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3700 FR/3720 Refrigerated Sampler

Installation and Operation Guide



Part #60-2723-159 of Assembly #60-3704-104
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Foreword

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

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

If a problem persists, call or e-mail Teledyne Isco technical support for assistance. Simple difficulties can often be diagnosed over the phone. For faster service, please have your serial number ready.

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

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

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

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3700FR/3720 Refrigerated Sampler
Safety

Electrical Requirements

The 3700FR/3720 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 $\overline{\text{---}}$ 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.

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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.

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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.

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3700FR/3720 Refrigerated Sampler

Section 1 Product Description

1.1 3700FR Refrigerated Sampler

The 3700FR/3720 Fiberglass Refrigerated Sampler is a programmable liquid sampler designed for sequential (discrete) sampling. It is one of Teledyne's 3700 Series of portable and refrigerated samplers. The extensive sampling capabilities, flexible programming, and durable construction make the 3700FR Sampler ideally suited for general purpose or priority pollutant sampling. The 3700 Sampler also provides storm-paced sampling capabilities designed to meet the EPA requirements for storm water runoff monitoring.

The 3700FR 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:

- Teledyne 4100 Series Flow Loggers, 4200 Series Flow Meters, 2100 Series Flow Modules, UniMag Closed-Pipe Flow Meters, 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.
- Teledyne 1640 Liquid Level Sampler Actuator for sampling when a liquid level reaches a predetermined height.

The 3700FR Refrigerated Sampler consists of the 3720 Sampler Refrigerator with the 3700 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.

1.1.1 3700 Controller

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 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.

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The control panel, containing the 40-character alphanumeric LCD (Liquid Crystal Display) and keypad, is located on the top of the control box. The 24-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, display the operating status and move the distributor arm to the next bottle. A desiccator is installed in the control box to prevent moisture damage to the electronics, pump, and distributor systems.

1.1.2 3720 Refrigerator

If you want to convert a 3700 Portable Sampler into a refrigerated unit, or to have both portable and refrigerated options with the same controller, the 3720 Sampler Refrigerator is available. The 3720 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 utilizes 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 3700FR/3720 are found in Table 1-1.

A full line of accessories and interfacing equipment is available to help you adapt the sampler to your specific application; some of the more common items are briefly discussed below. Other accessories are noted throughout this manual, where appropriate. A full list of accessories is found in Appendix B Accessories.

1.2 Programmable Features

An intuitive user interface allows the 3700FR Sampler to be easily 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 3700FR 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's Samplink software.

1.2.1 Flexible Sampling Intervals

The 3700FR is designed to collect as many as 24 separate sequential (discrete) samples and is fully programmable for true composite sampling. Both sequential and composite 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 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. Non-uniform 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.

1.2.2 Multiplexing

In addition to sequential sampling, which places one sample in each bottle, the sampler provides three standard types of multiplexed sample distribution: samples-per-bottle, bottles-per-sample multiplexing, and multiple bottle compositing. In samples-per-bottle multiplexing, more than one sample volume can be placed in a bottle. Samples-per-bottle multiplexing allows you to collect a series of small composite samples. By depositing several samples in each bottle, the contents of each

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bottle represent an average of the flow stream during the sampling period. In bottles-per-sample multiplexing, equal sample volumes can be placed in up to 24 bottles at each sample event. Bottles-per-sample multiplexing is ideal for situations where you need identical sets of samples – when you need to use more than one preservative, for example. Both time-paced and flow-paced sequential samples can be multiplexed.

The third type of multiplexing, multiple bottle compositing, is accessible through the extended programming mode. Multiple bottle compositing places more than one sample volume into more than one bottle. At each sample event, a sample volume is placed in several bottles, in sets of up to 24 bottles. Multiple bottle compositing combines bottles-per-samples multiplexing and samples-per-bottle multiplexing; it is applicable to situations where you need a series of identical sets of samples. Multiple bottle compositing can also be used when you need to acquire a series of larger volume composite samples by taking a number of smaller samples and distributing them over several bottles.

In the extended programming mode, you can switch multiplexed bottles or bottle sets after a programmed number of samples have been deposited or after a programmed period of time has elapsed.

Both methods can be used with either time-paced or flow-paced routines. By specifying the number of samples to be deposited, you can control the volume of each bottle precisely.

By specifying the sets be switched after specific time periods, you can control the time frame for a series of sample volumes. This is especially useful for flow-paced sampling. Although the flow-rate may vary, each bottle or bottle set represents a fixed time period.

1.2.3 Storm Sampling

The 3700FR Sampler's storm capabilities are ideal for monitoring storm water runoff. The sampler allows you to divide the bottles into two groups. The first group of bottles is normally reserved for a first flush grab sample. The second bottle group receives the flow weighted composite samples. Samples can be distributed in either group sequentially or in any of the three types of multiplexing. Three bottle configurations are available for STORM sampling: the standard 24-bottle configuration with either 1000 or 350 ml bottles, a 12 bottle configuration containing 1 quart (950 ml) glass bottles, and a 4 bottle configuration with 1 gallon (3800 ml) glass bottles.

STORM sampling takes full advantage of the sampler enable programming available through the Teledyne Flow Meters and the Flowlink[®] software. You can program the flow meter to monitor the flow stream for “storm” conditions— a specific amount of rainfall, for example — and enable the sampler when it detects those conditions.

1.2.4 Accurate Sample Volumes

The sampler can be programmed to take sample volumes of 10 to 9990 milliliters. Equipped with the patented LD90 (Patent 5,125,801) liquid presence detector, the 3700 Sampler delivers accurate, repeatable sample volumes in changing head condi-

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tions. 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.

1.2.5 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 in advance of the current date. The start time delay is the period between the time you press the START SAMPLING key and the time the routine actually starts. It is adjustable from zero to 9999 minutes.

Other features are available. 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.

1.2.6 Foreign Languages and Metric Units of Measure

The 3700FR 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 Delivery System

The 3700FR 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 3700FR 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/minute is generated when using $\frac{3}{8}$ inch ID suction line at 3 ft of head. The line transport velocity, using the same suction line and head, is 2.5 ft/sec. Volumetric accuracy is not significantly affected by pump speed since the delivered volume is based on an electronic count of the number of pump revolutions.

1.3.1 Liquid Detector

The LD90 gives the 3700FR 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 – up to three times – to clear the clogged line.

1.3.2 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 $\frac{1}{4}$ or $\frac{3}{8}$ inch ID vinyl or $\frac{3}{8}$ 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.

1.3.3 Strainers

The $\frac{3}{8}$ inch ID vinyl suction lines are shipped from the factory with our standard weighted polypropylene strainer (Figure 1-1) installed on one end of the suction line and a tubing coupling on the other end.

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

For sampling from highly acidic flow streams, a weighted plastic CPVC strainer is available (Figure 1-3).

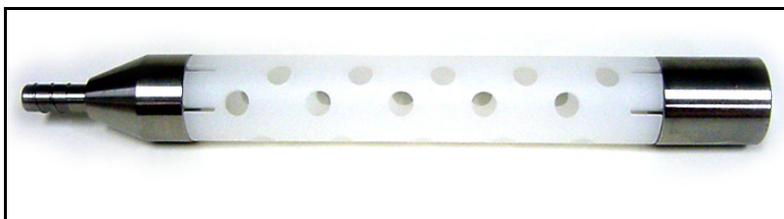


Figure 1-1 Standard Weighted Polypropylene Strainer

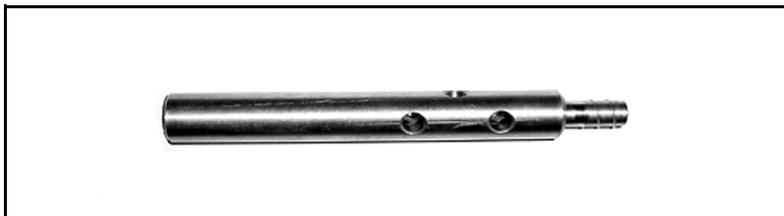


Figure 1-2 Stainless Steel Strainer

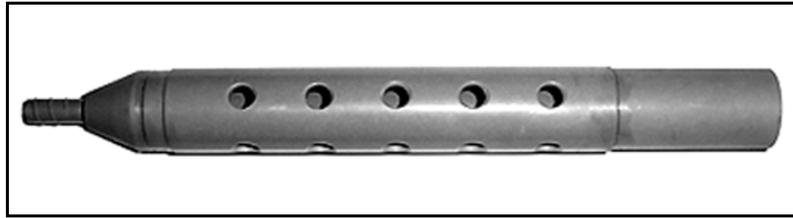


Figure 1-3 Weighted CPVC Coated Strainer

1.3.4 Bottle Configurations

A number of sample containers are available for both sequential sampling and composite conversion sampling:

24-Bottle Configurations

- 350 ml glass with PTFE lined caps
- 1000 ml polypropylene bottles with polyethylene foam lined caps

12-Bottle Configuration

- 2500 ml polyethylene with foam lined caps (Note: This configuration is available for Teledyne's fiberglass refrigerators only.)

4- and 8- Bottle Configuration

- 3800 ml (1 gallon) glass with PTFE lined caps

Single Bottle Composite Configurations

- 9400 ml (2.5 gallon) glass composite bottle with unlined cap
- 9400 ml (2.5 gallon) polyethylene composite bottle with unlined cap
- 15,000 ml (4 gallon) polyethylene composite bottle with unlined cap
- 20,800 ml (5.5 gallon) polyethylene composite bottle with unlined cap

1.4 Power Sources

The 3720 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 2.3. This allows sampling to continue even if a power failure causes the refrigerator's cooling system to stop functioning.

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1.5 Compatible Equipment

1.5.1 Teledyne 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 3700FR Sampler will accept flow pulses from all Teledyne flow meters and flow loggers for flow proportional sampling.

These instruments are equipped with a sampler enable feature, allowing them to inhibit a 3700FR Sampler until the level of the flow stream reaches a predetermined height; 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 predetermined height, the flow meter can disable the sampler and halt the routine.

The 4200 Series Flow Meters and 4100 Series Flow Loggers can monitor rainfall when equipped with a rain gauge. 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.

In addition to enable control conditions, Teledyne’s flow meters provide internal memory. When programmed with the Flowlink software, the flow meters use the memory to 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 Flowlink’s Help files. The 3700 Sampler sends event marks to both Teledyne and non-Teledyne flow meters each time a sample is taken.

1.5.2 Samplink for Sampling Data Retrieval

Teledyne 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 (no longer sold by Teledyne). 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.

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The sample event files are identical to those created by Flowlink when it retrieves sample event data from Teledyne'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.

1.5.3 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's standard, Teledyne offers special interfacing devices. See Sections 4.1.2 and 4.1.3.

1.5.4 Liquid Level Actuator

The Liquid Level Actuator is used to provide level-sensitive control of the sampler. The actuator can be used as a simplified alternative to a flow meter.

1.6 Technical Specifications, Controls, and Connectors

The following tables contain technical specifications for the 3700FR/3720 Sampler, and an explanation of the controls and connectors. Refer to Figure 2-3 for a picture of the controls and connectors.

Table 1-1 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
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)

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Table 1-1 Technical Specifications (Continued)

Current: Running Starting Stalled compressor	3.5 amp, typical 120 V \sim . (1.75 amp, typical 230 V \sim) 15 amp, typical 120 V \sim . (7.5 amp, typical 230 V \sim) 20.7 amp, maximum 120 V \sim . (10.4 amp at 230 V \sim)
Controller Internal 3V Lithium Battery Capacity	5 years, minimum (maintains internal logic and program settings)
Refrigeration System	
Compressor	$\frac{1}{6}$ HP Tecumseh AE1343A for refrigerators with serial numbers before 11901-001 $\frac{1}{5}$ 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: $\frac{1}{4}$ inch ID vinyl $\frac{3}{8}$ inch ID vinyl $\frac{3}{8}$ inch ID PTFE lined
Suction Lift	26 feet (7.9 m), maximum
Pumping Rate (at 3 feet of head)	$\frac{1}{4}$ inch ID suction tubing: 3000 ml/minute $\frac{3}{8}$ inch ID suction tubing: 3500 ml/minute
Line Transport Velocity (at 3 feet of head)	$\frac{1}{4}$ inch ID suction tubing: 5.1 ft/sec $\frac{3}{8}$ 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 $\pm 10\%$ 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).

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3700FR/3720 Refrigerated Sampler
Section 1 Product Description

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 3700FR to Teledyne 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

 **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.

 **CAUTION**

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.

 **Note**

The 3700FR/3720 Refrigerator has been tested and found to comply with the following standards: EN 61 010 – Safety of Laboratory Equipment, EN 60 335-2-24 – Particular Requirements for Refrigerators, EN 50 082-1 – Light Industrial Generic Immunity Requirements, EN 55 011 – Class A Emissions Requirements, EN 55 022 –Class A for FCC in USA.

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3700FR/3720 Refrigerated Sampler
Section 1 Product Description

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3700FR/3720 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 of Setup Procedures

The following sections explain the preparations made before using the refrigerator.

<input checked="" type="checkbox"/> Note

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

To place the sampler into 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 or flow logger, if required.
7. Program the sampler. Guidelines for programming the sampler are in Section 3.
8. Calibrate the sample volume, if desired. (Section 3 contains calibration instructions.)
9. Start the sampling routine.

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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.

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.

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.

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

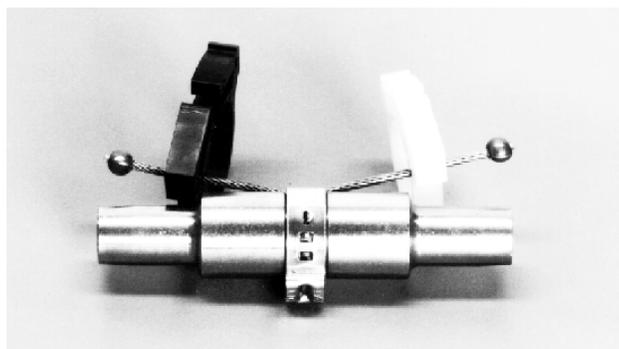


Figure 2-1 Tube Coupling Without Suction Line and Pump Tubing Attached

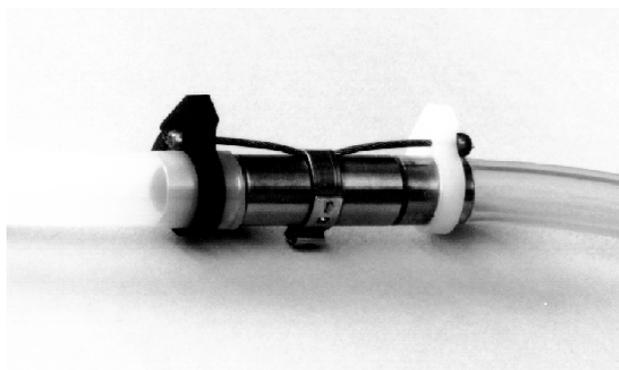


Figure 2-2 Tube Coupling With Suction Line and Pump Tubing

2.2.3 Positioning of 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.

2.2.4 Strainers

The $\frac{1}{4}$ and $\frac{3}{8}$ inch ID (inside diameter) vinyl suction lines are shipped from the factory with a stainless steel inlet strainer (Figure 1-2) installed on the end of the suction line.

For sampling from highly acidic flow streams, a CPVC strainer is available (Figure 1-3). Bulk suction line can be purchased without strainers. Refer to Appendix B for more information.

The strainer prevents solid particles over a specific diameter from entering and clogging the suction line. It is recommended 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

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suction line have $^{15}/_{64}$ inch (0.56 cm) diameter holes. The $^{3}/_{8}$ inch strainers supplied for use with the vinyl or PTFE $^{3}/_{8}$ inch ID suction line have $^{23}/_{64}$ inch (0.9 cm) diameter holes.

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		PTFE
	$^{1}/_{4}$ -inch (6 mm)	$^{3}/_{8}$ -inch (9 mm)	$^{3}/_{8}$ -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)

2.2.5 Intake Placement

The proper placement of the sampler intake assures the collection of representative samples. The intake should be placed 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.

2.3 Connection to a Power Source

The 3720 operates from 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 shown in Figure 2-3 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.

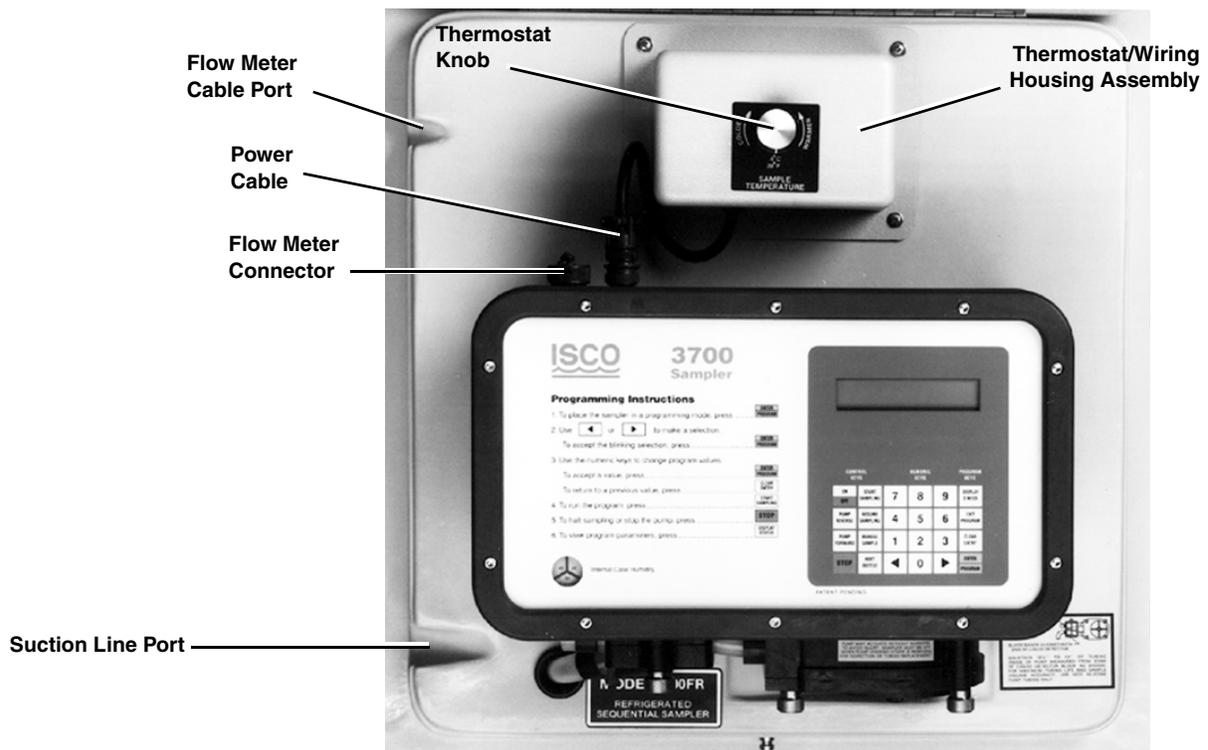


Figure 2-3 Flow Meter Cable Connection and Suction Line Port

2.4 Connection to a Flow Meter or Flow Logger

To permit flow paced 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 2-3. A small port is provided on the left 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.

2.5 Sample Bottle Rack or Bottle Locating Base

The sample bottle rack is used with the 24, 12, and 8 bottle configurations to hold the bottles in place inside the refrigerator. The bottle locating base is used with the 2 bottle configuration to position the bottles in place inside the refrigerator. All three configurations are described in detail below.

If you want to use a bottle configuration other than the one presently being used, conversion kits are available. Consult the factory or your sales representative for more information.

