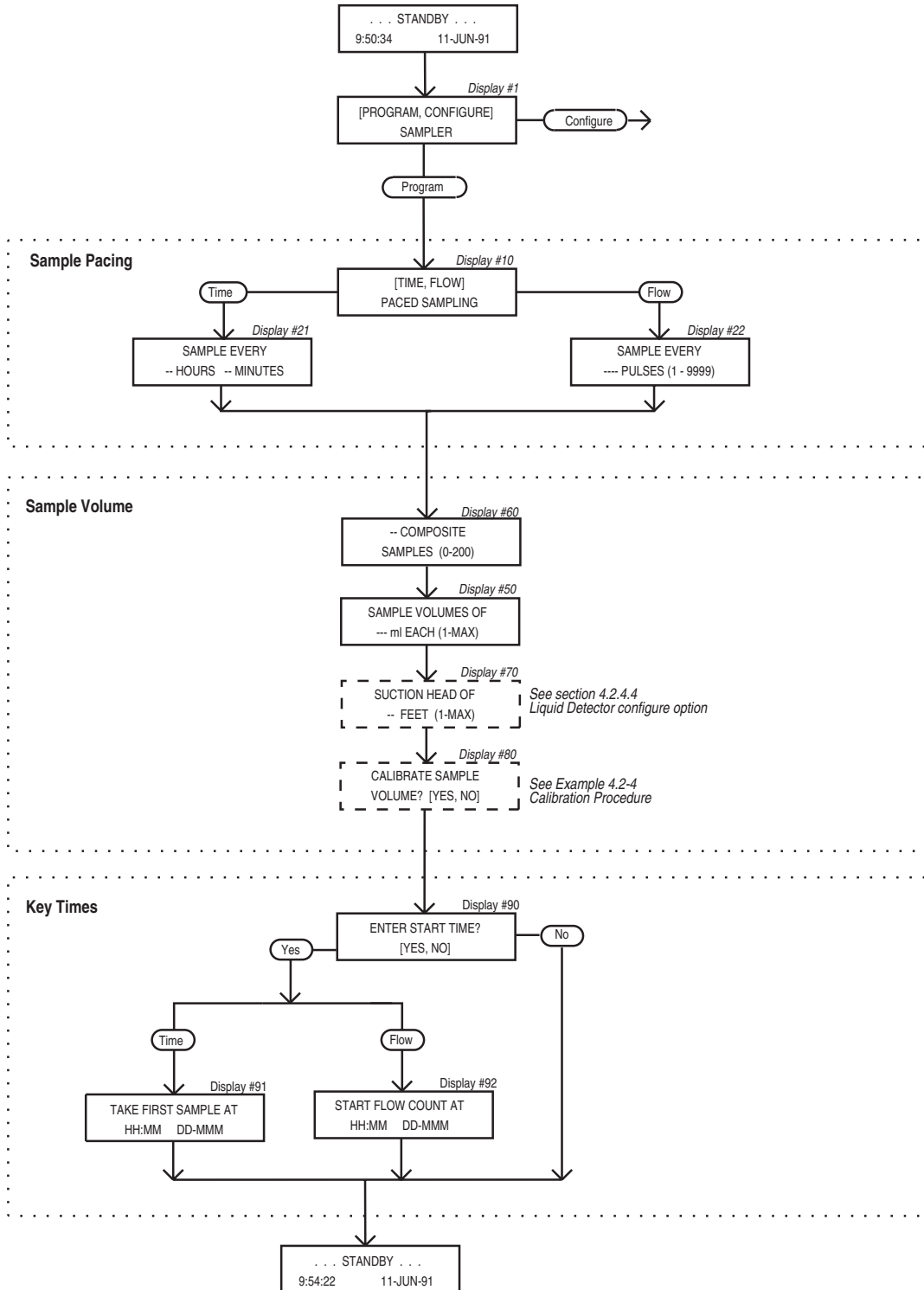


Figure 3-3 Basic Programming Mode: Program Sequence Structure

Examples for both programming modes are accompanied by flow charts. These charts diagram the program sequence structure for each mode. Figure 3-3 charts the Basic Programming Mode structure. Figure 3-5 charts the structure of the Extended Programming Mode. The charts are provided to act as a “map” to the programming process. Both charts are divided into sections – Sample Pacing, Sample Volume, and Key Times –which correspond to the steps listed in the procedure discussed below. Each chart contains the input displays used in the sequence. The input displays on each chart are labeled with their display number so they can be cross-referenced with the listing found in Appendix C.

As noted earlier, the sampler is shipped with a test program and factory configuration settings. The examples in this manual assume that all factory settings are being used, that the sampler will use a 2.5 gallon (9400 ml) container and a 10 foot length of $\frac{3}{8}$ -inch vinyl suction line. The settings with which your sampler is shipped include settings for the size of bottle ordered and for the size, type, and length of suction line. When you check the configuration settings, make sure the settings match your equipment, not the example.

Most program and configure settings can be re-initialized to factory settings, if desired. Tables 3-5 and 3-4 list the factory settings. A discussion of the re-initialize option, located in the Run Diagnostics configure option, is found in Section 3.9.20. Instructions for re-initializing the sampler are also included as part of Example *Checking the Configure Option Settings*, on page 3-17.

3.8 Basic Programming Procedure

The steps needed to program the sampler in the basic mode follow the procedure outlined below.

1. Turn the sampler on with the ON/OFF key. The sampler always “wakes up” in the standby state. The “STANDBY” message will appear. If the sampler were turned off while running a routine, the “PROGRAM HALTED” message will be displayed. Both messages indicate the sampler is in standby.
2. Press the ENTER/PROGRAM key to access the interactive state. Select “PROGRAM.” Refer to Figure 3-3 for displays noted in steps 3 - 6.
To return to a previous display when programming the sampler, press the EXIT PROGRAM key. The sampler will return to standby. Press the ENTER/PROGRAM key again to re-enter the interactive state. Continue to press the ENTER/PROGRAM key to scroll through the displays until you locate the display in question.
3. Enter the Sample Pacing settings. The sampler will prompt you to select either time- or flow-pacing. Depending on your selection, you will then be prompted to enter the time or flow pulse interval between samples.
NOTE: If you will be using very short sample intervals, be sure the interval is longer than the duration of the sampling cycle. For truly representative sampling, the interval

in either time- or flow-paced sampling should be longer than the duration of the sampling cycle.

If the intervals are too short, no sample events will be missed, although some events will occur at improper times. The duration of the cycle can be determined by programming the sampler with the desired settings, pressing the MANUAL SAMPLE key, and simply timing the cycle.

When programming the sampler for flow pacing, you must enter the number of pulses that make up the flow interval.

If the flow meter has been set to send a pulse once every 1000 gallons, you can program the sampler to collect a sample once every 1000 gallons by entering a flow pulse interval of "1." To collect a sample once every 50,000 gallons, you would enter a sample interval of 50 pulses.

Appendix E provides a discussion of some of the calculations needed when determining flow pulse intervals.

4. Enter the Sample Volume settings. The Sample Volume program section will always contain prompts for the number of samples and sample volume. Depending on the selections made in the configure sequence, it may also contain prompts for the suction head and for calibrating the sampler.

The first display of the Sample Volume section, display #60, prompts you for the number of samples you want deposited in the bottle. The acceptable range for number of samples is 0 to 999; the range is determined by the bottle size entered in the Bottle Size configure option. Enter 0 if you want the sampler to take samples indefinitely until the float shutoff terminates the sampling. If you enter a number greater than zero, the sampler will take samples until it has deposited that number of samples or the float shutoff terminates the sampling. The next display prompts you for the sample volume and indicates the range of acceptable volumes. The maximum range of sample volumes is dependent on the number of samples entered in the previous display; it will never exceed 9990 ml.

When entering the sample volume, the ± 10 ml sample volume repeatability should be kept in mind. Because the entered volume is a "nominal" value, it is prudent to calculate a total sample volume that is somewhat less than the volumetric capacity of the bottle as a safety factor. This will minimize the effects of cumulative error. Refer to Section 3.9.2 for notes on cumulative error and bottle size.

If you will be using a preservative in the sample bottle, be sure to take the volume of the preservative into account. The sampler can be configured, through the Liquid Detector configure option, to add the suction head setting to the program sequence. The suction head display will appear after you enter the sample volume. However, when the head is unknown or variable, the suction head setting should be omitted by disabling the suction head setting in the Liquid Detector configure option. By disabling the setting, you allow the liquid detector to determine the operat-

ing suction head each time a sample is taken.

If you want to calibrate the sample volume, the calibration option must be enabled. To enable this option, select “ENABLE” in the Calibrate Sampler configure option. (Refer to Section 3.9.11.) Enabling the option will add the calibration displays to the Sample Volume program section. The calibration displays are included in Example *Calibration*, on page 3-23.

5. Enter the Key Times settings. In the basic programming mode, you will be asked if you want to enter a start time for the routine. If you select “YES,” you will be prompted to enter a specific start time and date. If you select “NO,” the sampler will use the start time delay. The start time delay can be set from 0 to 9999 minutes in the Start Time Delay configure option. (See Section 3.9.13.) When you select “NO,” the routine will start according to the delay setting in the Start Time Delay configure option. The time remaining between the time you press the START SAMPLING key and the next full minute will pass before beginning the delay countdown. In other words, with a start time delay of one minute, if you press the START SAMPLING key at 10:05:30, the routine will begin the one minute countdown at 10:05:00 and start the routine at 10:06:00. When the sampler is operating under factory configuration settings and running a time-paced program, the first sample will be taken at the start time for time-paced sampling. This is true whether you enter a specific start time and date, or if you use the start time delay. For flow-paced sampling, however, the flow pulse countdown will begin at the start time and the first sample will be taken when the countdown reaches zero. Refer to the discussion on the *Flow Mode* option, in Section 3.9.10, for additional information.
6. The sampler will automatically return to standby.
7. From standby, start the routine by pressing the START SAMPLING key. This places the sampler into the run state. If you happen to start the routine after the programmed start time, the sampler will allow you to reprogram the start time.
8. Use the run state displays to monitor the sampler’s progress.

Before programming the sampler – especially if you are unfamiliar with the settings used in the previous routine, or if you think the settings have been changed – verify the configure option settings. You *must* change the settings if they do not match your bottle size or the suction line used with your unit. Entries suggested in Example *Checking the Configure Option Settings*, on page 3-17, configure the sampler for the 2.5 gallon (9400 ml) container and a 10 foot length of $\frac{3}{8}$ -inch vinyl suction line, enable the liquid detector, and select the basic programming mode. Procedures for re-initializing the program settings and configure options to factory settings are placed in steps 21 to 22.

Example: Checking the Configure Option Settings

1. If the sampler is not already on, press the ON/OFF key to turn it on. The standby display shown here will appear. Press the ENTER/PROGRAM key to access the interactive state. The next display you'll see is shown in Step 2.

```

. . . STANDBY . . .
10:34:50 19-JUN-04
    
```

2. Access the configure sequence by selecting "CONFIGURE." Select "CONFIGURE" by pressing the RIGHT ARROW key once. When "CONFIGURE" blinks, accept the selection by pressing the ENTER/PROGRAM key.

```

[PROGRAM, CONFIGURE]
SAMPLER
    
```

3. The first option displayed is the Set Clock configure option. If the time displayed on the LCD in the standby message is not correct, reset the time with the Set Clock configure option. Press the ENTER/PROGRAM key to access the Set Clock input display.

```

SELECT OPTION: (< ← →)
SET CLOCK
    
```

4. Use this display to reset the time. Five entries are required. The LEFT ARROW and RIGHT ARROW keys can be used to move back and forth between each of the five entries. Use the arrow keys until the entry you want to change blinks. Type in the new time or date; press the ENTER/PROGRAM key to accept it. Press the RIGHT ARROW or ENTER/PROGRAM key on the *last* entry to store the values and advance to the next display

```

HH:MM DD-MM-YY
10:35:20 19-06-04
    
```

5. To verify the Bottle Size settings, press the ENTER/PROGRAM key. The display shown in Step 6 will appear.

```

SELECT OPTION: (< ← →)
BOTTLE SIZE
    
```

6. Select "REFRIG." Isco 3700 Series portable and refrigerated samplers use the same controller. You would not need to select "PORTABLE" unless you moved the controller to a portable sampler.

```

(PORTABLE, REFRIG)
SAMPLER
    
```

7. Enter the bottle size here. Enter "9400" for the 2.5 gallon bottles, "15000" for 4 gallon bottle. Press the enter/program key.
If you enter a number that exceeds the maximum standard bottle size (15000), the message, "WARNING: STANDARD BTL VOLUME EXCEEDED!", will be displayed for a short time. The sampler will then prompt you to confirm the volume entered. This prompt is displayed in step 8.

```

BOTTLE VOLUME IS
9400 ml
    
```

8. Select "YES" if you want to use the nonstandard bottle volume. Select "NO" if you want to revise the entry. The display shown in step 7 will reappear; use it to enter the revised bottle volume. Press the ENTER/PROGRAM key to accept the entry and advance to step 9

```

15001 ml! . . . ARE YOU
SURE? (YES, NO)
    
```

9. Press the ENTER/PROGRAM key at this display to access the Suction-Line input displays shown in steps 11 to 13.

```

SELECT OPTION: (< ← →)
SUCTION LINE
    
```

10. Select "1/4" if you are using 1/4-inch suction line, "3/8" if you are using 3/8-inch suction line. Press the ENTER/PROGRAM key to accept the selection. If you select "1/4," you will not see the display shown in step 12; instead you will be prompted for the suction-line length, as shown in step 13. (You do not need to specify vinyl line type because only 1/4-inch suction line is available.)

Example: Checking the Configure Option Settings (Continued)

```
SUCTION LINE ID IS  
< 1/4, 3/8 INCH
```

11. This display appears when you have selected "3/8" in step 11. Select "VINYL" if you are using vinyl suction line, "TEFLON" if you are using PTFE suction line. Press the ENTER/PROGRAM key to accept the selection

```
SUCTION LINE IS  
< VINYL, TEFLON>
```

12. Enter the length of the suction line. Do not include the tube coupling or the strainer in the length. Press the ENTER/PROGRAM key to accept the entry and move to step 14. If you change the suction line settings, the "... CALCULATING ... PUMP TABLE VALUES" message will appear for a short time

```
SUCTION LINE LENGTH  
IS 10 FEET (3 - 99)
```

13. Press the ENTER/PROGRAM key at this display to access the Liquid Detector input displays shown in steps 15 to 18.

```
SELECT OPTION: <← →>  
LIQUID DETECTOR
```

14. Select "ENABLE" to turn on the Liquid Detector on, "DISABLE" to turn off the Liquid Detector. For the purposes of the following examples, select "ENABLE." Press the ENTER/PROGRAM key to accept the selection. You should normally leave the detector enabled unless you suspect it is malfunctioning. If you disable the detector, you will need to enter the suction head in the program sequence.

```
[ENABLE, DISABLE]  
LIQUID DETECTOR
```

15. This display appears when you select "ENABLE" in step 15. For the purposes of this example, enter "0." Press the ENTER/PROGRAM key to accept the entry. Rinse cycles condition the suction line to reduce cross contamination.

```
0 RINSE CYCLES (0-3)
```

16. This display appears when you select "ENABLE" in step 15. For the purposes of the following examples, select "NO" to omit the setting. Press the ENTER/PROGRAM key to accept the selection.

```
ENTER HEAD MANUALLY?  
[YES, NO]
```

17. This display appears when you select "ENABLE" in step 15. For the purposes of this example, set the number of retries to "0." Press the ENTER/PROGRAM key to accept the entry. This setting determines the number of times the sampler will try to detect the presence of liquid for each sample event.

```
RETRY UP TO 0 TIMES  
WHEN SAMPLING (0-3)
```

18. To verify the programming mode setting, press the ENTER/PROGRAM key.

```
SELECT OPTION: <← →>  
PROGRAMMING MODE
```

19. Select "BASIC." Press the ENTER/PROGRAM key to accept the selection

```
[BASIC, EXTENDED]  
PROGRAMMING MODE
```

The steps in Example *Time-Paced Sampling* program the sampler to take 250 ml samples every 15 minutes for a six hour period of time. The sampling routine is to start at 6:00 a.m.

When entering the program settings, you must enter the number of samples required before entering the sample volume. At four samples per hour, the 6 hour period would yield 24 samples. The total sample volume collected at the end of the routine would be 6000 ml (24 samples 250 ml/sample), well within the capacity of the 9400 ml (2.5 gallon) bottle.

Example: Time-Paced Sampling

1. If the sampler is not already on, press the ON/OFF key to turn it on. The standby display shown here will appear. Press ENTER/PROGRAM to access the interactive state

```
. . . . STANDBY . . . .  
5:34:50 19-JUN-04
```

2. Access the program sequence by selecting "PROGRAM." Because "PROGRAM" will already be selected (blinking), press the ENTER/PROGRAM key to accept it and move to the next step.

```
[PROGRAM, CONFIGURE]  
SAMPLER
```

3. To enter the interval between samples in time increments, select "TIME." If "TIME" is already blinking, press the ENTER/PROGRAM key to accept the selection. If "FLOW" is blinking, press the LEFT ARROW key once so that "TIME" blinks. Then, press the ENTER/PROGRAM key to accept "TIME."

```
[TIME, FLOW]  
PACED SAMPLING
```

4. This display requires two entries: one for the hours, one for the minutes. Enter "0" to set the hours at zero. Press ENTER/PROGRAM to accept the number "0" and move to the minutes entry shown in step 5.

```
SAMPLE EVERY  
0 HOURS, 1 MINUTES
```

5. Enter "15" to set the minute entry. Press ENTER/PROGRAM to accept the entry.

```
SAMPLE EVERY  
0 HOURS, 15 MINUTES
```

6. Enter the number of samples to be collected: "24." Press ENTER/PROGRAM to accept the entry.

```
24 COMPOSITE  
SAMPLES (0-470)
```

7. Enter the sample volume: "250." Press ENTER/PROGRAM to accept the entry.

```
SAMPLE VOLUMES OF  
250 ml (10 - 1000)
```

8. Select "YES" to enter the start time for the routine.

```
ENTER START TIME?  
[YES, NO]
```

9. Enter the start time and date: 6:00 on April 19.

```
TAKE FIRST SAMPLE AT  
6:00 19-APR
```

After this message is displayed briefly, the sampler will automatically return to the standby state.

```
PROGRAMMING SEQUENCE  
COMPLETE
```

10. After the sampler is properly installed, press the START SAMPLING key to run the program.

Example: Time-Paced Sampling (Continued)

```
... STANDBY ...  
5:38:50 19-APR-04
```

The first line of this display indicates the number of the upcoming sample event and the total number of programmed samples. The second line indicates the scheduled time of the upcoming event followed by the current time

```
SAMPLE 1 OF 24  
AT 6:00 5:39:43
```

When the time to the next sample event has elapsed and the sampler has initiated the sample event, the sampling cycle begins. When the pump reverses for the pre-sample purge, the second line disappears.

```
SAMPLE 1 OF 24
```

At the end of the pre-sample purge, the pump runs forward to deliver the sample, and the second line appears on the display. This display remains through the end of the post-sample purge

```
SAMPLE 1 OF 24  
PUMPING 250 ml
```

At the end of the sample event, the display changes to indicate the number and time of the next event. The current time is reported in the lower right corner.

```
SAMPLE 2 OF 24  
AT 6:15 6:00:33
```

The cycle is repeated for the remainder of the sampling routine

```
SAMPLE 2 OF 24
```

```
SAMPLE 2 OF 24  
PUMPING 250 ml
```



This display appears when the routine is completed. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

```
DONE ... 24 SAMPLES  
6:10:35 21-JUN-04
```

The steps in Example *Flow-Paced Sampling* program the sampler to take 24, 250 ml samples at a flow pulse interval of 10 pulses. The sampling routine is to start according to the start time delay. A discussion of the calculations needed to determine the estimated time interval of flow-paced samples, the number of flow pulses, and sample volume can be found in Appendix E.

Example: Flow-Paced Sampling

1. Press the ENTER/PROGRAM key to reenter the interactive state.

```
STANDBY . . .
10:38:50 19-APR-04
```

2. Access the program sequence by selecting "PROGRAM."

```
[PROGRAM, CONFIGURE]
SAMPLER
```

3. Select "FLOW."

```
[TIME, FLOW]
PACED SAMPLING
```

4. Enter "10" to set the pulse interval to 10 pulses. (Note: An entry of "0" will instruct the sampler to take samples until the float shut-off terminates the sampling routine.)

```
SAMPLE EVERY
10 PULSES (1 - 9999)
```

5. Enter the number of samples to be collected: "24."

```
24 COMPOSITE
SAMPLES (0-470)
```

6. Enter the sample volume: "250."

```
SAMPLE VOLUMES OF
250 ml (10 - 1000)
```

7. Select "NO" to use the start time delay set in the configure sequence

```
ENTER START TIME?
[YES, NO]
```

After this message is displayed briefly, the sampler will automatically return to the standby state

```
PROGRAMMING SEQUENCE
COMPLETE
```

8. After the sampler is properly installed, press the START SAMPLING key to run the program.

```
. . . STANDBY . . .
10:40:23 19-APR-04
```

This display appears during the start time delay countdown:

```
START AT 10:42 19-APR
10:40:35 19-APR-04
```

The first line of this display indicates the number of the upcoming sample event and the total number of programmed samples. The second line indicates the number of pulses remaining to the sample event.

```
SAMPLE 1 OF 24
AFTER 10 PULSES
```

This display indicates that one pulse has been received. The pulse countdown will continue until the next sample event.

```
SAMPLE 1 OF 24
AFTER 9 PULSES
```

Example: Flow-Paced Sampling (Continued)



When the flow countdown reaches zero and the sampler has initiated the sample event, the sampling cycle begins. When the pump reverses for the pre-sample purge, the second line disappears.

```
SAMPLE 1 OF 24
```

At the end of the pre-sample purge, the pump runs forward to deliver the sample, and the second line appears on the display. This display remains through the end of the post-sample purge.

```
SAMPLE 1 OF 24  
PUMPING 250 ml
```

At the end of the sample event, the display changes to indicate the number and time of the next event.

```
SAMPLE 2 OF 24  
AFTER      10 PULSES
```

The cycle is repeated for the remainder of the sampling routine.

```
SAMPLE 2 OF 24
```

```
SAMPLE 2 OF 24  
PUMPING 250 ml
```



This display appears when the routine is completed. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

```
DONE . . . 24 SAMPLES  
6:10:35      20-APR-04
```

Example *Calibration* demonstrates the method used to calibrate the sampler for a 200 ml sample volume. The Calibrate Sampler configure option must be enabled in the configure sequence before the calibration displays shown below will appear.

Even without calibrating, the 3710 Sampler will deliver accurate sample volumes. If your sample volumes vary significantly with the entered values, check the suction line first. Be sure the line slopes continuously downhill and is draining completely after each pumping cycle. Then, check the suction line entries in the configure sequence to see that they are accurate. The calibration procedure is intended to be for "fine tuning" only.

After you enter the sample volume actually delivered, as shown in step 8, all subsequent sample volumes delivered will be adjusted to correct for the difference between the expected sample volume and the actual volume entered. Clear the adjustment by changing a suction line entry in the Suction Line configure option or by re-initializing the sampler.

Because the sample volume can be calibrated to ± 10 ml, a graduated cylinder should be used to facilitate measurement. A graduated cylinder is available from the factory. Refer to Appendix B for details.

The calibration pump cycle will include rinse cycles and retries, if the sampler is configured to perform them (see Section 3.9.6). This ensures that the calibration procedure includes the pump cycle used while running the sampling program.

Example: Calibration

1. Press the ENTER/PROGRAM key to reenter the interactive state.

```
STANDBY . . .  
10:38:50 19-APR-04
```

2. Access the program sequence by selecting "PROGRAM."

```
[PROGRAM, CONFIGURE]  
SAMPLER
```

3. Step through the program until the "CALIBRATE SAMPLER?" input display appears (step 4).

```
[TIME, FLOW]  
PACED SAMPLING
```

Other program sequence displays.



4. Select "YES."

```
CALIBRATE SAMPLER?  
[YES, NO]
```

5. Before pressing the MANUAL SAMPLE key, make sure a collection container is underneath the pump tube.

```
PRESS MANUAL SAMPLE  
KEY WHEN READY . . .
```

6. The sampler will deliver the programmed sample volume.

```
. . . MANUAL SAMPLE . . .  
PUMPING 200 ml
```

7. Measure the actual volume delivered and enter that value here.

```
200 ml VOLUME  
DELIVERED
```

8. Repeat the procedure if desired by selecting "YES." When you are satisfied with the calibration, select "NO." Under normal conditions, you should not need to repeat the procedure.

```
CALIBRATE SAMPLER?  
[YES, NO]
```

Other program sequence displays.



Other program sequence displays.

```
. . . STANDBY . . .  
9:39:50 19-APR-04
```

3.9 Configure Sequence

The configure sequence provides a number of setup options. Some options enable sampling features, some provide reference data, and others affect run state operations.

Example *Checking the Configure Option Settings* shows the procedure used to access the configure sequence. (When you see a “SELECT OPTION: (← →)” display, you are in the configure sequence.) Each option uses at least two displays. The first display lists the option name. The second and any additional displays are input displays. To access an input display, press the ENTER/PROGRAM key while the desired option name is displayed. Once you’ve accessed the input display, use the keypad to enter numbers and make choices as described in Section 3.6.2 through 3.6.6.

Pressing the EXIT PROGRAM key in the configure option list will return the sampler to standby. Pressing the EXIT PROGRAM key in a configure option *input display* will return you to the list of configure options without changing the display’s setting.

By pressing the LEFT ARROW or RIGHT ARROW key at the “SELECT OPTION” display in the configure sequence, you can scroll through the list of configure options without viewing each input display. If you are interested in only one or two options, you can use this method to locate the option of interest quickly.

Each option is discussed below in the order in which it appears when configuring the sampler. Individual input displays and their settings, are discussed separately within the discussion of each option. The name of the setting is placed in the left margin so you can identify each topic. Illustrations of displays are not included in each discussion; however, each discussion includes the display number, should you need to refer to display listing in Appendix C.

3.9.1 Set Clock

The Set Clock option is used to synchronize the sampler’s clock with real time. Times must be entered in military time: 9:30 a.m. would be entered as 9:30, 9:30 p.m. would be entered as 21:30. When the year entry is accepted, the seconds will be reset to zero. (*Display #210*)

3.9.2 Bottle Size

The Bottle Size option is used to enter the bottle volume. The option uses two input displays:

- the first display allows you to specify a portable or refrigerated sampler
- the second sets the bottle volume.

The sampler uses the bottle volume to calculate the range of acceptable values in the sample volume input display. It also uses the volume to check for probable overflow when the sampler is programmed for flow-paced sampling.

3.9.3 Portable or Refrigerated Sampler

Because the 3700 Series portable and refrigerated samplers use the same control box, you must specify the type of unit. The 3710FR Sampler will be shipped with this setting as “REFRIG-

ERATED.” This setting is not changed when you re-initialize the settings. You should not specify “PORTABLE” unless you move the control box to a portable sampler. (*Display #220*)

3.9.4 Bottle Volume

The following chart lists Teledyne Isco’s standard bottle sizes for composite samplers. When using Teledyne Isco’s bottles, enter the bottle volume setting listed in the third column of the table. The recommended bottle sizes have been adjusted downward. Using the lower, adjusted volume helps prevent overfilling. If you are using a non-standard bottle, enter a bottle volume smaller than the actual bottle capacity. This will help prevent overfilling. (There are approximately 3785 ml per gallon.)

Bottle Configuration	Bottle Size	Bottle Volume Setting
Glass or polyethylene	2.5 gal	9400
1 polyethylene bottle	4 gal	15000
1 polyethylene bottle	5.5 gal	20800

Cumulative Error – The sample accuracy is the greater of 10% of the sample volume or 20 ml and is repeatable to ± 10 ml. Since samples of 150 ml can vary by 10% or ± 15 ml, the cumulative error for 24 samples would be ± 360 ml. If the sampler consistently places 24 sample volumes of 165 ml (150 ml + a 10% variation of 15 ml) in a 3800 ml bottle, the total volume deposited would be 3960 ml, overfilling the bottle by 160 ml. Again, to avoid possible overfilling, enter a bottle volume that is less than the actual bottle capacity.

3.9.5 Suction Line

The Suction Line configure option is used to configure the sampler for the type (vinyl or PTFE), diameter, and length of the suction line used. The volumetric delivery varies with line diameter, type, and length, so it is important that these settings be entered accurately. An incorrect setting will impair the accuracy of the sample volume. These settings are also used to determine the number of post-sample purge counts. It is important to have sufficient counts to completely clear the line.

If you change the current suction line settings, the “. . . CALCULATING . . . PUMP TABLE VALUES” message will appear for a short time. Because the volumetric delivery of the sample varies with the diameter, type, and length of the suction line; the sampler must revise the internal pump tables. The tables are used as reference for the electronic pump count for sample delivery.

There are three types of suction lines available for use with the 3710 sampler: 1/4-inch vinyl, 3/8-inch vinyl, and 3/8-inch PTFE. If you specify 1/4-inch line, the sampler will prompt you for the line

length immediately. If you specify $\frac{3}{8}$ -inch line, the sampler will prompt you to specify vinyl or PTFE before prompting for the line length. (*Display #'s 230 and 231*)

The sampler will accept suction line lengths of 3 to 99 feet. When measuring the line, do not include the tube coupling or the strainer in the measurement. The line should be cut to even foot lengths. (*Display #232*)

3.9.6 Liquid Detector

The Liquid Detector configure option is used to turn the liquid detector on or off, set the number of rinse cycles, add a suction head setting to the program sequence, and set the number of sampling retries should the suction line become clogged. The option uses four input displays: Enable/Disable Detector, Rinse Cycles, Enter Head Manually, and Sampling Retries.

Enable/Disable Detector – The recommended setting for the Enable/Disable Detector option is “ENABLE.” The 3710 Sampler determines the delivered sample volume suction head by counting revolutions of the peristaltic pump rotor. The volume of liquid delivered by one revolution of the pump rotor is a function of the suction head; as the suction head increases, the volume delivered by one revolution of the pump rotor decreases. By enabling the detector, the sampler can accurately determine the operating suction head. It does not have to rely on a programmed suction head value, but can instead begin its volume delivery count when liquid is detected. This minimizes inaccuracies that can occur in changing head conditions, or when measurement of the suction head is difficult to determine accurately.