2.5.1 Installing the 24, 12, or 8 Bottle Configuration

Install the bottle rack, with bottles, in the refrigerator by sliding it into the unit until it drops over the two ramps which hold it in place. The five posts and two ramps which locate the bottles under the distributor arm are adjusted at the factory; however, manufacturing tolerances may result in misalignment between the bottles and distributor arm. Check the alignment by rotating the distributor arm using the NEXT BOTTLE key. If there is any misalignment, adjust the five posts and two ramps until proper alignment is attained.

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2.5.2 Sample Bottle Rack with 24 or 12 Sample Bottles

The sample bottle rack will hold either 24 round 350 ml, glass sample bottles with PTFE lined caps or 24 wedge-shaped 1000 ml, polypropylene sample bottles with foamed-polyethylene lined caps. The 12 bottle rack is similar, using 12 wedge-shaped plastic bottles.

The glass bottles are held in place by a stainless steel retaining ring installed inside the circle of bottles. The ring expands to hold the bottles firmly against the interior of the wire rack. The plastic bottles for both the 24 and 12 bottle configurations are held in place by a plastic, funnel-shaped retaining ring that rests on top of the slanted portion of the bottles and fits down inside the circle of bottles. It is held in place by three large draw cords attached to the bottom of the rack. Each of these draw cords is stretched up and hooked onto a corresponding projection located on the ring.

The sets of glass and plastic bottles are interchangeable in the sample bottle rack. However, since each set of bottles has its own retaining ring, only one type of bottle can be used at a time; they cannot be mixed. The order in which the bottles are filled is indicated on the plate on the bottom of the rack. Since the bottle rack is used for both 24 and 8 bottle configurations, the plate is numbered 1 through 24 and 1 through 8. The 12 bottle rack is numbered similarly.

The bottle rack is removed by slightly lifting the front edge of the rack to disengage it from the two ramps, indicated in Figure 2-5, and pulling it straight out of the refrigerator. Be careful not to catch the distributor arm. The rack with bottles is reinstalled in the refrigerator by sliding it straight in on the shelf provided. Place the bottle caps on the bottles before attempting to remove them so the sample does not spill.

To remove the glass sample bottles, lift each bottle out of the bottle rack leaving the retaining ring in place. Once all bottles are removed, lift the retaining ring out of the rack by squeezing the two finger grips. Place the new glass bottles in the rack as shown in Figure 2-6. Make sure all bottles are fitted properly in the rack. Note the four metal triangles on the inside of the rack which rotationally align the bottles. Finally, replace the bottle retaining ring.

To remove the plastic sample bottles, disconnect the draw cords from the projections on the retaining ring, lift out the retaining ring, and remove the full bottles. Place the new plastic bottles in the rack as shown in Figure 2-8, note the four metal triangles on the inside of the rack which rotationally align the bottles. Replace the bottle retaining ring making sure that all the bottles fit properly into the rack.

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All 24 bottles must be installed in the rack to ensure they are properly held in place.

2.5.3 Sample Bottle Rack with 8 Sample Bottles

The sample bottle rack, with the 8 bottle adapter, will hold either 8, 1.8 liter, glass sample bottles with PTFE lined caps or 8, 2 liter, polypropylene sample bottles with caps. The glass and plastic bottles are held in place by an 8 bottle adapter that hooks over the four bottle alignment triangles located on the inside edge of the bottle rack. The glass and plastic bottles are interchangeable in the sample bottle rack. Combinations of glass and plastic bottles may be used if desired. Note: All 8 bottles should be installed in the rack to insure that they are properly held in place.

The order in which the bottles are filled is indicated on the plate located on the bottom of the rack. Since the bottle rack is used for both 24 and 8 bottle configurations, the plate is numbered 1 through 24 and 1 through 8.

The bottle rack is removed by slightly lifting the front edge of the rack to disengage it from the two ramps, indicated in Figure 2-5, and pulling it straight out of the refrigerator. Be careful not to catch the distributor arm. The rack with bottles is reinstalled in the refrigerator by sliding it straight in on the shelf provided. To remove the glass or plastic sample bottles, simply lift the bottles straight out of the rack. Place the new bottles in the rack as shown in Figure 2-8 Make sure all bottles are fitted properly in the rack.

Cross contamination caused by splashing between bottles is eliminated by the use of a liquid deflector. The liquid deflector is coated with PTFE (polytetrafluoroethylene) PTFE. It is installed by pushing the short width part of the deflector up between the flat surface of the distributor arm and the pump tubing. See Figure 2-4.

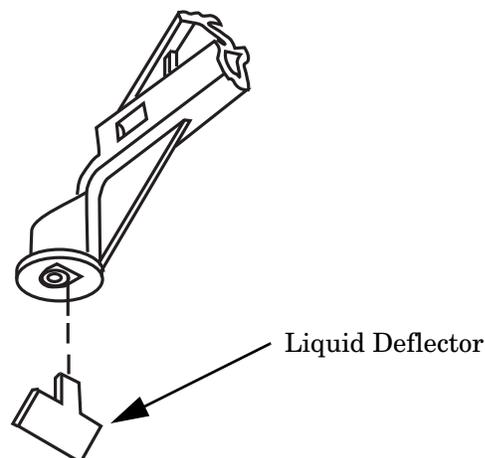


Figure 2-4 Liquid Deflector

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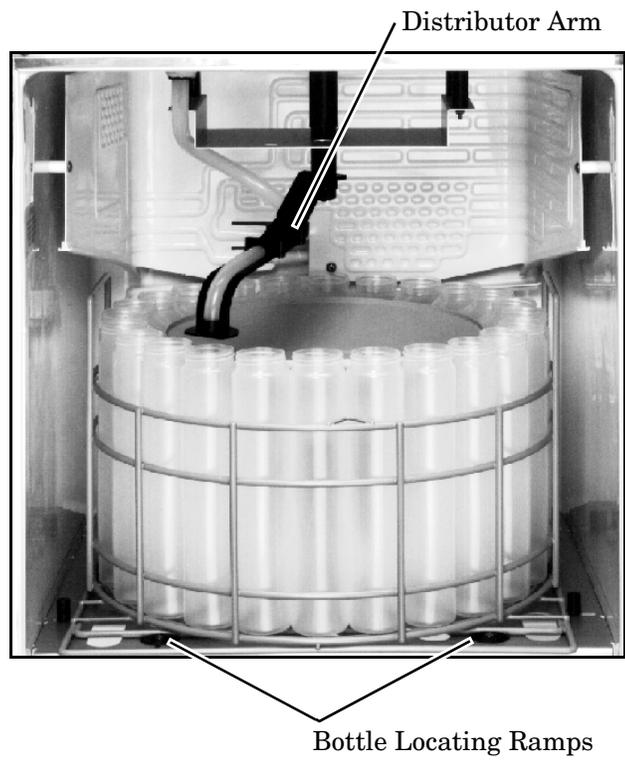


Figure 2-5 Interior of the Refrigerator

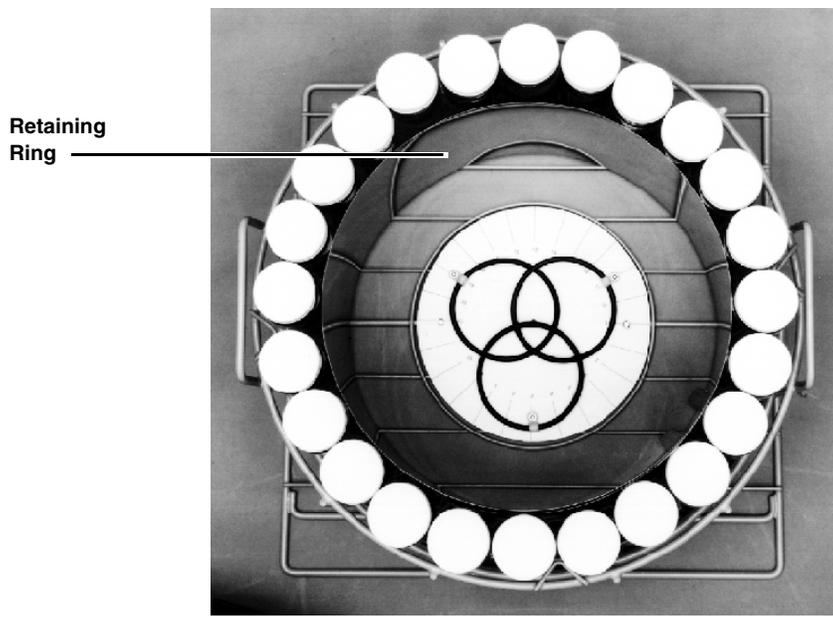


Figure 2-6 Sample Bottle Rack with 24 Glass Bottles (lidded)

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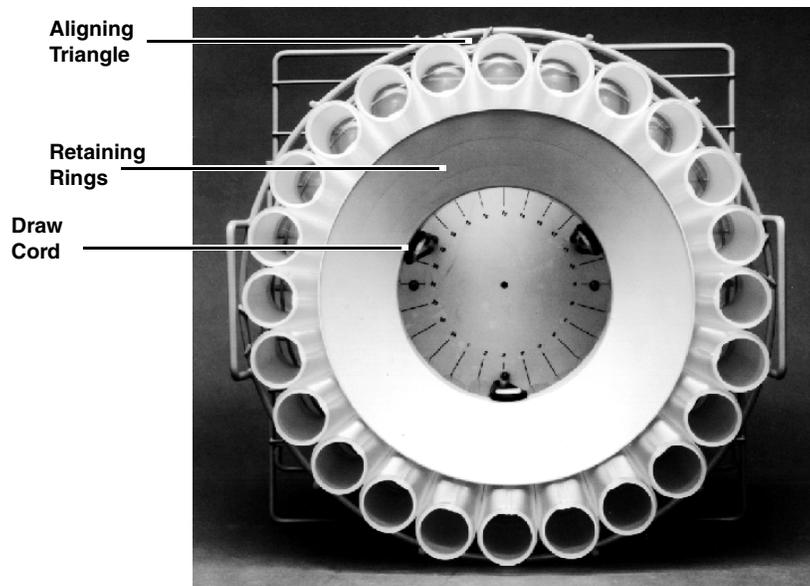


Figure 2-7 Sample Bottle Rack with 24 Plastic Bottles

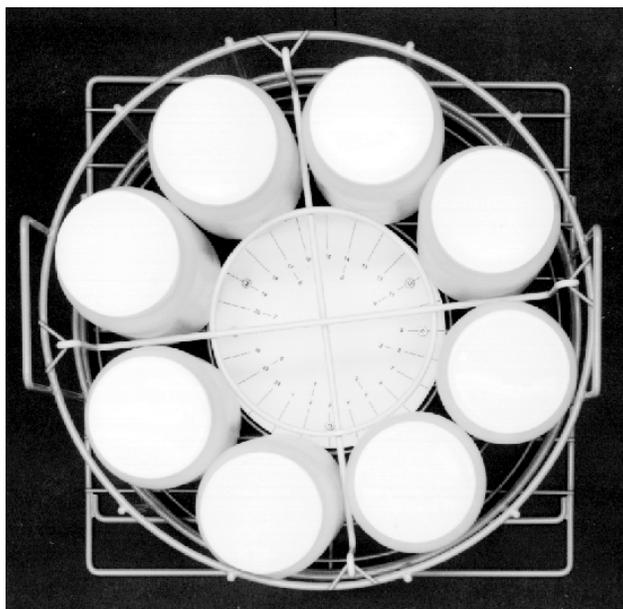


Figure 2-8 Sample Bottle Rack with 8 Plastic Bottles

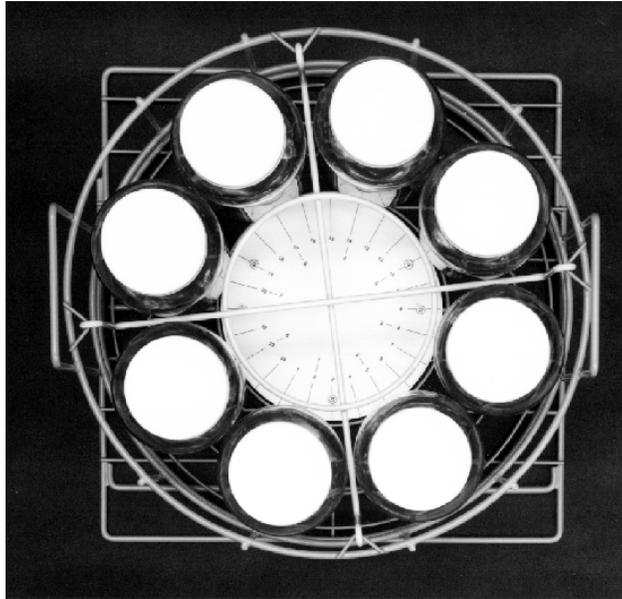


Figure 2-9 Sample Bottle Rack with 8 Glass Bottles

2.5.4 Bottle Locating Base for 2 Sample Bottles

The locating base is designed to be permanently installed over the wire rack mounting plate. It is held in place by five screws, washers, and nuts and a bottle locating base retainer. Four of the screws, washers, and nuts replace the four locating posts on the wire rack mounting plate. The fifth screw, washer, and nut and the bottle locating base retainer are used to hold the center of the bottle locating base to the wire rack mounting plate. The locating base will hold either the 2.5 gallon glass or 2 gallon plastic bottles.

To install the bottles, center them within the bosses provided on the locating base. Bottle number one is the left bottle when looking from the front of the refrigerator. To remove the bottles, simply lift them out of the refrigerator.

2.6 Operation of the Refrigerator

To operate the refrigerator, turn the thermostat knob, shown in Figure 2-3, to the desired sample temperature. The interior air temperature should reach the set value within 20 to 30 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.

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Section 2 Setup and Operating Procedures

<input checked="" type="checkbox"/> 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 cooling coil temperature always cycles from below freezing (when the compressor is running) to above freezing (when the compressor is off) during the normal refrigeration cycle.

If the unit is used in hot, humid conditions, you may need to defrost the unit after several days of operation. Turn the thermostat off and allow the refrigerator to defrost. The refrigerator is equipped with a water diverting tray and a drain tube to route defrost water to an evaporating tray in the rear of the refrigerator. Water in the tray is evaporated by the warm air from the condensing system. The refrigerator compressor may not start immediately when the thermostat is turned on or turned to a lower setting due to the action of the compressor overload relay. After a short time, the compressor will start and initiate the cooling cycle.

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Section 2 Setup and Operating Procedures

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Section 3 Programming Guidelines

This section discusses in detail the sampling features of the 3700FR Sampler and the procedures for programming your sampler.

Teledyne Isco has found that the most effective way to learn to program the sampler is to read this section with a sampler in front of you. The time that you spend in the office or laboratory actually programming the sampler and observing its operation is usually time well spent.

If you are already familiar with the sampling capabilities of the 3700FR Sampler, you may prefer to begin with the section entitled *Programming Introduction* on page 3-8. This section introduces the specifics of programming the sampler.

- *Description of Sampling Operations* contains a description of the sampling cycle, as well as the operations.
- The *Types of Samples* section discusses sample types that can be taken in both basic and extended mode with the 3700 Sampler.
- The *Programming Introduction* section discusses the sampler's program structure and introduces both basic and extended programming modes.
- The *Operating States* section discusses the sampler's three operating states.
- *Introduction to the Programming Procedures* describes the basic programming mode.
- The sections *Using the Keypad to Respond to Displays*, *Keypad Description*, and *Displays* discuss programming the sampler with the keypad.
- *Basic Programming* provides examples for the basic programming mode.
- The *Configure Sequence* section discusses how to tailor the sampler to your specific application.
- The *Extended Programming Mode* section discusses the mode and presents programming examples.
- *Foreign Languages and Metric Units of Measure* discusses adjusting the sampler for a foreign language and or metric units.
- The *Standby State* section discusses your options when the sampler is in standby.

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- The *Run State* section discusses what is occurring when your sampler is operating in the run state.

3.1 Description of Sampling Operation

This information introduces the types of sampling performed by the 3700FR and the terminology that describes those capabilities.

3.1.1 Sample Events and the Sampling Cycle

A sample event is the complete cycle involved in taking a sample. Although the cycle varies according to the program settings that define the sampling routine, the cycle described here follows the typical sequence. The information presented here is intended to provide you with a frame of reference for the remainder of this section.

1. A sample event occurs when either the programmed interval has expired or programmed flow volume has passed through the stream. The 3700FR takes a time-paced sample when an internal clock reaches the time selected for the sample. For flow-paced samples, the 3700FR takes a sample after receiving a specific of flow pulses from the flow meter. Each flow pulse counts for a specific flow volume as measured by the flow meter.
2. When the time-interval expires or pulse-count reaches a user-programmed flow volume, the distributor moves to the bottle that will receive the sample.
3. For the pre-sample purge, the pump rotates in reverse. The pre-sample purge is an air purge of the suction line and inlet that clears the line of any accumulated debris. It also purges residual liquid to avoid cross-contamination of samples.
4. The pump direction changes, moving forward to fill the suction line up to the liquid detector.
5. The sample-volume measuring portion of the sampling cycle begins after liquid fills the suction line to the liquid detector. The pump rotates forward until the programmed volume of liquid is delivered to the sample bottle. (In this manual, the amount of liquid delivered to the bottle is referred to as the “sample volume.”)
6. The pump direction changes, pumping in the reverse direction for the post-sample purge. Like the pre-sample purge, the post-sample purge air purges the suction line. After the post-sample purge, the pump shuts off.
7. The sample interval resets and the cycle resumes at Step 1.

3.2 Types of Samples

The 3700FR Sampler is principally designed to collect sequential (discrete) samples. However, you can program it to collect a number of other types of samples. The 3700 controller 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. Section 3.3 discusses this in detail.

You can characterize sample types by sample distribution and sample pacing. Sample distribution is the order in which samples are placed in the bottles. Sample pacing is the interval between samples.

3.2.1 Types of Sample Pacing

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 that has passed a measuring point in a flow stream. Flow-paced sampling requires a flow meter. (You can interface the 3700 controller with Isco Flow meters, flow loggers, 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.

3.2.2 Types of Sample Distribution

There are two primary types of sample distribution: sequential and composite sampling. In a sequential sample, each bottle receives one sample. A sequential sample represents a “snapshot” of the flow stream at a particular point in time.

Figure 3-1 shows a diagram of sequential sample distribution. In a composite sample, the individual samples are combined – “composited” – into a single container. A composite sample represents an average of the characteristics of the flow stream over the total elapsed time of sampling.

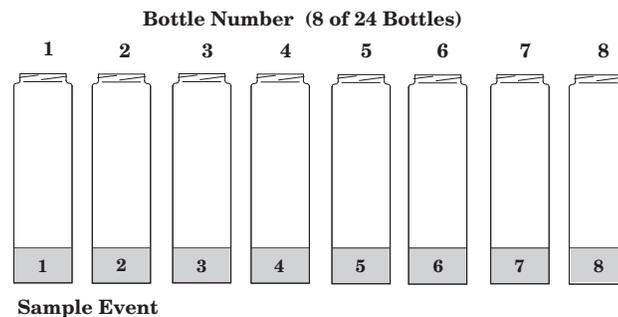


Figure 3-1 Sequential Sample Distribution

Note

The 3700FR Sampler is fully programmable for both sequential and composite sampling; however, in addition to programming the controller for composite sampling, you must convert the sampler mechanically for single-bottle compositing. This requires the composite conversion kit which contains the extra equipment needed to adapt the sampler for composite sampling. Conversion procedures are discussed in the instruction sheets provided with the conversion kit.

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You can combine the types of sample pacing and sample distribution. Thus, you can take time- or flow-paced sequential samples and time- or flow-paced composite samples. Each combination of pacing is noted below.

Time-Paced Sequential – In a time-paced sequential sample, samples are collected at equal increments of time. Each bottle receives one sample.

Flow-Paced Sequential – In a flow-paced sequential sample, samples are collected at equal volumes of flow, as measured by an associated flow meter. Each bottle receives one sample.

Time-Paced Composite – In a composite time sample, the individual samples are combined into a single container. Samples are collected at equal increments of time.

Flow-Paced Composite – In a composite flow sample, the individual samples are combined into a single container. Samples are collected at equal increments of flow volume, as measured by an associated flow meter.

Multiplexing – You can multiplex both time-paced and flow-paced sequential samples. Multiplexing places more than one sample in a bottle at different sample events or places a sample in several bottles at the same sample event. There are two types of multiplexing: samples-per-bottle and bottles-per-sample.

Samples-per-Bottle Multiplexing – In samples-per-bottle multiplexing, the 3700FR deposits a number of individual samples in the same bottle. Samples-per-bottle multiplexing is useful when you need to collect a series of small composite samples. In samples-per-bottle multiplexing, users can modify the normal sampling cycle (relocate distributor, pre-sample purge, sample delivery, post-sample purge) by altering the number of times the distributor is relocated.

Because a bottle will receive more than one sample from more than one sample event, the distributor does not relocate to a new bottle at each sample event. At the first sample event, the distributor relocates, if necessary, to the appropriate bottle. The normal sampling cycle is completed. At the next sample event, the distributor does not relocate, and a second sample is deposited into the same bottle.

Compositing multiple samples continues up to the programmed number of samples. After the last sample is deposited in the bottle, the sampler pauses until another sample event occurs, the distributor *then* rotates to the new bottle position, and multiple samples are deposited into the new bottle. Figure 3-2 illustrates samples-per-bottle multiplexing.

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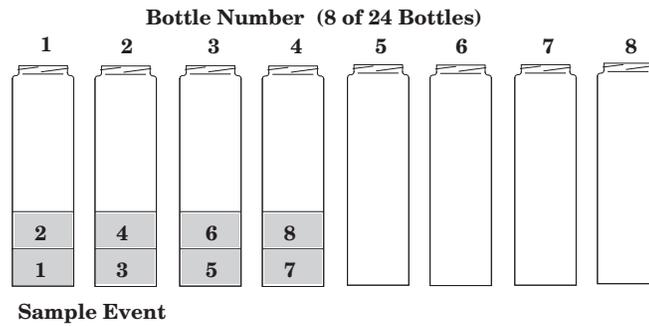


Figure 3-2 Samples-Per-Bottle Multiplexing

Bottles-Per-Sample Multiplexing – In bottles-per-sample multiplexing, you fill a programmed number of bottles at each sample event. (The programmed number of bottles is a bottle set; as many as 24 bottles can be used.) Bottles-per-sample multiplexing is useful when you need a sample that exceeds the capacity of your bottles. It is also useful when you need sets of identical samples; for example, when using more than one preservative.

When you use bottles-per-sample multiplexing, you modify the normal sampling cycle (relocate distributor, pre-sample purge, sample delivery, post-sample purge) by delaying the complete post-sample purge until sample volumes have been delivered to each bottle of the set. Instead, the pump reverses until the *pump tubing* is purged just beyond the liquid detector. When the purged liquid passes the detector, the distributor moves to the next bottle, and the pump begins pumping forward to deliver the next sample. This repeats until each bottle of the set is filled. A full post-sample purge is completed at the end of the sample event. The sampler then pauses until the next sample event occurs, at which time the cycle repeats for the following bottle set. Figure 3-3 illustrates bottles-per-sample multiplexing.

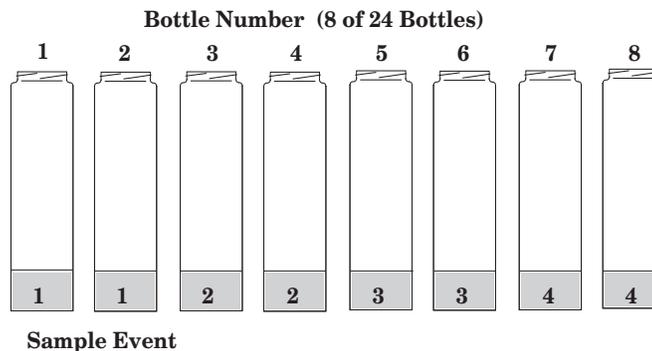


Figure 3-3 Bottles-Per-Sample Multiplexing

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3.3 Types of Sampling Available in Extended Programming Mode

The extended programming mode expands the variations of sample pacing and distribution. The extended features listed below are used in more complex sampling routines. Note, however, that the sampling capabilities described in the Section 3.2 are available in both the basic and the extended programming modes. Note also that STORM programming is available only in the extended programming mode.

3.3.1 Nonuniform Time Intervals

In the extended programming mode, the 3700 controller can pace samples at nonuniform time intervals. With nonuniform time intervals, the sampler takes samples at irregular intervals, rather than at equal intervals.

Nonuniform time intervals are typically used in run-off studies, often in conjunction with an Isco 1640 Liquid Level Actuator. Nonuniform time intervals let you collect a number of samples at short intervals after a rainfall or other event occurs and collect remaining samples at widening intervals. For example, when you use the sampler with the actuator in a run-off study, the actuator turns on the sampler when the liquid level of the flow stream rises to contact the actuator's probe. With nonuniform time intervals, the sampler can collect samples frequently when the flow rate is highest and less frequently as the flow rate decreases.

You can also use nonuniform times 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 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, six samples at 10-minute intervals, four 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 as many as 999 sample events spaced in nonuniform minutes, or as many as 99 events 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 reenter the nonuniform times.) You can use nonuniform time intervals with sequential, multiplexed, and composite sampling.

3.3.2 Extended Multiplexing

Multiplexing is somewhat more flexible in the extended programming mode than in the basic mode. In the extended mode, you can switch multiplexed bottles or bottle sets after a programmed number of samples have been deposited, or after a programmed period of time has elapsed. Under most conditions, we recommend you switch bottles or sets after collecting a programmed

number of samples. This allows you to control the number of samples in each bottle. When you switch bottles or sets on a time basis, the total volume of each bottle or bottle set may vary in samples-per-bottle multiplexing.

3.3.3 Multiple-Bottle Compositing

The extended programming mode offers a third multiplexing possibility: multiple-bottle compositing. Multiple-bottle compositing combines samples-per-bottle and bottles-per-sample multiplexing by depositing multiple samples in a bottle set. At each sample event, the sampler places a sample into each bottle of a set. This is repeated until each bottle of the set contains a programmed number of samples. Figure 3-4 illustrates multiple bottle compositing. You can switch the bottle sets after a programmed number of samples have been deposited or after a programmed period of time elapses. Multiple-bottle compositing is useful when you want a series of identical sets of samples or a larger volume composite sample than you can collect in one bottle. You can use multiple-bottle compositing with time-paced or flow-paced routines.

3.3.4 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, and then resume the routine later. You can enter as many as 12 stop times and 12 resume times. Stops and resumes can be used with time-paced and flow-paced routines and with routines programmed for nonuniform time intervals.

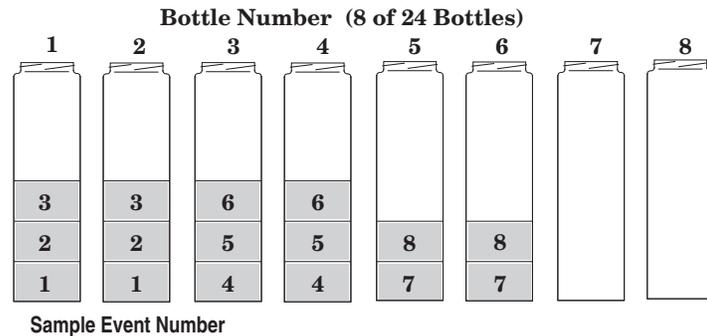


Figure 3-4 Multiple-Bottle Compositing

3.4 Stormwater Sampling

The 3700 controller's STORM programming lets you meet stormwater monitoring requirements easily. The sampler's STORM pacing program divides the bottles of the 4, 12, and 24 bottle configurations into two separate groups. The first group receives a first flush (time-paced) grab sample. The second bottle group receives either a flow-paced or time-paced "composite" sample.

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3.4.1 Storm-Event Sample Distribution Schemes

A bottle group can consist of one or more bottles. Thus, the first-flush sample can be a large sample delivered to a single bottle or distributed to several bottles with a multiplexing scheme. The remaining samples can be distributed to the second bottle group sequentially or according to any of the three available multiplexing distribution schemes: bottles-per-sample, samples-per-bottle, or multiple-bottle compositing. By dividing the samples into multiple bottles, you can analyze the pollutant concentration from each phase of the storm event. To obtain an analysis of a composite sample, combine the contents of the bottles into a composite for the grab sample and a composite for the flow-paced samples.

Figure 3-5 shows a storm-distribution scheme that combines time-paced bottles-per-sample multiplexing with flow-paced samples-per-bottle multiplexing. The program has allocated bottles 1, 2, and 3 for the timed grab samples, and bottles 4 through 24 for flow-weighted samples. At each time-paced sample event, the sampler places a single sample in the first bottle group: bottles 1, 2, and 3. Each bottle of the second group receives two samples per bottle.

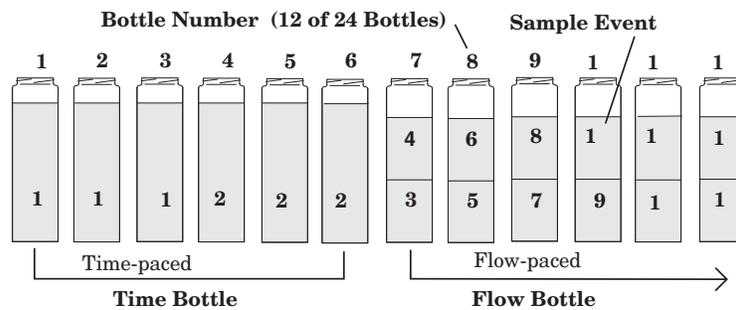


Figure 3-5 Storm-Distribution Scheme

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 accepts only appropriate values for the program settings and rejects any unacceptable values. If you turn off the unit or the power is disconnected, the lithium battery retains settings in the sampler's memory.

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, which is used to program the sampler. Each state serves a different purpose and is discussed separately.

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, which is discussed in an upcoming section.

Run State – In the run state, the sampler is executing the sampling routine and operating under program control. While the sampling routine is executed, the LCD displays a number of messages communicating the sampler's progress through the routine.

It reports the current bottle or bottle set, current time or flow-pulse count, and remaining time or pulse count to the next sample. These messages vary according to the sampling routine.

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. You can retrieve results with the Display Status procedure, discussed in an upcoming section in this section.

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. See the section *Run State* for more information.

Interactive State – The interactive state lets you program the sampler. The interactive state contains two branches: the program sequence and the configure sequence. Figure 3-6 diagrams the structure of the interactive state. The program sequence defines the sampling routine; it allows you to enter the interval between samples, the number of samples in each bottle, 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 3700 Standard can use different-sized sequential bottles: 350 ml and 1000 ml. You must enter the correct bottle size so that the sampler can calculate the range of sample volumes for a given number of samples and prevent overfilling. Other options allow you to set the sampler's real-time clock, calibrate the sampler, or enable the password program protection.

3.5.2 Programming Modes

The configure sequence also allows you to select either of the programming modes: basic or extended.

Basic Programming – Use the basic programming mode for conventional sampling routines. In the basic programming mode, you can take sequential or composite samples at uniform time intervals or at flow-pulse intervals. You can multiplex samples, if desired; both bottles-per-sample and samples-per-bottle multiplexing are available. You can control the start time of the routine by entering a specific time and date or with the adjustable start-time delay.

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Extended Programming – The extended programming mode increases the number of available features, making more complex sampling routines possible. For example, you can use nonuniform time intervals, and create an intermittent sampling schedule with the Stops and Resumes feature. Although all basic programming features are available in the extended programming mode, the less frequently used features have been separated into the extended mode to simplify the programming process.

Although the basic and extended program sequences vary in detail, you can divide both into four sections: Sample Pacing (interval between samples), Sample Distribution (number of samples in each bottle), Sample Volume (sample size in ml), and Key Times (start times or, in the extended mode, stop and resume times). These sections are noted in the Program Sequence section of the diagram shown in Figure 3-6.

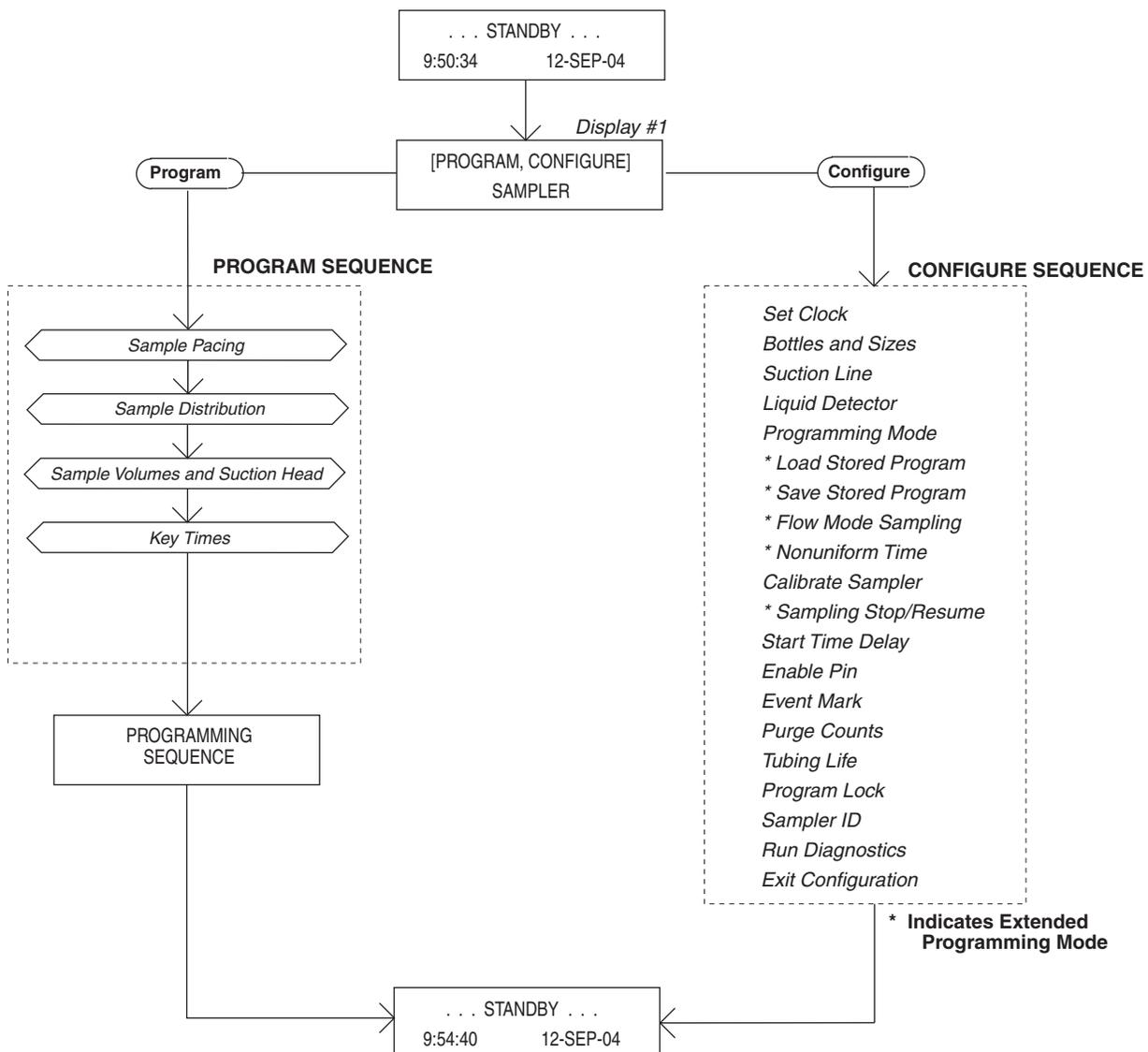


Figure 3-6 Interactive State Structure

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Section 3 Programming Guidelines

Table 3-1 Configure Option Functions

Configure Option	Programming Mode	Function
Set Clock	Basic & Extended	Sets the sampler's real-time clock.
Bottles and Sizes	Basic & Extended	Sets the sampler for Portable or Compact configuration. Sets the number and size of bottles used in the tub or inner sleeve.
Suction Line	Basic & Extended	Sets the type of line (vinyl or PTFE), line diameter ($\frac{1}{4}$ or $\frac{3}{8}$ inch), and line length (3 to 99 feet).
Liquid Detector	Basic & Extended	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	Basic & Extended	Sets the programming mode: basic or extended.
Load Stored Program	Extended	Loads one of as many as three previously saved sampling programs.
Save Current Program	Extended	Saves current sampling program.
Flow-Mode Sampling	Extended	Directs sampler to take a sample at the beginning of a flow-paced program. Directs sampler to sample at time-switches.
Nonuniform Time	Extended	Directs sampler to accept nonuniform intervals as specific clock times or in minutes.
Calibrate Sampler	Basic & Extended	Enables/disables the calibration sequence.
Sampling Stop/Resume	Extended	Enables/disables Sampling Stops and Resumes feature.
Start-Time Delay	Basic & Extended	Sets the start time delay (from 0 to 9999 minutes). If no specific start time is entered in the program sequence, the program uses the entered start-time delay. The delay is the amount of time that will elapse after you press the start sampling key or after the sampler is enabled.
Enable Pin	Basic & Extended	Directs the sampler to take a sample when disabled and/or enabled by a Liquid Level Actuator or other Isco Flow-monitoring equipment. Allows you to restart the sampling interval when the sampler is enabled.
Event Mark	Basic & Extended	Allows you to select one of four types of event marks.
Purge Counts	Basic & Extended	Adjusts the number of pre- and post-sample purge counts.
Tubing Life	Basic & Extended	Displays the pump tubing life information. Resets the tubing life count.
Program Lock	Basic & Extended	Enables/disables the password protection for input displays.
Sampler ID	Basic & Extended	Allows you to enter a 10-character ID number for the sampler.
Run Diagnostics	Basic & Extended	Tests the RAM, ROM, pump, and distributor. Allows for reinitialization of certain program and configure settings.

3.5.3 Configure Sequence

The program sequence and the configure sequence are interdependent. The selections you make in the configure sequence determine what settings will be available to you in the program

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sequence. When you select the extended programming mode, the program sequence is modified to accommodate the extended features by adding one or more input displays.

The extended programming mode not only extends the number of features available in the program sequence, it extends the number of configure options. When you select extended programming, for example, you can enable the Sampling Stop and Resumes and/or Nonuniform Times features so you can use them in the extended program sequence.

When you select the basic programming mode, these configure options are not available to you. As in the programming sequence, less frequently used options have been separated to simplify the configuration process.

Most configure options are available in both programming modes. Table 3-1 summarizes the configure sequence options; each option is marked as available in both modes or available only in the extended mode. A detailed discussion of each configuration option is found in the sections beginning with *Set Clock* through *Exit Configuration*.

It is usually not necessary to change the configure option settings unless the sampling application changes significantly. The sampler is *always* programmed and configured: the sampler's internal battery maintains program and configure settings. In fact, the sampler is shipped with factory program and configure settings. It is configured for the basic program mode and for the bottle configuration and suction line ordered with the sampler.

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 bottles and the inside diameter, type (vinyl or PTFE), and length of the suction line. You will need this information to verify and revise the configuration settings in step 2.
If you will be using the sampler for composite sampling, you will need to convert the sampler. Example *Time-Paced Composite Sampling* provides information on converting the 3700 Standard for composite sampling. Example *Time-Paced Composite Sampling* demonstrates the configuration changes you must make.
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* shows you how to check and revise the configuration settings in the configure sequence. (We recommend you review the upcoming sections *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.)