The disable option is provided should the detector or its associated circuitry become suspect. If the detector is disabled, the manual suction head setting (*Display #70*) is automatically added to the Sample Volume program section in the program sequence. If the detector is disabled, the sampler will use a calculated number of pump counts based on the suction head entry to deliver the correct sample volume. The sampler will operate at diminished accuracy with the detector disabled. (*Display #240*)

Rinse Cycles – The Rinse Cycle setting is available only when the detector is enabled. It is used to set the number of suction line rinses, from 0 to 3. Rinses are used to condition the suction line to reduce cross contamination. During a rinse cycle, the pump draws liquid up through the line until it is detected by the liquid detector. At that point, the pump reverses to purge the line. This cycle is repeated according to the number of rinse cycles entered. (*Display #241*)

Rinse cycles contribute to the wear on pump tubing; therefore, if you use rinse cycles, it may be necessary to replace the tubing more frequently. The Tubing Life configure option (see Section 3.9.17) allows you to monitor pump tubing wear.

Enter Head Manually – Entering the head manually is available as an option when the detector is enabled and allows you to add the suction head entry (*Display #70*) to the program sequence. When the detector is disabled, the Suction Head entry is automatically added to the program sequence. By disabling the

suction head setting, you allow the liquid detector to determine the operating suction head each time a sample is taken. Using the Suction Head entry in conjunction with the liquid detector, *when the head is stable and known accurately*, further increases accuracy of the delivered volume. When the head is variable or unknown, you should select “NO” because an incorrect head setting diminishes the delivered volume accuracy. (Display #242)

Sampling Retries – The Sampling Retries option is available as an option when the detector is enabled. It sets the number of times, from 0 to 3, the sampler will try to detect liquid in the line before skipping the sample. This option can be used when sampling liquid with a high concentration of solids which tend to clog the suction line or the strainer. The sampler will also retry the rinse cycle when you are using the Sampling Retry option. (Display #243)

Table 3-3 Sampling Capabilities Through the Program Sequence

Pacing	Mode	Feature
Time-Pacing: Uniform Time Intervals	Basic & Extended	Samples taken at regular time intervals from 1 minute to 99 hours, 59 minutes.
Time-Pacing: Nonuniform Clock Time Intervals	Extended	Samples taken at irregular time intervals by specifying the time and date of each sample. You can enter dates as far as one month in advance of the current date.
Time-Pacing: Nonuniform Intervals in Minutes	Extended	Samples taken at irregular time intervals by specifying the amount of time in minutes between each sample. You can enter intervals from 1 to 999 minutes.
Flow-Pacing	Basic & Extended	Samples taken at regular flow intervals. The sampler will totalize flow intervals of 1 to 9,999 pulses.
Volumes and Accuracy		
Number of Samples	Basic & Extended	Number of samples needed to complete the routine. A specific number of samples (up to 999) can be entered or the sampler can be programmed to terminate the routine with the float shut-off.
Sample Volume	Basic & Extended	You can enter volumes from 10 to 9,990 ml.
Suction Head	Basic & Extended	You can enter suction heads from 1 to 20 feet.
Calibration	Basic & Extended	You can calibrate sample volumes if desired.
Key Times		
Start Times	Basic & Extended	You can enter specific start times for both time-paced and flow-paced routines. If you do not enter a start time, Start Time Delay is used.
Stop/Resume Times	Extended	You can perform intermittent sampling by defining sampling stop and resume times. You can enter as many as 12 stop and 12 resume times.
Time-Pacing	Extended	Samples taken at regular time intervals from 1 minute to 99 hours, 59 minutes.

3.9.7 Programming Mode

The Programming Mode option allows you to specify either the basic or extended programming mode. The basic programming mode is used for conventional routines; the extended programming mode can be used for either conventional or more complex routines. (*Display #250*)

Table 3-3 summarizes the sampling features according to the programming mode in the program sequence. Table 3-1 summarizes the features available in the configure sequence.

3.9.8 Load Stored Program

The Load Stored Program option allows you to load one of up to three sampling programs which have been previously saved with the *Save Current Program* configure option, discussed in Section 3.9.9. After loading a program, the sampler will adjust the time settings to current times and dates. Check the settings before starting the program to be sure they are appropriate for your application. (*Display #255*).

The sampler is shipped from the factory with four programs: the current program and three stored programs, numbered from 1 to 3. All four programs contain the factory default program settings. Unless you have previously saved a program under one of the program numbers, loading a program will replace the current program with the factory default settings. When you reinitialize the sampler, all four programs return to the default program settings.

The following example shows you how to load a stored program.

Example: Load Stored Program

1. Press ENTER/PROGRAM to access the interactive state.

. . . STANDBY . . .
10:34:50 19-JUN-04
2. Access the configure sequence by selecting "CONFIGURE."

[PROGRAM, *CONFIGURE*]
SAMPLER
3. Press the LEFT ARROW or RIGHT ARROW key to scroll through the configure options. The first option displayed is the Set Clock configure option.

SELECT OPTION: (< ← →)
SET CLOCK

↓
↓
4. You can load a stored programmed only when the sampler is configured for the extended programming mode. To verify the programming mode setting, press the ENTER/PROGRAM key.

SELECT OPTION: (< ← →)
PROGRAMMING MODE
5. Select "EXTENDED." Press the enter/program key to accept the selection.

[BASIC, *EXTENDED*]
PROGRAMMING MODE
6. Press ENTER/PROGRAM to access the Load Stored Program configure option.

Example: Load Stored Program (Continued)

SELECT OPTION: <← →>
LOAD STORED PROGRAM

7. Select the number of the program you want to load. Select "NONE" when you do not want to load a program.

LOAD PROGRAM
[#1, #2, #3, NONE]

8. When the sampler has loaded the program, it will display the next configure option. When you are done configuring the sampler, press EXIT/PROGRAM to return to Standby.

SELECT OPTION: <← →>
SAVE CURRENT PROGRAM

9. After you properly install the sampler, press the START SAMPLING key to run the program.

. . . STANDBY . . .
10:37:23 19-JUN-04

3.9.9 Save Current Program

The Save Current Program option allows you to assign up to three sampling routines a number and store them. This option eliminates the need to reprogram the sampler for recurrent routines. Only the program settings are saved; if different routines require different configurations, the sampler must be reconfigured for each routine. For example, if the sampler is used at two sites, each requiring a specific sampling routine and different suction line lengths; the sampling routines can be stored for each site, but the suction line length settings must be reentered each time the line changes. (*Display #260*)

The sampler is shipped from the factory with four programs: the current program and three stored programs, numbered from 1 to 3. All four programs contain the factory default program settings. Saving a program will replace the default program with the current settings. Reinitializing the sampler will restore the default program settings. The default program settings are listed in Table 3-5.

Note

Saving a program will overwrite a program saved earlier under the same number. Settings for the current program can be viewed with the Display Status procedure.

The Following example shows you how to save a program.

Example: Save Current Program

1. Press ENTER/PROGRAM to access the interactive state.

```
... STANDBY ...  
10:34:50 19-JUN-04
```
2. Access the configure sequence by selecting "CONFIGURE."

```
[PROGRAM, CONFIGURE]  
SAMPLER
```
3. Press the LEFT ARROW or RIGHT ARROW key to scroll through the configure options. The first option displayed is the Set Clock configure option.

```
SELECT OPTION: (<- ->)  
SET CLOCK
```

↓
↓
4. You can save the current program only when the sampler is configured for the extended programming mode. To verify the programming mode setting, press the ENTER/PROGRAM key.

```
SELECT OPTION: (<- ->)  
PROGRAMMING MODE
```
5. Select "EXTENDED." Press the ENTER/PROGRAM key to accept the selection.

```
[BASIC, EXTENDED]  
PROGRAMMING MODE
```
6. Press the RIGHT ARROW key to skip the Load Stored Program configure option.

```
SELECT OPTION: (<- ->)  
LOAD STORED PROGRAM
```
7. Press the ENTER/PROGRAM key to access the Save Current Program configure option.

```
SELECT OPTION: (<- ->)  
SAVE CURRENT PROGRAM
```
8. Select the number you want to use as the program "name." Select "NONE" when you do not want to save a program. When the sampler has saved the program, it will display the next configure option. When you are done configuring the sampler, press EXIT/PROGRAM to return to Standby.

```
SAVE PROGRAM AS  
[#1, #2, #3, NONE]
```
9. When the sampler is properly installed, press the START SAMPLING key to run the program.

```
... STANDBY ...  
10:37:23 19-JUN-04
```

3.9.10 Flow Mode Sampling

The Flow Mode Sampling option is used to direct the sampler to take a sample at key times in a flow-paced sampling program.

Sample at Start Time – If you select "YES," the first sample will be taken at the start time entered in the program sequence. If you select "NO," the first sample is delayed until the number of flow pulses, set in the program sequence, have been counted down to zero. (*Display #270*)

Nonuniform Time – The Nonuniform Time option specifies the method in which nonuniform intervals are to be entered in the extended program sequence (*Display #'s 26 or 27*). If you select “CLOCK-TIME,” you will be able to enter a specific time and date for each sample event when entering settings in the program sequence. If you select “MINUTES,” you will be able to enter non-uniform intervals in minutes. (*Display #280*)

When you enter nonuniform times, you will be prompted to enter the number of nonuniform samples before you enter the non-uniform times. This display replaces the Number of Composite Samples display (*Display #60*) in the program sequence.

3.9.11 Calibrate Sampler

The Calibrate Sampler option is used to add or remove the calibration settings to the program sequence. If you select “ENABLE,” the calibration displays will be added to the program sequence and you will be able to precisely calibrate the sample volumes. (*Display #290*)

3.9.12 Sampling Stop/Resume

The Sampling Stop/Resume configure option allows you to add stop and resume settings (*Display #'s 100, 101, and 102*) to the program sequence. The Stop/Resume settings appear in the key time section of the program sequence. (You can enter up to 24 times: 12 stop times and 12 resume times.) For example, the Stop/Resume option allows you to define a sampling routine which will take samples at intervals of 15 minutes between 6:00 a.m. to 8:00 a.m. and between 4:00 p.m. to 6:00 p.m. The stop and resume entries for this routine are shown in Example *Extended Time-Paced Sampling*, on page 3-47.

Enable/Disable – Select “ENABLE” to add the stops and resume settings to the program sequence. (*Display #300*)

Sample at Stop – The Sample at Stop setting is to direct the sampler to take a sample at stop times. (*Display #301*)

Sample at Resume – The Sample at Resume setting is used to direct the sampler to take a sample at resume times. (*Display #302*)

3.9.13 Start Time Delay

The Start Time Delay option is used to set the amount of time in minutes, between the time you press the START SAMPLING key and the time the sampling routine is initiated. The sampler’s response varies according to specific entries: “0,” “1,” and entries greater than 1.

```
----- MINUTE DELAY  
TO START (0 - 9999)
```

Display #310

An entry of “0” eliminates the delay to start time; the start time occurs the moment you press START SAMPLING. For example, if you press START SAMPLING at 10:32:15, the sampler will initiate a time-paced sample event at 10:32:15.

However, the sampler will start clocking time intervals at the beginning of the minute (HH:MM:00) of the first sample event. If a sampling routine requires 10 minute intervals and you pressed START SAMPLING at 10:32:15, the sampler would begin the time interval at 10:32:00. It would initiate the second sample event at 10:42:00. The sampler would begin the flow interval at 10:32:15 for flow-paced routines.

If you enter a start time delay of “1,” the sampler will begin the routine at the beginning of the next minute. Thus, if you pressed START SAMPLING at 10:32:15, the sampler would initiate the sample event at 10:33:00. The sampler would begin time and flow intervals at 10:33:00. If you enter a start time delay of “2,” the sampler would begin time or flow intervals at 10:34:00. (*Display #310*)

Note: If you enter a start time, the sampler will disregard the start time delay. The sampler will use the start time delay setting when you do not enter the start time in the program sequence. Care must be taken when using a start time delay of greater than zero when the sampler is being inhibited by another sampler, an Isco Flow Meter, or a Liquid Level Actuator. Refer to Section 3.9.14.

3.9.14 Enable Pin

The Enable Pin option allows you to program the sampler’s response to a device controlling pin F of the flow meter connector: for example, an Isco Flow Meter or the Isco 1640 Liquid Level Actuator. There are five Enable Pin setup options: Master/Slave Mode, Sample Upon Disable, Sample Upon Enable, Reset Sample Interval, and Inhibit Countdown.

Sample Upon Disable – When you are using an Isco Flow Meter or Liquid Level Actuator, “SAMPLE UPON DISABLE?” allows you to direct the sampler to take a sample as soon as the sampler is disabled through pin F. A response of “YES” will cause the sampler to take a sample when the pin is disabled; a response of “NO” will prevent the sampler from taking a sample. (*Display #321*)

The sampler determines an enable or disable condition by monitoring the voltage on pin F. High voltage is interpreted as an enable signal. Low voltage or ground is interpreted as a disable signal.

Sample Upon Enable – When you are using an Isco Flow Meter or Liquid Level Actuator, “SAMPLE UPON ENABLE?” allows you to direct the sampler to take a sample as soon as the sampler is enabled through pin F. A response of “YES” will cause the sampler to take a sample when the pin is enabled. A response of “NO” will prevent the sampler from taking a sample when the pin is enabled. (*Display #322*)

Reset Sample Interval – “RESET SAMPLE INTERVAL?” is used to control the time or flow pulse countdown. If you select “YES,” a full sample interval will begin when pin F is enabled. If you select “NO,” the interval will not be reset when the sampler is enabled; the interval is then governed by settings entered in

the “INHIBIT COUNTDOWN?” option. If you are sampling on a time-paced basis and wish to synchronize all sampling with real time, do not reset the sample interval. (*Display #323*)

Inhibit Countdown – “INHIBIT COUNTDOWN?” is only applicable when you respond “NO” to “RESET SAMPLE INTERVAL?” The Inhibit Countdown option is used to control the countdown while the sampler is disabled. Select “YES” to freeze the countdown to the next sample. The count will resume when the sampler is enabled. Select “NO” to allow the countdown to continue while the sampler is disabled. (*Display #324*)

3.9.15 Event Mark

The Event Mark option configures the sampler to send an event mark to an interfaced flow meter or other equipment. The sampler will supply a variable duration pulse of up to 700 mA at 12 V on pin E of the flow meter connector. Four types of signals can be sent:

- a pulse at the beginning of the pre-sample purge
- a pulse at the beginning of forward pumping only
- continuous during the entire pump cycle
- continuous during forward pumping only

The type of signal selected from the Event Mark configure option affects the event mark signal on pin E. In Figure 3-4A, a pulse signal is sent at the beginning of the pre-sample purge. In Figure 3-4B, a pulse signal is sent during the sample volume delivery portion of the sample event. In Figure 3-4C, a continuous signal is sent during the entire pump cycle. In Figure 3-4D, a continuous pulse is sent for the duration of the sample volume delivery.

Continuous/Pulse Signal – The Continuous/Pulse setting is used to select either continuous or pulse signals. Pulse signals are three seconds in duration; continuous signals are three seconds or longer and depend on the setting and the pump cycle. (*Display #330*)

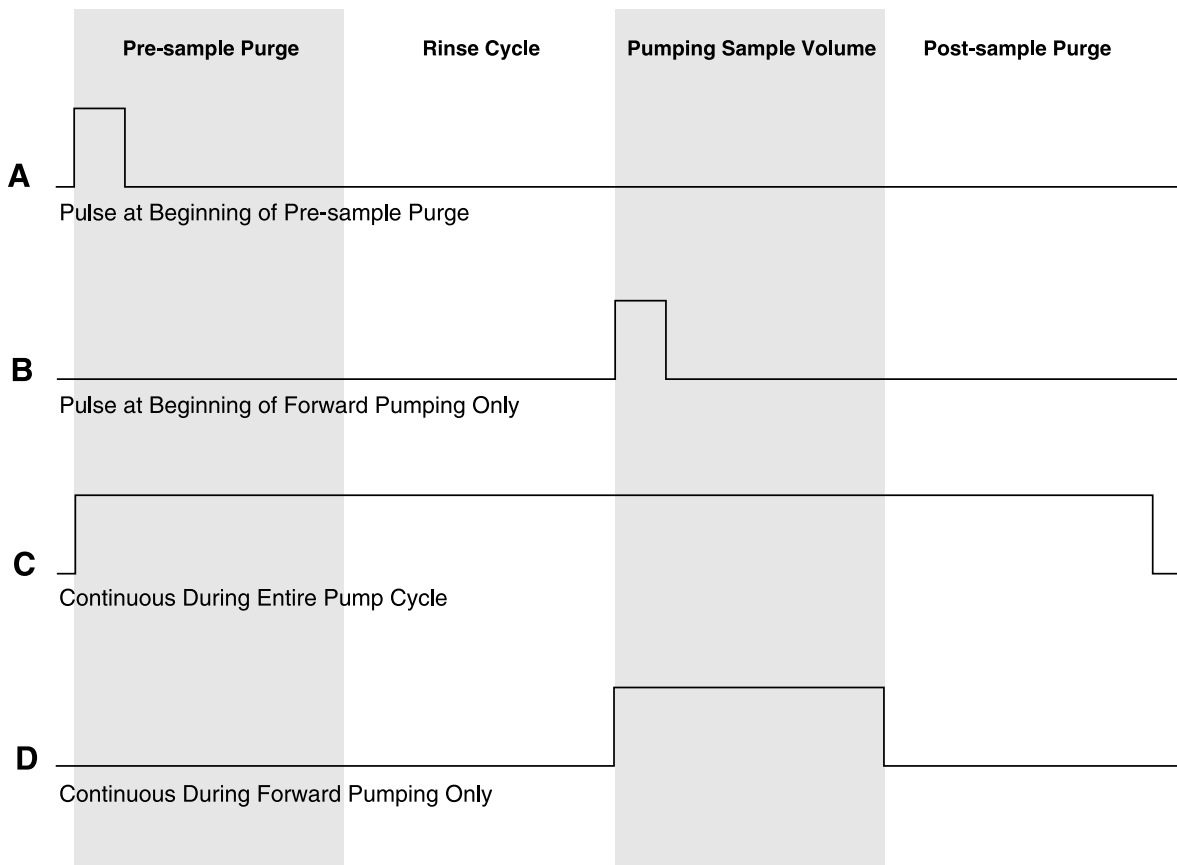


Figure 3-4 Event Mark Signal Output

Continuous Signal Timing – The Pump Cycle/Fwd Pumping settings will appear when you have selected “CONTINUOUS SIGNAL.” Select “PUMP CYCLE” when you want a continuous signal transmitted during the entire pump cycle, from the beginning of the pre-sample purge to the end of the post-sample purge. Select “FWD PUMPING” when you want a continuous signal transmitted while the pump is delivering a sample volume. (*Display #331*)

Pulse Signal – The Pulse Signal setting will appear when you have selected “PULSE.” Two options are available. The first option, “PURGE,” is used to send a pulse at the beginning of the pre-sample purge. The second option, “FWD PUMPING,” is used to send a pulse at the beginning of the sample delivery when the pump is running forward. (*Display #332*)

3.9.16 Purge Counts

The Purge Counts option is used to override the number of pump counts needed to clear the suction line in both pre-sample purge and post-sample purge cycles. The pre-sample purge count is normally set to 150 counts and will be reset to this value if the sampler is re-initialized. The post-sample purge count is derived from the suction line diameter and length settings. If your observations indicate that a greater or lesser number of pump counts in either purge is needed, you can change the count settings.

Acceptable entries are between 0 and 9999 for both purges. A purge count can be obtained using the PUMP FORWARD or PUMP REVERSE keys. (*Display #'s 340 and 341*)

3.9.17 Tubing Life

The Tubing Life option is used to set the number of pump counts needed to trigger the “REPLACE PUMP TUBING” warning. The warning will be activated when the pump count reaches the entered value. You must reset the pump counter after replacing the pump tubing. If you consistently experience a tubing failure at a pump count that differs significantly from the current setting, enter that value here. The factory set value of 500,000 pump counts will deliver approximately 500 samples of 200 ml each, using a 3/8-inch × 10 ft vinyl suction line at a 5 ft suction head. (*Display #350, 351, and 352*)

3.9.18 Program Lock

The Program Lock option allows you to protect program and configure settings with a pass-number. Select “ENABLE” to turn the protection on. When the Program Lock is enabled, each protected display can be viewed, but no values can be changed without first entering the pass-number: 3710. Once the pass-number has been entered, you can change any value or setting in either the program or configure sequence. (*Display #360*)

3.9.19 Sampler ID

The Sampler ID option allows you to enter a 10 character identification number (ID) for the sampler. The ID number is used to identify sampling reports produced by the Isco Field Printer and in files created by SAMPLINK. The sampler is shipped from the factory with 10 dashes (-) entered for the ID. (*Display #365*)

Acceptable Characters – The ID field will accept digits, dashes, spaces, and periods. You can enter spaces, dashes, and periods with three of the control keys. Enter a space with the START SAMPLING key, a dash (-) with the MANUAL SAMPLE key, and a period with the RESUME SAMPLING key.

3.9.20 Run Diagnostics

Run Diagnostics is used to perform a number of diagnostic functions. This option contains the software revision number; tests the sampler’s RAM (Random Access Memory), ROM (Read Only Memory), display, and pump; and allows for re-initializing RAM. The display information is discussed below in the order of appearance.

Software Revision Number – The sampler will display the software revision number for a short period of time.

Test RAM and ROM – The software revision display is replaced by the RAM and ROM test messages. A successful test is indicated by the messages “RAM PASSED TEST” or “ROM PASSED TEST.” If either the RAM or ROM fail the test, the sampler will display one of the following messages: “RAM FAILED TEST” or “ROM FAILED TEST” and beep every three seconds until you turn the sampler off. If either the RAM or ROM fail their test, the sampler should be serviced. Contact Teledyne Isco Customer Service for assistance.

LCD Test – After successful RAM and ROM tests, the sampler will then test the LCD by first filling the display with solid rectangles and then printing the alphabet and other characters. Each character position in the display should contain a character.

Pump Test – The next step tests the pump. During the test, the pump will run briefly and the display will indicate an “OFF/ON” number. The number should fall within the range of 50 to 200. If the count falls below 50 or exceeds 200, the pump should be serviced. A count near 100 is typical.

Re-initialize Controller – The final step allows you to re-initialize the sampler. If you select “NO,” the sampler will return to the configure option list. If you select “YES,” the sampler will reset a number of configuration and program settings, then turn the sampler off. (*Display #371*)

Tables 3-5 and 3-4 list the re-initialized settings. **Not all settings are reset.** Set Clock, Bottle Size, Suction Line, and Sampler ID configure option settings remain unchanged. This reduces the number of settings you would need to change if the sampler were accidentally re-initialized. The Pump Count total is not reset to maintain an accurate count for the Tubing Life Warning.

3.9.21 Exit Configuration

This option allows you to leave the configure sequence and return to the standby state. There are no input displays. Press the ENTER/PROGRAM key to exit the configure sequence. The configuration sequence can also be exited at any time using the EXIT PROGRAM key.

3.10 Extended Programming Mode

Sampling capabilities available in the basic programming mode are available in the extended programming mode. (See Table 3-3, on page 3-27.) The extended programming mode provides several additional capabilities: Nonuniform Time pacing, Sampling Stops and Resumes, program storage, and Flow Mode Sampling controls.

The procedure used to program the sampler in the extended mode is the same as the procedure used to program the sampler in the basic programming mode. This procedure is outlined in Section 3.7. There are some exceptions, however. The extended mode modifies the sections of the program sequence to allow you to take advantage of the additional features.

The Sample Pacing program section is extended to include settings for nonuniform times. If you have enabled the Sampling Stops and Resumes configure option, the Key Times section is extended to included displays for sampling stops and resumes.

Each of these extended features is discussed briefly below. You may find it helpful to refer to Figure 3-5, which charts the program sequence in the extended mode.

**3.10.1 Extended Mode
Sample Pacing**

In the extended programming mode, the Sample Pacing section allows you to select flow pacing, or one of two types of time-pacing: uniform or nonuniform. If you select uniform time intervals, the settings for time intervals are identical to the time intervals entered in the basic programming mode.

Nonuniform times allow you to pace the sampler at irregular intervals. Before you enter nonuniform time intervals, you must specify either minutes or clock times in the Nonuniform Times configure option. You can enter nonuniform intervals in two ways. The first method allows you to define the interval between each sample event in minutes. For example, you can program the sampler to take sample #2 after an interval of 10 minutes, sample #3 after an interval of 30 minutes, sample #4 after an interval of 60 minutes, and so on. Sample #1 would be taken at the start time. The second method allows you to enter a specific time and date for each sample event. For example, with non-uniform time pacing, samples can be collected at specific times and dates at irregular intervals: 6:00 a.m. on April 15, noon on April 15, 7:00 a.m. on April 16, and 1:00 p.m. (or 13:00 in military time) on April 16. If you have several sequences of nonuniform times, you can use the program storage feature to save the programs using each sequence.

When you enter nonuniform times, you will be prompted to enter the number of nonuniform samples — “TAKE - - SAMPLES” (*Display 25*) — before you enter the nonuniform times. This display replaces the Number of Composite Samples display (*Display #60*) in the program sequence.

**3.10.2 Extended Mode
Sample Volumes**

The extended mode Sample Volumes section is identical to the basic Sample Volume section. It is modified only when you are using nonuniform times. The Number of Composite Samples display is removed (*Display #60*) as discussed above.

**3.10.3 Extended Mode Key
Times**

The extended mode Key Times section has one additional set of displays which allow you to set up the sampling stop and resume times. The Stops and Resumes settings are available only when you have enabled the Sampling Stop/Resume configure option (see Section 3.9.12). You must first enter the number of stops and resumes, from 0 to 24. (Enter “0” if you want to omit the stop and resume settings without returning to the configure sequence and disabling the Stops and Resumes option.) Then enter the stop and resume clock times. The first entry will be a stop time. Refer to the Key Times section of Figure 3-5, display #'s 100, 101, and 102.

Table 3-4 Factory Program Settings		
Program Setting	Display Number	Factory Setting
[TIME, FLOW] PACED SAMPLING	10	TIME
UNIFORM/ NONUNIFORM TIME INTERVALS	11	UNIFORM
SAMPLE EVERY -- HOURS -- MINUTES	21	1 HOUR, 0 MINUTES
SAMPLE EVERY ---- PULSES (1 - 9999)	22	10
TAKE --- SAMPLES (1 - MAX)	25	10
QUANTITY AT INTERVAL 1. -- AT --- MINUTES	27	1 at 60 MINUTES
SAMPLE VOLUMES OF --- ml EACH (10 - MAX)	50	200
--- COMPOSITE SAMPLES (0 - MAX)	60	10
SUCTION HEAD OF -- FEET (1 - MAX)	70	10
ENTER START TIME? [YES, NO]	90	NO

Table 3-5 Factory Configure Option Settings		
Configure Option	Display Number	Factory Setting
Set Clock	210	Not Reset
Bottle Size	220, 223	Not Reset
Suction Line	230, 231, 232	Not Reset
Liquid Detector		
Liquid Detector	240	Enable
Rinses	241	0
Enter Head Manually	242	No
# Of Retries	243	0
Programming Mode	250	Basic
Load Stored Program	255	
Save Current Program	260	
Flow Mode Sampling		
Sample At Start Time	270	No
Nonuniform Time	280	Minutes

Table 3-5 Factory Configure Option Settings (Continued)

Configure Option	Display Number	Factory Setting
Calibrate Sampler	290	Disable
Sampling Stop/resume	300	Disable
Sample At Stop Times	301	No
Sample At Resume Times	302	No
Start Time Delay	310	2
Enable Pin		
Master/slave	320	Disable
Sample Upon Disable	321	No
Sample Upon Enable	322	No
Reset Sample Interval	323	No
Inhibit Countdown	324	No
Event Mark		
Continuous /pulse	330	Continuous Signal
Pump Cycle/fwd Only	331	Fwd Pumping Only
Purge/fwd Pumping	332	Fwd Pumping
Purge Counts		
Pre-sample Counts	340	150
Post-sample Counts	341	Based On Line Length
Tubing Life		
Reset Pump Counter	351	No
# Pump Counts	352	Not Reset
Program Lock	360	Disable
Sampler Id	365	Not Reset
Run Diagnostics		
Re-initialize?	371	No

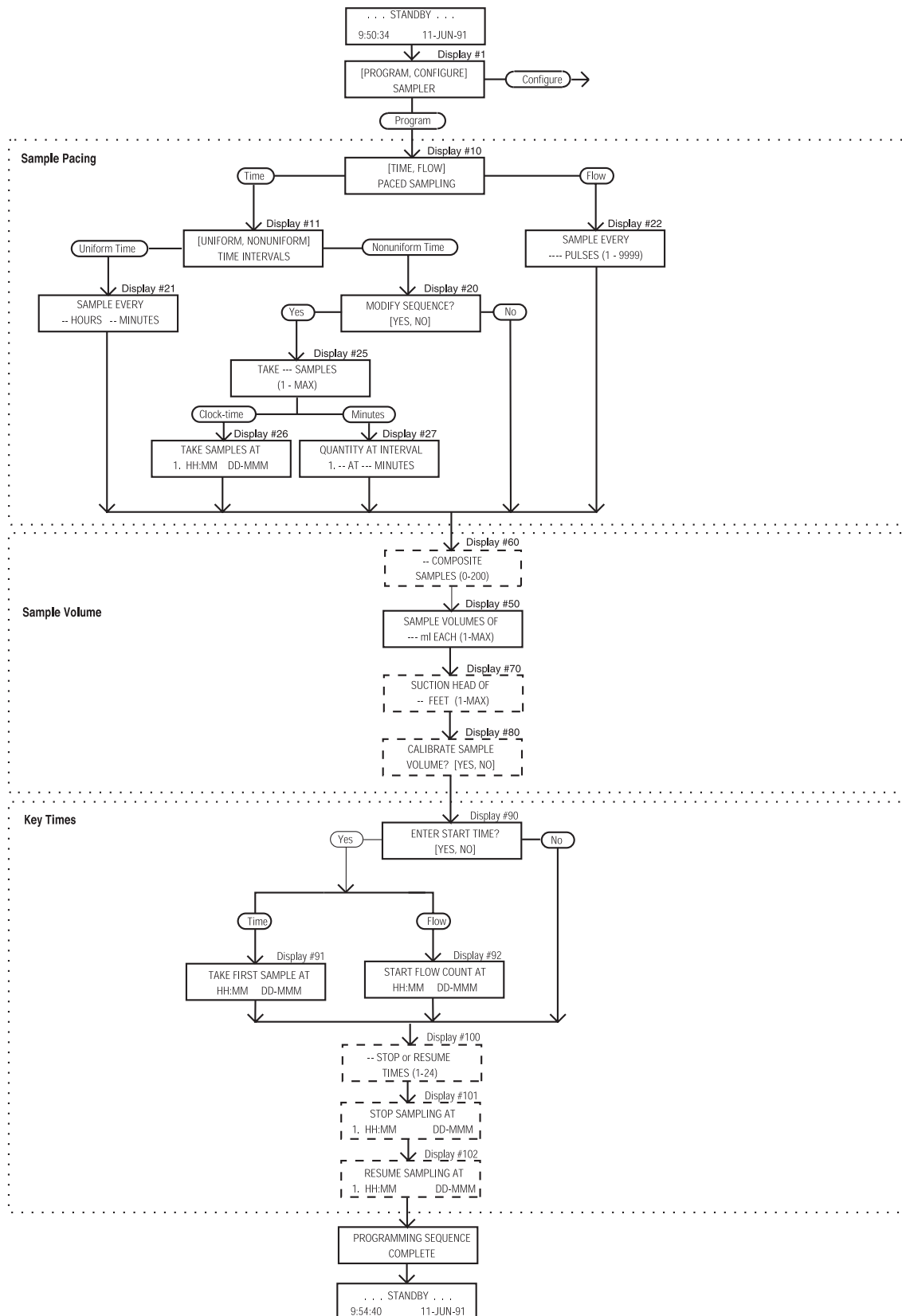


Figure 3-5 Extended Programming Mode: Program Sequence Structure

Determining the Number of Samples with Stops and Resumes – When using stops and resumes, determining the number of samples you want deposited in the container requires a little planning. With a time-paced routine, a sample will always be taken automatically at the *start* time. No sample will be taken at the *stop* time unless you have selected “ENABLE” in the Sample at Stop Time display of the Sampling Stops and Resumes configure option, even if the stop time falls at a scheduled sample event time. No sample will be taken at the *resume* time unless you have selected “ENABLE” in the Sample at Resume display of the Sampling Stops and Resumes option.