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.

For a more detailed discussion of the programming procedure, see the section *Basic Programming Procedure*. The examples given demonstrate several types of sampling programs in the basic mode. Examples of extended mode sampling programs are also shown.

4. 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 bottles. If you wish, use the Display Status procedure discussed in detail later in this section to examine the sampler's log of sampling results.
7. If you need to reprogram the sampler, follow this procedure from the beginning. If the sampler's current program is correct, restart the sampling routine.

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 3700 Sampler control panel.

The following section, *Keypad Description*, summarizes each key's function. The section *Displays* discusses LCD displays and ways you can use the keypad to interact with the sampler.

3.6.2 Keypad Description

Keys are grouped together on the control panel to assist you in identifying related functions. Control keys 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. Key names are represented by small capital letters in this manual.

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 you press a key switch, you

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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.



Figure 3-7 3700 Control Panel

Control Keys – Control keys let you turn the sampler on or off, start or resume the currently entered program, and control the sampler manually. Control key functions are:

- **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 / 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, either of the messages below is displayed, depending on the pumping direction.

PUMPING FORWARD . . .

PUMPING REVERSE . . .

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CAUTION

Tests indicate that the pump produces sound levels in excess of 85db at one meter. Prolonged exposure to this sound level could result in hearing loss and requires the use of protective ear plugs.

- When you press the STOP key, the sampler will display a message similar to the one shown below. 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 the *Purge Counts* configure option. Press any key, except STOP and ON/OFF, to return to the standby display..

311 COUNTS FORWARD

- **STOP** - The STOP key will stop the pump any time it is running. When you press the STOP key in the run state, the sampling routine will halt, the sampler will transfer 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, this 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 were it was halted. When entering a sampler ID, this 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. 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.
When entering a sampler ID, this key will type a dash (-).
- **NEXT BOTTLE** - If you want to reposition the distributor, use the NEXT BOTTLE key. The sampler will advance the distributor to the next bottle position. (The sampler determines the bottle positions by referring to the Bottle Number configuration setting.) The sampler will display the distributor’s location as illustrated in g. After a short time, the display will revert to standby. If

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the distributor is over the last bottle position when you press next bottle, the distributor will move to Bottle 1

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 allows you to view the program settings or the sampling results. See page 3-101 for more details.
- **EXIT PROGRAM** - Pressing the EXIT PROGRAM key while in the program sequence will return the sampler to standby. If you press the EXIT PROGRAM key while in the run state, it will halt the program; the message “PROGRAM HALTED” will be displayed.
- **CLEAR ENTRY** - When entering a number, use the CLEAR ENTRY key to return to the original entry.
- **ENTER/PROGRAM** - Press the ENTER/PROGRAM key while in the standby state to cause the sampler to enter the interactive state. While at an input display, press the ENTER/PROGRAM key to accept an entered value or a blinking option and direct the sampler to proceed to the next step.

Numeric Keys – The numeric keys consist of 10 digit keys, a key, and a key. You use the digit keys to enter quantities and the arrow keys to move through the configure option list or program options.

- **Left Arrow** - Press the left arrow key 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 – you can use the left arrow key to step back to a previously entered value. When entering a number, use the left arrow key to erase the most recently entered digit. It is also used to step through display status information and configure option list.
- **Right Arrow** - Use the right arrow key to select 1 of 2 or more program options in an input display. You can also press it to step through display status information and configure option list.

3.6.3 Displays

There are two types of displays: displays that communicate information about the sampler’s status and displays that 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

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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-JUN-04
```

Input Displays – You can easily identify input displays 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. *Italic* characters are used to represent blinking words or numbers in illustrations in this manual.

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

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

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 C. If you have a question about a given input display, you can easily locate the description of the display.

To access the display number, press 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 C.

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

When the display illustrated in *a* 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 prompts you 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, you do not need 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.

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The sampler will not accept a number that exceeds the allowable range of values placed in parentheses on the display. In the next illustration, you cannot enter a value less than 10 ml or greater than 990 ml 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. You must enter an acceptable value to advance to the next step.

Editing Numbers – You can use the left arrow and CLEAR ENTRY keys 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 reappear. The left arrow will erase the most recently typed number.

Some numeric input displays prompt you to enter more than one value. In the illustration below, the prompt asks for five numeric entries: hours, minutes, day, month, and year. You can use the left and right arrow keys to move back and forth between each of the five entries. Changed individual entries as discussed above. Pressing the right arrow or ENTER/PROGRAM key on the *last* entry will store the values and advance the display.

HH:MM	DD-MM-YY
12:33	14-06-04

Military Times – You must enter times 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 you do not need to change the month or year entry, accept the entry by pressing the right arrow or ENTER/PROGRAM key. Use the left arrow key to return to a previous position. Press the right arrow or ENTER/PROGRAM key on the *last* entry, “04,” to store the value and advance to the next display.

European Date Format – The sampler uses the European date format where the day precedes the month’s three-letter abbreviation. To enter a date, enter the day before the month’s number, and the year. The sampler converts the numeric entry to the three-letter abbreviation for you.

Exit Program Key – The user can exit an input display by pressing the EXIT PROGRAM key. If you use the EXIT PROGRAM key, it will not alter the currently stored setting.

Programming Examples – The following examples demonstrate the steps used to check the configure option settings and to 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. You can use the run-state displays to monitor the sampler's progress through a routine.

Examples *Time-Paced Sequential Sampling* through *Time-Paced Composite Sampling* illustrate the basic programming sequence. 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 section *Foreign Languages and Metric Units of Measure*. 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 mode and are not repeated in the extended programming procedures section.

Flow charts accompany examples for both programming modes. These charts diagram the program sequence structure for each mode. Figure 3-8 charts the Basic Programming Mode structure. Figures 3-10, 3-11, and 3-12 chart 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 Distribution, 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, Teledyne Isco ships the sampler with a test program and factory configuration settings. The examples in this manual assume that you are using all factory settings, and that the sampler will use the 24-bottle base and a 10-foot length of $\frac{3}{8}$ -inch vinyl suction line. The settings with which your 3700 is shipped include the size of bottle ordered and the size, type, and length of suction line. When you check the configuration settings, be sure the settings match your equipment, not the example.

Most program and configure settings can be reinitialized to factory settings, if desired. Table 3-4 lists the factory settings. The *Run Diagnostics* section discusses the reinitialize option.

3.7 Basic Programming Procedure

The steps for programming the sampler in basic mode follow the procedure outlined below.

1. Turn on the sampler with the ON/OFF key. The sampler always “wakes up” in the standby state. The “STANDBY” message will appear. If the sampler is 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 3-8 for displays noted in Steps 3 to 6.

To return to a previous display when programming the sampler, press the exit program key. The sampler will

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return to standby. Press the ENTER/PROGRAM key again to reenter 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.

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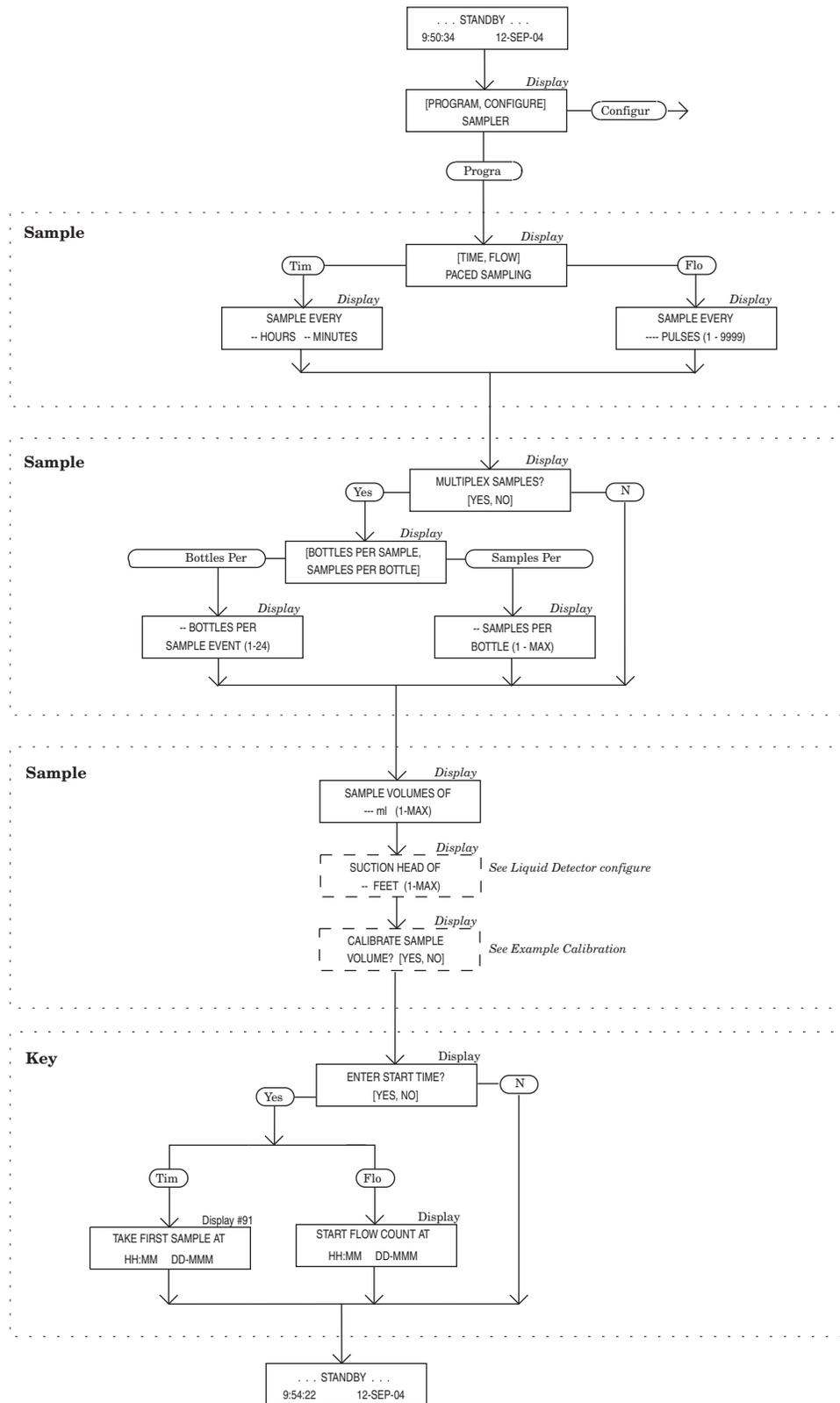


Figure 3-8 Basic Programming Mode: Program Sequence Structure

OBSOLETE

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, you will not miss any sample events, although some events will occur at improper times. You can determine the duration of the cycle by programming the sampler with the desired settings, pressing the manual sample key, and 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 1,000 gallons, you can program the sampler to collect a sample once every 1,000 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 D discusses some of the calculations needed when determining flow-pulse intervals.

4. Enter the Sample Distribution settings. The settings in the Sample Distribution section allow you to perform sequential or multiplexed sampling. The first display of the Sample Distribution section asks whether you want to multiplex samples. If you want simple sequential sampling – one sample per bottle – select "NO." The sampler will then prompt you for the Sample Volume settings. If you want to use bottles-per-sample or samples-per-bottle multiplexing, select "YES." The next display will prompt you to select either "BOTTLES PER SAMPLE" or "SAMPLES PER BOTTLE."
Bottles-per-sample multiplexing is useful if you require a sample volume greater than the capacity of a single bottle, or where various types of preservatives must be added to the samples. Samples-per-bottle multiplexing is useful when you want to collect a series of small composite samples. For example, you can collect four samples at 15-minute intervals in each bottle, resulting in a series of hourly composite samples. The section *Types of Samples* discusses the types of multiplexing.
5. Enter the Sample Volume settings, as shown in the *Sample Volume Program* section. Depending on the selections you make in the configure sequence, it may contain prompts for the suction head and sampler calibration.
When entering the sample volume, keep in mind the ± 10 ml sample volume repeatability. 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 the section *Bottles and Sizes* for notes on cumulative error and bottle size.

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If you are using bottles-per-sample multiplexing to add preservatives to consecutive samples, be sure to consider the volume of the preservative into account.

Suction Head- You can configure the sampler, 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, omit the suction-head setting by disabling that setting in the Liquid Detector configure option. By disabling the setting, you allow the liquid detector to determine the operating suction head each time a sample is taken.

Calibration Settings- If you want to calibrate the sample volume, you must enable the calibration option. To enable this option, select “ENABLE” in the Calibrate Sampler configure option. Enabling the option will add the calibration displays to the *Sample Volume Program* section. The calibration displays are shown in Example *Calibration*.

6. 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 9,999 minutes in the Start-Time Delay configure option. 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 the delay countdown begins. 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 1-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 3700 will take the first sample 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 the *Nonuniform Time* section for additional information.

7. The sampler automatically returns to standby.
8. From standby, start the routine by pressing the start sampling key. This places the sampler into the run state. If you to start the routine after the programmed start time, the sampler will allow you to reprogram the start time.
9. Use the run state displays to monitor the sampler’s progress.

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Before programming the sampler – Especially if you are unfamiliar with the settings used in the previous routine, or if 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 this example configure the sampler for 24 1000-ml bottles 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 reinitialization of the program settings and configure options to factory settings are placed in Steps 22 through 24 in Example *Checking the Configure Option Settings*.

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 Bottles and Sizes settings, press the ENTER/PROGRAM key. The display shown in Step 5 will appear.

```
SELECT OPTION: (< ← → >)  
BOTTLES AND SIZES
```

6. Select "PORTABLE" or "REFRIG" depending upon which model you have. Enter PORTABLE for either the 3700 Standard or Compact.

```
<PORTABLE, REFRIG  
SAMPLER
```

7. For the purposes of this example, select "24" when you are using the 24-bottle base. Use the arrow keys until "24" blinks, then press the ENTER/PROGRAM key. Select "1" when you are using a single-bottle for composite sampling.

```
(< 1, 4, 12, 24 >  
BOTTLES
```

8. Enter the bottle size here. Enter "350" for the 350 ml glass bottles, "1000" for plastic bottles, for example. Press the ENTER/PROGRAM key. If you enter a number that exceeds the maximum standard bottle size (15,000), the message, "WARNING: STANDARD BTL VOLUME EXCEEDED!," will display for a short time. The sampler will then prompt you to confirm the volume entered. This prompt is displayed in Step 9.

OBSOLETE

Example: Checking the Configure Option Settings (Continued)

```
BOTTLE VOLUME IS
  1000 ml
```

9. 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 8 will reappear; use it to enter the revised bottle volume. Press the ENTER/PROGRAM key to accept the entry and advance to step 10

```
1001 ml! . . . ARE YOU
SURE? (YES, NO)
```

10. 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
```

11. 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.)

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

12. 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)
```

13. 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)
```

14. 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
```

15. 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
```

16. 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)
```

17. 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]
```

18. 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.

OBSOLETE

Example: Checking the Configure Option Settings (Continued)

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

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

```
SELECT OPTION: (<- ->)  
PROGRAMMING MODE
```

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

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

21. Scroll through the remaining options with the arrow keys. Use the techniques above to change or verify the settings. If you want to reinitialize the configure and program settings to factory settings, follow the procedures given in Steps 22 to 24.



22. To access the displays used in this option, press the ENTER/PROGRAM key.

```
SELECT OPTION: (<- ->)  
RUN DIAGNOSTICS
```

The sampler displays the software revision number for a short period of time.

```
SOFTWARE REVISION  
#4.6
```

The software revision display will be replaced by the RAM and ROM test messages. A successful test is indicated by the messages "RAM PASSED TEST" and "ROM PASSED TEST."

```
'RAM' PASSED TEST  
TESTING 'ROM'
```

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 position in the display should contain a character.

```
ABCDEFGHIJKLMNQRST  
UVWXYZ [#]^_`abcdefgh
```

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. A count near 100 is typical.

```
PUMP COUNT TEST  
OFF/ON = 105
```

23. For the purposes of this example, select "NO" to skip the test. Press ENTER/PROGRAM to accept the selection

```
TEST DISTRIBUTOR  
[YES, NO]
```

24. If you want to reinitialize the settings, select "YES." The entire RAM – with the exception of the current pump-count total, bottle-size settings, suction-line settings, and sampler ID – will be reinitialized to factory settings. The sampler will automatically turn itself off as part of the reinitialization process. Select "NO" if you do not want to reinitialize the settings. Press the ENTER/PROGRAM key to accept the selection

```
REINITIALIZE?  
[YES, NO]
```

OBSOLETE

The steps in Example *Time-Paced Sequential Sampling* program the sampler to take samples every 30 minutes. Each bottle is to receive one 250 ml sample volume. The sampling routine is to begin according to the start time delay: one minute after you press the START SAMPLING key.

Example: Time-Paced Sequential 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 "30" to set the minute entry. Press ENTER/PROGRAM to accept the entry.

```
SAMPLE EVERY  
0 HOURS, 30 MINUTES
```

6. For this example, select "NO." Press the ENTER/PROGRAM key to accept the entry. If you select "YES" in response to this question, you can select bottles-per-sample or samples-per-bottle multiplexing for your routine.

```
MULTIPLEX SAMPLES?  
[YES, NO]
```

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

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

8. Because this sampling routine does not require a specific start time, use the arrow keys to select "NO." Press the ENTER/PROGRAM key to accept the entry. If you select "YES," you can enter a specific start time and date for the routine.

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

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

```
PROGRAMMING SEQUENCE  
COMPLETE
```

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

```
. . . . STANDBY . . . .  
5:42:23 19-JUN-04
```

10. To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number.

```
START SAMPLING  
BOTTLE 1 (1-24)
```

OBSOLETE

Example: Time-Paced Sequential Sampling (Continued)

This display appears as the sampler counts down the time remaining to the start time. The first line reports the bottle which will receive the next sample volume. The second line reports the start time at the left and the current time on the right.

```
BOTTLE 1
AT 5:44      5:42:33
```

When the start time arrives, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge. During the purge, the display indicates the number of the bottle that will receive the sample volume.

```
BOTTLE 1
```

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.

```
BOTTLE 1
PUMPING 250 ml
```

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

```
BOTTLE 2
AT 6:14      5:45:11
```

The cycle of displays, shown in Steps 12 through 13, is repeated for each bottle 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 . . . 24 SAMPLES
6:10:35      21-JUN-04
```

Example *Flow-Paced Sequential Sampling* shows how to program the sampler to take flow-paced samples at intervals of 5 pulses. One 500 ml sample is to be placed in each bottle. The sampling program will default to the value entered in Start Time Delay option.

Example: Flow-Paced Sequential 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 'FLOW'.

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

4. Enter "5" as the flow pulse interval. The sampler will take a sample every fifth flow pulse received.

OBSOLETE

Example: Flow-Paced Sequential Sampling (Continued)

5. Select "NO."

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

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

```
MULTIPLEX SAMPLES?  
[YES, NO]
```

7. Select "NO."

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

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

After this message displays briefly, the sampler automatically returns to the standby state.

```
PROGRAMMING SEQUENCE  
COMPLETE
```

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

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

9. To start the sampling routine with the first bottle, press the ENTER/PROGRAM key. To start the routine with another bottle, enter the starting bottle number here.

```
START SAMPLING  
AT BOTTLE 1 (1-24)
```

The first line of this display indicates the start time. The second line reports the current time and date.

```
START AT 10:38 19-JUN  
10:37:26 19-JUN
```

This display indicates the bottle that will receive a sample at the next sample event. The second line indicates the number of pulses remaining in the sample.

```
BOTTLE 1  
AFTER 5 PULSES
```

This display shows that one flow pulse has been received. The pulse countdown continues until the sample event concludes.

```
BOTTLE 1  
AFTER 4 PULSES
```



The second line of the display will disappear as the sampler begins the pre-sample purge.

```
BOTTLE 1
```

This display appears when the pump begins to run in the forward direction to deliver the sample volume. It remains through the end of the post-sample purge.

```
BOTTLE 1  
PUMPING 500 ml
```

When the first sample volume has been delivered, the display indicates the next sample bottle and the number of pulses remaining until the next sample event. This series of displays will repeat until the last sample is taken at bottle 24 and the sampling routine is done.

```
BOTTLE 2  
AFTER 5 PULSES
```

OBSOLETE

Example: Flow-Paced Sequential Sampling (Continued)



This display informs you that the sampling routine is completed. The number of sample events displays in the upper right corner. The second line indicates the current time and date.

```
DONE . . . 24 SAMPLES  
22:48:32      20-JUN-04
```

Example *Checking the Configure Option Settings* shows samples-per-bottle multiplexed sampling. Samples are taken every 15 minutes. Each bottle receives four sample volumes of 200 ml each, so that bottles are switched every hour. The sampling routine is to start at 6:00 AM on the following day.

Example: Time-Paced Multiplexed (samples-per-bottle) 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. 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, 1 MINUTES
```

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

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

6. Select "YES" to set up the samples-per-bottle multiplexing.

```
MULTIPLEX SAMPLES?  
[YES, NO]
```

7. Select "SAMPLES PER BOTTLE."

```
[BOTTLES PER SAMPLE,  
SAMPLES PER BOTTLE]
```

8. Enter "4" to set the number of samples per bottle to 4.

```
4 SAMPLES PER  
BOTTLE <1 - 50>
```

9. Enter the sample volume of "200" ml.

```
SAMPLE VOLUMES OF  
200 ml <10 - 250>
```

10. Select "YES" so you can enter the specific start time.

OBSOLETE

Example: Time-Paced Multiplexed (samples-per-bottle) Sampling

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

11. When this display first appears, it will show you the sampler's "guess" at the start time. Type in the desired start time. For this example, the start time is 6:00 on 6/20/91.

```
TAKE FIRST SAMPLE AT  
6:00 20-JUN-04
```

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

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

12. To run the program, press the START SAMPLING key after the sampler is installed.

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

13. To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.

```
START SAMPLING  
AT BOTTLE 1 (1-24)
```

This is used with samples-per-bottle multiplexing. The first line tells the number of the upcoming sample, the total number of samples each bottle is to receive, and the current bottle number. Here, the upcoming sample is the first of four samples, Bottle 1. The second line indicates the scheduled time of the sample and displays the current time in the right corner.

```
1 OF 4, BOTTLE 1  
AT 6:00 5:55:33
```

When the scheduled sample event time arrives, the second line disappears while the sampler completes the pre-sample purge.

```
1 OF 4, BOTTLE 1
```

When the pump begins to pump forward to deliver the sample, sample delivery is indicated by the word "PUMPING" followed by the sample volume. The message remains through the post-sample purge.

```
1 OF 4, BOTTLE 1  
PUMPING 200 ml
```

When the sampling cycle is completed, the display again indicates the upcoming sample.

```
2 OF 4, BOTTLE 1  
AT 6:15 6:00:26
```

The next displays shown here, in Steps 18 through 20, show the displays as the sample volumes are deposited in Bottle 1.

```
2 OF 4, BOTTLE 1
```

```
2 OF 4, BOTTLE 1  
PUMPING 200 ml
```

```
3 OF 4, BOTTLE 1  
AT 6:30 6:15:27
```

```
3 OF 4, BOTTLE 1
```

OBSOLETE

Example: Time-Paced Multiplexed (samples-per-bottle) Sampling

```
3 OF 4, BOTTLE 1  
PUMPING 200 ml
```



When the final sample has been deposited in the first bottle, the display changes to indicate the new sample bottle. This display indicates that the upcoming sample event will place the first of four sample volumes in Bottle 2 at 7:00

```
1 OF 4, BOTTLE 2  
AT 7:00 6:45:25
```

This display appears as the pump begins the pre-sample purge for the first sample delivered to Bottle 2.

```
1 OF 4, BOTTLE 2
```

```
1 OF 4, BOTTLE 2  
PUMPING 200 ml
```

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



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

```
DONE . . . 96 SAMPLES  
6:10:35 21-JUN-04
```

Example *Flow-Paced Multiplexed (bottles-per-sample) Sampling* demonstrates the steps needed to program the sampler for a flow-paced routine that will place a sample in two bottles at each sample event. Sample volumes of 500 ml are to be placed in the bottle sets at intervals of 10 flow-pulses. The routine is to start at 5:00 AM, the following morning.

Example: Flow-Paced Multiplexed (bottles-per-sample) 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 "FLOW."

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

4. Enter "10" as the flow--pulse interval. The sampler will take a sample every tenth flow pulse received.

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

5. Select "YES" to multiplex samples.

OBSOLETE

Example: Flow-Paced Multiplexed (bottles-per-sample) Sampling

6. Select "BOTTLES PER SAMPLE."

```
MULTIPLEX SAMPLES?  
[YES, NO]
```

7. Enter the number of bottles per sample event: "2."

```
[BOTTLES PER SAMPLE,  
SAMPLES PER BOTTLE]
```

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

```
2 BOTTLES PER  
SAMPLE EVENT (1-24)
```

9. Select "YES."

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

ENTER START TIME?
[YES, NO]

Enter the start time for the sampling routine. Note that the sampler may receive flow pulses before the sampling routine begins. Any pulses received before the start time will be disregarded.

```
START FLOW COUNT AT  
5:00 20-06 JUN
```

After this message appears briefly, the sampler automatically returns to the standby state.

```
PROGRAMMING SEQUENCE  
COMPLETE
```

Press the START SAMPLING key to run the program.

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

To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number.

```
START SAMPLING  
AT BOTTLE 1 (1-23)
```

This display appears after you press the START SAMPLING key to start the routine. It reports the scheduled start time on the first line. The second line reports the current time and date.

```
START FLOW COUNT  
AT 5:00 10:37:23
```

When the scheduled start time arrives, the sampler begins to count flow pulses. This display indicates the bottles that will receive sample volumes at the upcoming sample event. (If the bottle set consisted of four bottles, the first line of the display would read, "BOTTLES 1 to 4.") The second line displays the number of flow pulses remaining until the sample event.

```
BOTTLES 1- 2  
AFTER 10 PULSES
```

The second line of the display changes as each flow pulse is received.

```
BOTTLES 1- 2  
AFTER 9 PULSES
```



This display shows one pulse remaining until the sample event.

```
BOTTLES 1- 2  
AFTER 1 PULSES
```

OBSOLETE

Example: Flow-Paced Multiplexed (bottles-per-sample) Sampling

When the sampler receives the tenth pulse, the first line reports the current bottle number.

```
BOTTLE 1
```

When the pump begins to run forward to deliver the sample volume, the second line appears. After the pump completes the sample delivery, it reverses to purge the liquid from the pump tube past the liquid detector. The suction line is not completely purged; instead, the liquid is pumped just past the liquid detector. At the end of the pump-tube purge, the distributor moves to the next bottle of the set. The display remains unchanged until the distributor relocates to the next bottle of the set.

```
BOTTLE 1  
PUMPING 500 ml
```

When the distributor relocates above the next bottle, the bottle number reported in the display changes to indicate the bottle number. The message, "PUMPING 500 ml," will remain on the display. When the distributor reaches the correct position over the second bottle, the pump delivers the sample volume. When the delivery is done, the pump reverses to complete the post-sample purge.

```
BOTTLE 2  
PUMPING 500 ml
```

At the end of the post-sample purge, the display changes to indicate the bottle numbers of the next bottle set. The display will change as it receives each flow pulse.

```
BOTTLE 3-4  
AFTER 10 PULSES
```

The cycle repeats until the sampling routine is completed.



When the routine is complete, the display indicates the status ("DONE"), the number of sample events, and the current time and date.

```
DONE . . . 12 SAMPLES  
6:10:35 21-JUN-04
```

Example *Time-Paced Composite Sampling* demonstrates the programming procedures for a composite sampling routine. When using the 3700FR Sampler for composite sampling, the unit must be mechanically converted for single bottle sampling.

After converting the sampler, check the configure settings to verify the sampler is configured for composite sampling. This example begins with a demonstration of the steps needed to check the Bottles and Sizes configure option settings. The Bottles and Sizes configure settings should indicate that only one bottle is being used. Be sure to enter the correct bottle volume. The settings used in this example are for the 4-gallon (15000 ml) composite bottle. Please refer to Section . for a discussion of the Bottles and Sizes configure option.

This time-paced routine takes samples at 15-minute intervals for a 12-hour period. Sample volumes are to be 250 ml each. When entering the program settings, you must enter the number of samples required before entering the sample volumes. At four samples per hour, the 12 hour period would yield 48 samples. The

OBSOLETE

total volume at the end of the routine would be 12000 ml (48 samples x 250 ml/sample), well within the capacity of the 4-gallon bottle.

Example: Time-Paced Composite Sampling

1. If the sampler is not already on, press the ON/OFF key to turn it on. 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 until the Bottles and Sizes configure option appears.

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

4. Press the ENTER/PROGRAM key to access the Bottles and Sizes settings.

```
SELECT OPTION: (< ← →)  
BOTTLES AND SIZES
```

5. Select "PORTABLE" for either the 3700 Standard or Compact.

```
[PORTABLE, REFRIG  
SAMPLER
```

6. Select "1" for single bottle composite sampling.

```
[1, 4, 12, 24]  
BOTTLES
```

7. Enter the bottle size here, "15,000." (Table 3-2 lists the standard Isco bottle sizes.)

```
BOTTLE VOLUME IS  
15000 ml
```

8. Press the ENTER/PROGRAM key at this display to access the Suction Line input displays.

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

9. Select "1/4" if you are using 1/4-inch suction line, "3/8" if you are using 3/8-inch suction line.

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

This display appears when you have selected "3/8" in step 9. Select "VINYL" if you are using vinyl suction line, "TEFLON" if you are using TEFLON suction line.

```
SUCTION LINE IS  
[VINYL, TEFLON]
```

10. Enter the length of the suction line. The length should not include the tube coupling or the strainer.

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

11. To verify the Liquid Detector configure options, press the ENTER/PROGRAM key.

```
SELECT OPTION: (< ← →)  
LIQUID DETECTOR
```

12. Continue to scroll through the configure options with the right arrow key. When you have checked the settings for the desired options, press the EXIT PROGRAM key to return to standby.

OBSOLETE

Example: Time-Paced Composite Sampling (Continued)



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

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

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

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

15. Select "TIME."

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

16. 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, 1 MINUTES
```

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

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

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

```
48 COMPOSITE  
SAMPLES (0-200)
```

19. Enter the sample volume: "250." Note that the upper limit of the range of acceptable volumes has been adjusted. When you want to collect 48 samples, the maximum sample volume is 310 ml. If you need to use a larger sample volume, you must adjust the sample number downward.

```
SAMPLE VOLUMES OF  
250 ml EACH (10 - 310)
```

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

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

21. Enter the start time and date: "6:00" on June 20.

```
TAKE FIRST SAMPLE AT  
6:00 20-06 JUN
```

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

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

After this messages displays briefly, the sampler will automatically return to the standby state.

```
... STANDBY ...  
10:40:23 19-JUN-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 48  
AT 6:00 5:50:43
```

When the time to the next sample event has elapsed and the sampler has initiated the sample event, the sampling cycle begins.

```
SAMPLE 1 OF 48
```

OBSOLETE

Example: Time-Paced Composite Sampling (Continued)

When the pump reverses for the pre-sample purge, the second line disappears. 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 48  
PUMPING 250 ml
```

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

```
SAMPLE 2 OF 48  
AT 6:15           6:00:33
```

The cycle repeats for the remainder of the sampling routine.

```
SAMPLE 2 OF 48
```



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

```
DONE . . . 48 SAMPLES  
6:10:35           21-JUN-04
```

Example *Calibration* shows how to calibrate the sampler for a 200-ml sample volume. You must enable the Calibrate Sampler configure option in the configure sequence before the calibration displays shown below appear.

Even without calibrating, the 3700 Sampler delivers 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 6, 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 reinitialization of the sampler.

Because the sample volume can be calibrated to ± 10 ml, use a graduated cylinder to facilitate measurement. Teledyne Isco offers a graduated cylinder and spare bottles as accessories 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. This ensures that the calibration procedure includes the pump cycle used while running the sampling program.

OBSOLETE

Example: Calibration

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

```
.... STANDBY ....  
9:34:50      19-JUN-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 distributor.

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

The sampler will deliver the programmed sample volume.

```
.... MANUAL SAMPLE ....  
PUMPING 200 ml
```
6. Measure the actual volume delivered and enter that value here.

```
200 ml VOLUME  
DELIVERED
```
7. 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.

↓
8. The sampler returns to standby. Press the START SAMPLING key to run the program.

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

3.8 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.

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 at the left of each option so you can identify each topic. Each discussion does not include illustrations of displays; however, discussions do include display numbers, which are identified in Appendix C.

3.8.1 Set Clock

Use this option to synchronize the sampler's clock with real time. You must make entries using military time: 9:30 AM would be entered as 9:30, 9:30 PM would be entered as 21:30, etc. When the sampler accepts a year entry, the seconds will be reset to zero. (*Display #210*)

3.8.2 Bottles and Sizes

You can use the Bottles and Sizes option to enter the number of bottles and the bottle volume. The option uses four input displays:

- The first display specifies a Portable or Refrigerated Sampler.
- The second display sets the number of bottles (1, 4, 12, or 24) for portable configurations. The second display appears *only* when you specify a Portable sampler in the first display.
- The third display sets the number of bottles (1, 2, 4, 8, 12, 24) for Refrigerated Samplers.
- The fourth display sets the bottle volume.

3.8.3 Portable or Refrigerated Sampler

Because the 3700 Series Portable and Refrigerated Samplers use the same control box, you specify the type of unit. The 3700FR Sampler will be shipped with this setting as REFRIGERATED. This setting is not changed when you reinitialize the settings. You should not specify PORTABLE unless you move the control box to a portable sampler. (*Display #220*)

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Note

The sampler uses the bottle configuration setting to position the distributor. If you enter a bottle configuration that does not correspond to the actual configuration used in the sampler, the sampler may position the distributor over locations without a bottle and fill the refrigerator instead of a sample bottle.

3.8.4 Portable

If you specify PORTABLE in the previous display, you will be able to specify a 1, 4, 12, or 24 bottle configuration. The sampler comes configured for the number of bottles ordered with the sampler. Each bottle configuration requires a different bottle base section. The 1-bottle configuration requires the composite base section; the 4 bottle configuration requires the 4 bottle base section, and so on. Change the configuration setting only when you have moved the controller to a portable sampler. If you change the bottle configuration without changing the base section, the sampler will not position the distributor arm over the bottles and will miss the bottle mouth, filling the base section instead of the bottles. (*Display #222*)

3.8.5 Refrigerated

If you specify REFRIGERATED, you will be able to specify a 1, 2, 4, 8, 12, or 24 bottle configuration. The 2 and 8 bottle configurations are used only with Teledyne Isco's 3700 Series Refrigerated Samplers (*Display #221*)

3.8.6 Continuous Sampling

You can program the 3700FR for continuous sampling. A 3700FR programmed for continuous sampling will deposit samples into successive sets of bottles until it reaches the last set of bottles. It then returns to the first set of bottles and continues sampling indefinitely into successive sets. Continuous sampling is available for all multiple-bottle configurations.

Before programming a sampler for continuous sampling, configure the sampler as follows: Select REFRIGERATED and 2, 4, 8, 12, or 24 bottles in the Bottles and Sizes configure option. Next, configure the sampler for extended programming in the Programming Mode configure option. Under these settings, the display illustrated below will appear in the sample distribution section.

SAMPLE CONTINUOUSLY?
[YES, NO]

Display #48

Note

The sampler will deposit samples indefinitely, even though the bottles have been filled to capacity. To avoid overfilling the bottles, replace them at regular time intervals or as soon as they are filled.

3.8.7 Cumulative Error

The sample accuracy is the greater of 10% of the sample volume or 20 ml and is repeatable to ± 10 ml. If you wish to fill a 1000 ml bottle with five 200 ml samples, adjust the actual sample volume according to the sample accuracy. Since samples of 200 ml can vary by 10% or ± 20 ml, the cumulative error for five samples would be ± 100 ml. If the sampler consistently places an actual sample volume of 220 ml for each of five samples, the total volume held by the bottle would be 1100 ml. Again, to avoid possible overfilling, enter a bottle volume that is less than the actual bottle capacity.

Table 3-2 Bottle Volume Settings for Standard Bottle Configurations

Bottle Configuration	Bottle Size	Bottle Volume Setting
24 (polypropylene)	1000 ml	1000
24 (polyethylene)	500 ml	500
24 (glass)	350 ml	350
12 (polypropylene, glass)	945 ml	945
12 (polypropylene, glass)	300 ml	300
4 (glass and polyethylene)	1 gal	3800
1 (glass and polyethylene)	2.5 gal	9400
1 (polyethylene)	4 gal	15,000

3.8.8 Suction Line

You can use the Suction Line configure option 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 you enter these settings accurately. An incorrect setting will impair the accuracy of the sample volume. These settings can also 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 electronic pump count uses the tables as reference for sample delivery.

There are three types of suction lines available for use with the 3700FR sampler: $\frac{1}{4}$ -inch vinyl, $\frac{3}{8}$ -inch vinyl, and $\frac{3}{8}$ -inch PTFE. If you specify $\frac{1}{4}$ -inch line, the sampler will prompt you for the line length immediately. If you specify $\frac{3}{8}$ -inch line, the sampler prompts 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, such as 6, not 6.5, feet. It is important to enter these settings accurately. These settings affect the accuracy of the sample volume and are used to determine the number of post-sample

purge counts. It is important to have sufficient counts to completely clear the line. (Refer to Purge Counts, Section 3.8.20.) (*Display #232*)

3.8.9 Liquid Detector

You can use the Liquid Detector configure option 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. Each display is discussed below.

Enable/Disable Detector – Teledyne Isco recommends setting the Enable/Disable Detector option to “ENABLE.” The 3700FR 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 it detects liquid. This minimizes inaccuracies that can occur in changing head conditions, or when it is difficult to measure the suction head accurately.

The disable option is provided should the detector or its associated circuitry become suspect. If you disable the detector, 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 uses a calculated number of pump counts based on the suction-head entry to deliver the correct sample volume. With the detector disabled, the sampler operates at diminished accuracy. (*Display #240*)

Rinse Cycles – The Rinse Cycle setting is available only when the detector is enabled. It sets 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 the liquid detector senses it. At that point, the pump reverses to purge the line. This cycle repeats 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, you may need to replace the tubing more frequently. The Tubing Life configure option allows you to monitor pump-tubing wear.

Enter Head Manually – When the detector is enabled, you can optionally enter the head manually, allowing 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.

When the head is stable and known accurately, you can further increase the accuracy of the delivered volume by using the Suction Head entry in conjunction with the liquid detector. When the head is variable or unknown, select “NO” because an incorrect head setting will diminish the delivered volume accuracy. (*Display #242*)

Sampling Retries – The Sampling Retries option is available 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. You can use this option when sampling liquid with a high concentration of solids that 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*)

3.8.10 Programming Mode

The Programming Mode option allows you to specify either basic or extended programming mode. The basic programming mode is used for conventional routines; you can use the extended programming mode for either conventional or more complex routines. Storm programming is available through the extended programming mode.

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. (*Display #250*)

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.
Distribution		
Sequential	Basic & Extended	One sample volume placed in each bottle.
Samples-per-Bottle Multiplexing	Basic & Extended	More than one sample volume placed in each bottle. You can switch bottles after a specified number of samples have been deposited or after a specified time period.
Bottles-per-Sample Multiplexing	Basic & Extended	Sample volumes placed in more than one bottle at each sample event.
Multiple-Bottle Compositing	Extended	More than one sample volume placed in a set of bottles. You can switch bottle sets after a specified number of samples have been deposited or after a specified time period.

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Table 3-3 Sampling Capabilities Through the Program Sequence (Continued)

Volumes and Accuracy		
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.
First Switch Time	Extended	Bottles can be switched after specified time intervals. After the routine starts, the first switch time allows the first bottle or bottle set to receive samples for a partial interval. After the first switch, the remaining sets will receive samples for full time intervals. This allows you to place the sampler on schedule.
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.
STORM Programming (Available through the Extended Mode Only.)		
Storm Pacing		
Flow-Pacing	Extended	Samples taken at regular flow intervals. The sampler will totalize flow intervals of 1 to 9,999 pulses.
Storm Distribution		
Sequential	Extended	One sample volume placed in each bottle.
Samples-per-Bottle Multiplexing	Extended	More than one sample volume placed in each bottle. You can switch bottles after a specified number of samples have been deposited.
Bottles-per-Sample Multiplexing	Extended	Sample volumes placed in more than one bottle at each sample event.
Multiple-Bottle Compositing	Extended	More than one sample volume placed in a set of bottles. You can switch bottle sets after a specified number of samples have been deposited.
Storm Volumes and Accuracy		
Sample Volume	Extended	Enter volumes from 10 to 990 ml for the time-paced and flow-paced segments separately.
Suction Head	Extended	You can enter suction heads from 1 to 20 feet.
Calibration	Extended	Calibrate sample volumes if desired. Sets calibration using the timed sample volume only.
Storm Key Times		
Delay to First Group Sample	Extended	Enter a time of up to 99 minutes to delay the first sample delivered to the first bottle group. The delay begins after the programmed start time for the STORM routine. In applications where there is a flow meter programmed to enable the sampler, the delay begins after the sampler is enabled.

Table 3-3 Sampling Capabilities Through the Program Sequence (Continued)

Delay to Second Group Sample	Extended	A time of up to 99 minutes can be entered to delay the first sample delivered to the second bottle group, when the second bottle group receives time-paced samples. The delay begins after the programmed start time for the STORM routine. In applications where there is a flow meter programmed to enable the sampler, the delay begins after the sampler is enabled.
Start Times	Extended	You can enter a specific start time for the STORM routine. If no start time is entered, the Start Time Delay will be used.
Maximum Flow Interval	Extended	You can enter maximum period of time between flow-paced sample events. If this period of time is exceeded, the sampler will terminate the routine.

3.8.11 Load Stored Program

The Load Stored Program option allows you to load one of as many as three sampling programs that you have previously saved with the Save Current Program configure option. 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, you will replace the current program with the factory default settings by loading a program. When you reinitialize the sampler, all four programs return to the default program settings.

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.

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Example: Load Stored Program (Continued)

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

3.8.12 Save Current Program

The Save Current Program option allows you to assign a different number to as many as three sampling routines and save those numbers.

This option eliminates the need to reprogram the sampler for recurrent routines. Only the program settings are saved; if different routines require different configurations, you must reconfigure the sampler 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 you must reenter the suction-line length settings 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. Reinitialization of the sampler restores the default program settings, shown in Tables 3-4 and 3-5.

Note

Saving a program will overwrite a program saved earlier under the same number. You can view settings for the current program with the Display Status procedure. Example *Save Current Program* shows how to save a current sampling 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
```