When you are using Stops and Resumes with flow-paced routines, a sample will not be taken at the start time, unless you have configured the sampler to do so in the Flow Mode Sampling configure option. With flow-paced routines, no sample will be taken at the stop time unless you have selected “ENABLE” in the Sample at Stop Time display of the Sampling Stops and Resumes option. No sample will be taken at the resume time unless you have selected “ENABLE” in the Sample at Resume display of the Sampling Stops and Resumes option.

If the number of samples deposited is not important to you or if you are using a flow-paced routine for a flow-stream with an unpredictable flow rate, enter “0” in the Number of Composite Samples display (*Display #60*). The sampler will take samples indefinitely, governed by the scheduled stop and resume time. It will be “DONE” at the final stop time or when the float shut-off terminates the routine.

3.11 Start Times

This section discusses the sampler’s start times. It begins by outlining the sequence of events preceding the start time for most sampling routines.

3.11.1 Events Preceding Sampling Routine

After you program a sampler, you must start the sampling routine by pressing the START SAMPLING key. However, depending on the program and configure option settings, the sampling routine may not start as soon as you press the key. The “Delay to Start Time” is the period between the time you press START SAMPLING and the start time for the routine. Figure 3-6 diagrams the sequence of events preceding the start time.

The start time for a routine is either the programmed start time or the time at which the delay to start time expires. The programmed start time is determined by entries made in Displays #90, #91, and #92. The delay to start time is determined by the entry in Display #310 of the Start Time Delay configure option. These input displays are illustrated in Table 3-6, on page 3-42.

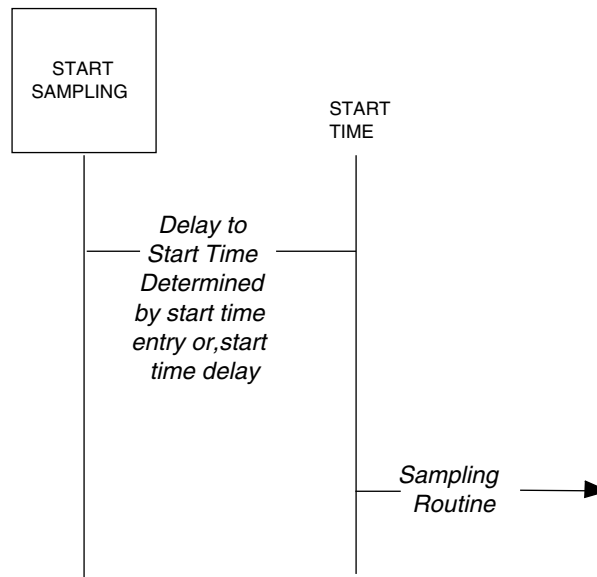


Figure 3-6 Simplified Start Time Diagram

Table 3-6 Start Time Displays

ENTER START TIME? [YES, NO]	Display #90
TAKE FIRST SAMPLE AT HH:MM DD-MMM	Display #91 (time-paced sampling)
START FLOW COUNT AT HH:MM DD-MMM	Display #92 (flow-paced sampling)
STORM ENABLED AFTER HH:MM DD-MMM	Display #93 (storm-paced sampling)
Start Time Delay display (Configure Sequence)	
---- MINUTE DELAY TO START (0 - 9999)	Display #310 (Start Time Delay configure option)

Note

Unless the sampling routine contains a programmed start time (Displays #91 or #92), the sampler will delay the start time according to the amount of time specified in the Start Time Delay configure option. A programmed start time entry always overrides any settings made in the Start Time Delay configure option.

Isco Flow Meters and Flow Loggers provide two essential functions for certain sampling applications. They send flow-pacing signals — flow pulses — to the sampler for flow-paced sampling. The second function provides disable (inhibit) or enable signals to the sampler. A sampler receiving a disable signal will suspend the sampling routine until it receives an enable signal.

The sampler will *disregard* a disable signal received from a flow meter during the delay to start time. If the sampler is disabled when the start time occurs, it will suspend the routine until it is enabled. Once enabled, the sampler will begin the time or flow intervals. The sampler will initiate a sample event when enabled for all time-paced routines. For flow-paced routines, it will initiate a sample event when the sampler is configured to take a sample upon enable in the Enable Pin configure option (Section 3.9.14).

If the sampler is enabled when the start time occurs, it will begin the routine. The sampler will initiate a sample event at the start time for all time-paced routines. It will initiate a sample event at the start time for flow-paced routines when configured for sample at start time in the Flow Mode configure option (Section 3.9.10). Refer to Figure 3-7, on page 3-45. The diagram shows the sampler's response when enabled or disabled at the start time for most basic and extended mode routines.

3.11.2 Nonuniform Times and Disable Signals

Figure 3-8, on page 3-46, diagrams the sequence of events preceding a routine programmed for nonuniform clock times. Nonuniform clock time programming allows you to enter a specific time and date for each sample event. Samplers programmed with nonuniform clock times may skip a number of samples if disabled for long periods. If the sampler is disabled and subsequently enabled, it will initiate only one event to compensate for the skipped sample events even if several sample event times have been passed.

 Note

Nonuniform clock time programming is designed to replace flow-pacing when a flow meter is not available at the site. Before using a sampler programmed for nonuniform clock times with a flow meter, be sure flow-pacing is not a more appropriate application.

3.11.3 Manual Sample Key and Programmed Start Times

The sampler will disregard the MANUAL SAMPLE key during the delay to start time and during the disable period. The periods where the sampler disregards disable signals (Delay to Start) and the MANUAL SAMPLE key (when disabled) appear in Figures 3-7 and 3-8.

Entries made in the Start Time Delay configure option affect the start times. See Section 3.9.13.

3.12 Foreign Languages and Metric Units

The 3710 Sampler provides displays in French, Spanish, and German. Additionally, it supports entries in metric units of measure. Metric units include volumes in milliliters, suction head and suction line length in decimeters, and suction line ID in millimeters.

Samplers using French, Spanish, and German language displays support metric units for suction line and suction head measurements. Samplers operating with English displays support either English or metric units for suction line and suction head measurements. (Sample volumes are always entered in milliliters, regardless of the selected language.)

To program the sampler for foreign language displays, begin by placing the sampler in standby. Then, access the language programming sequence by pressing the STOP key five times. The standby display will be replaced by the input display illustrated below.

```
[English, German,  
Spanish, French]
```

Select the preferred language from this display. If you select French, Spanish, or German, the sampler will automatically convert English units of measure to metric units and return to standby. If you select English, the input display shown below will appear. Select the units of measure from this display. After you've made the selection, the sampler will convert the units of measure as required and return to standby

```
[U.S., Metric]  
Units
```

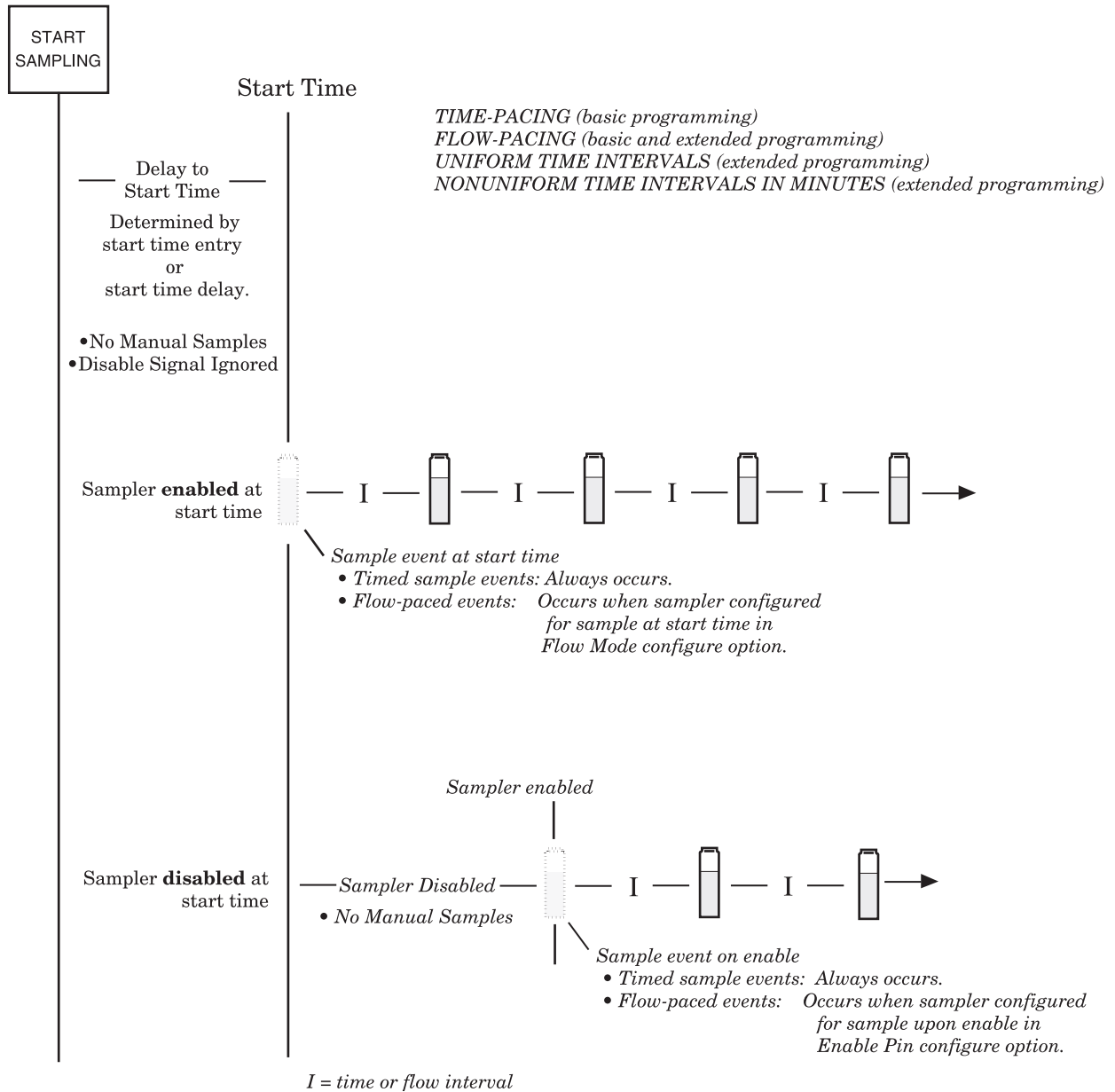


Figure 3-7 Start Time Diagram

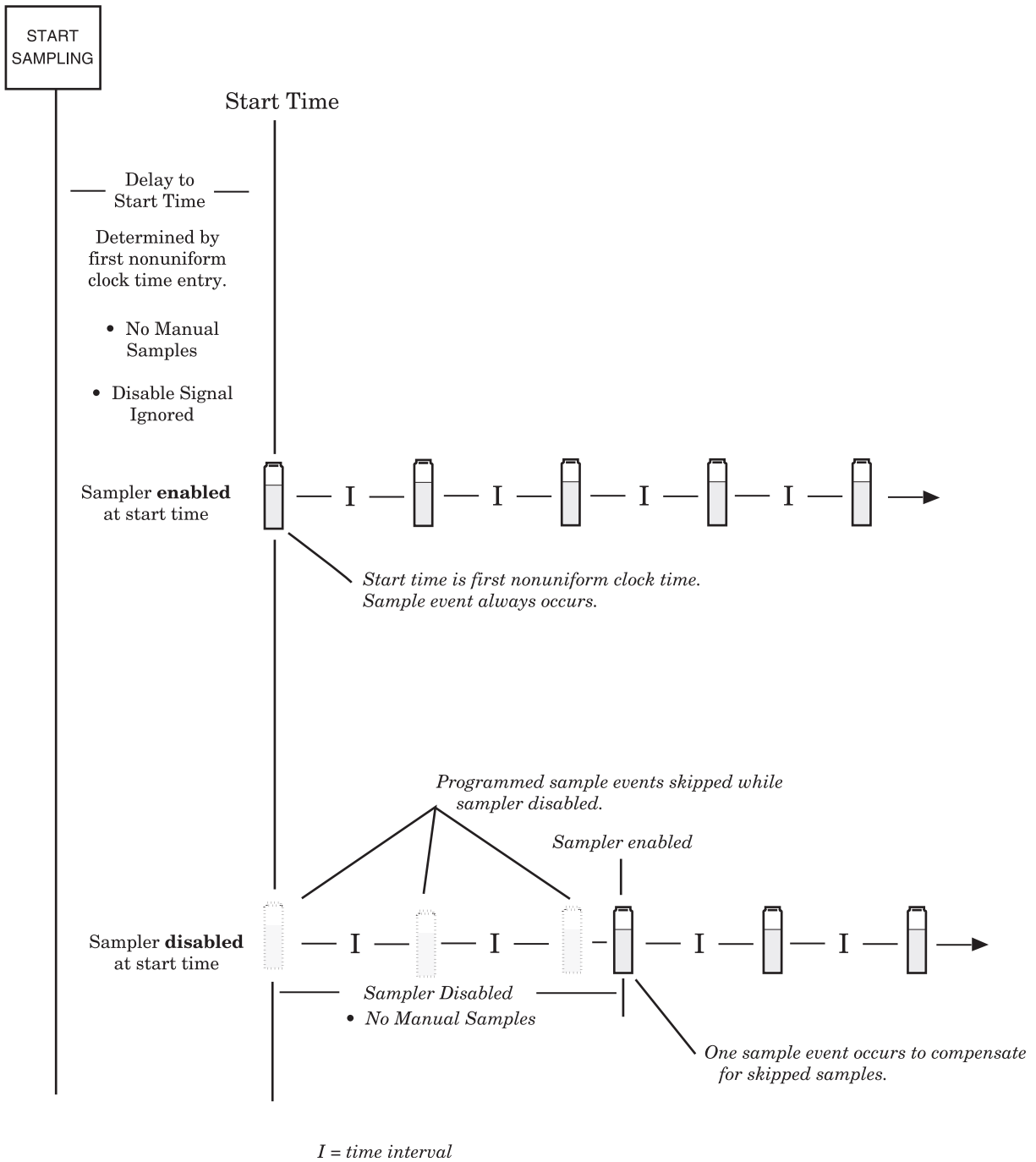


Figure 3-8 Start Time Diagram for Nonuniform Clock Time Routines

3.13 Programming Examples

The examples throughout this section demonstrate the steps used to program the sampler for several different sampling routines in the extended programming mode. Each programming example concludes with the run state displays that appear for that routine. The examples assume you are familiar with the functions of the keys as discussed in Sections 3.6.2 and 3.6.6.

The following example programs the sampler to take 12 time-paced 500 ml samples. Samples are to be taken at uniform time intervals of 30 minutes starting at 8:00 a.m. on the following day.

Example: Extended Time-Paced Sampling

1. Press ENTER/PROGRAM to access the interactive state.

```

. . . STANDBY . . .
10:34:50 19-APR-04
    
```

2. Access the program sequence by selecting "PROGRAM."

```

[PROGRAM, CONFIGURE]
SAMPLER
    
```

3. Select "TIME."

```

[TIME, FLOW]
PACED SAMPLING
    
```

4. Select "UNIFORM."

```

[TIME, FLOW]
PACED SAMPLING
    
```

5. Enter "0" to set the hours at zero. Press ENTER/PROGRAM to store the number "0" and move to the minutes entry.

```

SAMPLE EVERY
0 HOURS, 10 MINUTES
    
```

6. Enter "30" to set the minutes entry to 30.

```

SAMPLE EVERY
0 HOURS, 30 MINUTES
    
```

7. Enter the number of samples to be collected: "12."

```

12 COMPOSITE
SAMPLES < 0-470 >
    
```

8. Enter "500" to set the sample volume at 500 ml.

```

SAMPLE VOLUMES OF
500 ml EACH < 10 - 780 >
    
```

9. Select "YES."

```

ENTER START TIME?
[YES, NO]
    
```

10. Enter the start time and date: 8:00 on April 20.

```

TAKE FIRST SAMPLE AT
8:00 20-APR
    
```

After this message is displayed briefly, the sampler will automatically return to the standby state.

```

PROGRAMMING SEQUENCE
COMPLETE . . .
    
```

When the sampler is properly installed, press the START SAMPLING key to run the program.

Example: Extended Time-Paced Sampling (Continued)

```
... STANDBY ...  
10:37:23 19-APR-04
```

This display appears as the sampler counts down the time remaining to the start time. The first line reports the number of the upcoming sample event and the total number of sample events for the routine. The second line reports the start time at the left and the current time on the right.

```
SAMPLE 1 OF 12  
AT 8:00 10:38:07
```

When the start time occurs, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge. During the purge, the display indicates the sample event number and the number of sample events for the routine.

```
SAMPLE 1 OF 12
```

As soon as the pump runs forward to deliver the sample volume, the message on the second line appears and remains through the post-sample purge.

```
SAMPLE 1 OF 12  
PUMPING 500 ml
```

This display appears when the post-sample purge from the previous sample event is completed. It indicates the number of the upcoming sample event. The second line displays the scheduled time for the next event on the left. The current time is displayed on the right.

```
SAMPLE 2 OF 12  
AT 8:30 8:01:11
```

The cycle of displays is repeated until the sampling routine is done.



When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

```
DONE . . . 12 SAMPLES  
2:10:35 20-APR-04
```

The following example programs the sampler to take time-paced samples at nonuniform time intervals. This example assumes the sampler is connected to a Liquid Level Actuator which will inhibit the sampler until the liquid level rises to contact the Actuator probe.

The sampler is to take 20, 100 ml samples: the first samples are to occur at 10 minute intervals for one hour, the following samples at 20 minute intervals for one hour, and the remaining samples at 30 minute intervals. Although this example assumes that nonuniform times are being used with the Actuator, uniform time intervals or flow intervals can be used with the Actuator as well.

Example: Nonuniform Time-Paced Sampling

1. Press ENTER/PROGRAM to access the interactive state.

```
. . . STANDBY . . .  
10:34:50 19-JUN-04
```

2. Access the program sequence by selecting "PROGRAM."

```
[PROGRAM, CONFIGURE]  
SAMPLER
```

3. Select "TIME."

```
[TIME, FLOW]  
PACED SAMPLING
```

4. Select "NONUNIFORM."

```
[UNIFORM, NONUNIFORM]  
TIME INTERVALS
```

5. Select "YES" to modify the sequence of nonuniform time entries.

```
MODIFY SEQUENCE?  
[YES, NO]
```

6. Enter the total number of samples: "20." This entry should always include the sample taken at the start time.

```
TAKE 20 SAMPLES  
<1-470>
```

7. Enter the number of samples to occur at the first interval. The sampler is to take samples at 10 minute intervals for one hour or 6 samples in the first hour. Since the first sample is taken at the start time, the remaining five samples will occur at the 10 minute intervals.

```
QUANTITY AT INTERVAL  
1. 5 AT 10 MINUTES
```

8. When you have completed the first entries, the display will "roll" to move the first interval entries to the first line, and add the second line entries for the next series of samples and intervals. Enter the next entries: "3" samples at "20" minutes.

```
1. 5 AT 10 MINUTES  
2. 3 AT 20 MINUTES
```

9. Enter the third set of samples and intervals, "11" samples at "30" minutes.

```
2. 3 AT 20 MINUTES  
3. 11 AT 30 MINUTES
```

10. Enter "100" to set the sample volume at 100 ml.

```
SAMPLE VOLUMES OF  
100 ml EACH <10 - 470>
```

11. Select "NO."

```
ENTER START TIME?  
[YES, NO]
```

After this message is displayed briefly, the sampler will automatically return to the standby state.

```
PROGRAMMING SEQUENCE  
COMPLETE
```

12. Press the START SAMPLING key to run the program.

```
. . . STANDBY . . .  
10:37:23 19-APR-04
```

Example: Nonuniform Time-Paced Sampling (Continued)

This display appears while the actuator is inhibiting the sampler. The second line indicates the current time and date.

```
SAMPLER INHIBITED!  
10:35      20-APR-04J
```

This display appears when the sampler becomes enabled and counts down the time remaining to the start time. The first line reports the number of the upcoming sample event and the total number of sample events for the routine. The second line reports the start time at the left and the current time on the right.

```
SAMPLE 1 OF 20  
AT 11:26      11:25:47
```

13. When the start time occurs, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge.

```
SAMPLE 1 OF 20
```

As soon as the pump runs forward to deliver the sample volume, the message on the second line appears. This message remains through the post-sample purge.

```
SAMPLE 1 OF 20  
PUMPING 100 ml
```

This display appears when the post-sample purge from the previous sample event is completed. It indicates the number of the upcoming sample event. The second line displays the scheduled time for the next event on the left; the current time is displayed on the right.

```
SAMPLE 2 OF 20  
AT 11:36:      11:26:11
```

The cycle of displays is repeated until the sampling routine is done.

```
↓  
↓
```

When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

```
DONE . . 20 SAMPLES  
8:10:35      21-APR-04
```

Nonuniform times can be entered in either the method shown in the previous example or by specifying a clock time and date for each sample. The abbreviated example below shows the displays used to enter the clock times. (The type of display, clock time or minutes, used in the program sequence is controlled by the settings in the Nonuniform Times configure option; you must specify either clock time or minutes.)

Example: Entering Nonuniform Times as Specific Clock Times

1. Enter the time and date for the first sample event. Times and dates are entered on the second line of the display.

```
TAKE SAMPLES AT  
1. 06:00 19-APR
```

2. Enter the time and date for the second sample event. The controller will guess a time at the hour succeeding the previously entered time.

```
1. 06:00 19-APR  
2. 07:00 19-APR
```

3. Enter the time and date for the third sample event.

```
2. 06:30 19-APR  
3. 07:00 19-APR
```

4. Continue to enter times and dates for each sample event.

↓
↓

The following example programs the sampler to take time-paced 200 ml samples at uniform time intervals of 15 minutes starting at 6:00 a.m. on the following day. The sampling is to continue from 6:00 a.m. until 8:00 a.m. The sampling will resume again at 11:00 a.m. and continue until 1:30 p.m. It will pause until 4:00 p.m. and continue until 6:00 p.m.

When the sampling is stopped at 6:00 p.m., 24 to 29 samples will have been taken. However, in this particular application, the number of samples is not important, so the sampler will be instructed to take samples indefinitely. This is done by entering "0" in the Number of Samples display as demonstrated in step 7 below. Note: The Sampling Stops and Resumes configure option has settings which allow you to take a sample at the stop and resume times. See Section 3.9.12.

Example: Extended Time-Paced Sampling Using Stops and Resumes

1. Press ENTER/PROGRAM to access the interactive state.

```
. . . . STANDBY . . . .  
10:34:50 19-JUN-04
```

2. Access the program sequence by selecting "PROGRAM."

```
[PROGRAM, CONFIGURE]  
SAMPLER
```

3. Select "TIME."

```
[TIME, FLOW]  
PACED SAMPLING
```

4. Select "UNIFORM."

```
[UNIFORM, NONUNIFORM]  
TIME INTERVALS
```

5. Enter "0" to set the hours at zero. Press ENTER/PROGRAM to store the number "0" and move to the minutes entry.

```
SAMPLE EVERY  
0 HOURS, 10 MINUTES
```

6. Enter "15" to set the minutes entry to 15.

```
SAMPLE EVERY  
0 HOURS, 15 MINUTES
```

7. Enter "0" so that the sampler will take samples until the last stop time or until the shut-off float terminates the sampling routine.

```
0 COMPOSITE  
SAMPLES (0-470)
```

8. Enter "200" to set the sample volume at 200 ml.

```
SAMPLE VOLUMES OF  
200 ml EACH (10 - 9400)
```

9. Select "YES."

```
ENTER START TIME?  
[YES, NO]
```

10. Enter the start time and date of the sampling program: 6:00 a.m. tomorrow.

```
TAKE FIRST SAMPLE AT  
06:00 20-APR
```

11. Enter "5." There are three stop times and two resume times.

```
5 STOP or RESUME  
TIMES (0-24)
```

12. Enter the time and date of the first stop time: 8:00 a.m.

```
STOP SAMPLING AT  
1. 08:00 20-APR
```

13. Enter the time and date the program should resume: 11:00 a.m.

```
RESUME SAMPLING AT  
1. 11:00 20-APR
```

14. Enter the time and date of the second stop time: 1:30 p.m. or 13:30. You must enter the times in military time.

```
STOP SAMPLING AT  
2. 13:30 20-APR
```

15. Enter the time and date the program should resume: 4:00 p.m. or 16:00 in military time.

Example: Extended Time-Paced Sampling Using Stops and Resumes

```
RESUME SAMPLING AT  
2. 16:00 20-AP
```

16. Enter the final stop time: 6:00 p.m. or 18:00 in military time.

```
STOP SAMPLING AT  
3. 18:00 20-APR
```

After this message is displayed briefly, the sampler will automatically return to the standby state.

```
PROGRAMMING SEQUENCE  
COMPLETE . . .
```

17. Press the START SAMPLING key to run the program.

```
. . . STANDBY . . .  
10:37:23 19-APR-04
```

This display appears as the sampler counts down the time remaining to the start time. The first line reports the number of the upcoming sample event. The question marks, in the upper right, appear for routines which will take an indeterminate number of samples. The routine will terminate when the float shut-off is triggered. The second line reports the start time at the left and the current time on the right.

```
SAMPLE 1 OF ???  
AT 6:00 10:38:07
```

When the start time arrives, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge.

```
SAMPLE 1 OF ???
```

As soon as the pump runs forward to deliver the sample volume, the message on the second line appears. This message remains through the post-sample purge.

```
SAMPLE 1 OF ???  
PUMPING 500 ml
```

This display appears when the post-sample purge from the previous sample event is completed. It indicates the number of the upcoming sample event. The second line displays the scheduled time for the event on the left. The current time is displayed on the right.

```
SAMPLE 2 OF ???  
AT 6:15 8:01:11
```

The cycle of displays is repeated until the sampling routine is done.



When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

```
DONE . . . 26 SAMPLES  
18:10:35 21-APR-04
```

Example: Program Started Later Than Programmed Start Time

This display informs you of the expired start time. The sampler presents this display for a short time, then advances to the next display.

```
PAST START TIME . . .
```

This display reports the number of samples that will be skipped if you do not change the start time; it appears only if more than one sample event time has passed.

```
1 SAMPLES WILL BE  
SKIPPED
```

1. Select "YES" if you want to change the start time. Select "NO" if missed samples are acceptable.

```
CHANGE START TIME?  
[YES, NO]
```

Display 142

2. This display appears when you select "YES" in display #142 and a sample event is to occur at the start time. Enter the new start time.

```
TAKE FIRST SAMPLE AT  
12:30 19-JUN
```

Display 93

3. This display appears when you select "YES" in display #142 and no sample is to occur at the start time for a flow-paced sampling routine. Enter the new start time.

```
START FLOW COUNT AT  
12:30 19-JUN
```

Display 9

Example: Program Started Later Than Programmed Stop Time

This display informs you of the expired stop time. The sampler presents this display for a short time, then reverts to standby.

```
PAST STOP TIME . . .  
PLEASE REPROGRAM
```

You must access the program sequence to change the expired stop and resume times. Once you've made the changes, start the routine again with the start sampling key.

```
. . . STANDBY . . .  
10:22:34 21-JUN-04
```

3.14 Standby State

A sampler in the standby state is waiting for your instructions. From standby, you can start or resume a sampling program, access the program or configure sequences, take manual samples, and use the DISPLAY STATUS key to review program settings or the results of a sampling routine.

A sampler in standby uses a number of displays to communicate its status. Some of these displays are associated with the function of a specific key; other displays are used to notify you

that a sampling program is done, halted, or has encountered a problem. The standby state displays and valid keys are discussed below.

3.14.1 Standby Display

When you first turn the sampler on, the sampler “wakes up” in the standby state. The standby display, shown below, simply informs you that the sampler is in standby and reports the current time and date.

```
    . . . STANDBY . . .  
10:37:23    19-APR-04
```

At this point, the following keys are operable: ON/OFF, PUMP REVERSE, PUMP FORWARD, START SAMPLING, MANUAL SAMPLE, DISPLAY STATUS, and ENTER/PROGRAM.

3.14.2 Program Halted

A sampling program can be halted with either the STOP or EXIT PROGRAM key; if this occurs, the sampler will display the halt message shown below. If you halt the program to take a manual sample or to change a setting in the program or configure sequence, the sampler will return to standby. If this is the case, you will not be able to use the RESUME SAMPLING key.

```
    . . . PROGRAM HALTED . . .  
10:37:33    19-APR-04
```

Each operable key is listed and discussed below.

On/Off – When in the standby state, this key simply shuts the sampler off.

PUMP FORWARD and PUMP REVERSE – The PUMP FORWARD and PUMP REVERSE keys run the pump forward or in reverse until you interrupt it with the STOP key. While the pump is running, one of the two messages below is displayed, depending on the pumping direction.

```
PUMPING FORWARD . . .
```

```
PUMPING REVERSE . . .
```

When you press the STOP key, the sampler will display a message similar to the one shown here. This message indicates the total number of pump counts that occurred while the pump was running. This information can be used to set the desired number of purge counts required to purge the suction line. See Section 3.9.16. Press any key, except STOP and ON/OFF, to return to the standby display.

```
311 COUNTS FORWARD
```

Manual Sample – You can take manual samples in standby by pressing the MANUAL SAMPLE key. After you press the MANUAL SAMPLE key, the sampler will deliver the programmed sample volume. A manual sample delivers the sample volume currently entered as a programmed setting, and includes the pre-sample and post-sample purges. It will also include any programmed rinses and retries. The sampling process can be stopped with the STOP key at any time. If you press the MANUAL SAMPLE key while a sampling program is in progress, the manual sample will be counted as one of the programmed samples.