3.8.13 Flow Mode Sampling

The Flow Mode Sampling option directs the sampler to take a sample at key times in a flow-paced sampling program. There are two settings. The first setting directs the sampler to take a sample at the start time. The second directs the sampler to take a sample at the switch times (when the bottle set changes are based on time). Both settings of the option are disregarded in STORM sampling routines. (*Display #40*)

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Sample at Start Time – If you select “YES,” the 3700FR will take the first sample 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, has counted down to zero. (*Display #270*)

Sample at Time Switch – If you select “YES,” the sampler will switch to a new bottle or set, take a sample, and reset the flow pulse count. The next sample will occur after a full pulse countdown. If you select “NO,” no samples be taken at the switch time and the pulse countdown will not be reset. The switch will occur in the middle of a pulse countdown and the first sample will be deposited in the new bottle or set when the countdown is completed. (*Display #271*)

3.8.14 Nonuniform Time

The Nonuniform Time option specifies the method by which non-uniform 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 nonuniform intervals in minutes. Nonuniform times are not available in a STORM sampling routine. (*Display #280*)

3.8.15 Calibrate Sampler

The Calibrate Sampler option adds or removes 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*)

3.8.16 Sampling Stop/Resume

The Sampling Stop/Resume configure option lets you 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 as many as 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 AM to 8 AM and between 4 PM to 6 PM. Sampling Stops and Resumes are not available in a storm routine.

If you are using a time-switched sampling routine that includes the use of stops and resumes, the sampler will reset the time-switch interval at each resume time. If a routine with time-switches every hour is programmed for stop and resume times, the first time-switch would occur an hour after the resume time.

Switches would repeat every hour until a stop time occurred or the routine was completed. See Example *Sampling with Stops and Resumes*.

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 directs the sampler to take a sample at stop times. (*Display #301*)

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

3.8.17 Start Time Delay

The Start Time Delay option sets 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.

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 required 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 entered a start-time delay of 1, the sampler would 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. When using a start time delay of greater than 0, take care when the sampler is being inhibited by another sampler, a flow meter, or a Liquid Level Actuator.

3.8.18 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, a 4200 Series Flow Meter, a 4100 Series Flow Logger, or the 1640 Liquid Level Actuator. There are four Enable Pin setup options: Sample Upon Disable, Sample Upon Enable, Reset Sample Interval, and Inhibit Countdown. The sampler disregards the Enable Pin configure option settings when running a storm routine. Each of these options is discussed below.

Sample Upon Disable – When you are using a flow meter or Liquid Level Actuator, “SAMPLE UPON DISABLE?” allows you to direct the sampler to take a sample as soon as you disable the sampler through pin F.

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A response of “YES” causes the sampler to take a sample when the pin is disabled; a response of “NO” prevents the sampler from taking a sample. (*Display #321*)

The sampler determines an enable or disable condition by monitoring the voltage on pin F. It interprets high voltage as an enable signal and low voltage or ground as a disable signal.

Sample Upon Enable – When you are using a 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” causes the sampler to take a sample when the pin is enabled. A response of “NO” prevents the sampler from taking a sample when the pin is enabled. (*Display #322*)

Reset Sample Interval – “Reset Sample Interval?” controls the time- or flow-pulse countdown. If you select “YES,” a full sample interval begins when pin F is enabled. If you select “NO,” the interval will not be reset when the sampler is enabled; the settings entered in the “INHIBIT COUNTDOWN?” option will be used. 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 controls 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*)

A sampler that has been inhibited while running a routine will move to the next bottle set when enabled, if at least one sample volume has been deposited in the current bottle set. This is true for both time-switched and count-switched routines, and for bottles sets composed of one or more bottles.

A sampler that has been inhibited while running a time-switched routine will advance to the next bottle or bottle set, regardless of the number of time-switches that elapse while the sampler is inhibited.

If the bottle sets were switched every two hours and the sampler has been inhibited for six hours, the restarted routine will begin with the next bottle set. The routine may not continue with the bottle set that would have been used had the sampler not been inhibited.

3.8.19 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

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- a continuous signal during the entire pump cycle
- a continuous signal during forward pumping only

The event mark includes a signal sent on pin D which is interpreted and recorded by the Isco Flow meter as the bottle number(s) for the sample event.

The bottle number signal consists of a number of 100 millisecond, 12-volt pulses that equal the bottle number; *i.e.*, four pulses represent bottle #4, 20 pulses represent bottle #20.

The type of signal selected from the Event Mark configure option affects the event mark signal on pin E. In Figure 3-9A, a pulse signal is sent at the beginning of the pre-sample purge. In Figure 3-9B, a pulse signal is sent during the sample volume delivery portion of the sample event. In Figure 3-9C, a continuous signal is sent during the entire pump cycle. In Figure 3-9D, a continuous pulse is sent for the duration of the sample-volume delivery.

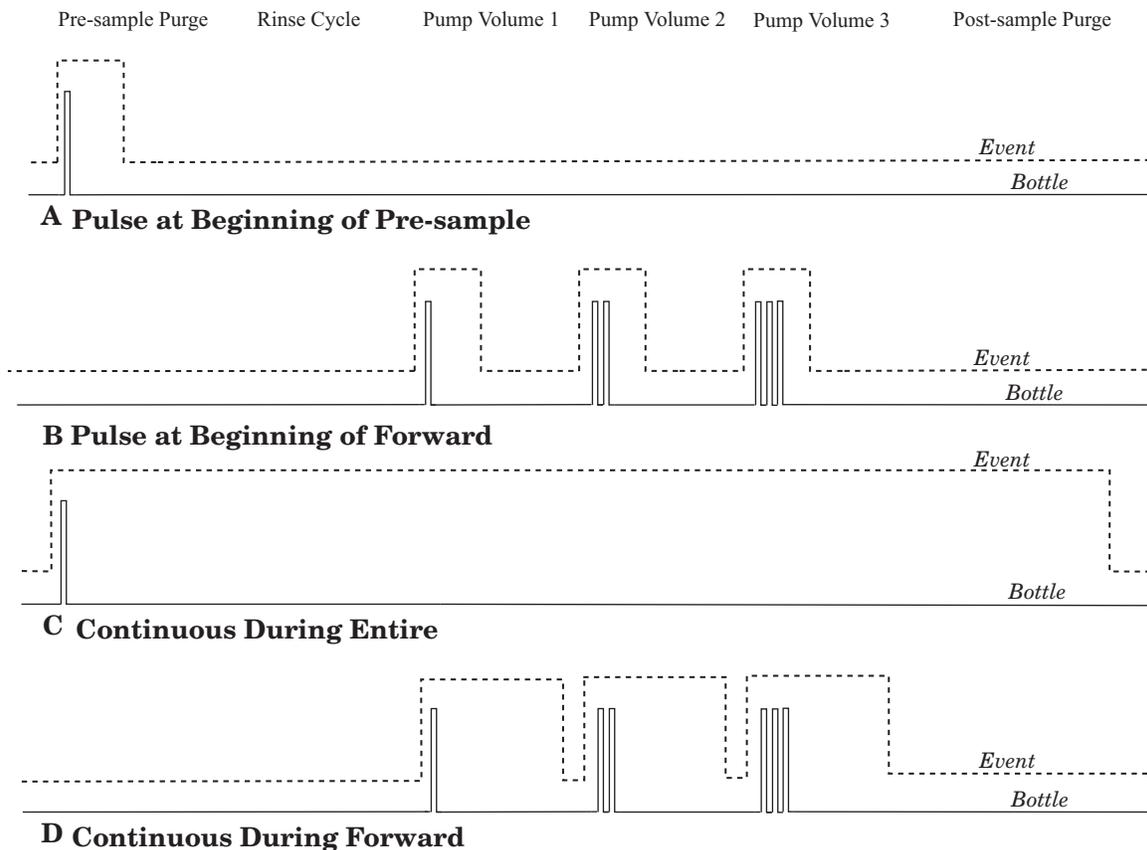


Figure 3-9 Event Mark and Bottle Number Signal Output

Continuous/Pulse Signal – The Continuous/Pulse setting selects 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*)

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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 select “PULSE.” Two options are available. The first option, “PURGE,” sends a pulse at the beginning of the pre-sample purge. The second option, “FWD PUMPING,” sends a pulse at the beginning of the sample delivery when the pump is running forward. (*Display #332*)

3.8.20 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 reinitialized. 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. Entries are to be between 0 and 9,999 for both purges. You can obtain a purge count using the pump forward or pump reverse keys. (*Display #s 340 and 341*)

3.8.21 Tubing Life

The Tubing Life option sets the number of pump counts needed to trigger the “Replace Pump Tubing” warning. The warning is activated when the pump count reaches the entered value, and only appears after you press DISPLAY STATUS. 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 $\frac{3}{8}$ -inch-by-10-foot vinyl suction line at a 5-foot suction head. (*Display #350, 351, and 352*)

3.8.22 Program Lock

Select “ENABLE” to turn the lock 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: 3700. Once the pass-number has been entered, you can change any value or setting in either the program or configure sequence. (*Display #360*)

3.8.23 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.

3.8.24 Run Diagnostics

Run Diagnostics performs 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, distributor, and pump; and lets you reinitialize RAM. The display information is discussed below in order of appearance.

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

Test RAM and ROM – RAM and ROM test messages replaced the software revision display. A successful test is indicated by the messages “RAM PASSED TEST” or “ROM PASSED TEST.” If either RAM or ROM fail the test, the sampler displays one of the following messages: “RAM FAILED TEST” or “ROM FAILED TEST” and beeps every three seconds until you turn it off. If either the RAM or ROM fail the test, service the sampler. Contact Teledyne Isco Technical 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, have the pump serviced. A count near 100 is typical.

Distributor Test – Following the pump test, you can test the distributor. If you elect to test the distributor, the sampler will move the distributor to Position 24, then return it to Position 1.

The positions are indicated on the display. If the message, “DISTRIBUTOR JAMMED” is displayed, check the routing of the pump tubing and the bottles in the tub. If the tubing and bottles are correctly positioned, the distributor drive mechanism may need servicing. (*Display #370*)

Reinitialize Controller – In the final steps you reinitialize 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 you can turn off the sampler. (*Display #371*)

Table 3-4 lists the reinitialized 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 reinitialized. The Pump Count total is not reset to maintain an accurate count for the Tubing Life Warning.

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3.8.25 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. You can exit the configuration sequence at any time using the EXIT PROGRAM key.

Table 3-4 Factory Configure Option Settings

Configure Option	Display Number	Factory Setting
SET CLOCK	210	Not Reset
BOTTLES AND SIZE	220, 221, 222, 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
sample at switch times	271	NO
NONUNIFORM TIME	280	MINUTES
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		

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Table 3-4 Factory Configure Option Settings (Continued)

Configure Option	Display Number	Factory Setting
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		

Table 3-5 Factory Program Settings

Program Setting	Display Number	Factory Setting
[TIME, FLOW] PACED SAMPLING	10	TIME
UNIFORM/ NONUNIFORM TIME INTERVALS	11	UNIFORM
[TIME, FLOW, STORM] PACED SAMPLING	12	TIME
[TIME, FLOW] BOTTLE GROUP	14	FLOW
-- MINUTE DELAY TO FIRST TIMED SAMPLE	15	0 MINUTES
[DURING, AFTER] TIME MODE	16	DURING
_MINUTE DELAY TO SECOND GROUP SAMPLES	17	30
SAMPLE EVERY -- HOURS -- MINUTES	21	1 HOUR 0 MINUTES
SAMPLE EVERY -- PULSES (1 - 9999)	22	10
TAKE -- TIMED SAMPLE EVENTS (1-MAX)	23	1
SAMPLE INTERVALS OF --MINUTES (1-99)	24	60
TAKE --- SAMPLES (1 - MAX)	25	10
QUANTITY AT INTERVAL 1. -- AT -- MINUTES	27	1 AT 60 MINUTES
-- BOTTLES PER SAMPLE EVENT (1 - 24)	30	1
-- SAMPLES PER BOTTLE (1-MAX)	31	1

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Table 3-5 Factory Program Settings (Continued)

Program Setting	Display Number	Factory Setting
MULTIPLEX SAMPLES? [YES, NO]	35	NO
[BOTTLES/SAMPLE, SAMPLES PER BOTTLE]	36	SAMPLES PER BOTTLE
CHANGE BOTTLES BASED ON [TIME, SAMPLE]	40	COUNT
CHANGE SETS BASED ON [TIME, SAMPLE]	41	COUNT
CHANGE BOTTLES EVERY --HOURS, -- MIN.	42	2 HOURS 0 MINUTES
CHANGE SETS AFTER -- HOURS -- MINUTES	43	2 HOURS 0 MINUTES
CHANGE BOTTLES AFTER -- SAMPLES	44	1
CHANGE SETS AFTER SAMPLES	45	1
SAMPLE CONTINUOUSLY? [YES, NO]	48	NO
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
STORM ENABLED AFTER HH:MM MM/DD	93	
ENTER FIRST SWITCH TIME? [YES, NO]	95	NO
-- STOP or RESUME TIMES (0 - 24)	100	0
MAX FLOW INTERVAL OF -- HOURS, --MINUTES	110	2 HOURS 0 MINUTES

3.9 Extended Programming Mode

All sampling capabilities available in the basic programming mode are available in the extended programming mode. (A listing of the capabilities is in Table 3-3.) The extended programming mode provides several additional capabilities: Non-uniform Time Pacing, an additional multiplexing scheme (multiple-bottle compositing), Sampling Stops and Resumes, program storage, and Flow-Mode Sampling controls.

The procedure for programming the sampler in the extended mode is the same as that used to program the sampler in the basic programming mode. 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. The Sample Distribution section is modified to let you program the sampler for multiple-bottle compositing. The procedure and displays used to program the sampler for bottles-per-sample and samples-per-bottle multiplexing, and sequential sampling are somewhat different. The section is also extended to allow you to switch multiplexed bottles or bottle sets after programmed periods of time. (With the extended mode, you can still switch bottles after a programmed number of samples have been deposited.) The *Key Times* section is extended to allow you to enter the time of the first bottle or bottle set change. 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 Figures 3-10, 3-11, and 3-12, which chart the program sequence in the extended mode.

3.9.1 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 nonuniform time pacing, you can collect samples at specific times and dates at irregular intervals: 6 AM on April 15, noon on April 15, 7 AM on April 16, and 1 PM 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.

3.9.2 Extended Mode Sample Distribution

The extended Sample Distribution section expands the multiplexing capabilities of the sampler. Both the bottles-per-sample and samples-per-bottle multiplexing are available; however, the procedure used to program them differs slightly from the procedure used in the basic programming mode. Example *Time-Paced Multiplexed (samples-per-bottle) Sampling* demonstrates the procedure used for samples-per-bottle multiplexing; Example *Extended Flow-Paced Multiplexed (bottles-per-sample)*

OBSOLETE

Sampling shows the bottles-per-sample multiplexing procedure. The extended mode also offers multiple bottle compositing; refer to Example *Flow-Paced Sampling / Time-Based Bottle Sets*.

In the extended programming mode, you can switch bottles or bottle sets after a programmed time period elapses or after a programmed number of samples have been deposited. The displays used to specify the type of switches are shown in the Sample Distribution section of Figures 3-10, 3-11, and 3-12. Display #40 allows you to select either "TIME" or "SAMPLES." If you select "TIME," the bottles can be changed after a programmed period of time. If you select "SAMPLES," the bottles can be switched after a programmed number of samples. In Display #41, which allows you to switch bottle sets, you can select either "TIME" or "SAMPLES/BTL." If you select "TIME," the bottle sets can be changed after a programmed period of time. If you select "SAMPLES/BTL," the bottle sets can be changed after a programmed number of samples. You can use select either "TIME," "SAMPLES," or "SAMPLE/BTL" settings with both time- and flow-paced sampling.

3.9.3 Extended Mode Sample Volumes

The extended mode Sample Volumes section is identical to the basic Sample Volume section.

3.9.4 Extended Mode Key Times

The extended mode Key Times section has two additional sets of displays which allow you to specify the time of the first bottle or bottle set change and to set up the sampling stop and resume times.