While the sample is being delivered, the sampler displays a message similar to the one below. The second line will not appear until the pump begins to pump forward to deliver the sample. The display will revert to standby after the manual sample has been delivered.

```
. . . MANUAL SAMPLE . . .  
PUMPING 200 ml
```

Start Sampling – Once you have programmed and configured the sampler, use the START SAMPLING key to run the sampling program. There are two instances where the sampler will not be able to run the program immediately. These occur when the program has been started after the programmed start time or after one or more programmed stop times.

When you press the START SAMPLING key after a program has been halted, the sampler will give you the choice between resuming the program and starting the program:

```
[START, RESUME]  
SAMPLING PROGRAM?
```

Select “START” to start the program from the beginning. Select “RESUME” to resume the program at the point at which it halted. If you do not make a selection from this display within 60 seconds, the sampler will automatically select the currently blinking response. START will re-initialize the display status memory.

Resume Sampling – To resume or restart the program, press the RESUME SAMPLING or START SAMPLING key. When you press the RESUME SAMPLING key, the program will resume at the point it was halted. The display must read “PROGRAM HALTED” for the RESUME SAMPLING key to be active. If any samples were missed during the time the program was halted, the sampler will inform you with the message shown here. The sampler will initiate one sample event if one or more sample events were missed.


```
2 SAMPLES WILL BE  
SKIPPED
```

3.14.3 Additional Displays

There are three additional displays used in the run state. These displays are discussed below.

Done – The sampler will inform you it has completed a program by displaying the message illustrated below. This message is displayed until you press any key, at which time the display will return to the standby message.

```
DONE . . .      24 SAMPLES  
10:37:33      19-APR-04
```

Problem Occurred – You will be informed that a problem was encountered during the sampling routine with the message illustrated below. This display will alternate with the “DONE” display at approximately three second intervals until you press any key.

```
PROBLEM OCCURRED . . .  
PRESS DISPLAY STATUS
```

Float Tripped – 3710 Samplers use the display below to notify you that the program finished because the shut-off float was tripped. This display alternates with the “DONE” display at approximately three second intervals.

```
FLOAT/WEIGHT TRIPPED
```

The message shown above is also used in 3700 Series refrigerated samplers. The refrigerated samplers use a weight table to determine when the composite bottle becomes full.

3.15 Display Status

You can access a summary of the current program settings and the results of the most recent sampling routine with the DISPLAY STATUS key. This key is valid in both the run and standby states. The summary of the program settings consists of a number of informational displays describing the settings. The results of the sampling program include information about each sample event and reports problems encountered during the program. This information remains in memory until you start another program.

You can retrieve this information with Teledyne Isco’s Field Printer (no longer sold) or a laptop computer running Teledyne Isco’s Samplink software. Both methods produce two reports which contain the sampler ID, current status, program settings, and sampling results.

If a sampling routine is in progress when you press the DISPLAY STATUS key, the sampling routine will be suspended. No samples will be taken until you exit Display Status.

If the pump count reaches the number entered for the Tubing Life Warning setting, the Pump Tubing Warning will be displayed. An illustration of the warning is shown below.

```
WARNING: REPLACE  
PUMP TUBING!
```

3.15.1 Reviewing or Printing Program Information

The sampler tracks and reports the following items:

- program start time and date
- sample volume
- source of each sample event
- cause of any missed samples
- start time of each sample event
- number of pump counts to liquid detection for each event
- time the routine was completed
- sampler ID
- current time and date
- program settings

Each of these items is illustrated in Example *Reviewing the Sampling Results*.

When you press DISPLAY STATUS, the display shown below follows the pump tubing warning. It allows you to review the program settings or sampling results.

```
[REVIEW, PRINT]  
PROGRAM INFORMATION
```

Display
#148

Example: Reviewing the Sampling Results

1. Press display status to view the results of the sampling program.

```
DONE . . . 24 SAMPLES  
12:34:50 20-JUN-04
```

2. Select "REVIEW."

```
[REVIEW, PRINT]  
PROGRAM INFORMATION
```

3. Select "RESULTS."

```
REVIEW PROGRAM [NO,  
SETTINGS, RESULTS]
```

4. This display reports the start time and date of the program. Press ENTER/PROGRAM to advance to the next display.

```
PROGRAM STARTED AT  
5:30 19-JUN-04
```

5. This display reports the nominal sample volume. Press ENTER/PROGRAM to advance to the next display.

```
200 ml SAMPLES
```

Example: Reviewing the Sampling Results (Continued)

This display reports the number of each sample event. It also reports the source of the event; in this case, the sample was taken at the start time. Press ENTER/PROGRAM to advance to the next display.

```
SAMPLE: 1 OF 24
SOURCE: START
```

6. This display reports the initiation time of the sample and the number of pump counts to liquid detection in the sample delivery cycle. These values indicate changes in the sampling conditions – head changes, for example. Press ENTER/PROGRAM to advance to the next display.

```
TIME: 5:30      19-JUN-04
COUNTS:      280
```

7. Press ENTER/PROGRAM to continue to review the information for the remaining sample events.

↓
↓

8. Press ENTER/PROGRAM to return to the “REVIEW PROGRAM” display.

```
PROGRAM FINISHED AT
12:00      20-JUN-04
```

9. Select “NO” to return to stand.

```
REVIEW PROGRAM [NO,
SETTINGS, RESULTS]
```

```
. . . STANDBY . . .
15:39:50      19-JUN-04
```

Review – Select “REVIEW” to review the program settings and sampling results. The sampler will present the display shown below. Use this display to leave the display status procedure or to review the program settings or sampling results.

```
REVIEW PROGRAM [NO,
SETTINGS, RESULTS]
```

Display
#150

No – Select “NO” to return to the previous operating state. If you entered display status from standby, the standby message will reappear. If you entered display status from the run state, the sampling routine will resume.

Settings – Select “SETTINGS” to review the program settings. Use the LEFT ARROW, RIGHT ARROW, and the ENTER/PROGRAM keys to move through the sampling settings. When the RIGHT ARROW or the ENTER/PROGRAM key is pressed at the last settings display, the “REVIEW PROGRAM” display will reappear.

Results – Select “RESULTS” to review the results of the sampling routine. The first display reports the time and date the sampling program started. Use the LEFT ARROW, RIGHT ARROW, and ENTER/PROGRAM keys to move through the results. If the routine was finished at the time you pressed the DISPLAY STATUS key, the last display will report the time and date the routine ended.

Print – Select “PRINT” from Display #148 to send the current status, program settings, or sampling results to the Isco Field Printer. For information on the reports produced by the Field Printer, refer to the *Field Printer Instruction Manual*.

When you select “PRINT,” Display #149 appears. Use this display to select the settings or results report. (The sampler will interrupt the reports to take a sample, if necessary.) Select “NO” to return to standby.

PRINT PROGRAM [NO, SETTINGS, RESULTS]	Display # 149
--	--------------------------------

The sampler will display one of two messages as it sends the data to the printer. The first message informs you that the transmission is in progress. The second message is a warning which informs you that the sampler is unable to detect the printer. If you see the warning message, check the cable connections between the printer and the sampler.

. . . PRINTING . . . PROGRAM INFORMATION

PRINT ABORTED NO PRINTER DETECTED!

Note

The Isco Field Printer is no longer sold. These instructions are intended for users who still own and use Field Printers.

Source of Sample Event – The display illustrated in step 5 of Example *Reviewing the Sampling Results*, on page 3-58, shows the sample event number and the source of the sample event. Source refers to the programmed or configured setting that initiated the sample event. For example, the sampler will report “TIME” as a source if the sample was taken as one of the program’s time-paced samples. Eight sources are tracked and reported for a composite sampler:

Time - The sample event was one of the program’s time-paced samples.

Flow - The sample event was one of the program’s flow-paced samples.

Start - The sample event was initiated at the program’s start time.

Resume - The sample event was initiated to compensate for a missed sample which should have occurred while the sampler was halted. If more than one sample event was missed, only one sample will be taken.

Power - The sample event was initiated to compensate for a missed sample which should have occurred while the sampler was without power. If more than one sample was missed, only one sample will be taken.

Enable - The sample event was initiated when the sampler became enabled by a device connected to pin F of the flow meter connector, generally an Isco Flow Meter or Liquid Level Actuator. This source is also reported when the sample was initiated at a programmed resume time. Two different configure option settings control this event: the Sample Upon Enable setting in the Enable Pin configure option and the Sample at Resume setting in the Sampling Stop/Resume configure option.

Manual - The sample event was initiated with the MANUAL SAMPLE key and was counted as one of the programmed sample events.

Disable - The sample event was initiated when the sampler became disabled by a device connected to pin F of the flow meter connector. This source is also reported when the sample was taken at a programmed stop time. Two different configure option settings control this event: the Sample Upon Disable setting in the Enable Pin configure option and the Sample at Stop setting in the Sampling Stop/Resume configure option.

3.16 Error Messages and Missed Samples

The probable cause of any missed sample is reported after the sample number/source display. A missed sample display is illustrated below.

SAMPLE MISSED: NO LIQUID DETECTED!

Ten causes are tracked and reported:

Pump “STOP” Key Hit! - The sampler was halted with the STOP key during the sample event.

Pump Jammed! - The sampler was unable to take the sample because the pump jammed.

Started Too Late! - The sampling routine was started after the programmed start time for the first sample. This message is reported for all samples skipped because of an expired start time.

Program Halted! - The sampling routine was interrupted by the STOP or EXIT PROGRAM key when the sample event was to occur.

Power Lost! - The sampler was unable to take the sample because the sampler’s power source was disconnected.

Sampler Inhibited! - The sampler was prevented from taking the sample by an inhibit signal sent to the sampler by an Isco Flow Meter or a Liquid Level Actuator.

Float/Weight Tripped! - 3710 Samplers detect overflow with a liquid level float located at the mouth of the composite bottle. If the liquid level of the bottle raises the float past the trip point, the sampler will interrupt the sample event and record the “Float/Weight Tripped” condition.

No More Liquid! - The sampler was unable to take the sample because, in attempting to take the sample, the sampler pumped all liquid from the flow stream.

No Liquid Detected! - The sampler was unable to take the sample because no liquid was detected.

Sampler Shut "Off"! - The sampler was unable to take the sample because it was halted with the ON/OFF key during the sample event.

3.17 Run State

A sampler in the run state is executing the sampler's instructions according to the settings you've entered in the program and configure sequences.

To start a sampling program and place the sampler into the run state, press the START SAMPLING key. While running the sampling program, the sampler will present a number of displays which allow you to monitor the sampler's progress. The displays are listed with a brief explanation in Table 3-7, on page 3-62.

If a problem is encountered while running a sampling routine which has resulted in missed samples, an asterisk will appear in the lower right corner of the display, as illustrated below.

```
SAMPLE 17 OF 48
AT 6:00      5:42:33 *
```

There is one instance where the refrigerated sampler will enter the run state after the START SAMPLING key is pressed, but will not begin the sampling program. If the sampler is interfaced with a Liquid Level Actuator, or other equipment capable of transmitting an inhibit signal, the sampler will not begin the program until the inhibit signal is suspended. The sampler will use the following display to inform you of these conditions.

```
SAMPLER INHIBITED!
10:32      20-APR
```

Table 3-7 Run State Displays: Composite Sampling

<pre>SAMPLE 1 OF 12 AT 6:00 5:43:33</pre>	<p>Indicates the sample number of the next sample and the total number of samples for time-paced routines. The current time is shown in the lower right corner.</p>
<pre>SAMPLE 1 OF 12 AFTER 10 PULSES</pre>	<p>Indicates the sample number of the next sample and the total number of samples for flow-paced routines.</p>
<pre>SAMPLE 2 OF ??? AT 6:00 5:43:33</pre>	<p>Indicates the sample number of the next sample. The question marks indicate the sampler will use the float shut-off to terminate the routine. The second line reports the scheduled time of the upcoming sample event and the current time.</p>
<pre>SAMPLE 1 OF ??? AFTER 100 PULSES</pre>	<p>Indicates the sample number of the next sample. The question marks indicate the sampler will use the float shut-off to terminate the routine. The second line reports the number of flow pulses remaining until the next sample event.</p>
<pre>SAMPLE 2 OF 12 PUMPING 200 ml</pre>	<p>Indicates a sample in progress.</p>

3710FR/3730 Refrigerated Sampler

Section 4 Options and Interfacing Equipment

This section discusses major options available with the Isco 3710FR.

4.1 Connections to External Devices

The 3700 Series Samplers can collect samples on a flow-paced basis using flow inputs from an external flow meter. The sampler requires a 5-to-15 VDC pulse of at least 25-millisecond duration to register a flow pulse. **Open-channel** flow meters are connected to the sampler by attaching a flow meter connect cable to the flow meter connector located on the rear of the sampler. **Closed-pipe** flow meters are connected to the sampler's Flow Meter port using the Isco 4-20 mA Input Interface device (see Appendix B Accessories).

Your sampler has an additional connector, labeled "PRINTER," used to connect the sampler to an Isco Field Printer or laptop computer. Both the flow meter connector and the printer connector use the same 6-pin configuration. The printer cable connector accepts both the connector from the field printer and a cable from a field computer or a laptop computer running the Samplink software.

Note

The Field Printer has been discontinued and is no longer sold by Teledyne Isco.

4.1.1 Isco Flow Meters and Flow Loggers

The 4200 Series Flow Meters, 2100 Series Flow Modules, and 4100 Series Flow Loggers, and UniMag Closed-Pipe Flow Meters, are collectively called "flow meters" in this manual. You can purchase cables to connect the 3700 samplers to an Isco flow meter, flow logger, or 2100 series flow module. Refer to the *Accessories List* in the back of this manual for details. To make the connection, attach the appropriate cable connector to the flow meter according to directions in the flow meter instruction manual, attach the other connector to the 6-pin flow meter connector on the rear of the sampler.

Note

If a connect cable is not attached to the flow meter or print connectors, be sure that the protective covers are tightly fastened in place.

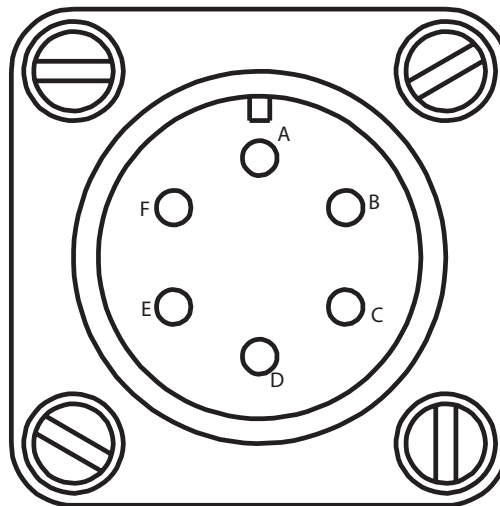


Figure 4-1 6-pin Connector Diagram

Table 4-1 Flow Meter Connector Wiring	
A	+12 VDC
B	Common
C	Flow Pulses In
D	Bottle Number Out Master/Slave Out (portable samplers)
E	Event Mark Out
F	Inhibit In

Table 4-2 Printer Connector Wiring	
A	+12 VDC
B	Common
C	Printer Source
D	Transmit
E	Receive
F	NC

4.1.2 Non-Isco Flow Meters

You can connect certain non-Isco Flow meters directly to a 3710 for flow-paced sampling. The flow meter must have an isolated contact closure of at least 25 milliseconds to provide acceptable flow pulses to the sampler. The frequency of the contact closure must be directly proportional to total flow. Teledyne Isco offers both a connector and cable clamp to connect a non-Isco Flow meter to the 3700 samplers. Connect the flow meter pulse output

to the A and C pins of the 6-pin Flow Meter connector on the 3710 (Figure 4-1). Refer to your flow meter's instruction manual for further details.

Teledyne Isco also offers a connector prewired to a 22-foot (6.7-meter) cable that terminates in two wires. The black wire is connected to pin A; the white wire to pin C.

Note that you will be unable to communicate anything other than the flow pulse contact closure with a non-Isco Flow meter. The non-Isco Flow meter will not be able to interpret event and bottle number information.

If the flow pulse generated by the contact closure on the flow meter is not compatible with Teledyne Isco's standard, contact Teledyne Isco's Special Products Department for an appropriate interface device.

4.1.3 4-20 mA Flow Signals

The 3710 Sampler can also be used with flow meters having other types of outputs, for example, a 4 to 20 mA output directly proportional to the flow rate. However, these flow meters require a special interface device to convert their output signal to one compatible with the 3710 sampler.

The **4-20 mA Sampler Input Interface** converts 4 to 20 mA output signals from both non-Isco Flow meters and closed-pipe flow meters to flow pulses acceptable to the 3710 Sampler.

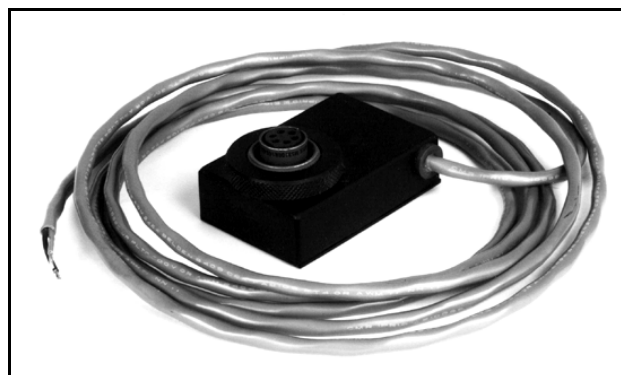


Figure 4-2 4-20 mA Sampler Input Interface

4.1.4 1640 Liquid Level Actuator

The 1640 Liquid Level Actuator is a device used to begin a sampling routine when the liquid level of the sample flow stream reaches a predetermined height. The actuator is used to inhibit sampling according to flow levels; i.e., if the level of the flow stream falls below the actuator's probe, the actuator will inhibit sampling until the level again rises to contact the probe.

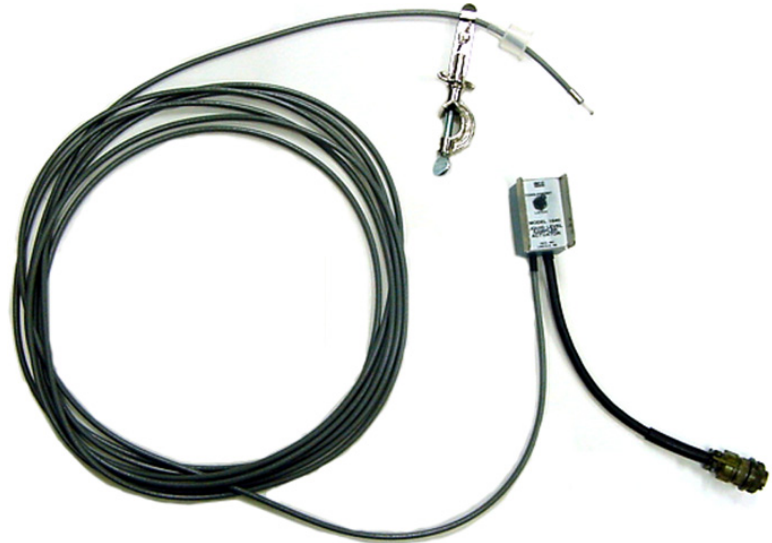


Figure 4-3 1640 Liquid Level Actuator

The actuator can be set to control the sampler in two modes:

Latch Mode – The sampler continues the sampling routine even though the liquid level has receded and liquid no longer contacts the sensor.

Toggle Mode – The sampler will halt the routine when the liquid ceases to contact the sensor.

To connect the actuator to the sampler, attach the actuator cable to the flow meter connector. Refer to Figure 2-7 for the location of the flow meter connector. Refer to the Liquid Level Actuator Instruction Manual for additional information.

The sampler must be configured to respond to the actuator. Refer to the discussion of the Enable Pin configure option (Section 3.9.14).

3710FR/3730 Refrigerated Sampler

Section 5 Routine Maintenance

This section discusses routine maintenance necessary to keep the refrigerator in top operating condition. Included are sections on the weather and corrosion resistance of the refrigerator and cleaning the refrigerator.

The 3710FR/3730, although ruggedly built to withstand difficult field operating conditions, will maintain maximum reliability when these simple maintenance procedures are followed. As with any piece of field operated equipment, a certain amount of preventive maintenance is necessary to keep it functioning properly.

5.1 Weather and Corrosion Resistance

The 3710FR/3730 is designed to be operated in relatively hostile environments. It may be directly exposed to wet environments and still function properly. The refrigerator's mechanical and electrical components, and the sampler controller are protected from rain, accidental spray, etc.

The refrigerator's base, exterior, and controller cover are constructed of a fiberglass reinforced polyester with an ultra-violet-resistant gel coat. The exterior metal parts are either anodized or Iridited™ aluminum, or stainless steel. The control box is made of Noryl (polyphenylene oxide) and is rated at NEMA 4X, 6. The interior of the refrigerator is made of a food grade ABS plastic which will not support bacterial growth or leach plasticizers into the sample. The evaporator is a roll bonded aluminum plate with a special refrigeration powder coated epoxy finish. The power supply and solid state thermostat are enclosed in a sealed aluminum enclosure inside the refrigerator's base.

5.2 Cleaning

The following sections present information on cleaning the sample bottles and pump tubing. Information is also included for cleaning the refrigerator's interior, exterior, condenser coil, and bottle locating base.

5.2.1 Tubing

The suction line and pump tubing can be cleaned by placing the end of the suction line in a cleaning solution and pumping this solution through the tubing system using the PUMP FORWARD and PUMP REVERSE keys. Follow with a clean water rinse.

5.2.2 Sample Bottles

The bottles have a wide mouth to facilitate cleaning and can be washed with a brush and soapy water or washed in a dishwasher. The glass bottles can be autoclaved; however, the plastic lids and bottles should **not** be autoclaved.

5.3 Cleaning Protocols for Priority Pollutants

The following sections are excerpted from U.S. Environmental Protection Agency Publications EPA-600/4-77-039 ("Sampling of Water and Wastewater" by Dr. Phillip E. Shelley) to provide an example of sampler cleaning procedures for priority pollutants.

Proper cleaning of all equipment used in the sampling of water and wastewater is essential to ensuring valid results from laboratory analysis. Cleaning protocols should be developed for all sampling equipment early in the design of the wastewater characterization program. Here also, the laboratory analyst should be consulted, both to ensure that the procedures and techniques are adequate, as well as to avoid including practices that are not warranted in view of the analysis to be performed.

As an example, Lair (1974) has set down the standard operating procedures for the cleaning of sample bottles and field procedures equipment used by USEPA Region IV Surveillance and Analysis field personnel engaged in NPDES compliance monitoring. They are reproduced following for a typical automatic sampler and related sampling equipment.

Isco Glass Sample Bottles:

1. One spectro-grade acetone rinse.
2. Dishwasher cycle (wash and tap water rinse, no detergent).
3. Acid wash with at least 20 percent hydrochloric acid.
4. Dishwasher cycle, tap and distilled water rinse cycles, no detergent.
5. Replace in covered Isco bases.

Suction Line ($\frac{1}{4}$ or $\frac{3}{8}$ Vinyl):

1. Do not reuse sample tubing. No cleaning required. New sample tubing is to be used for each new sampling setup.
2. Use PTFE tubing where samples for organics are to be collected.

Isco Pump Tube:

1. Rinse by pumping hot tap water through tubing for at least 2 minutes.
2. Acid wash tubing by pumping at least a 20 percent solution of hydrochloric acid through tubing for at least 2 minutes.
3. Rinse by pumping hot tap water through tubing for at least 2 minutes.
4. Rinse by pumping distilled water through tubing for at least 2 minutes.

PTFE Tubing:

1. Rinse twice with spectro-grade acetone.
2. Rinse thoroughly with hot tap water using a brush if possible to remove particulate matter and surface film.
3. Rinse thoroughly three times with tap water.
4. Acid wash with at least 20 percent hydrochloric acid.
5. Rinse thoroughly three times with tap water.

6. Rinse thoroughly three times with distilled water.
7. Rinse thoroughly with petroleum ether and dry by pulling room air through tubing.
8. Dry overnight in warm oven (less than 150° F), if possible.
9. Cap ends with aluminum foil.

5.4 Cleaning the Refrigerator

The refrigerator's exterior may be periodically cleaned with soapy water using a sponge or non-metallic brush to keep it free from corrosive solutions, grease, oil, etc. The thermal-formed, high impact ABS refrigerator interior may also be cleaned with soapy water. Do not direct a hose spray toward the underside or into the front grille of the refrigerator.

After cleaning, wipe the refrigerator dry. To maintain the appearance of the refrigerator's exterior, apply an automotive or marine wax that is recommended for fiberglass treated with an ultraviolet gel coat.

Because the refrigerator uses a forced-air system for cooling the compressor and condenser coil; dust, lint, and other debris will be pulled into the unit and will eventually accumulate on the filter. If the filter is not cleaned periodically, damage due to overheated components may result.

CAUTION

If the filter is not cleaned periodically, damage due to overheated components may result.

WARNING

Removing the front or back panel exposes electrical and mechanical hazards. Disconnect power before performing any service activities.

In order to prevent damage due to overheated components, the filter should be cleaned every three months; more frequently under severe operating conditions. To clean:

1. Remove the thumbscrews holding on the refrigerator's grille.
2. Remove the grille and filter then steam clean or wash in hot soapy water. After washing, treat the filter with a standard filter coat.

The condenser coil and surrounding areas should be cleaned annually; more frequently under severe operating conditions. To clean:

1. Remove the screws that hold the back panel on to the refrigerator and remove the panel.
2. Vacuum the fan, compressor, and surrounding areas.
3. Check the fan for freedom of movement. Oiling the fan motor is not necessary because the motor bearings are

sealed. If the fan motor does not rotate freely, it should be replaced.

4. Replace the back panel.
5. Remove the front grille and filter. Vacuum the condenser coil and surrounding areas.
6. Replace the filter and grille.

5.4.1 Cleaning the Locating Base and Bottles

The bottle locating base may be cleaned with soapy water and a sponge.

The sample bottles have a wide mouth to facilitate cleaning. The 2.5 gallon glass bottle may be washed with a brush and soapy water then washed in a dishwasher or autoclaved. The 2.5, 4, and 5.5 gallon polyethylene bottles may be washed with a brush and soapy water or washed in a dishwasher, but not autoclaved.

5.5 Pump Tubing

The pump tube serves two functions: it is a pump tube in the peristaltic pump and a distribution tube, routing the sample liquid from the pump outlet to the sample bottle. The pump tube consists of a single 39.5 inch (101 cm) piece of medical grade Silastic™ silicone rubber tubing. Medical grade tubing is used because of its superior mechanical properties and because it does not contain any organic materials.

Non-medical grade silicone rubber tubing can contain organic vulcanizing agents. During the vulcanizing process, these agents are converted into other compounds which can be leached into the sample. The medical grade silicone rubber tubing supplied by Teledyne Isco for use with the 3710FR Sampler will **not** contribute any organic material to the sample.

5.5.1 Inspection of Pump Tubing

The pump tubing is extremely durable. However, the constant mechanical strain placed on the tubing by the peristaltic action of the pump will eventually cause the tubing to fatigue and fail.



WARNING

Pump may actuate without warning. To avoid injury, sampler must be off when pump housing cover is removed for inspection or tubing replacement.

Inspect the pump tubing periodically for wear inside the pump by removing the cover. Check the tubing for cracks where the pump roller compresses the tubing. Replace it with a new pump tube, if necessary.

The inspections should be frequent when the liquid being sampled contains a high percentage of suspended solids. If the liquid is relatively free of solids, the inspections can be less frequent. The Tubing Life configure option reports the number of pump counts elapsed during the life of the tube.

 **Note**

The importance of regular tubing replacement cannot be overstated. The key is to replace the tube before failure, not after. When a pump tube ruptures, grit and other abrasive debris can be driven into the pump shaft seal. Over time, this abrasive material will degrade the pump seal, jeopardizing the NEMA 4x 6 rating of the controller.

Failure to maintain the pump tube may result in permanent damage to the sampler. Check the condition of the pump tube regularly and if the tube shows signs of fatigue or wear, replace it immediately. A properly maintained sampler will provide the years of reliable service that is expected of an Isco Sampler.

The amount of tubing (13.5 inches) used in the pump is less than half the total length of the pump tube (39.5 inches). In some cases, when the tube has not been damaged to the point of leaking, the tube can be used twice by simply turning it around.

 **Note**

The black bands used to assist you in correctly positioning the tubing in the pump and detector are placed on one end only. If you turn the tubing around, you will not be able to use the bands for reference.

5.5.2 Removing the Pump Tubing

To remove the tubing:

1. Disconnect power from the unit.

 **WARNING**

Pump may actuate without warning. To avoid injury, sampler must be off when pump housing cover is removed for inspection or tubing replacement.

2. Detach the outer lids of the liquid detector and pump by loosening the captivated thumbscrews shown in Figure 5-1. This will expose the pump tubing as shown in Figure 5-2.

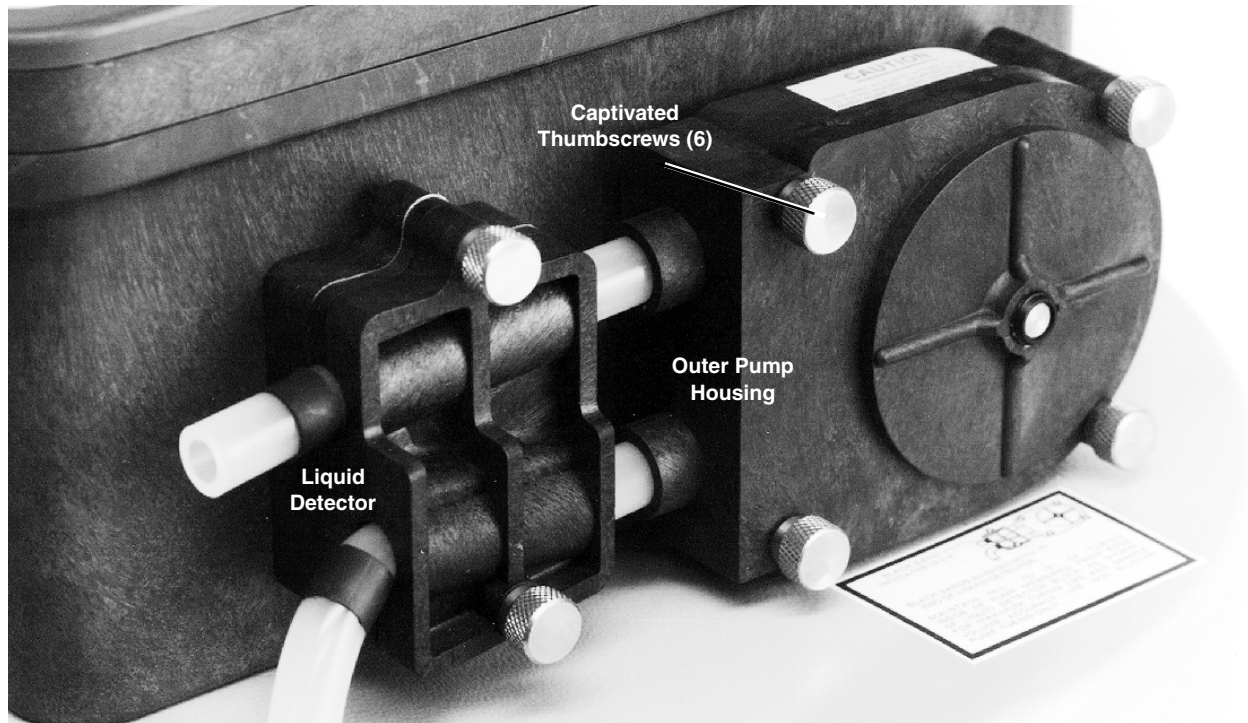


Figure 5-1 Liquid Detector and Pump Housing

3. Pull the tubing away from the detector. Extract the tubing from the pump. The pump rollers can be rotated manually to facilitate the removal of the tubing. After the tubing is removed, clean the interior of the pump case thoroughly.
4. Remove the suction line, if attached, and pull the pump tubing from the pump tube port.