First Switch Time – The first switch time displays will appear only when you have specified bottle or bottle set changes based on time in the Sample Distribution section. If you select "TIME" rather than "SAMPLES" in the "CHANGE SETS BASED ON [TIME, SAMPLES]" display, you first will be asked if you want to enter a setting for the first switch time. If you respond "YES," you will be prompted for the time of the first bottle or set change. The first time-switch displays are indicated by Display #s 95, 46, and 47 in Figure 3-11.

The first switch- time setting allows you to control the times of each bottle switch without delaying the routine and thereby missing samples. For example, if you have programmed the sampler for time switches every hour and you want the switches to occur on the hour, you can set the time of the first switch at the next even hour, start the sampling routine early, and deposit samples in the first bottle set until the first switch time. At the first switch time, the distributor moves to the next bottle set. The first bottle set may not be completely filled; however, by starting the routine early, you can sample until the bottle switches are placed "on schedule" to avoid missing any samples. If you do not enter a first switch time, the sampler will begin timing the switch interval from the start time for the routine and the first bottle or bottle set will receive samples for the full time period. Switch times are not available in STORM routines.

OBSOLETE

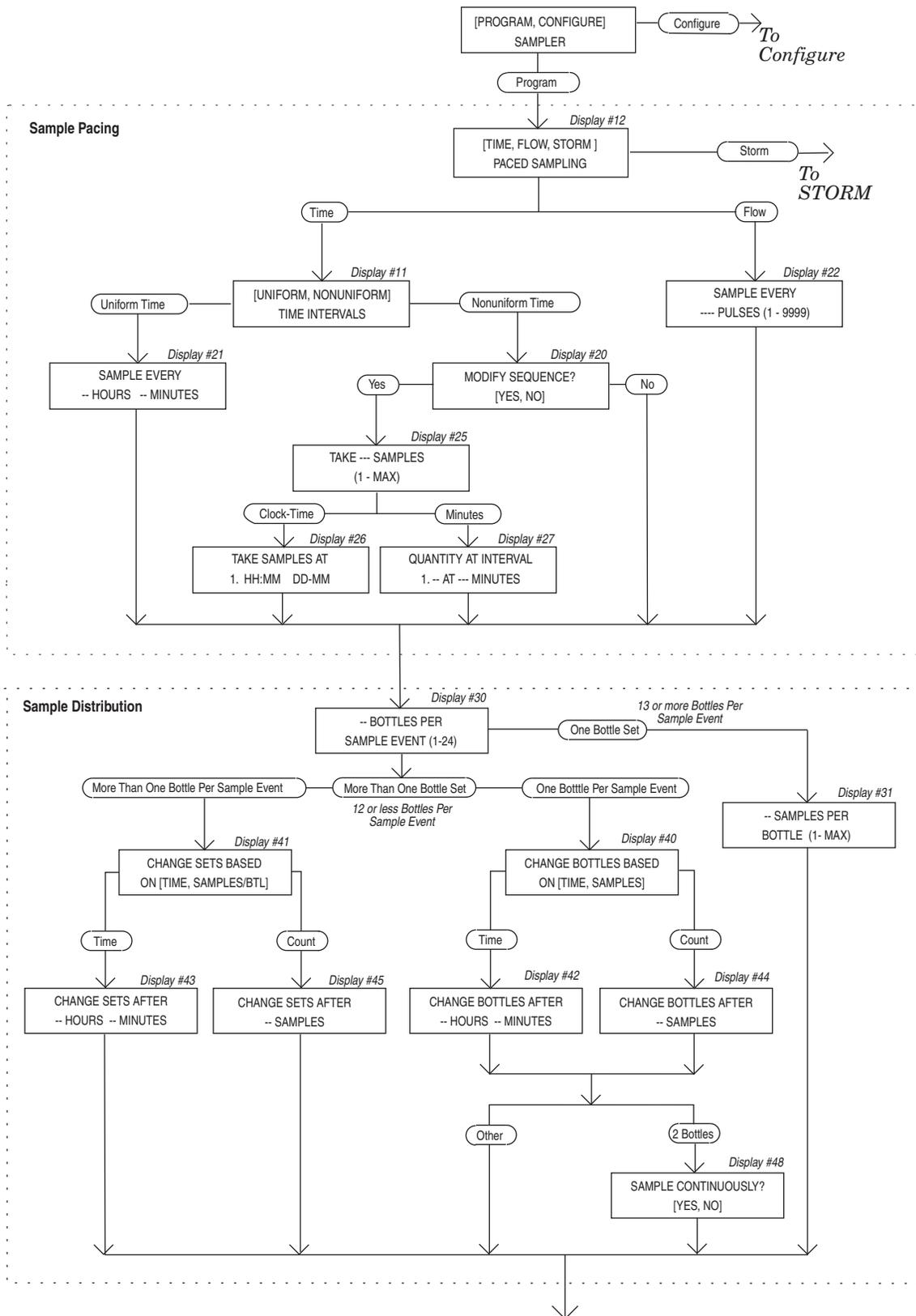


Figure 3-10 Programming Mode: Sample Pacing and Distribution

OBSOLETE

Continued from Figure 3-10

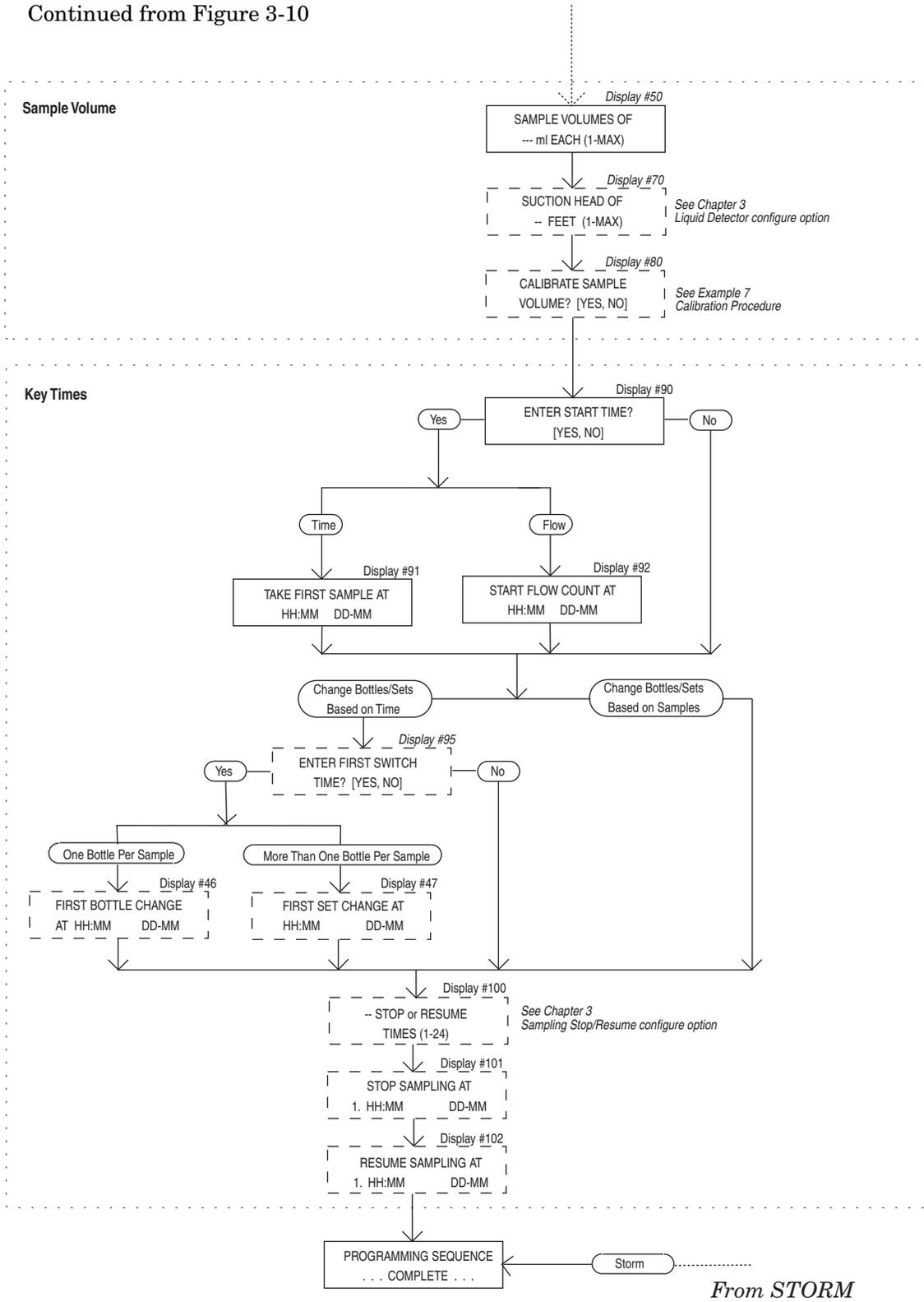


Figure 3-11 Extended Programming Mode: Sample Volume and Key Times

OBSOLETE

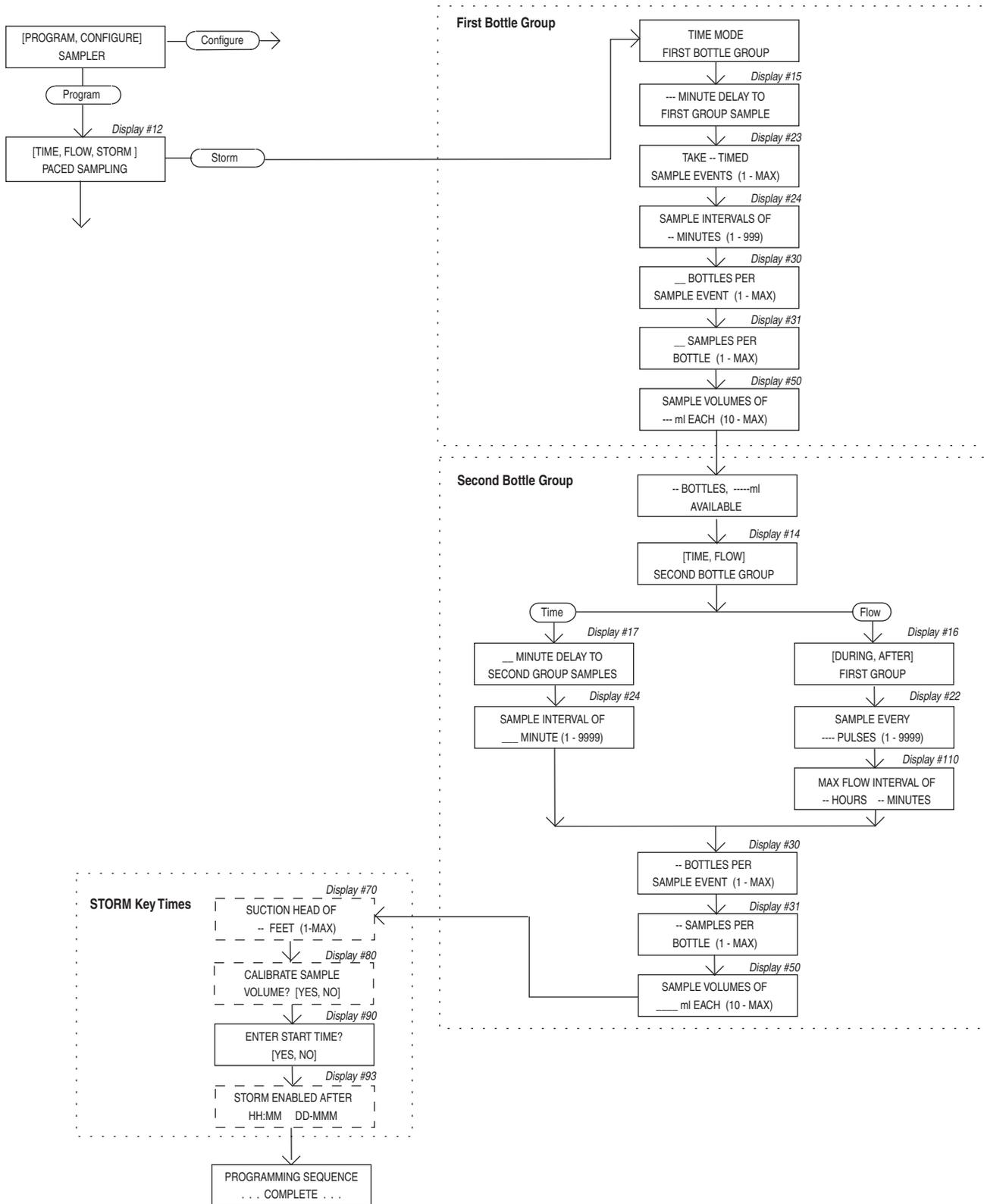


Figure 3-12 Extended Programming Mode: STORM Programming

OBSOLETE

Stops and Resumes – The Stops and Resumes settings are available only when you have enabled the Sampling Stop/Resume configure option. 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 3-12, Display #s 100, 101, and 102.

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, the 3700 will always take a sample automatically at the *start* time. It will not take a sample 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, the 3700 will not take a sample 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. The 3700 will not take a sample at the resume time unless you have selected “ENABLE” in the Sample at Resume display of the Sampling Stops and Resumes option.

3.10 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.

After programming, you must start the sampling by pressing the start sampling key. 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 3-13 diagrams the sequence of events preceding the start time.

OBSOLETE

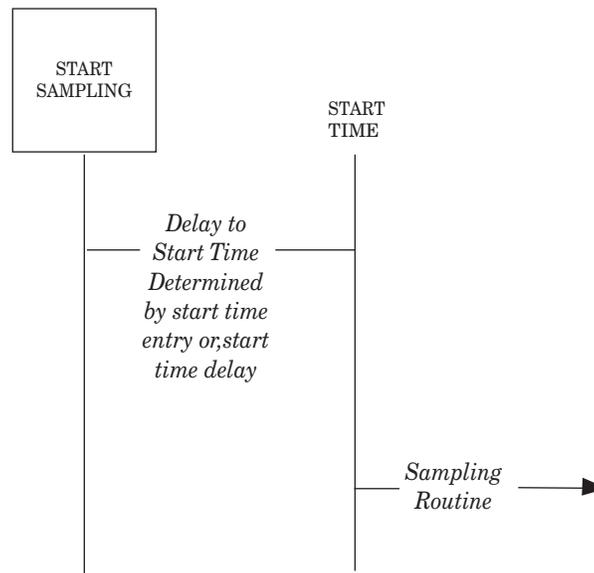


Figure 3-13 Simplified Start Time Diagram

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, #92, and #93. The delay-to-start time is determined by the entry in Display #310 of the Start Time Delay configure option. These input displays are shown in Table 3-6 and in the charts in Figures 3-8, 3-10, 3-11, and 3-12.

Note

Unless the sampling routine contains a programmed start time (Displays #91, #92, or #93), 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 4200 Series Flow Meters and 4100 Series 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 it receives 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.

OBSOLETE

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. Refer to Figure 3-14. The diagram shows the sampler's response when enabled or disabled at the start time for most basic and extended mode routines.

Figure 3-15 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.

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 3-14 and 3-15.

Start Time Delay – Entries made in the Start Time Delay configure option affect the start times. The Start Time Delay section discusses this configure option.

Table 3-6 Start Time Displays

ENTER START TIME? [YES, NO]	Display #90	---- MINUTE DELAY TO START (0 - 9999)	Display #310(Start Time Delay configure option)
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)		