5.5.3 Installing a New Pump Tube

The steps below outline the procedure needed to install a new pump tube.

The pump tube is marked with two black bands. These bands are used to correctly locate the tubing in the detector and pump. Correct placement is critical to prolong the life of the pump tube and to assure efficient operation and accurate sample volumes.

WARNING

Pump may actuate without warning. To avoid injury, sampler must be off when pump housing cover is removed for inspection or tubing replacement.

1. Facing the liquid detector, place the inner edge of the end band against the upper left inlet of the liquid detector. Place the inner band at the lower outlet of the liquid detec-

tor. Figure 5-2 shows the correct placement of the tubing at the liquid detector.

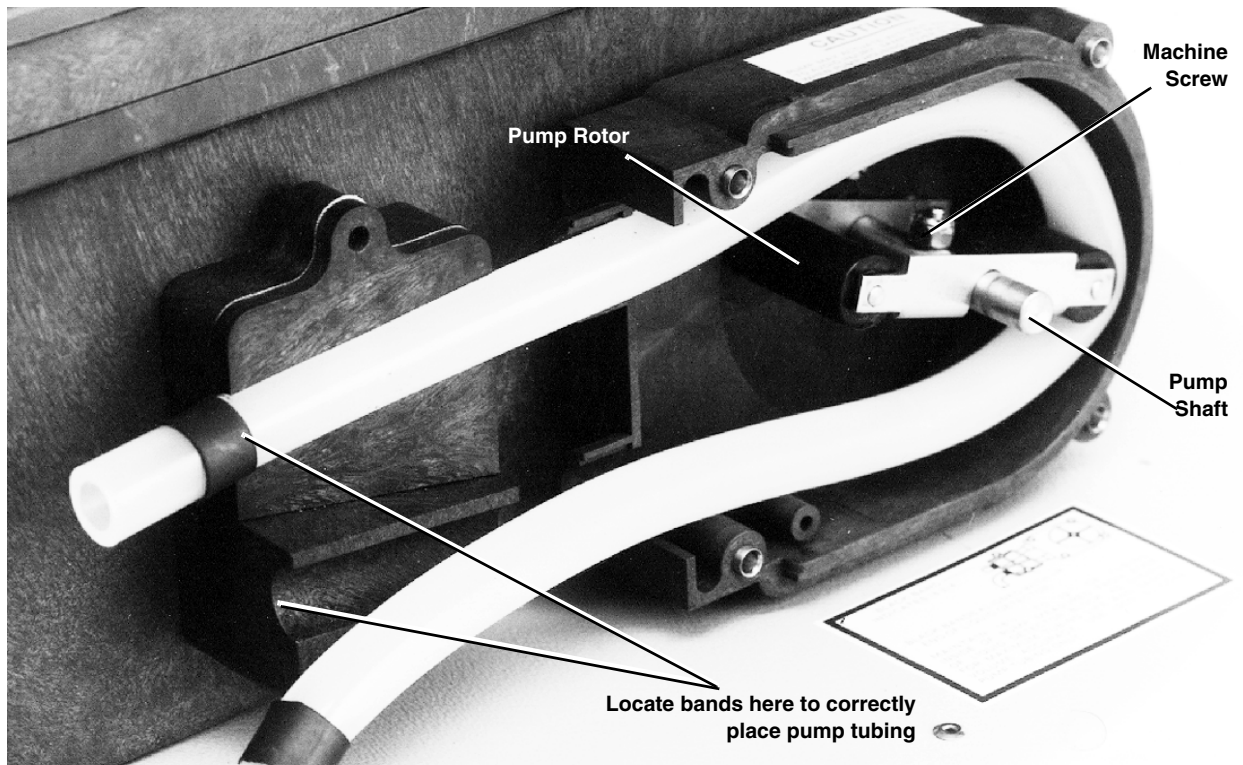


Figure 5-2 Pump Tube and Interior of Liquid Detector

2. Slip the pump tubing under the rollers so that the pump tubing does not interfere with the installation of the outer pump lid.
3. Replace the outer pump lid and tighten the four thumbscrews.
4. Re-check the position of the marker bands and adjust the tubing if the position of the bands indicate the tubing has slipped.
5. Replace the outer case of the liquid detector and tighten the two thumbscrews. **For proper operation of the liquid detector, tighten the thumbscrews securely.**
6. Feed the free end of the tube down through the pump tube port.
7. Re-install the suction line, as described in Section 2.2, on page 2-1.
8. Reset the Pump Tube count to zero. Refer to the discussion of the Tubing Life configure option in Section 3.9.17, on page 3-35.

5.6 Suction Line

It may be desirable to replace the suction line for one of several reasons. The suction line may be worn, cut, contaminated, or otherwise damaged; it should be periodically inspected for damage. In critical sampling, it may be necessary to replace the suction line between sampling programs to avoid cross contamination. When sampling site conditions change, it may be necessary to replace the suction line with a different diameter or type of line (vinyl or PTFE). The vinyl suction line contains a very low PPM (parts per million) level of phenols. If this affects your samples, use the PTFE line.

The suction line and the remainder of the pump tube system should be cleaned occasionally.

5.6.1 Replacing Vinyl Suction Line

Remove the $\frac{1}{4}$ or $\frac{3}{8}$ inch suction line from the pump tubing by detaching the tube coupling. Twisting the tube coupling until the teeth disengage will loosen the coupling.

Replacement vinyl suction lines are available from Teledyne Isco in two forms. First, a complete suction line, with strainer and tube coupling, is available in 10 ft. and 25 ft. lengths for each of the $\frac{1}{4}$ inch and $\frac{3}{8}$ inch ID (Inside Diameter) vinyl suction lines. Second, bulk suction line in the $\frac{1}{4}$ inch ID and $\frac{3}{8}$ inch ID vinyl tube is available in 100 and 500 ft. rolls.

5.6.2 Bulk Suction Line

If you are using bulk suction line to replace the old line, detach the old line from the tube coupling and remove the strainer. Cut the new suction line to the desired length in one foot increments. The line must be between 3 and 99 feet long. To ensure accurate sample volumes, it is important that the line is cut in one foot increments and that the line length is correctly entered in the Suction Line configure option Section 3.9.5, on page 3-25. Screw the strainer into the new suction line. The new suction line can now be attached to the pump tube as described in Section 2.2.1, on page 2-3.

5.6.3 Replacing PTFE Suction Line

The suction line is removed from the pump by loosening the clamp which secures the line to the pump tube and pulling the suction line out of the pump tube. Install the new PTFE suction line by pushing it into the pump tube and securing the connection with a clamp.

To install the optional stainless steel strainer, heat the end of the suction line to make it more flexible, then carefully screw the strainer's threaded connector into the suction line.

The $\frac{3}{8}$ inch ID PTFE suction line is available from Teledyne Isco in line lengths of 10 and 25 feet.

5.7 Internal Desiccant

A humidity indicator, labeled "INTERNAL CASE HUMIDITY," is located in the lower left corner of the control panel. It indicates the amount of moisture present inside the control box. The paper indicator is blue in a dry state.

The control box is a completely sealed unit. (The control box does not need to be opened during normal operation.) The desiccant should absorb any moisture which may accumulate in the control box. Thus, the humidity indicator should remain blue under

normal conditions. If moisture does accumulate, the numbered areas on the indicator will turn light pink or white, starting with the area numbered “20.” This indicates that the relative humidity inside the control box exceeds 20%. As more moisture accumulates, the areas numbered “30” and “40” will turn light pink or white, indicating relative humidities of 30% and 40%.

If the 30% area of the humidity indicator turns light pink or white, the control unit should be opened, inspected for leaks, and the desiccant renewed. This is done by unscrewing the ten screws around the outer rim of the control box bezel, and carefully lifting the frame and cover off the control box. Refer to Figure 5-4, on page 5-10. The control box contains electronic circuitry which may be damaged by static discharge. Open the control box only in a static free environment.

5.7.1 Renewing the Desiccant

Place a sheet of brown paper on a flat metal sheet. You can use a brown grocery bag and a typical cookie sheet. Place only the bags on the sheet. Do not stack the bags on top of each other, or allow them to touch. Place in vented, circulating forced air, convection oven in a well ventilated room. Allow two inches of air space between the tops of the bags and the next metal tray above the bags. Keep the tray a minimum of 16 inches from the heating element. Heat the bags at a temperature of 240 to 250° F (116 to 121° C) for 12 to 16 hours. At the end of the time period, the bags should be immediately removed and placed in an airtight container for cooling.

The desiccant will be recharged to approximately 80 to 90% of its previous capacity. After repeated recharging, the bag may require replacement.

Some bags will have the temperature and time for recharging printed on the bag. If they differ, use the temperature and time printed on the bag.

To reassemble the controller, place the renewed desiccant in the tray as shown in Figure 5-4. If you have disconnected any wiring or the grounding strap between the control box and the panel, reconnect them. Before reinstalling the cover, coat the cover's gasket with a light film of silicone grease to seal the control box. Tighten the ten screws which hold the control box cover and bezel in place using an even cross-torquing pattern.



Figure 5-3 Location of 10 Screws on Control Box Bezel

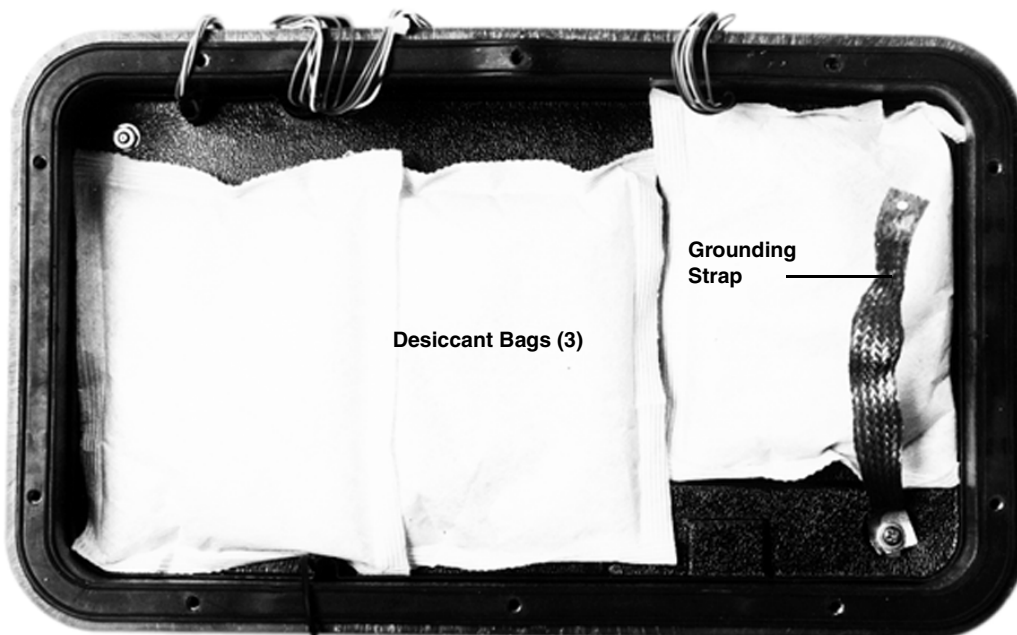


Figure 5-4 Control Box Internal Desiccant

3710FR/3730 Refrigerated Sampler

Section 6 Servicing

This section presents refrigerator servicing information to assist you in correcting malfunctions which may occur. Included are sections providing information on the electrical and refrigeration systems, and on servicing the sampler's controller. An illustrated list of common replacement parts is also included.

An illustrated **Replacement Parts List** and a list of **Accessories** available for the 3710FR/3730 Refrigerated Sampler appear in Appendices A and B.

6.1 Electrical System ⚠️⚡️

To view schematic drawings of the circuit boards discussed in this section, first find the serial number on your controller, then go to our web site, www.isco.com. Go to Training and Support and select Product Support. Click Automatic Wastewater Samplers. In the left margin, click Schematics. Enter the serial number of your instrument, then click Get Schematics to view a list of PDF files that contain the available schematics.

Access to the electrical and refrigeration components can be gained by removing the nine screws on the back of the refrigerator. Refer to Figure 6-1.

⚠️ WARNING

Removing the back panel exposes electrical and mechanical hazards. Disconnect power before performing any service activities.

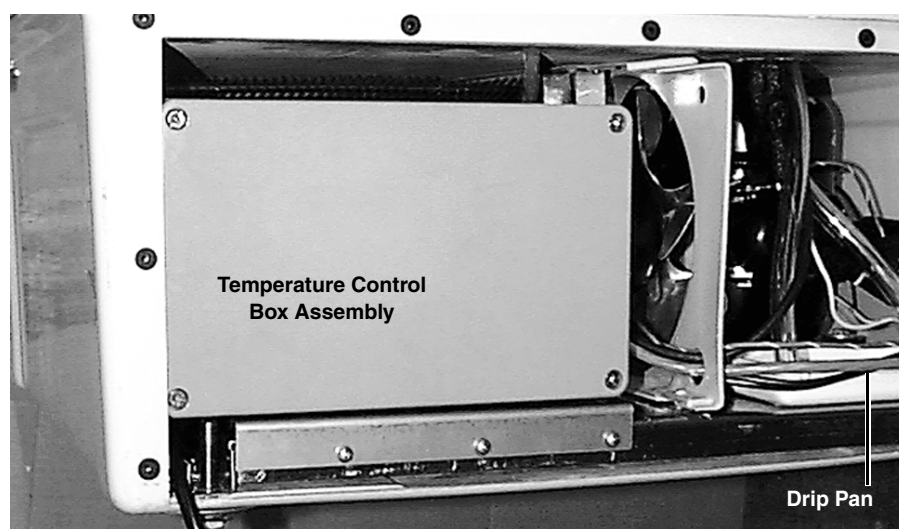


Figure 6-1 Rear View of the 3710FR/3730

The temperature control box assembly, which houses the thermostat logic circuit board, the transformer, and the solid state relay, is located on the left-hand side of the refrigerator base as shown in Figure 6-1. Access to these components can be gained by removing the four screws securing the lid of the temperature control box. See Figure 6-2.

You can remove the temperature control box from the refrigerator by removing the screws from its mounting plate and disconnecting the wires from the backside of the box. See Figures 6-3 and 6-4.

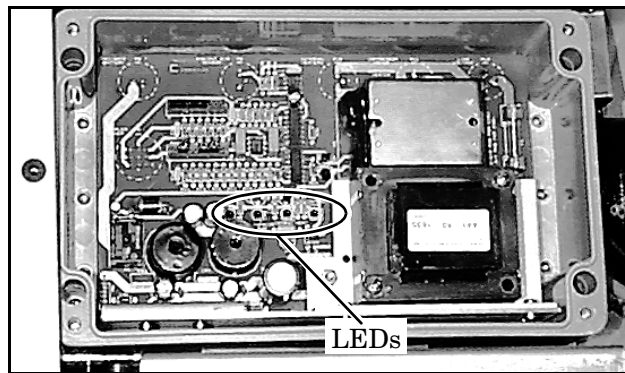


Figure 6-2 Thermostat Logic Circuit Board



Figure 6-3 Control Box Wiring



Figure 6-4 Control Box Connections

Figure 6-5 is a wiring diagram for the refrigerator. The diagram shows where all the connections are made within the refrigerator and the color of wires. It also points out the location of the various components within the refrigerator.

The refrigerator schematic shows the refrigerator's 12 V^{DC} power supply and temperature control circuitry. The refrigerator circuit board is equipped with light emitting diode (LED) indicators showing the various functions of the thermostat circuitry and power supply. Because the indicators are helpful in identifying malfunctions, they are described in detail in the circuit description below.

Refer to the refrigerator schematic. The barrier block on the circuit board contains all the 120 V^{AC} (230 V^{AC}) circuit connections. A fuse, F1, is placed on the primary side of T1 for current protection. F1 is a 1½ amp slow-blow fuse for 120 V^{AC} systems, 230 V^{AC} systems use a ¾ amp slow-blow fuse. Refer to the Replacement Parts Listing for replacement fuse part numbers. The power is then rectified and passes through the switching regulators U7 and U8 to create the 12 V^{DC} supply for the logic and sampler controller.

The signals from the ambient air temperature sensor, the internal refrigerator thermistor, the evaporator plate thermistor and the temperature control potentiometer come into the circuit board on connector P10.

The ambient air sensor samples the air temperature outside the refrigerator. It is located in the temperature assembly located on the right of the refrigerator grille. If the ambient temperature is cold, three heaters will be turned on by the circuitry.

Two of the heaters are located on the sides of the evaporator plate inside the refrigerator and one heater is located on the compressor.

The fuse, F2, is included on the supply side of the heaters to prevent an electrical hazard in the event of a fault in either heater. Refer to the Replacement Parts Listing for replacement fuse part numbers.

The heaters prevent the sample from freezing when the outside air temperature falls below freezing. The compressor will cycle approximately the same amount of times at cold temperatures as at room temperatures.

The ambient air temperature signal comes from the sensor into the circuit board on pins 7 and 8 of connector P10. The signal is then sent to pin 2 of U1, which is an oscillator. Depending on the temperature, the voltage at pin 2 of U1 will vary. This varies the duty cycle of the oscillator, which in turn, varies the duty cycle of the heaters. This circuitry is linear; at 65 °F the heaters will begin to come on and at -35 °F the heaters will be on continuously. When the heaters are on, the internal heat LED indicator will be lit.

The internal temperature sensor is a thermistor that samples the internal air temperature of the refrigerator. It is mounted at the top of the refrigerator's interior. The internal temperature

signal comes from the sensor, through the plug in the thermostat/wiring housing assembly, and into the board across pins 1 and 3 of P10. The setting on the temperature control knob comes from the potentiometer, through the plug in the thermostat/wiring housing assembly and into the board across pins 3 and 4 of connector P10. The signals are compared in comparator U2. If the interior of the refrigerator is warmer than the temperature control potentiometer setting, the internal temperature LED indicator will be lit. The temperature control potentiometer is located in the thermostat/wiring housing assembly.

The evaporator temperature sensor is mounted on the front of the evaporator plate. The signal from the sensor comes through the connector in the thermostat/wiring housing assembly and into the circuit board across pins 1 and 2 of connector P10. The signal is compared with a calibrated setting in comparator U2. The evaporator temperature LED indicator will be lit if the evaporator temperature is warm (and all the frost has been melted).

Connectors P4 and P5 are used for calibration purposes only. They are used at the factory to set up the correct resistances so the internal temperature and evaporator temperature indicators are “on” at the proper temperatures. It is not recommended that the user try adjusting these settings. The operation of the compressor and the compressor run LED indicator is determined by the temperature control potentiometer setting, the internal refrigerator temperature, and the evaporator temperature.

The following describes the operation of a compressor cycle, assuming the compressor is already running.

As the compressor runs, the temperature of the evaporator will fall below 32°F (0°C) and the evaporator temperature indicator, located on the circuit board, will go out. The internal temperature and the compressor run indicators will both be lit. The compressor will continue running until the internal air temperature of the refrigerator reaches the temperature set on the temperature control knob. Once this temperature is reached the internal temperature indicator will go off, the compressor run indicator will go off, and the compressor will shut off. After the compressor shuts off, the refrigerator melts the frost that accumulated on the evaporator while the compressor was running. Once the evaporator temperature has warmed to the calibrated temperature (approximately 2°C) the evaporator temperature LED indicator will turn on.

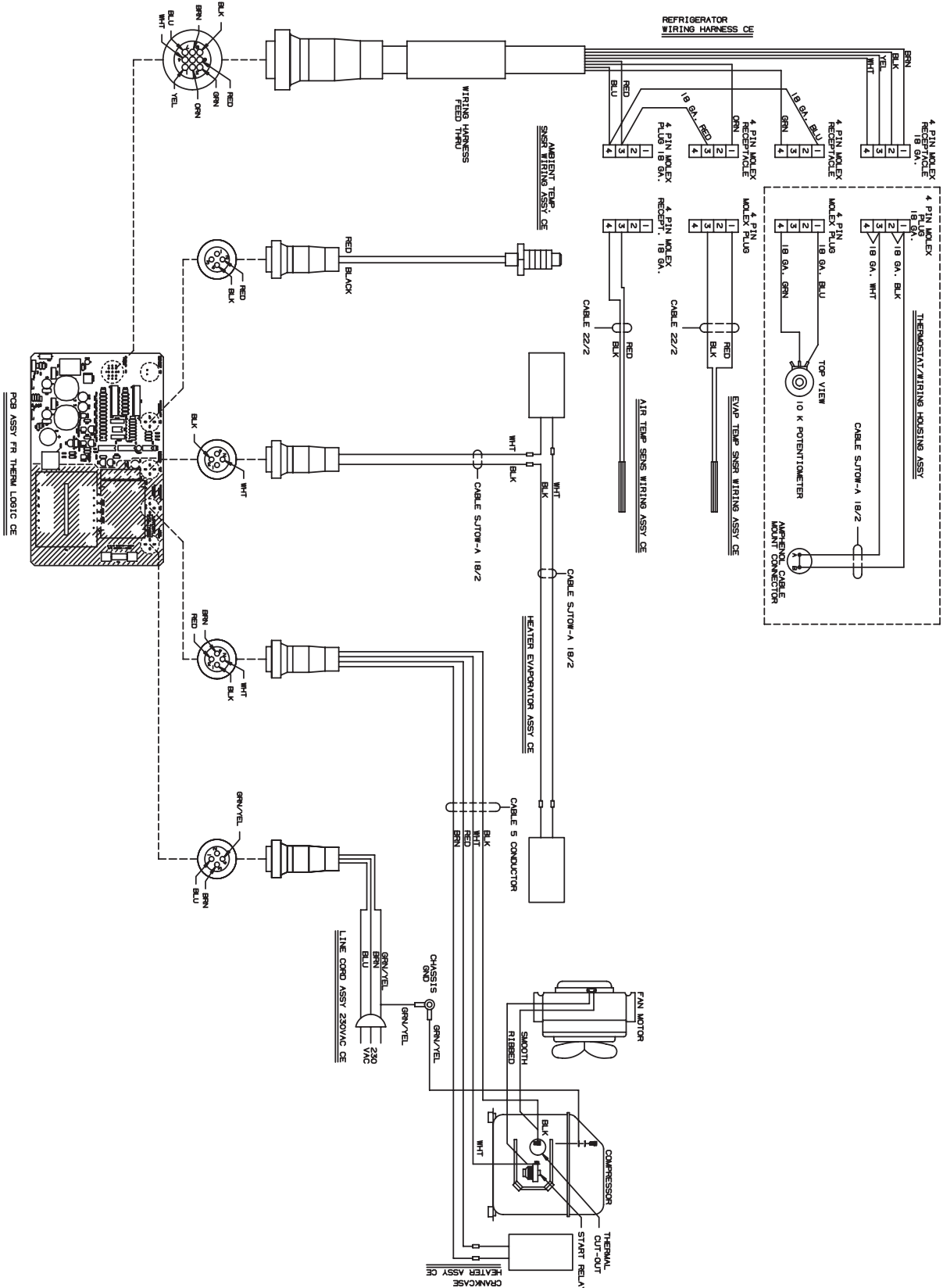


Figure 6-5 3730 Refrigerator Wiring Diagram

When the refrigerator's internal temperature gets warmer than the temperature setting, the internal temperature indicator will light. When both the evaporator temperature and the internal temperature indicators are lit, a signal is sent through connectors P2 and P3 to the solid state relay. This activates the refrigerator's compressor and turns on the compressor run indicator. The compressor will continue to run until the internal temperature indicator goes out.

If it is suspected that there is a problem with the circuitry, remember that the compressor shuts off when the internal temperature sensor reaches the setting on the temperature control knob. But, to turn the compressor on, both the internal temperature sensor and the evaporator temperature sensor must be warm. The compressor/fan solid-state relay may be replaced but do not attempt to replace any other components. Otherwise, the calibration of the circuitry will be disturbed. It is suggested that the entire board be replaced or the board be returned to the factory for repair.

6.2 Refrigeration System

Refer to the refrigeration system schematic. The refrigerant-charge capacity of the system varies according to the age and AC power requirements of the refrigerator. When recharging the refrigeration system, refer to the following chart:

Before Serial Number 11901-001	R-12, 8.5 oz
After Serial Number 11901-001	R134a, 7.52 oz

CAUTION

All refrigeration repair work must be performed by a qualified refrigeration technician.

Always purge the system with nitrogen. NEVER USE AIR to purge the system.

Always recover the refrigerant.

When recharging, do not leave a line tap in the refrigeration system because of possible corrosion or leakage problems

Equipped with external over temperature and overload protection, the compressor may fail to start immediately when power is momentarily interrupted or when the thermostat setting is changed. The overload relay normally trips repeatedly until the refrigerant pressure equalizes. This does not indicate a malfunction.

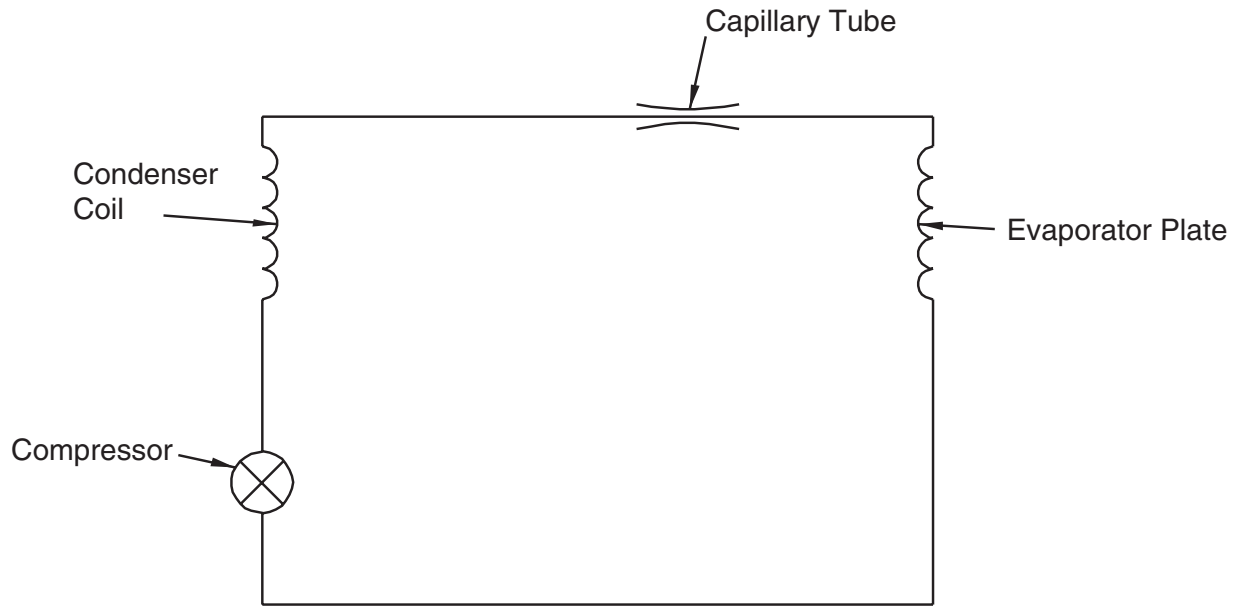


Figure 6-6 Refrigeration Schematic Diagram

6.3 Troubleshooting Guide

A troubleshooting guide appears in Table 6-1. This is meant as a general guide and is not intended to cover problems in detail.



WARNING

Removing the front and back panel exposes electrical and mechanical hazards. Troubleshooting and repair activities should be performed by a qualified refrigeration technician.

Table 6-1 Refrigerator Troubleshooting Table

Problem: Refrigerator will not cool.
<p>1. Make sure the operating voltage (120 or 230 V\sim) is present across pins 1 and 3 of circuit board connector P12.</p> <p>2. Is the compressor running?</p> <p style="padding-left: 20px;">NO</p> <p style="padding-left: 40px;">a. Is the compressor-run LED (on the circuit board) lit?</p> <p style="padding-left: 60px;">NO – Check the circuit board for a malfunction. YES – Continue.</p> <p style="padding-left: 40px;">b. Is there 12 V$\overline{\text{---}}$ across pins 4 and 4 of the compressor fan relay?</p> <p style="padding-left: 60px;">NO – Check the circuit board for a malfunction. YES – Continue.</p> <p style="padding-left: 40px;">c. Is there 120 or 230 V\sim across pins 1 and 2 of the circuit board connector P11?</p> <p style="padding-left: 60px;">NO – Replace the compressor/fan relay. YES – Continue.</p> <p style="padding-left: 40px;">d. Is there 120 or 230 V\sim across the start relay and compressor common?</p> <p style="padding-left: 60px;">NO – Check to see if the thermal cutout relay is open or the start relay is defective. YES – Check the compressor for an open winding.</p> <p style="padding-left: 20px;">YES</p> <p style="padding-left: 40px;">a. Is the fan running?</p> <p style="padding-left: 60px;">NO – Replace the fan. YES – Continue.</p> <p style="padding-left: 40px;">b. Check the refrigerant in the refrigeration system.</p>
Problem: Samples freezing.
<p>1. Is the Heaters LED (on the circuit board) lit?</p> <p style="padding-left: 20px;">NO – Check the circuit board for a malfunction. If the board is good, replace the ambient air sensor. YES – Continue.</p> <p>2. Is there 5 V$\overline{\text{---}}$ across pins 3 and 4 of heater relay K2?</p> <p style="padding-left: 20px;">NO – Check Q4 on the circuit board for a malfunction. YES – Continue.</p> <p>3. Is there 120 or 230 V\sim across pins 1 and 2 of heater relay K2?</p> <p style="padding-left: 20px;">NO – Replace heater relay. YES – Continue.</p> <p>4. Is there 120 or 230 V\sim across pins 2 and 3 on PCB connector P10?</p> <p style="padding-left: 20px;">NO – Replace heater fuse F2. Refer to the replacement parts listing for the correct part number. YES – Check heater wiring.</p>

Table 6-1 Refrigerator Troubleshooting Table (Continued)

Problem: Sampler has no power.

- | |
|---|
| <p>1. Is there 12 V⁻⁻⁻ at the sampler connector?
 NO – Continue.
 YES – Troubleshoot the sampler controller.</p> <p>2. Is there 12 V⁻⁻⁻ between pins 1 and 8 on PCB connector P5?
 NO – Check F1. If open, replace fuse. Refer to the replacement parts listing for the correct part number.
 YES – Check the power supply circuit for malfunction.</p> |
|---|

6.4 Servicing the 3710 Controller

The controller’s solid-state electronic circuitry is highly reliable. If the unit fails to operate properly, check the power cable or wiring harness connections. If problems persist, call the Teledyne Isco Customer Service department for information on returning the sampler to the factory for repair.

6.5 Installing a 3710 Controller on the 3730 Refrigerator

The 3730 Sampler Refrigerator is available to convert a 3710 Portable Sampler into a 3730FR Refrigerated Sampler. To do this, remove the control box from the portable sampler following the instructions in the *3710 Portable Sampler Instruction Manual*. Because of the longer distance between the pump discharge and the sample bottle in the refrigerator, the standard 42 inch (107 cm) pump tube must be replaced with the 46 inch (117 cm) pump tube supplied in the mounting kit. The new pump tube may be installed following the instructions in Section 5.5.3, on page 5-6.

Once the new pump tube is installed, use the parts supplied in the controller mounting kit and follow the instructions below to prepare and mount the controller on the refrigerator. Refer to Figure 6-7, on page 6-10. Turn the controller upside down and screw the four threaded mounting rods into the four corner feet of the controller. The two middle feet are not used. The controller is now ready to be installed on the refrigerator.

1. Open the controller cover on the top of the refrigerator and orient the controller on the top of the unit so the peristaltic pump and liquid detector face the front of the refrigerator.
2. Carefully insert the threaded rods into the four mating holes on the refrigerator and push the controller down so it is against the refrigerator.
3. Working inside the refrigerator, install the spacers and wing nuts on the threaded rods.
4. Feed the pump tube down through the tube guide port into the interior of the refrigerator and route the pump tube into the distributor arm.
5. Connect the two-pin connector on the power cable to the 12 V⁻⁻⁻ plug on the controller and the six-pin connector on the flow meter cable to the flow meter connector on the rear of the controller.

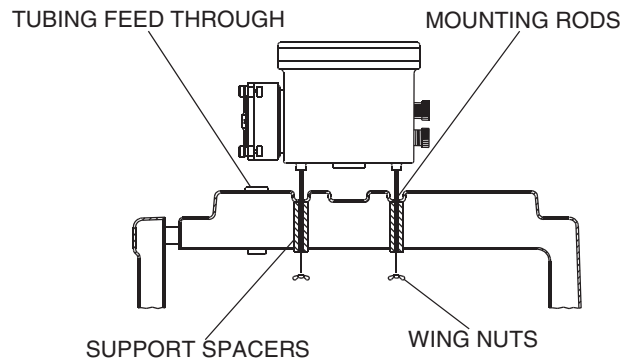


Figure 6-7 Mounting the Control Box

6.6 Access to Electronic Components

CAUTION

Disconnect power from the refrigerator and controller when working on the unit.
Keep yourself grounded when handling disassembled equipment.

To gain access to the electronic components housed in the control box:

1. Remove the ten screws around the outer edge of the control box bezel.
2. Lift the cover and frame off the control box and turn the cover over, as shown in Figure 6-8.
3. The control box cover assembly may be disconnected from the control box lower section by disconnecting the five connectors (see Figure 6-8) and the grounding strap (see Figure 5-4, on page 5-10).
4. The main circuit board assembly of the 3700 Sampler is protected by an aluminum shield. To remove this shield, unscrew the stop nut that holds the short grounding strap and unscrew the four screws located in each corner of the shield. Lifting the shield off will then reveal the main circuit board shown in Figure 6-9.
5. To remove the circuit board assembly from the control box cover, unscrew the four hex threaded standoffs and the phillips head screw, indicated in Figure 6-9. The circuit board may now be pulled away from the control box cover.
6. To completely disconnect the circuit board assembly from the cover, disconnect the connector shown in Figure 6-9.

The controller can be reassembled by reversing these steps. Ensure that all hardware and connections are secure.

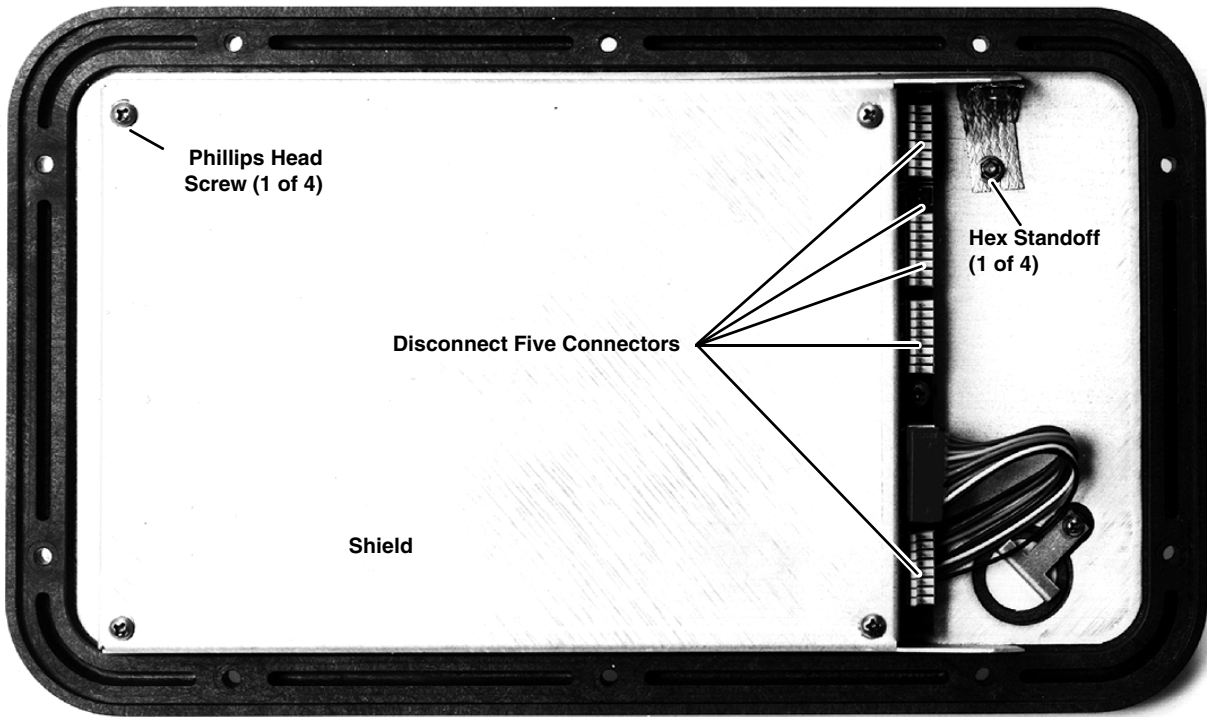


Figure 6-8 Underside of the Control Box Cover

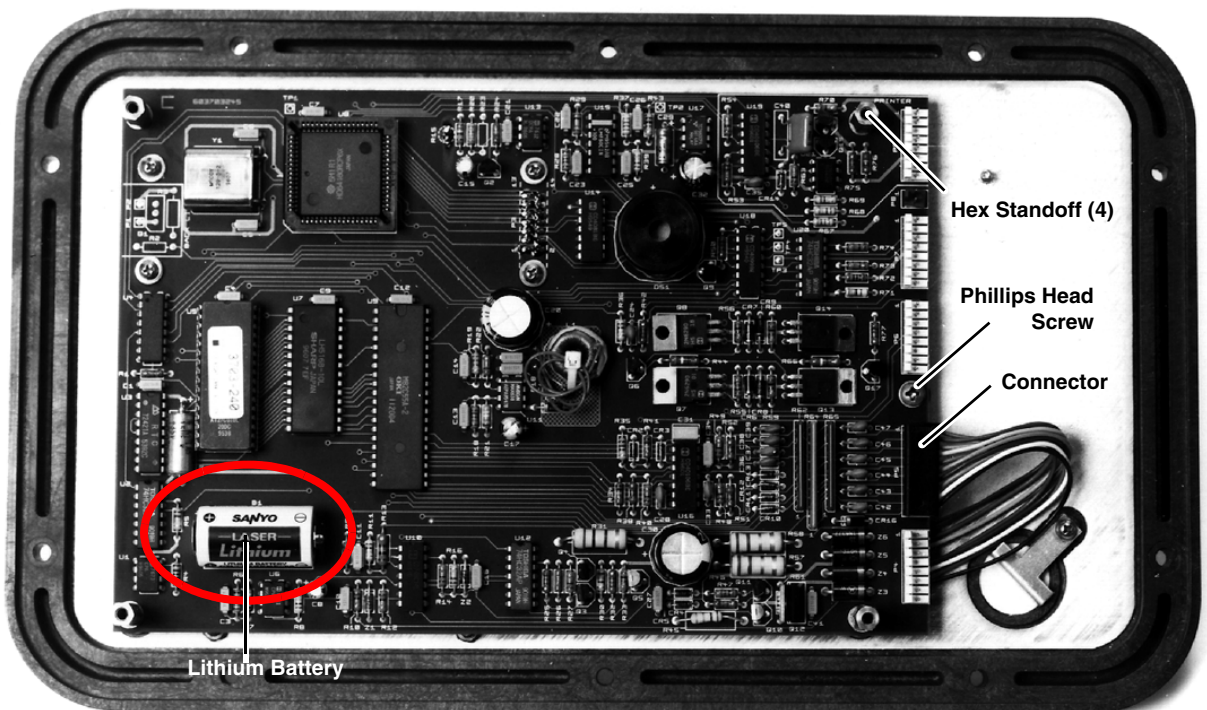


Figure 6-9 Main Circuit Board

6.7 Removal of the Pump Gear Case Assembly

 **CAUTION**

Disconnect power from the refrigerator and controller when working on the unit.
Keep yourself grounded when handling disassembled equipment.

The pump gear case assembly is located in the lower section of the control box. To gain access to the lower section of the control box, follow the instructions in Section 6.7. Use the following steps to remove the pump gear case.

1. Remove the two nuts, the screw, and the grounding strap indicated in Figure 6-10.
2. Lift the plastic tray straight up out of the control box.
3. Remove the liquid detector lid and the pump lid by loosening the captivated thumbscrews on the pump exterior. Figure 5-1, on page 5-6, shows the location of the thumbscrews.
4. Remove the pump tubing from the interior of the pump.
5. Remove the pump rotor by loosening the machine screw and locknut attaching the rotor to the pump shaft. Figure 5-2, on page 5-7, shows the location of the machine screw. Rotate the rotor until you can reach the screw with a screwdriver inserted through the pump case inlet sleeve.
6. Slide the rotor off the pump shaft.
7. Remove the pump case by unscrewing the four screws on the back of pump's inner case.
8. Lift the pump gear case assembly out of the control box.

The pump gear case can be replaced by reversing these steps. Ensure that all hardware and connections are secure.

6.8 Precautions for Servicing CMOS Circuitry

Most of the circuitry in the 3710 Sampler is made up of CMOS components. Because of the oxide gate structure of these devices, they are extremely susceptible to destruction caused by the discharge of static electricity through their inputs.

 **CAUTION**

Disconnect power from the refrigerator and controller when working on the unit.
Keep yourself grounded when handling disassembled equipment.

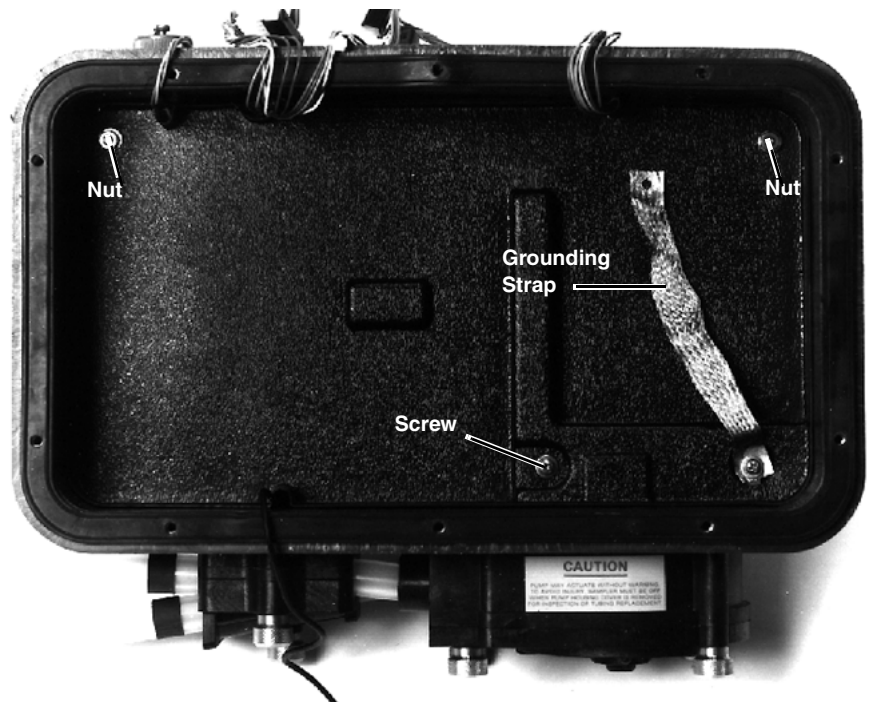


Figure 6-10 Control Box Tray Removal

6.9 Preliminary Electronics Troubleshooting Steps

Following are suggested areas to check before attempting to service the microprocessor CPU and associated circuitry. These checks should be made before looking at the CPU and memory.

1. Supply voltage is correct.
2. Wiring harnesses, connectors, and solder joints are in good condition.
3. Appearance of physical damage, such as burned or broken components, overly hot components, or evidence of water damage.
4. Shorted or open diodes and transistors, especially drive transistors.
5. Voltage regulators working properly.
6. Excessive current draw in the circuitry.
7. Correct input signals to unit.
8. Crystal oscillator operating at proper frequency.
9. Reset circuitry working properly.

6.9.1 Circuit Boards

The following is a general description of the 3710 electronic circuitry. While reading this description, refer to the main circuit board schematic diagram, the case schematic diagram, and the pictorial views of the circuit boards (Figures 6-11 and 6-12).

The 3710FR Sampler is a microprocessor-based device which executes a program stored in ROM. The program (software) is a series of instructions that tell the microprocessor what to do in order to accomplish the various functions which the sampler

must perform. The software is discussed only as is necessary to describe the operation of the circuitry (hardware). The hardware is discussed below.

A connector on the side of the control box is used to connect to an external 12 V $\overline{-}$ source. A 3.75 Amp PTC device provides circuit protection.

The 3710FR Sampler contains two printed circuit boards: the main board and the pump control board. The display module (attached to the main circuit board) also contains a small circuit board. This module is purchased assembled and does not contain any user-serviceable parts. Unless it is being replaced, the module should not be disturbed.

6.9.2 Main Board

Power is supplied to the circuitry through P4 – pin 1 is ground and pin 2 is 12 V. A 5 V switching regulator (IC U11) is used to obtain a 5 V rail from the 12 V supply. All of the ICs used in the 3700FR Sampler get their operating power from the 5 V rail. IC U11 is also used as a low voltage detector – it constantly monitors the 12 V supply. IC U17, a voltage converter, provides a -5 V supply which is needed for some components.

IC U8 is the microprocessor, IC U5 is the ROM, and IC U7 is the RAM. These three ICs make up the “brains” of the 3710FR Sampler. The microprocessor executes the program stored in ROM. While executing, information (program settings, sample data, etc.) is retrieved from and stored in RAM. A 4.608 MHz crystal oscillator (Y1) sets the microprocessor's execution speed. The 3710FR Sampler keeps track of time with a real time clock (IC U3). Both the RAM and IC U3 are battery-backed with a lithium battery (B1). IC U1 is a switch which selects between battery and system power.

Three devices allow the microprocessor to communicate with the outside world: the 2 line, 20 characters per line LCD, IC U9, and IC U18. The LCD allows for communication with the user and is connected through P3. IC U13, transistor Q2, thermistor R15, and other components provide the LCD with a temperature compensated driver voltage. By providing temperature compensation, the display quality is optimized over a wide temperature range. However, when the operating temperature drops below freezing, the LCD may become difficult to read, particularly if the text is blinking. The display will return to normal when the temperature rises above freezing.

IC U9 and IC U18 are I/O devices which allow the microprocessor to read the keypad, sound the beeper, count pump counts, and other tasks.

A 24 position keypad, connected at P5, is used to direct the microprocessor through the program. Many discrete components along with IC U9 are used to decode pressed keys. All user-originated instructions to the 3710FR Sampler enter the system through the keypad.

The 3710FR is supplied with a liquid detection system that gives it the ability to accurately deliver specified sample volumes. The liquid detection system consists of a piezoelectric sensor and filtering circuitry. The sensor, mounted on the exterior of the control box, produces a signal proportional to an induced strain on the pump tubing. This signal is routed through P8 to IC U15 and its associated circuitry where it is massaged into a YES or NO indication of liquid presence. IC U15, containing a switched capacitor low pass filter and two Op Amps, is the main circuit component of the detection system.

An RS-232 serial communications port is connected to the system at P9. This port is used to output sampler status, program settings, and sampling results to a printer or an interrogator. IC U21, IC U19, and a handful of discrete components are used to transmit serial information, receive serial information, and sense the externally connected device.

6.9.3 Pump Control Board

The pump control board is an integral part of the pump assembly and serves two functions: control the pump motor and sense pump revolutions. The pump motor control consists of a 2-pole double-throw relay (K201) and transistor switches (Q201, Q202 and Q203). The relay is used to change the pumping direction and will run the pump in the reverse direction when in the rest state. Each time the pump runs, the microprocessor sends the pumping direction signal through pin 1 of P7, waits for the relay to change state, then starts the pump by sending a high signal through pin 3 of P7. Waiting for the relay to change state before applying power prevents arcing at the relay contacts.

3710FR/3730 Refrigerated Sampler
 Section 6 Servicing

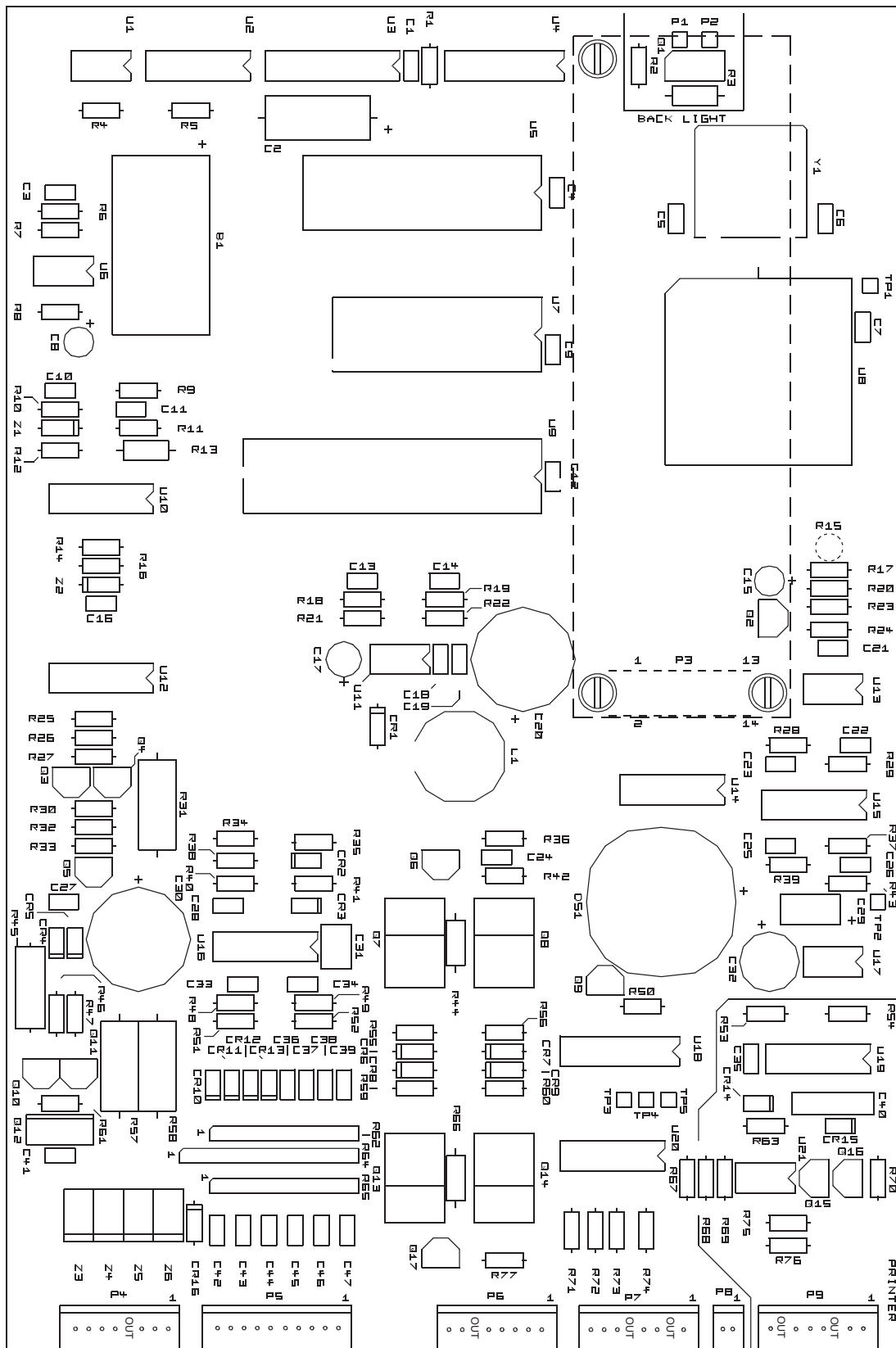


Figure 6-11 3710 Main Circuit Board Component Layout

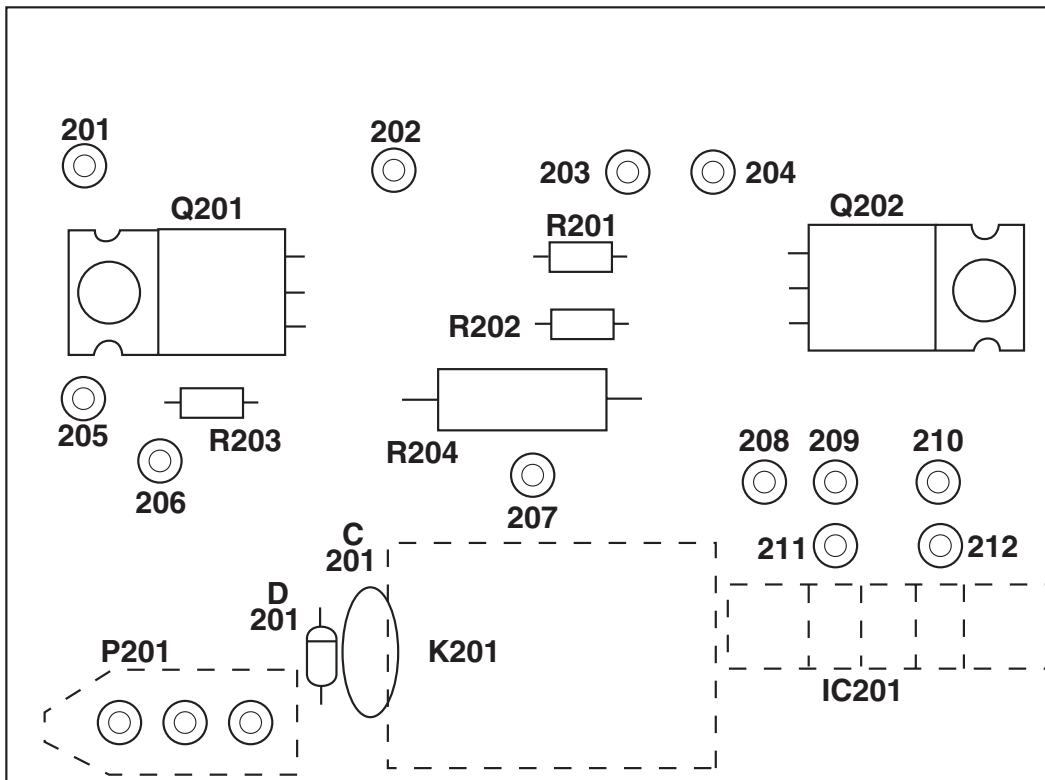


Figure 6-12 Optical Counter PCB Component Layout

A key element of the pump revolution count sensor is the LED-phototransistor device (IC201). Whenever the pump is running, power is supplied to IC201. A rotating disk positioned between the LED and phototransistor periodically interrupts the transmitted signal. These interruptions create pulses which are sent back to the main board at pin 8 of P7 to be counted. The microprocessor uses these counts to determine the pumped volume.

6.10 Sample Event Cycle and Delivery of Sample Volumes

The sequence of steps in a typical sequential sample event is described below. Should you suspect a malfunction in the delivery of the sample volumes, this information will assist you in determining the point at which the problem occurs.

1. A sample event is initiated.
2. The pump rotates in the reverse direction to air purge the suction line inlet of any debris.
3. The pump direction changes, pumping in the forward direction to fill the suction line.
4. After the suction line has been filled to the pump inlet, the sample volume measuring portion of the sampling cycle begins. The pump continues to rotate in the forward direction until the programmed sample volume is delivered.
5. The pump direction again changes, pumping in the reverse direction to air purge the suction line to avoid cross-contamination of samples. The pump then shuts off.

6. The sampler waits until another sample event is initiated and the cycle begins again at step 1.

6.10.1 Peristaltic Pump

The following is a brief description of the method by which the sample volume is determined. The 3710FR Sampler uses a peristaltic pump to transport the sample from the source to the sample bottle. When compared with other suction lift sample gathering methods, a peristaltic pump has numerous advantages: simplicity, reliability, no metering chamber required, easily cleaned, etc.

6.10.2 Volumetric Determination

The 3710FR determines the volumetric delivery of its peristaltic pump by electronically counting revolutions of the pump rotor. Each revolution of the pump rotor corresponds to a fixed number of “pump counts” and a certain volume of sample liquid. However, the volume of liquid delivered by one revolution of the pump rotor changes with the suction head and the type of suction line. At each sample event, the 3710 liquid detection system automatically compensates for changes in suction head and adjusts the volume delivered for each revolution of the pump. Thus, for a given type of suction line, each revolution of the pump rotor results in the delivery of a known amount of sample volume.

6.10.3 Sample Delivery

The sample pumping portion of a sample event consists of three parts: suction line fill, liquid detection, and sample volume delivery. The sampler counts the number of pump revolutions as the suction line fills. At liquid detection, the controller uses that count to determine the proper number of pump revolutions required to deliver the programmed sample volume. It is important to note that the volume delivered by a peristaltic pump can be influenced by a number of factors other than those discussed above. Thus, even with the sophistication of the sample volume measuring functions of the 3710FR, the volume of sample deposited in the sample bottle may vary from the programmed value. The repeatability of a sample volume from sample to sample (which normally is the most important consideration) will typically be within the ± 10 ml specification stated in Table 1-1, on page 1-7.

An illustrated list of common replacement parts for the 3710FR/3730 can be found in Appendix A. When ordering a replacement part, be sure to include the Isco part number, a complete description, and the serial number of the unit on which the part is to be used. The controller and the refrigerator are serialized separately. The controller serial number is located on the side of the unit and the refrigerator serial number is located on the inside of the door.

A list of options and accessory parts described throughout this manual can be found in Appendix B. When ordering an option or accessory, include the part description and the Isco part number.

3710FR/3730 Refrigerated Sampler

Appendix A Replacement Parts Lists

The following appendix contains illustrated replacement parts listings, including part descriptions and order numbers.

Replacement parts 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

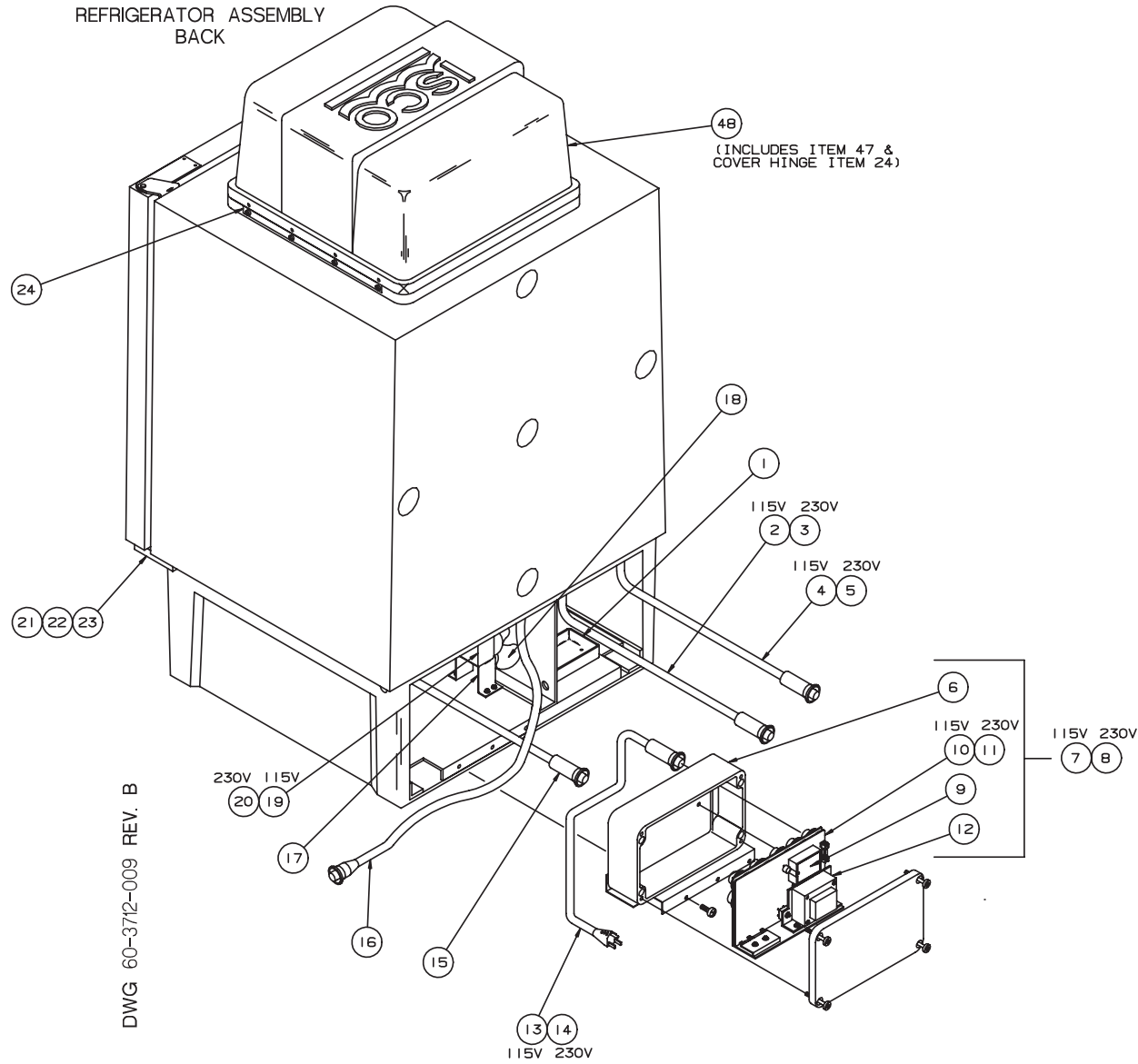
Phone: (800) 228-4373

(402) 464-0231

FAX: (402) 465-3022

E-mail: IscoInfo@teledyne.com

3710FR/3730 Refrigerated Sampler
 Appendix A Replacement Parts Lists

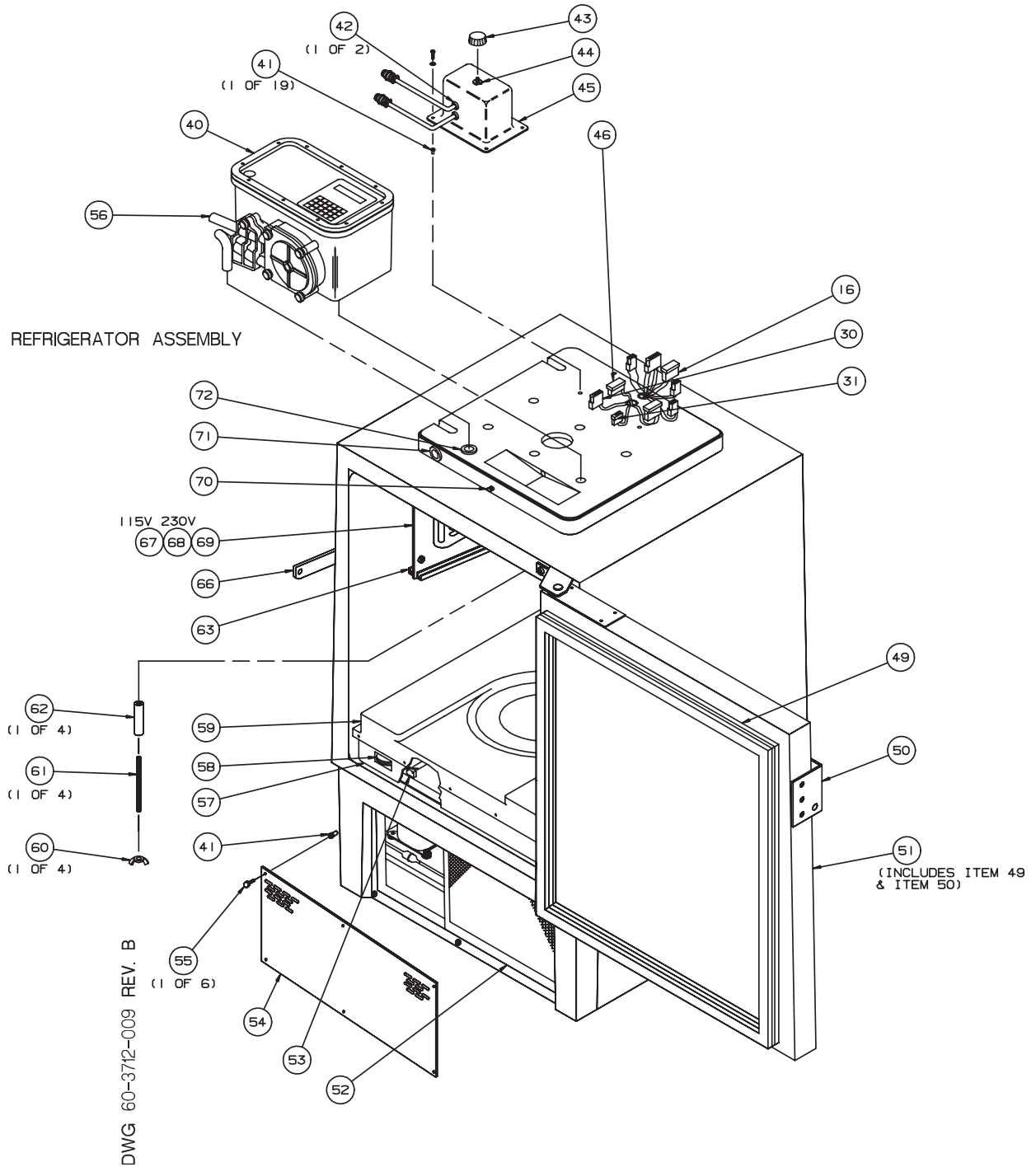


3710FR/3730 Refrigerated Sampler
Appendix A Replacement Parts Lists

ITEM	INVENTORY NO.	DESCRIPTION
1	60-2723-068	DRIP PAN
2	60-9004-260	EVAPORATOR HEATER ASSY. 115 VAC
3	60-9004-204	EVAPORATOR HEATER ASSY. 230 VAC
4	60-9004-256	CRANKCASE HEATER ASSY. 115 VAC
5	60-9004-228	CRANKCASE HEATER ASSY. 230 VAC
6	60-9003-479	TEMPERATURE CONTROL BOX
7	60-9004-208	TEMPERATURE CONTROL BOX ASSY 115 VAC
8	60-9004-225	TEMPERATURE CONTROL BOX ASSY 230 VAC
9	336-0001-00	SOLID STATE RELAY
10	60-9004-257	PCB ASSY, 115 VAC
11	60-9004-217	PCB ASSY, 230 VAC
12	442-4899-03	TRANSFORMER
13	60-9004-242	LINE CORD ASSY 115 VAC
14	60-9004-230	LINE CORD ASSY 230 VAC
15	60-9004-241	AMBIENT AIR TEMP. SENSOR
16	60-9004-224	SAMPLER POWER WIRING ASSY
17	60-2723-133	FAN MOUNT
18	209-0195-03	FAN BLADE
19	304-2300-09	MOTOR FAN 115 VAC
20	304-2300-19	MOTOR FAN 230VAC
21	60-2724-066	DOOR HING ASSY BOTTOM
22	231-0149-12	SCREW 1/4-20 X 3/4
23	60-2723-007	HINGE BUSHING
24	60-2723-085	COVER HINGE
*25	432-0000-00	HEATER FLEX (CRANKCASE) 115 VAC
*26	432-0000-01	HEATER FLEX (CRANKCASE) 230 VAC
*27	099-0002-00	DESICCANT (BAG 8 oz)
*28	60-9003-498	REFRIGERATOR BACK COVER
*29	239-0906-32	WELL-NUT FASTNER (FOR AIR TEMP SENSOR)
*30	60-9004-226	AIR TEMP. SENSOR WIRING ASSY
*31	60-9004-240	EVAP. TEMP. SENSOR
*32	60-2723-134	FAN SHROUD MOUNT
*33	210-0003-01	COMPRESSOR 600 BTU/hr 115VAC
*34	210-0004-01	COMPRESSOR 600 BTU/hr 230VAC
*35	210-0003-02	OVERLOAD FOR COMPRESSOR 115 VAC
*36	210-0001-08	OVERLOAD FOR COMPRESSOR 230 VAC
*37	210-0003-03	RELAY FOR COMPRESSOR 115 VAC
*38	210-0001-07	RELAY FOR COMPRESSOR 230 VAC
*39	61-2724-059	CONDENSING COIL

NOTE: * ITEM IS NOT SHOWN IN ILLUSTRATION

3710FR/3730 Refrigerated Sampler
 Appendix A Replacement Parts Lists

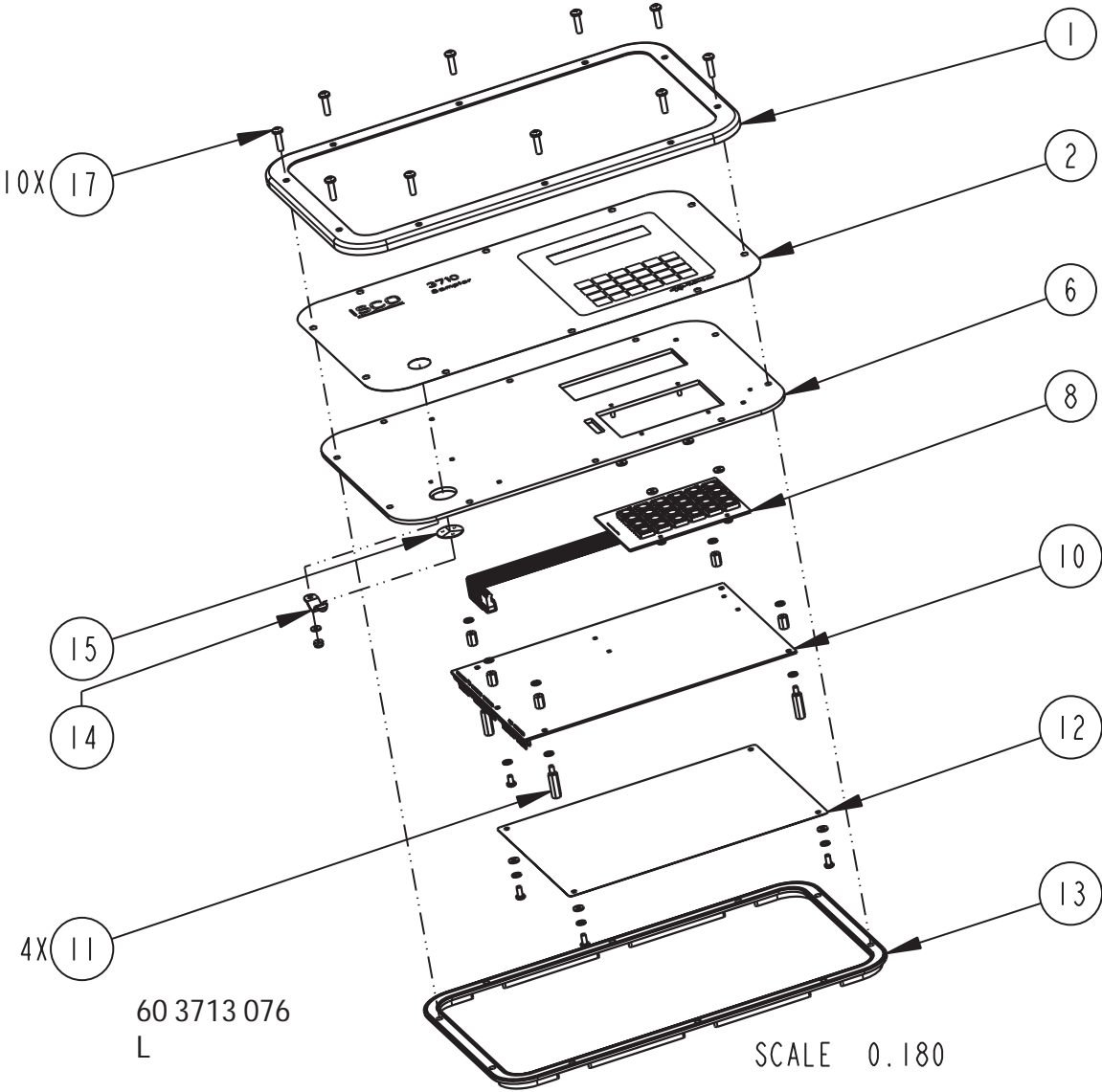


*3710FR/3730 Refrigerated Sampler
Appendix A Replacement Parts Lists*

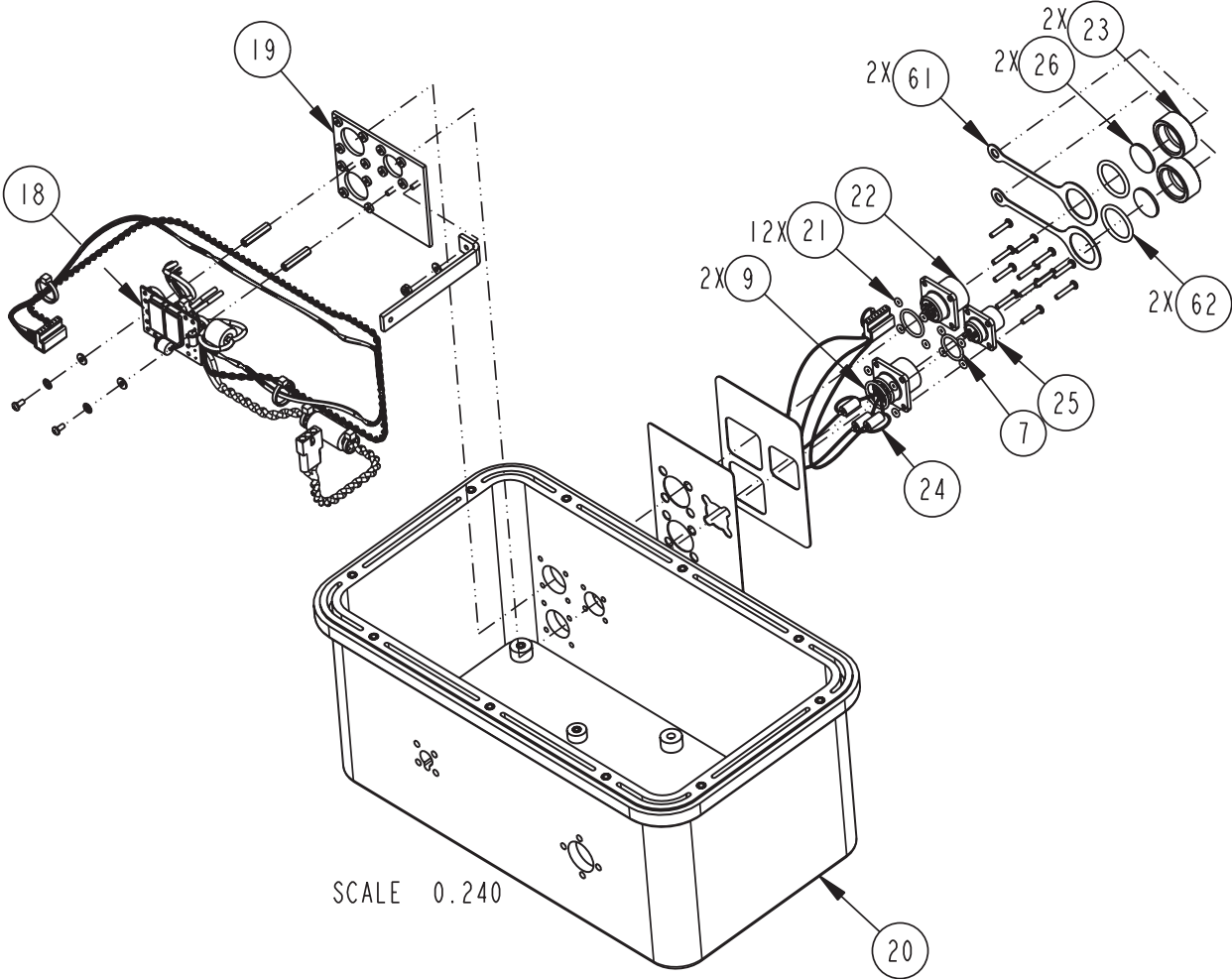
ITEM	INVENTORY NO.	DESCRIPTION
40	60-3714-001	MODEL 3710 CONTROLLER
41	239-0908-32	WELL-NUT FASTNER 8-32 THD
42	209-0075-05	BSHG SR NYLON
43	180-0012-01	KNOB PKG-100B-1/4
44	380-9510-70	POT 10K 2W 3/4 TURN
45	60-2733-025	THERMOSTAT HOUSING
46	60-2734-012	MICROSWITCH WIRING ASSY
*47	109-0800-00	OVER CENTER DRAW LATCH
48	60-2724-063	TOP COVER ASSY
49	60-2723-005	GASKET, REFRIGERATOR DOOR
50	61-2723-042	DOOR HANDLE PWDR COATED
51	60-2724-062	REFRIGERATOR DOOR ASSY
52	60-9003-182	FILTER FOR REFRIGERATOR
53	410-0120-05	SWITCH ACTR 10.1A 1/4 HP SPDT
54	60-2723-032	REFRIGERATOR GRILLE
55	60-2724-021	THUMBSCREW ASSY
56	60-3714-019	PUMP TUBING ASSY, 39-1/2"
57	60-2733-066	COVER PLATE
58	60-2733-001	ADJUSTMENT WHEEL
59	60-2733-011	BOTTLE LOCATING BASE
60	232-4150-00	NUT, WING 8-32 THD
61	60-2733-009	CONTROLLER MOUNTING ROD
62	60-2733-010	SPACER 3/4 RND DELRIN
63	60-9003-487	DRIP RAIL (LEFT)
*64	60-9003-489	DRIP RAIL (RIGHT)
*65	60-2723-034	DRIP TRAY
66	61-2723-043	DOOR LATCH
67	60-9004-259	EVAPORATOR PLATE, COP. TUBING, & HTR. ASSY 115 VAC
68	60-9004-222	EVAPORATOR PLATE, COP. TUBING, &HTR. ASSY 230 VAC
69	60-2723-035	EVAPORATOR PLATE MOD.
70	60-2723-054	KEEPER, TOP COVER LATCH
71	60-2734-013	INDICATING LIGHT ASSY, QA
72	60-2723-165	TUBE FEED THRU

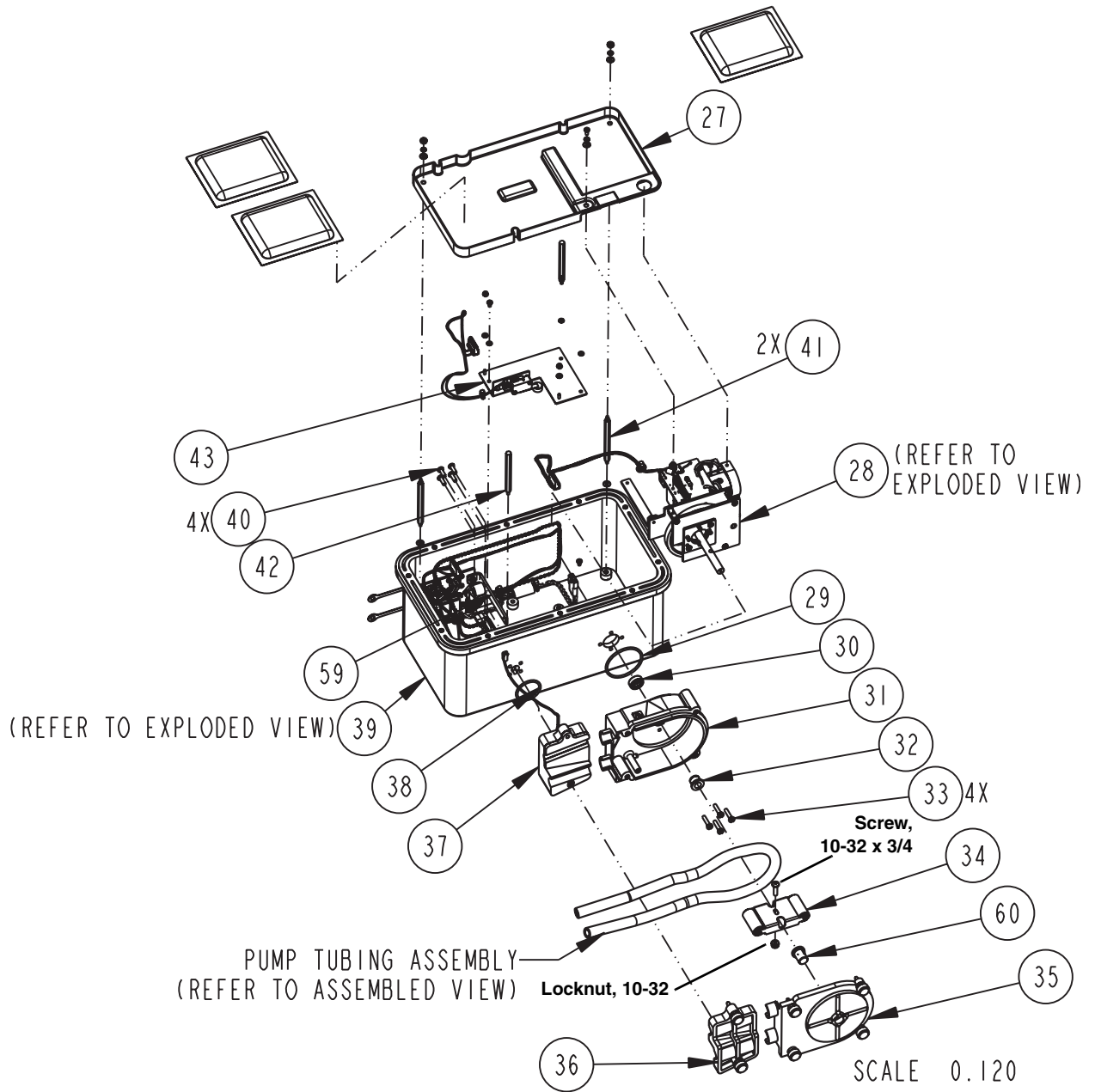
NOTE * ITEM IS NOT SHOWN IN ILLUSTRATION

3710FR/3730 Refrigerated Sampler
Appendix A Replacement Parts Lists

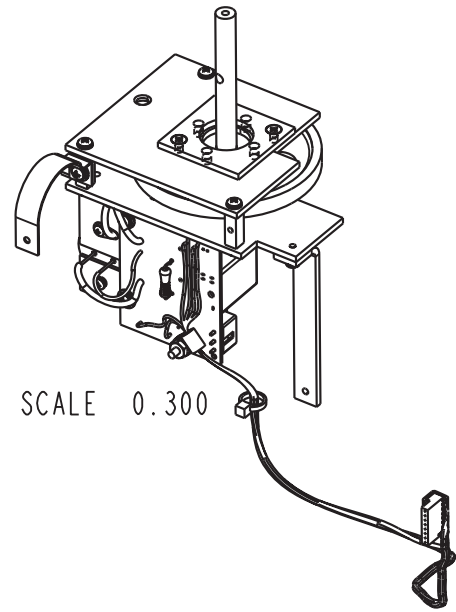
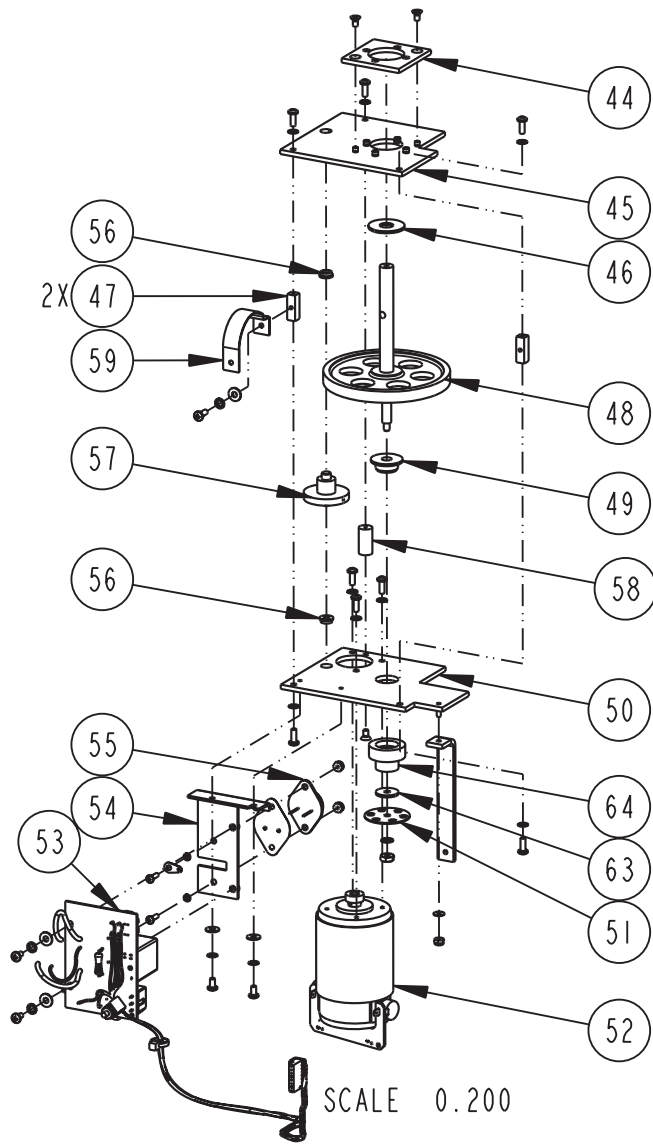


3710FR/3730 Refrigerated Sampler
Appendix A Replacement Parts Lists





REPLACEMENT PARTS LIST		
TELEDYNE ISCO, INC.		
		603713076
		SHEET: 5 OF 7
		REV: L DATE: 06010
ITEM NO.	PART NUMBER	DESCRIPTION
18	603704151	CIRCUIT BOARD ASSEMBLY, POWER SUPPLY CONNECTIONS
19	603704149	BACK PLATE STUD ASSEMBLY, CE
20	603714026	CONTROL BOX MODIFICATION ASSEMBLY
21	202907010	O RING, .100 ID, .070 CROSS SECTION
22	140100600	PLUG, PANEL MOUNT, 6 PIN
23	603113024	CONNECTOR PROTECTOR CAP, MEDIUM
24	603704091	PRINTER CONNECTOR ASSEMBLY
25	140100201	PLUG, PANEL MOUNT, 2 PIN
26	603113032	CONNECTOR CAP GASKET, MEDIUM
27	603703252	DESICCANT TRAY, CE
28	603704154	PUMP GEAR CASE ASSEMBLY, CE
29	202100135	O RING, 1.925 ID, .103 CROSS SECTION,
30	202999903	LIP SEAL, .375 ID X .750 OD
31	603704019	PUMP HOUSING ASSEMBLY, INSIDE
32	603703012	PUMP HOUSING BUSHING
33	231914512	SCREW, MACHINE, 8-32 X 3/4, PAN HEAD, SLOTTED, SST, SELF SEALING, O RING
34	602704019	PUMP ROTOR ASSEMBLY
35	603704017	PUMP HOUSING ASSEMBLY, OUTSIDE
36	603704021	DETECTOR LID ASSEMBLY
37	603704022	DETECTOR BASE ASSEMBLY
38	202401237	O RING, 1.237 ID, .103 CROSS SECTION,
39	603714047	CONTROL BOX SUB-ASSEMBLY, CE
40	231019508	SCREW, MACHINE, 8-32 X 1/2, PAN HEAD, PHILLIPS, SST, SELF SEALING, O-RING
41	602703170	STANDOFF, 6-32 X .25 HEX X 3.00 LONG, MALE, STAINLESS STEEL
42	603714017	SHORT STANDOFF ASSEMBLY
43	603714045	SHUTOFF MICROSWITCH ASSEMBLY, CE
59	603703256	INTERCONNECT STRAP, 5.5"
60	603703278	PUMP HOUSING BUSHING
NOTE: 1. For current prices and quotations on parts, contact Isco Service Department. 2. This list is subject to change without notice.		



REPLACEMENT PARTS LIST		
TELEDYNE ISCO, INC.		
		603713076
		SHEET: 7 OF 7
		REV: L DATE: 06010
ITEM NO.	PART NUMBER	DESCRIPTION
44	602703037	PUMP SHAFT SPACER PLATE
45	602703050	PUMP PLATE
46	602703058	SPACER, .380 ID X 1.00 OD X .060 LONG, DELRIN
47	602703096	STANDOFF, 6-32 X .25 SQUARE X .75 LONG, AL
48	602704010	PUMP SHAFT ASSEMBLY
49	602703076	FLANGED BEARING, .275 ID X .625 OD X .31 LONG
50	603704160	MOTOR PLATE ASSEMBLY, CE
51	602703063	PUMP SHAFT OPTICAL DISK
52	603704172	PUMP MOTOR WITH FILTER ASSEMBLY
53	602704039	CIRCUIT BOARD ASSEMBLY, COUNTER
54	602704048	MOUNTING PLATE ASSEMBLY, OPTICAL COUNTER
55	402025801	TRANSISTOR, 2N5881/2N5882
56	201311200	BEARING, BRONZE, FLANGED, .189ID, .314 OD, 1/8 LONG W/ 3/64 THICK .375 FLANGE
57	602704008	PUMP GEAR SHAFT ASSEMBLY
58	237115000	STANDOFF, 3/16 ROUND, 3/4 LONG, 6-32 FEMALE-FEMALE, AL, CLEAR IRIDITE
59	603703256	INTERCONNECT STRAP, 5.5"
61	609003250	STRAP, DRAIN CAP
62	202400114	'O' RING .612 ID, .103 CROSS SECTION
63	233010804	WSHR, FLAT .171 ID X .625 OD X .060
64	603703291	SPACER, PUMP GEAR CASE ASSEMBLY
NOTE: 1. For current prices and quotations on parts, contact Isco Service Department. 2. This list is subject to change without notice.		

3710FR/3730 Refrigerated Sampler

Appendix B Accessories

The following appendix contains the most commonly ordered accessories for the 3710FR sampler, including part descriptions and order numbers. For additional accessories, contact Teledyne Isco Customer Service or your local sales representative.

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

B.1 General Accessories

2.5 gallon polyethylene container with cap	299-0013-04
2.5 gallon glass container with cap and PTFE liner	68-2700-005
4 gallon polyethylene container with cap	299-0013-05
Extra Silastic pump tubing, 39.5" length	60-3714-019
Model 3710 Sampler controller with pump tubing	68-3730-005
Extra Pocket Guide, Model 3710R/3710FR	60-3713-049
Extra Silastic pump tubing, bulk 10' length.	68-6700-046
Extra Silastic pump tubing, bulk 50' length.	68-6700-047
Plastic graduated cylinder, 1000 ml, for sample volume calibration	299-0020-00

B.2 Suction Lines and Strainers

$\frac{3}{8}$ " ID x 10' vinyl suction line with standard weighted polypropylene strainer	60-9004-378
$\frac{3}{8}$ " ID x 25' vinyl suction line with standard weighted polypropylene strainer	60-9004-379
$\frac{3}{8}$ " ID x 10' PTFE suction line with protective coating, without strainer	60-1683-146
$\frac{3}{8}$ " ID x 25' PTFE suction line with protective coating, without strainer	60-2703-114
$\frac{3}{8}$ " Standard weighted polypropylene strainer	60-9004-367
$\frac{1}{4}$ " stainless steel low flow strainer only	69-2903-139
$\frac{3}{8}$ " stainless steel low flow strainer only	69-2903-138
Weighted strainer only, $\frac{3}{8}$ ", all plastic CPVC	60-3704-066

1/4" ID vinyl tubing, bulk 100'	68-1680-055
1/4" ID vinyl tubing, bulk 500'	68-1680-056
1/4" ID vinyl tubing, bulk 1000'	68-1680-057
3/8" ID vinyl tubing, bulk 100'	68-1680-058
3/8" ID vinyl tubing, bulk 500'	68-1680-059
1/4" Vinyl suction line accessory kit (required for 1/4" suction lines).	68-3700-006
3/8" Vinyl suction line accessory kit (required for 3/8" suction lines).	68-3700-007

B.3 Power Sources

Model 913 High Capacity Power Pack (120-volt)	60-1684-088
Model 914 Battery-Backed Power Pack (120-volt)	60-3004-130
Model 923 High Capacity Power Pack (240-volt)	60-1684-093
Model 924 Battery-Backed Power Pack (240-volt)	60-3004-160
Model 934 Nickel-Cadmium Battery	60-1684-040
Model 948 45-Amp-Hour Battery	68-3000-948
Portable 12-volt DC, 6-Amp Battery Charger for 948 Battery	341-0118-12
Model 961 Battery Charger (120-volt)	60-3004-059
Model 965 Five Station Battery Charger, 120/240V, with 120V power cord	68-3000-965
Model 965 Five Station Battery Charger, 120/240V, with 240V power cord	68-3000-966
Connect cable, for external 12 VDC power source; terminates in heavy duty battery clips	60-1394-023

B.4 Interfacing Equipment

1640 Liquid Level Actuator	60-1644-000
Extra Instruction Manual, 1640	60-1644-009
Connect cable, 25', Isco sampler to Isco Flow meter	60-3004-107
Connector only, without cable, for use with non-Isco Flow meters having an isolated contact closure proportional to flow	68-1680-060
Same as above, with 22' cable terminating in two wires	60-1394-077
2100 Series Sampler Interface Cable	60-2004-260
4-20 mA Sampler Input Interface (converts analog signal flow meter output as specified by user into pulses acceptable to Isco samplers)	60-3704-037
Flowlink Software with manual	call factory
Samplink Sampler Interrogation Software with manual	60-3774-013
Interrogator communications line kit - 9 pin (connects laptop computer with 9 pin serial port to sampler)	60-2544-044
Interrogator communications line kit - 25 pin (connects laptop computer with 25 pin serial port to sampler)	60-2544-040

3710FR/3730 Refrigerated Sampler

Appendix C Display Index

Note

To access the display number, press the STOP key while the sampler displays the screen in question. The display numbers are available in the Standby and Program states.

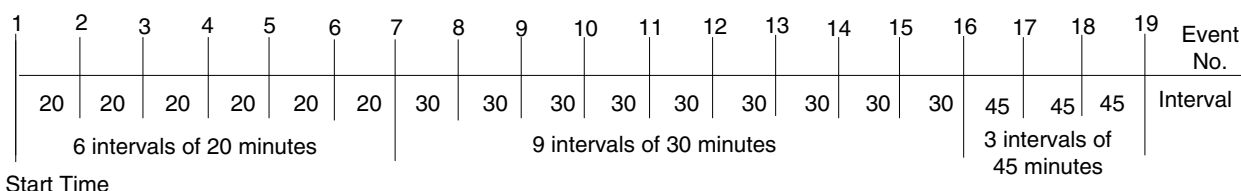


Figure C-1 Time Line

Table C-1 Display Index

This display appears after you press the ENTER/PROGRAM key while in standby. Select "PROGRAM" to access the program sequence. Select "CONFIGURE" to access the configure sequence.

Display 1

```
[PROGRAM, CONFIGURE]
SAMPLER
```

This informational display appears when you stop the pump with the STOP key after pressing the PUMP FORWARD key. It reports the number of pump counts detected while the pump was in operation. Exit this display by pressing any key except STOP and ON/OFF.

Display 3

```
----- COUNTS FORWARD
```

This informational display appears when you stop the pump with the STOP key after having pressed the PUMP REVERSE key. It reports the number of pump counts detected while the pump was in operation. Exit this display by pressing any key except STOP and ON/OFF.

Display 3

```
----- COUNTS REVERSE
```

This display appears after you select "PROGRAM" in Display #1. Select "TIME" for time-paced sampling, "FLOW" for flow-paced sampling.

Display 10

```
[TIME, FLOW]
PACED SAMPLING
```

This display appears only in the extended programming mode and follows Display #10 when you have selected "TIME." Select "UNIFORM" for uniform time intervals, "NONUNIFORM" for nonuniform time intervals.

Display 11

```
[UNIFORM, NONUNIFORM]
TIME INTERVALS
```

Table C-1 Display Index (Continued)

This display follows Display #11 when you have selected "NONUNIFORM." Select "YES" to modify the existing non-uniform intervals. Select "NO" to leave the nonuniform intervals unchanged.

Display 20 MODIFY SEQUENCE?
[YES, NO]

In the basic programming mode, this display appears after you have selected "TIME" in Display #10. In the extended programming mode, this display appears when you have selected "UNIFORM" in Display #11. Enter the uniform time interval. You need to make 2 entries: The first entry sets the hours, the second sets the minutes.

Display 21 SAMPLE EVERY
-- HOURS -- MINUTES

This display follows Display #10 when you have selected "FLOW." Enter the flow-pulse interval.

Display 22 SAMPLE EVERY
---- PULSES (1 - 9999)

This display follows Display #15. Use this display to enter the number of timed sample events in a storm program.

Display 23 TAKE -- TIMED
SAMPLE EVENTS (1 - MAX)

This display follows Display #23. Enter the time interval between time-paced sample events in a storm program.

Display 24 SAMPLE INTERVALS OF
-- MINUTES (1 - 99)

This display follows Display #20 when you select "YES" to modify the nonuniform time-interval sequence. Enter the number of sample events to occur at nonuniform time intervals. MAX varies according to the bottle size entered in Display #223

Display 25 TAKE --- SAMPLES
(1 - MAX)

This display follows Display #25. Enter the nonuniform clock times and dates for each sample event.

Display 26 TAKE SAMPLES AT
1. HH:MM DD-MMM

Enter the number of samples to be taken at each interval. The total quantity you enter will be 1 fewer than the total number of samples, because the first sample, taken at the start time, counts as 1. For example, if you want to take 19 samples (the first 6 at 20-minute intervals, the next 9 at 30-minute intervals, and the remaining 3 at 45-minute intervals), first enter a quantity of 6 at 20 minutes, 9 at 30 minutes, and 3 at 45 minutes. Figure C-1 shows a time line for the sampling routine.

QUANTITY AT INTERVAL
1. -- AT --- MINUTES)

Enter the size of the sample volume. MAX will vary according to the number of samples.

Display 50 SAMPLE VOLUMES OF
--- ml EACH (10 - MAX)

Enter the number of composite samples. An entry of "0" instructs the sampler to take samples until a float shut-off terminates the sampling routine.

Display 60 --- COMPOSITE
SAMPLES (0 - MAX)

This display appears when you select "YES" in Display #242 or select "DISABLE" in Display #240. Enter the measured suction head. MAX will be the smaller of the suction line length or "20."

Display 70 SUCTION HEAD OF
-- FEET (1 - MAX)

Table C-1 Display Index (Continued)

This display appears in the program sequence when you have selected "ENABLE" in Display #290. Select "YES" to use the calibration sequence, "NO" to omit the calibration sequence.

Display 80

```
CALIBRATE SAMPLE
VOLUME? [YES, NO]
```

This display is part of the calibration sequence. Press the MANUAL SAMPLE key when a collection bottle is underneath the pump tube and the suction line is in place.

Display 81

```
PRESS MANUAL SAMPLE
KEY WHEN READY...
```

This display is part of the calibration sequence. When it first appears, it reports the programmed sample volume. If the measured volume differs from the reported volume, enter the measured volume here.

Display 82

```
--- ml VOLUME
DELIVERED
```

This display is part of the calibration sequence and appears if the measured volume and the programmed volume differ by a factor of two or more. Select "YES" to confirm the number entered in Display #82. Select "NO" to return to Display #82.

Display 83

```
---ml! ARE YOU
SURE? [YES, NO]
```

Select "YES" to enter a start time. "NO" will begin the sampling routine according to the delay set in Display #310.

Display 90

```
ENTER START TIME?
[YES, NO]
```

This display appears when you have selected "YES" in Display #90. Enter the start time and date for the first sample event. This display will also appear if you have initiated the routine after a programmed start time so that you can reprogram the start time.

Display 91

```
TAKE FIRST SAMPLE AT
HH:MM DD-MMM
```

This display appears when you have selected "YES" in Display #90. Enter the start time and date for the flow -pulse countdown. This display will also appear if you have initiated the routine after a programmed start time so that you can reprogram the start time.

Display 92

```
START FLOW COUNT AT
HH:MM DD-MM
```

This display appears when you select "ENABLE" in Display #300. Enter the number of stop and resume times.

Display 100

```
-- STOP or RESUME
TIMES (0 - 24)
```

This display appears when the setting in Display #100 is greater than zero. Enter the appropriate stop time.

Display 101

```
STOP SAMPLING AT
1. HH:MMDD-MMM
```

This display appears when the setting in Display #100 is greater than one. It follows Display #101. Enter the appropriate resume time.

Display 102

```
RESUME SAMPLING AT
1. HH:MMDD-MMM
```

This display appears when a routine is halted and you press the start sampling key. Select "START" to start the sampling program at the beginning, "RESUME" to continue the sampling program at the point at which it was halted.

Display 140

```
[START, RESUME]
SAMPLING PROGRAM
```

Table C-1 Display Index (Continued)

This display appears when you have started a routine after the programmed start time. Select "YES" to enter a new start time. Select "NO" to start the routine immediately; some sample events may be missed or late.

Display 142 CHANGE START TIME?
[YES, NO]

This display appears after you press the display status key. Select "REVIEW" to view the summary of the current program settings and for sampling results. Select "PRINT" to send the current status, program settings, and sampling results to an Isco Field Printer. NOTE: The Isco Field Printer is no longer sold, but this function remains available for customers who still have Field Printers. The printed results include data for sample events completed when you pressed the display status key.

Display 148 [REVIEW, PRINT] PROGRAM
INFORMATION

This display appears after you select "Print" in Display #148. Select "NO" to return to standby. Select "Settings" to print the settings report. Select "RESULTS" to print the results report.

Display 149 PRINT PROGRAM [NO,
SETTINGS, RESULTS]

This display appears after you select "REVIEW" in Display #148. Select "NO" to return to the previous operating state. Select "SETTINGS" to view the summary of the current program settings. Select "RESULTS" to view the sampling results for sample events completed at the time you pressed the display status key.

Display 150 REVIEW PROGRAM [NO,
SETTINGS, RESULTS]

Display #151 is used to identify the displays used to summarize the current program settings which appear when you select "SETTINGS" in Display #150.

Display 151 SETTINGS DISPLAYS

Display #152 identifies sampling results displays that appear when you select "RESULTS" in Display #150.

Display 152 RESULTS DISPLAYS

Display #200 is used to identify the displays, which locate each configure option in the configure sequence. Press ENTER/PROGRAM to access the input displays for each option. Use the LEFT ARROW and the RIGHT ARROW keys to move through the options.

Display 200 SELECT OPTION (< ← → >
name of configure option)

Set Clock configure option. Enter the time and date to set the controller's clock. Use military time. Enter two digits each for the day (DD), month (MM), and year (YY).

Display 210 HH:MM DD/MM/YY
HH:MM DD/MM/YY

Bottles and Sizes configure option. Select REFRIG if you have a refrigerated base unit. Select PORTABLE only when you are using a 3710 Compact or Standard Sampler.

Display 220 [PORTABLE, REFRIG]
SAMPLER

Bottle and Size configure option. Enter the bottle volume in milliliters.

Display 223 BOTTLE VOLUME IS
----- ml

Bottle and Size configure option. This display appears when you have entered a bottle volume in Display #223 that exceeds a standard Isco bottle size.

Display 224 ---- ml ... ARE YOU
SURE? [YES, NO]

Table C-1 Display Index (Continued)

Suction Line configure option. Select “1/4” if you are using 1/4-inch suction line, “3/8” if you are using 3/8-inch suction line.

Display 230

```
SUCTION LINE ID IS
[1/4, 3/8] INCH
```

Suction Line configure option. This display appears when you have selected “3/8” in Display #230. Select “VINYL” if you are using vinyl suction line, “TEFLON” if you are using PTFE suction line.

Display 231

```
SUCTION LINE IS
[VINYL, TEFLON]
```

Suction Line configure option. Enter the length of the suction line. Do not include the tube coupling or the strainer in the length measurement.

Display 232

```
SUCTION LINE LENGTH
IS -- FEET (3 - 99)
```

Liquid Detector configure option. Select “ENABLE” to turn on the Liquid Detector, “DISABLE” to turn off the Liquid Detector. If you turn off the detector, you must enter the suction head (Display #70) in the program sequence.

Display 240

```
[ENABLE, DISABLE]
LIQUID DETECTOR
```

Liquid Detector configure option. This display appears when you select “ENABLE” in Display #240. Enter the number of rinse cycles. Rinse cycles condition the suction line to reduce cross-contamination.

Display 241

```
RINSE CYCLES (0 - 3)
```

Liquid Detector configure option. This display appears when you select “ENABLE” in Display #240. Select “YES” to add the suction-head setting (Display #70) to the program sequence. Select “NO” to omit the setting.

Display 242

```
ENTER HEAD MANUALLY?
[YES, NO]
```

Liquid Detector configure option. This display appears when you select “ENABLE” in Display #240. Enter the number of retries: the number of times the sampler will try to detect the presence of liquid for each sample event.

Display 243

```
RETRY UP TO - TIMES
WHEN SAMPLING (0 - 3)
```

Programming Mode configure option. Select “BASIC” to use the basic programming mode. To use the extended programming mode, select “EXTENDED.”

Display 250

```
[BASIC, EXTENDED]
PROGRAMMING MODE
```

Load Stored Program configure option. Select the sampling program you want to use. Select “NONE” to exit the display without loading a program.

Display 255

```
LOAD PROGRAM
[#1, #2, #3, NONE]
```

Save Current Program configure option. Select the number with which you want to use to identify the current program when saved. Select “NONE” to exit the display without saving a program.

Display 260

```
SAVE PROGRAM AS
[#1, #2, #3, NONE]
```

Flow Mode Sampling configure option. This setting affects flow-paced sampling routines. Select “YES” to take the first sample at the start time, “NO” to take the first sample at the end of the first flow-pulse interval.

Display 270

```
TAKE SAMPLE AT START
TIME? [YES, NO]
```

Table C-1 Display Index (Continued)

Nonuniform Time configure option. Select "CLOCK TIME" to enter the nonuniform time intervals as clock times (Display #26). Select "MINUTES" to set the nonuniform intervals in minutes (Display #27).

Display 280

ENTER INTERVALS IN
[CLOCK TIME, MINUTES]

Calibrate Sampler configure option. Select "ENABLE" to add calibration displays to the program sequence. Select "DISABLE" to omit the calibration displays.

Display 290

[ENABLE, DISABLE]
CALIBRATE SAMPLE

Sampling Stop/Resume configure option. Select "ENABLE" to add the Sampling Stop/Resume settings to the program sequence. Select "DISABLE" to omit the settings.

Display 300

[ENABLE, DISABLE]
SAMPLING STOP/RESUME

Sampling Stop/Resume configure option. This display appears when you select "ENABLE" in Display #300. Select "YES" to take a sample at stop times. Select "NO" if you do not want a sample event at the stop times.

Display 301

SAMPLE AT STOP?
[YES, NO]

Sampling Stop/Resume configure option. This display appears when you select "ENABLE" in Display #300. Select "YES" to take a sample at the resume times. Select "NO" if you do not want a sample event at the resume times.

Display 302

SAMPLE AT RESUME?
[YES, NO]

Start Time Delay configure option. Enter the amount of time, in minutes, you want to delay the start time. This entry affects programs that do not have a programmed start time.

Display 310

---- MINUTE DELAY
TO START (0 - 9999)

Enable Pin configure option. Select "YES" to take a sample at the time the sampler becomes disabled. Select "NO" if you do not want a sample event when the sampler becomes disabled.

Display 321

SAMPLE UPON DISABLE?
[YES, NO]

Enable Pin configure option. Select "YES" to take a sample when the sampler becomes enabled; *i.e.*, ceases to receive an inhibit signal from a flow meter or a Liquid Level Actuator. Note: No sample will be taken if the enable signal is used to initiate the start-time delay countdown. Select "NO" if you do not want a sample event when the sampler becomes enabled.

Display 322

SAMPLE UPON ENABLE?
[YES, NO]

Enable Pin configure option. Select "YES" to restart the sample interval countdown at the time the sampler is enabled. The interval countdown is determined by the setting if "NO" is selected in Display #324.

Display 323

RESET SAMPLE
INTERVAL? [YES, NO]

Enable Pin configure option. This display appears if you select "NO" in Display #323. Select "YES" to freeze the sample interval when the sampler becomes disabled. When the sampler is enabled, the interval countdown continues from the point where it had stopped. Select "NO" to let the sample interval countdown continue while the sampler is disabled.

Display 324

INHIBIT COUNTDOWN?
[YES, NO]

Event Mark configure option. Select "CONTINUOUS SIGNAL" to send a variable-duration event mark signal from pin E of the flow meter connector. Select "PULSE" to send a 3-second event mark signal.

Display 330

[CONTINUOUS SIGNAL,
PULSE]

Table C-1 Display Index (Continued)

Event Mark configure option. This setting appears when you select "CONTINUOUS SIGNAL" in Display #330. Select "PUMP CYCLE" to transmit the event mark signal during the entire pump cycle, including any programmed rinses and retries. Select "FWD PUMPING ONLY" to send the signal when the pump is delivering a sample volume only.

Display 331

```
DURING [PUMP CYCLE,
FWD PUMPING ONLY]
```

Event Mark configure option. This setting appears when you select "PULSE" in Display #330. Select "PURGE" to transmit an event mark signal to a flow meter at the beginning of the pre-sample purge. Select "FWD PUMPING" to transmit a signal when the pump switches forward to deliver the sample volume.

Display 332

```
AT THE BEGINNING OF
[PURGE, FWD PUMPING]
```

Purge Counts configure option. Enter the number of pre-sample pump counts needed to purge the suction line. This value is set to 150 when the controller is reinitialized.

Display 340

```
--- PRE-SAMPLE
COUNTS (0 - 9999)
```

Purge Counts configure option. Enter the number of post-sample pump counts needed to purge the suction line. The Controller derives the number that initially appears in this display from the suction line ID and length entered in Display #230 and #232.

Display 341

```
--- POST-SAMPLE
COUNTS (0 - 9999)
```

Tubing Life configure option. This informational display communicates the pump counts elapsed since the last reset and the counts required to trigger the Pump Tubing Warning. Exit this display by pressing any key.

Display 350

```
----- PUMP COUNTS,
WARNING AT -----
```

Tubing Life configure option. After changing the pump tube, select "YES" to reset the pump counter to zero. Select "NO" to leave the counter unchanged.

Display 351

```
--- POST-SAMPLE
COUNTS (0 - 9999)
```

Tubing Life configure option. Enter the number of pump counts required to trigger the pump-count warning if the factory setting is not suitable. This value is set to 500,000 when the controller is reinitialized.

Display 352

```
----- PUMP COUNTS
TO WARNING
```

Program Lock configure option. Select "ENABLE" to turn on the program lock. If you enable the program lock, input displays are protected by a pass-number: 3700. The controller will not allow you to make any changes to a program or configure sequence setting until you enter the pass-number when requested. Select "DISABLE" to turn the program lock off.

Display 360

```
[ENABLE, DISABLE]
PROGRAM LOCK
```

Sampler ID configure option. Enter the sampler identification here. The sampler will accept as many as 10 characters, including periods (press resume sampling), dashes (press manual sample), and spaces (press start sampling).

Display 365

```
SAMPLER ID NUMBER IS
-----
```

Run Diagnostics configure option. Select "YES" to "reinitialize" (reset) the controller: the entire RAM – with the exception of the configure option settings for current pump-count total, number of bottles, bottle size, suction-line length, and sampler ID – will be reset to factory settings. Select "NO" the leave the settings unchanged.

Display 371

```
RE-INITIALIZE?
[YES, NO]
```


3710FR/3730 Refrigerated Sampler

Appendix D Calculating Flow Increment Between Samples

The 3710FR Sampler will accept flow-proportional inputs from an external flow meter, flow module, or flow logger. These electronic flow-input signals are transmitted to the sampler at fixed increments of total flow, for example, every 10,000 gallons. Each time 10,000 gallons of liquid flows past the flow meter, it sends a signal to the sampler, which registers it as a single flow pulse. You can program the sampler to totalize any number of flow pulses from 1 to 9,999 before initiating a sampling event. For example, if the sampler were programmed to totalize 5 flow pulses and each flow pulse represented 10,000 gallons of total flow, a sample would be collected each time 50,000 gallons (5 flow pulses of 10,000 gallons each) had passed the flow meter.

Time Interval Known – If the desired average time interval between individual samples is known, the flow increment between samples can be determined by calculating how much flow (based on the average flow rate) occurs during that time interval. For example, assume that the average flow is 2.5 MGD and it is desired to collect a sample every 30 minutes. The flow increment between samples is calculated:

$$2.5 \text{ MGD} = 2,500,000 \text{ GAL/DAY}$$

$$2,500,000 \text{ GAL/DAY} \times 1 \text{ DAY/24 HR} \times 1 \text{ HR/60 MIN} = 1736 \text{ GAL/MIN}$$

$$1736 \text{ GAL/MIN} \times 30 \text{ MIN/SAMPLE} = 52,080 \text{ GAL/SAMPLE}$$

Thus, the desired flow increment between samples is approximately 52,000 gallons.

Number of Samples Known – Alternatively, if the total number of samples to be collected over the total sampling period is known, the flow increment between samples can be determined by calculating how much total flow will occur during the sampling period, and dividing this by the total number of samples to be collected. For example, assume that the average flow is 1.75 MGD, that the composite sampling period is 2 days, and that it is desired to collect 100 individual samples. The flow increment between samples is calculated:

$$1.75 \text{ MGD} = 1,750,000 \text{ GAL/DAY}$$

$$1,750,000 \text{ GAL/DAY} \times 2 \text{ DAYS} = 3,500,000 \text{ GAL}$$

$$3,500,000 \text{ GAL} \div 100 \text{ SAMPLES} = 35,000 \text{ GAL/SAMPLE}$$

Thus, the desired flow increment between samples is approximately 35,000 gallons.

Calculation of Number of Flow Pulses – Once the desired flow increment between samples is known, the number of flow pulses to be programmed into the sampler may be calculated, assuming that the volume of the flow pulses from the flow meter is known. The number of flow pulses is calculated by dividing the flow increment between samples by the volume of each flow pulse. Using the first example above, the flow increment between samples was calculated as 52,000 gallons; assume that each flow pulse represents 10,000 gallons of flow. The number of flow pulses to be programmed into the sampler is calculated:

$$52,000 \text{ GAL} \div 10,000 \text{ GAL/FLOW PULSE} = 5.2 \text{ FLOW PULSES}$$

Rounding this to an even number results in 5 flow pulses to be programmed into the sampler. This in turn results in a flow increment between samples of 50,000 gallons (5 flow pulses \times 10,000 gallons/flow pulse).

Total Number Of Samples – To calculate the total number of samples to be collected, three quantities must be known: the average flow rate, the flow increment between samples (calculated above), and the total time over which the composite sample is to be collected. The total number of samples to be collected is determined by first calculating the total flow volume over the sampling period, and then dividing this by the flow increment between samples. For example, assume that the average flow is 2.5 MGD, the flow increment between samples is 50,000 gallons, and the composite sample is to be collected over a 24 hour period. The total flow volume over a 24 hour period is:

$$2.5 \text{ MGD} = 2,500,000 \text{ GAL/DAY}$$

$$2,500,000 \text{ GAL/DAY} \times 1 \text{ DAY} = 2,500,000 \text{ GAL}$$

The total number of samples to be collected in this 24 hour period is then calculated:

$$2,500,000 \text{ GAL} \div 50,000 \text{ GAL/SAMPLES} = 50 \text{ SAMPLES}$$

Thus, based on an average flow of 2.5 MGD, 50 samples will be collected.

Calculation of Sample Volume – To calculate the volume of each individual sample, the volume of the composite sample container being used and the total number of samples to be collected (calculated above) must be known. The individual sample volume is calculated by simply dividing the volume of the composite sample container being used by the total number of samples to be collected. For example, assume that a 2.5 gallon (9,400 ml) plastic container is being used, and that a total of 50 samples are to be collected in it. The individual sample volume is then calculated:

$$9400 \text{ ML} \div 50 \text{ SAMPLES} = 188 \text{ ML}$$

Sample Volume Considerations – Thus, a sample volume of 188 ml will result in the desired composite sample. Because of the basic uncertainty of the delivered sample volume exactly matching the programmed nominal sample volume and the 10 ml sample repeatability, it is good practice to select a nominal sample volume which is slightly smaller than the calculated sample volume. This is to prevent overfilling of the sample container. In the example, an individual nominal sample volume of 125 ml might be a prudent choice. For critical applications, calibration of the sample volume can be used. It is important to select an individual sample volume which will not result in an overfilled sample container under worst-case conditions.

The nominal volume of the composite sample may be calculated by multiplying the programmed nominal sample volume by the total number of samples to be collected. In the example:

$$125 \text{ ML/SAMPLE} \times 50 \text{ SAMPLES} = 6,250 \text{ ML}$$

This calculated total volume may vary from the actual total volume because of variations in the actual volume of each individual sample. The total time needed to collect the 50 individual samples may vary from the desired 24 hour period because of variations in the average flow rate from the 2.5 MGD figure used in these calculations.

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Appendix E Glossary

Composite sampling – In composite sampling, multiple sample volumes are placed in bottle sets. Typically, composite sampling uses a single container. A composite sample represents an average of the characteristics of the flow stream for the elapsed time of sampling.

Controller – The controller, housed within the molded control box, is a collection of electronic components, which govern the actions of the sampler. It includes the microprocessor, RAM (Random Access Memory), ROM (Read Only Memory) and its imbedded software, the LCD (Liquid Crystal Display), and the keypad.

Cross contamination – Cross contamination occurs when portions of previous samples are mixed with the current sample. For example, cross contamination results when residual amounts of sample remain in the suction line or pump tube from a previous sample event.

Event mark – An event mark is a signal that the sampler sends to a flow meter or other device at each sample event. Each time the flow meter receives an event mark pulse, the flow meter places a mark on the its recording chart. Marking the recording chart cross-references the charted flow with the sample events.

Post-sample purge – Post-sample purge refers to the suction line purge that follows the delivery of the sample volume(s). It is also called post-purge.

Pre-sample purge – Pre-sample purge refers to the suction line purge that precedes the delivery of the sample volume(s). It is also called pre-purge.

Real-time clock – A real-time clock can be set to the actual time and date.

Sample event – A sample event consists of the complete sampling cycle resulting in the collection and distribution of one or more equal sample volumes. A sample event includes pre-sample and post-sample purges, line rinses, liquid detection retries, and deliveries of sample volumes. No more than one sample volume is placed in any one bottle during a sample event.

Sample volume – The sample volume is the discrete, programmed amount of sample delivered to each bottle. A single sample event may deliver several sample volumes.

Sampling routine – A sampling routine, also called a sampling program, is the process of taking samples according to the program settings you enter when programming and configuring the controller. The program settings define the sample pacing, distribution, volume, and key clock times.

Selection – A selection is represented by a blinking word or number in an input display. The blinking selection indicates the current choice or value. Selections are accepted and stored by pressing the enter/program key.

Suction head – Suction head is the vertical distance from the surface of the flow stream to the pump inlet.

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Appendix F Material Safety Data Sheets

This appendix provides Material Safety Data sheets for the internal desiccant used in the 3710 sampler.

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

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



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

SECTION I -- PRODUCT IDENTIFICATION

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

SECTION II -- HAZARDOUS INGREDIENTS

Components in the Solid Mixture

COMPONENT	CAS No	%	ACGIH/TLV (PPM)	OSHA-(PEL)
Amorphous Silica	63231-67-4	>99	PEL - 20 (RESPIRABLE), TLV - 5	LIMIT - NONE, HAZARD - IRRITANT "

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

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

SECTION III -- PHYSICAL DATA

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

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Belen, New Mexico 87002
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MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION IV -- FIRE EXPLOSION DATA

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

Flash Point - Nonflammable.

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

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

SECTION V -- HEALTH HAZARD DATA

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

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

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

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

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

SÜD-CHEMIE
Performance Packaging



ISO 9002

MATERIAL SAFETY DATA SHEET -- September 28, 1998

SORB-IT®

Packaged Desiccant

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

SECTION VI -- REACTIVITY DATA

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

SECTION VII -- SPILL OR LEAK PROCEDURES

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

SECTION VIII -- SPECIAL PROTECTION INFORMATION

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

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

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

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

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Belen, New Mexico 87002
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Fax: (505) 861-2355



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

SECTION IX -- SPECIAL PRECAUTIONS

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

* No Information Available

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

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

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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	CARCINOGEN LISTED IN	<input type="checkbox"/> NTP	<input type="checkbox"/> OSHA
	<input type="checkbox"/> Skin Absorption	<input type="checkbox"/> Not Hazardous		<input type="checkbox"/> IARC Monograph	<input type="checkbox"/> 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	<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

3710FR/3730 Refrigerated Sampler

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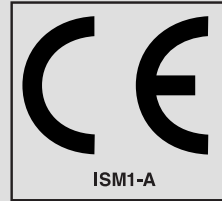
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DECLARATION OF CONFORMITY



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

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

Equipment Type/Environment: Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No: 3700FR/3710FR Refrigerated Sampler
Year of Issue: 2004

Standards to which Conformity is Declared: EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use
EN 61326:1998 EMC 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	A
EN61000-4-3	Radiated RF Immunity	80MHz to 1000MHz 80% AM at 1kHz Level 1 – 10V/m	A
EN61000-4-4	Electrical Fast Transient	Level 2 - 2kV on AC lines	A
EN61000-4-5	Surge on AC Lines	2kV L-Gnd, 1KV L-L	A
EN61000-4-6	Conducted RF on AC lines	150kHz to 80 MHz, 3V rms, 80% modulated	A
EN61000-4-11	AC Dips and short Interruptions	0.5 Cycle, each polarity/100%	A
CISPR11/ EN55011	RF Emissions	Group 1, Class A Industrial, Scientific, and Medical Equipment	
EN61000-3-2, 3-3	Harmonic, Flicker		

We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of May 28, 2004.

William Foster
USA Representative



William Foster
Director of Engineering
Teledyne Isco, Inc.
4700 Superior Street
Lincoln, Nebraska 68504
Phone: (402) 464-0231
Fax: (402) 464-4543

60-9003-421
Rev E

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