OBSOLETE

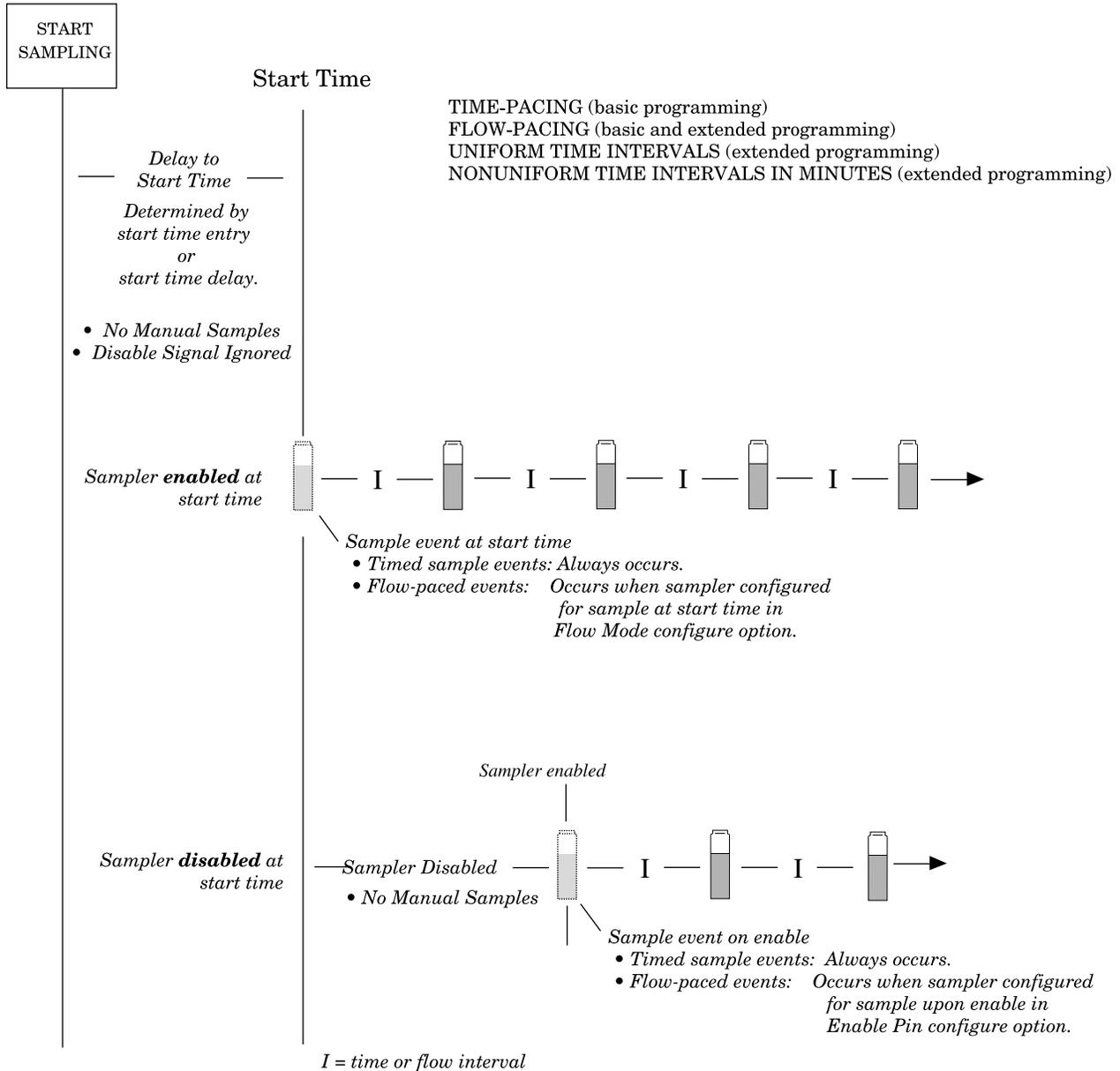


Figure 3-14 Start Time Diagram

OBSOLETE

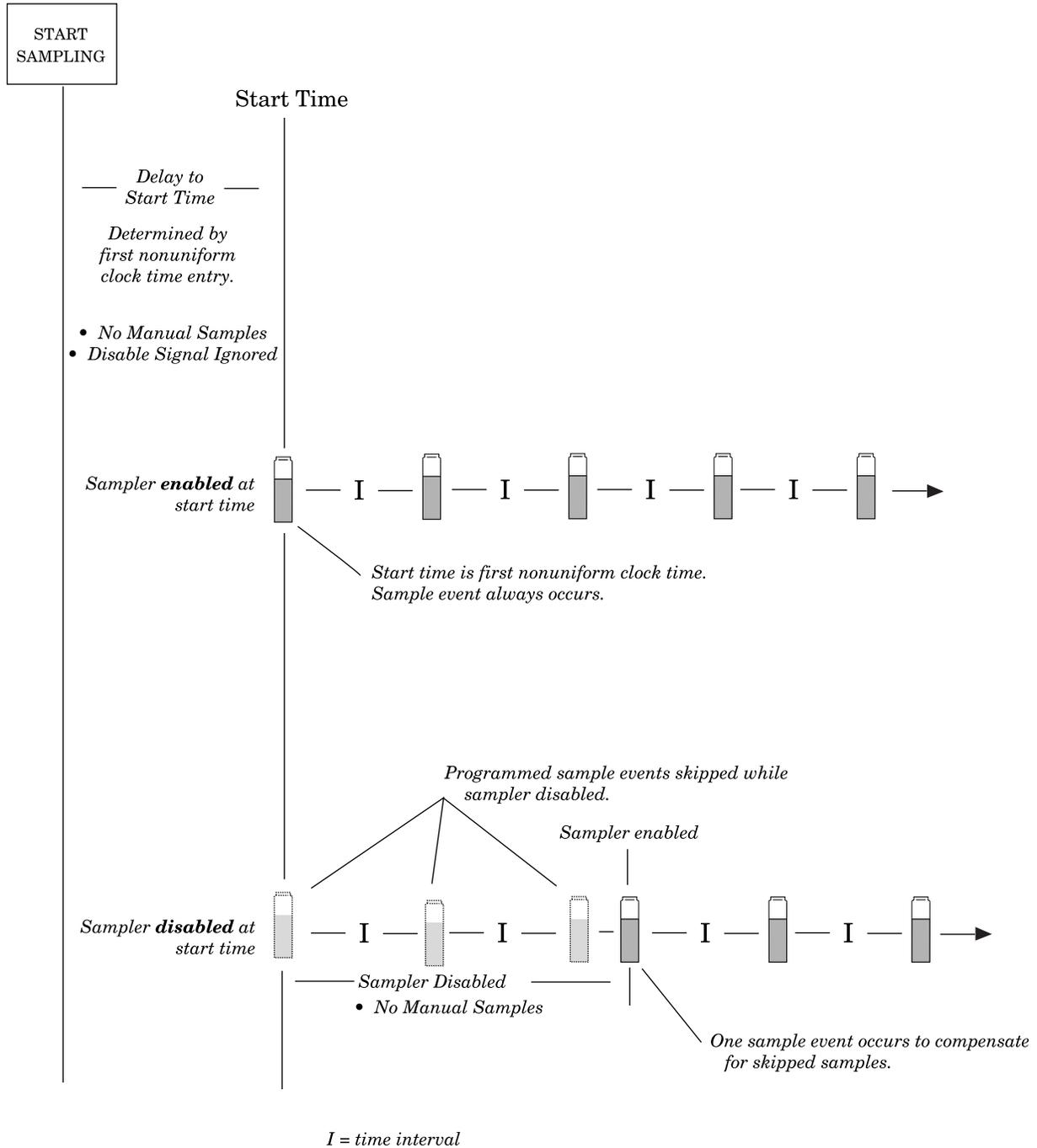


Figure 3-15 Start Time Diagram for Nonuniform Time Routines

3.11 Stormwater Sampling

Many stormwater runoff monitoring permits require a first-flush grab sample within the first 30 minutes of the storm event and a time- or flow-paced composite sample during the remainder of the event. The 3700 Sampler's STORM pacing is ideal for monitoring storm events. Storm pacing allows you to:

- Divide the sampler's bottles into two groups. The first bottle group receives the first flush grab sample. The grab sample is always a time-paced sample. The second bottle group receives either a flow-paced or time-paced sample.
- Collect samples for the second bottle group after collecting the first-flush samples or collect samples for both groups at the same time. See Figures 3-16 and 3-17.
- Distribute sample volumes to both bottle groups sequentially or in any of the three multiplexing schemes: bottles-per-sample, samples-per-bottle, or multiple-bottle compositing.
- Use an Isco 4200 Series Flow Meter or a 4100 Series Flow Logger to enable or disable the sampler according to the level or flow rate of the flow stream or to specific amount of rainfall.
- Use a maximum flow interval setting to terminate a STORM routine that uses flow-paced sampling.

The maximum-flow-interval setting affects routines that fill the second bottle group with flow-paced samples. The maximum-flow-interval setting limits the amount of time between flow-paced sample events. For example, if the flow rate declines so that the amount of time between flow-paced sample events exceeds a maximum-flow-interval setting of two hours, the sampler will terminate the routine when more than two hours elapses between events.

The maximum-flow-interval setting allows the sampler to terminate the routine when the flow rate falls below an acceptable rate or drops off completely. This limits the sampling routine to one storm event so that samples from multiple storm events are not deposited into the bottle groups.

3.11.1 Storm Sampling Checklist

This section provides two checklists: a list of suggested storm monitoring equipment and a brief installation checklist. Notes on terminating a routine, manual sampling during a storm routine, and a storm routine's run state displays follow the checklist. Example *Storm Sampling* contains a STORM programming example.

You can find additional information about storm monitoring installations in the Isco *Storm Water Runoff Monitoring Pocket Guide*. The pocket guide contains the following information:

- How to connect the sampler and rain gauge to the flow meter
- Programming examples for flow meters and samplers

OBSOLETE

- How to start and restart the monitoring installation

Equipment Checklist – The equipment listed below is suggested for typical storm-event monitoring:

- 3700 Sampler and power source.
You can use a 2-, 4-, 8-, or 24-bottle configuration for STORM routines (depending on which 3700 model you have)
- 4200 Series Flow Meter or 4100 Series Flow Logger, and power source
- A Sampler-to-Flow Meter Connect Cable

Optional Equipment Checklist –

- Rain gauge with cable and connector (Rain gauges are required for rain-event triggered sampling)
- Flowlink software (requires IBM-compatible computer system)
Although the flow meter contains the sampler-enable conditions most often used in storm water runoff monitoring, you can use the Flowlink system to download many additional sample enable conditions to the flow meter. Refer to the Flowlink help menu for more information.
- Interrogator communication line kit to connect a computer to the flow meter.
This kit provides the computer-to-flow meter cabling. Isco Flow Meters can also be equipped with a modem to communicate with Flowlink over standard telephone lines.
- Solar Panel Battery Charger.

Installation Checklist – This checklist summarizes the four steps required to set up a storm-monitoring installation:

1. Program and install the flow meter. Install the rain gauge, if used.
You can program 4200 Series Flow Meters for sampler enable control conditions from the flow meter front panel or use Flowlink and a computer to download the desired condition. The 4100 Series Flow Loggers must be programmed with Flowlink.
NOTE: You can program the sampler to start the routine at an exact time and date with a start-time entry. You do not need to use a flow meter to enable the sampler.
2. Program and install the sampler.
Programming the sampler includes adjusting certain configuration option settings as well as entering the STORM program settings. Table 3-7 lists the configure options and their recommended STORM settings.
3. Connect the flow meter to the sampler with the connect cable.
4. Turn the flow meter on. Turn the sampler on and start the sampling routine by pressing the start sampling key.
Connect the flow meter to the sampler and start the flow

OBSOLETE

meter *before* you press the start sampling key on the sampler. If you are using the flow meter to detect a storm event and enable the sampler when the event occurs, the sampler must be disabled by the flow meter when you press the start sampling key. If the sampler is not disabled, it will begin the routine as soon as you press the key. This means that the flow meter must not detect the enable control conditions. The flow meter will disable a sampler only when the conditions are *not* satisfied.

Terminating the Routine – A storm routine will terminate under the following conditions:

- The sampler completes the routine
- A flow meter disables the sampler when the enable-control condition is no longer satisfied. Once a sampler running a storm routine has been disabled, however, it cannot be re-enabled if control conditions are satisfied again. You can prevent the sampler from being disabled by “latching” the sampler enable through the flow meter’s control condition
- The time between flow-paced sample events exceeds the storm routine’s maximum flow interval setting

Manual Samples – Manual sampling is not available during a storm routine. If you press MANUAL SAMPLE during a storm routine, the sampler will disregard the key.

Run State Displays – Run state displays for storm routines are identical to displays used with conventional routines. However, the displays for the first and second bottle groups will alternate with each other.

Table 3-7 Recommended Configurations for Storm Sampling

Configure Option	Display Number	Recommended Setting
Set Clock	210	Enter correct time and date.
Bottles and Sizes		
Portable/Refrig	220	Select Portable for either the compact or standard 3700 sampler.
2, 4, 8, 12, 24	222	Select 4, 12, or 24, depending on your model, bottle configuration, and base section. Do not select 1. If the sampler is configured for one bottle (composite sampling), the storm branch is not accessible.
Bottle Volume	223	For 3700 Standard: 4 bottles, enter 3800 ml 24 plastic bottles, enter 1000 ml 24 glass bottles, enter 350 ml
Suction Line	230, 231, 232	Enter correct settings.
Liquid Detector		
Liquid Detector	240	Select “ENABLE.”
Rinses	241	0

OBSOLETE

Table 3-7 Recommended Configurations for Storm Sampling (Continued)

Configure Option	Display Number	Recommended Setting
Enter head manually	242	NO
# of retries	243	0
Programming Mode	250	Select "EXTENDED."
Load Stored Program	255	Load only a stored STORM program.
Save Current Program	260	Not applicable.
Flow Mode Sampling		
Sample at start time	270	Disregarded by STORM routines.
Sample at switch times	271	Disregarded by STORM routines.
Nonuniform Time	280	Disregarded by STORM routines.
Calibrate Sampler	290	Select "DISABLE."
Sampling Stop/resume	300	
Sample at stop times	301	Disregarded by STORM routines.
Sample at resume times	302	Disregarded by STORM routines.
Start Time Delay	310	
Enable Pin		
Sample upon disable	321	Disregarded by STORM routines.
Sample upon enable	322	Disregarded by STORM routines.
Reset sample interval	323	Disregarded by STORM routines.
Inhibit countdown	324	Disregarded by STORM routines.
Event Mark		
Continuous /pulse	330	Select preferred Event Mark.
Pump cycle/fwd only	331	Select preferred Event Mark.
Purge Counts		
Pre-sample counts	340	Enter preferred count.
Post-sample counts	341	Enter preferred count.
Tubing Life		
Reset pump counter	351	Reset if required.
# pump counts	352	Enter preferred count.
Program Lock	360	Select "ENABLE" or "DISABLE," "as preferred.
Sampler ID	365	Enter appropriate ID.
Run Diagnostics		No setting required.

3.12 Programming the Sampler for a Storm Routine

The extended programming mode contains two program sequences. The first sequence contains the displays for time- and flow-paced routines. The second sequence contains the displays for STORM paced routines. Figures 3-10 and 3-11 show first sequence displays; Figure 3-12 shows the STORM displays.

The storm input displays are divided into three sections. The first section contains the displays that control the pacing and distribution to the first bottle group. The second section contains the displays that control the pacing and distribution for the second bottle group. The third section controls the start time for the routine and may include calibration and manual suction head displays.

3.12.1 First Section: First Bottle Group Settings

The first section contains the input displays that:

- Set a delay to the first sample event of the first bottle group.
- Set the time pacing for the first bottle group.
- Allocate the bottles for the first bottle group.
- Determine sample distribution for the first bottle group: sequential, samples-per-bottle multiplexing, bottles-per-sample multiplexing, or multi-bottle compositing.

OBSOLETE

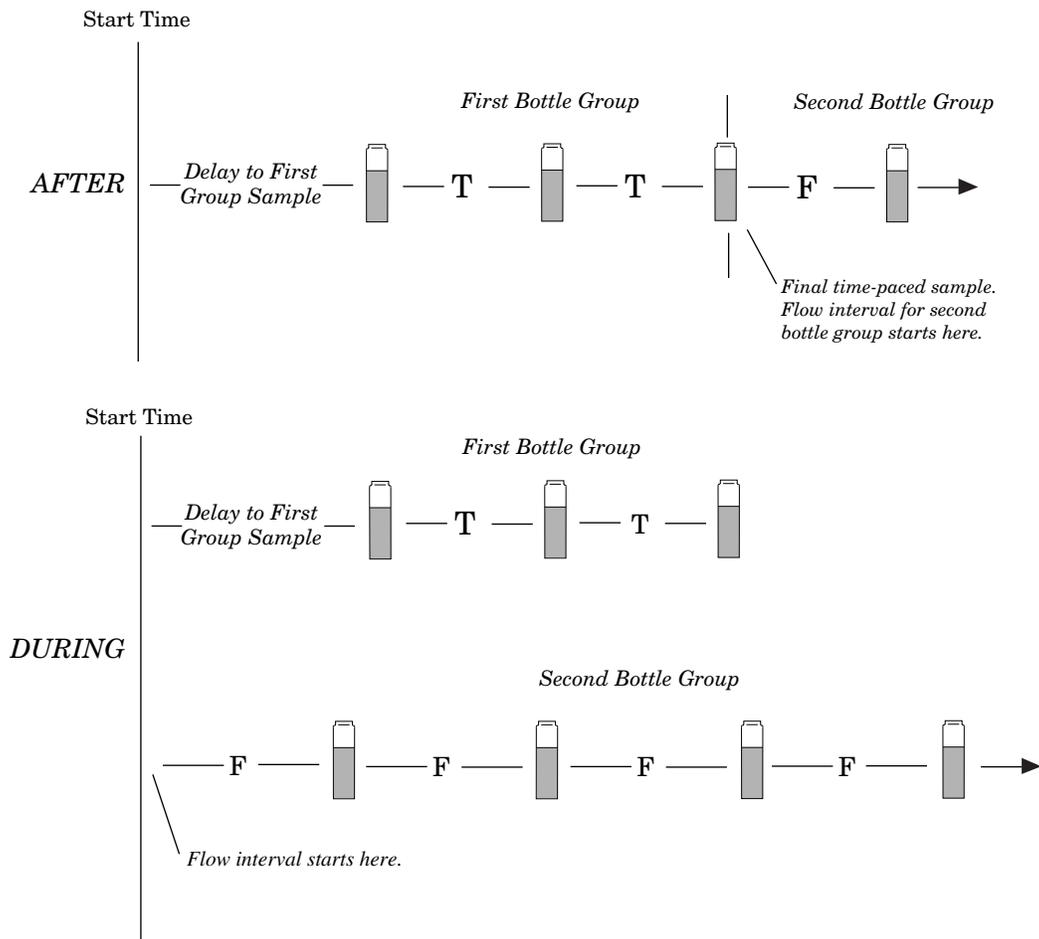
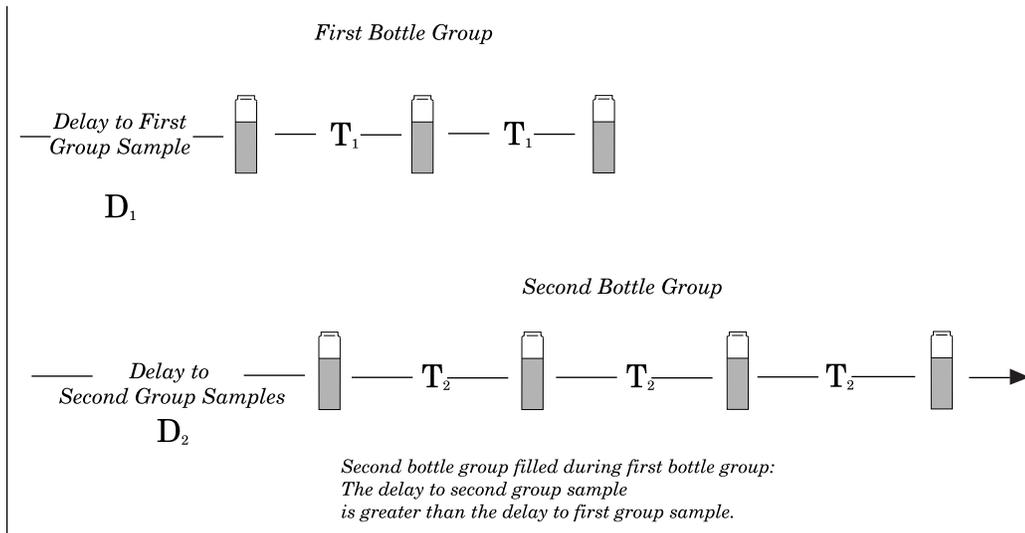


Figure 3-16 Storm Sampling: Flow Pacing for the Second Bottle Group

OBSOLETE

Start Time



Start Time

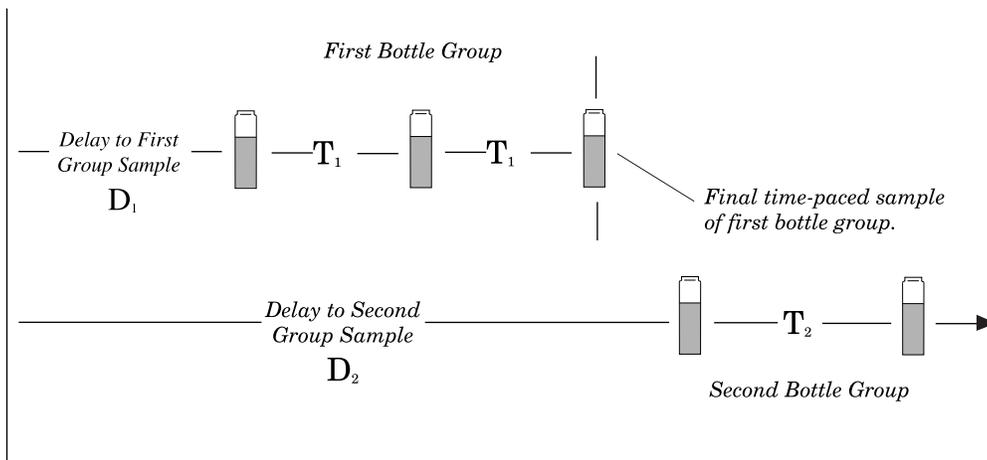


Figure 3-17 Storm Sampling: Time Pacing for the Second Bottle Group

The "TIME MODE" message marks the beginning of the first section. This message is followed by Display #15, below.

```
-- MINUTE DELAY TO  
FIRST GROUP SAMPLE
```

Display #15

Use this display to set amount of time between the time the sampler is enabled and the first sample delivered to the first bottle group. (The sampler may be enabled at the start time.)

The acceptable range of values for the delay to first group sample is 0 to 999 minutes. If the delay is 0, the sampler will take the first sample when enabled by the flow meter. Subsequent time-paced samples will occur at the time interval entered in Display #23.

OBSOLETE

How to allocate bottles to the bottle groups – Use the next three displays to determine the both the sample distribution and the number of bottles allocated to the bottle groups.

TAKE 2 TIMED SAMPLE EVENTS (1 - MAX)	Display #23
3 BOTTLES PER SAMPLE EVENT (1 - MAX)	Display #30
1 SAMPLES PER BOTTLE(1 - MAX)	Display #31

A bottle group can contain one or more bottles. You can allocate all bottles but one to the first bottle group. The STORM routine will automatically allocate the remaining bottles (or bottle) to the second bottle group. (It obtains the total number of bottles from the bottle number setting in the bottles and sizes configure option.) Refer to the displays above; a 24-bottle sampler programmed to distribute samples to three bottles at two sample events would allocate six bottles to the first bottle group. The remaining 18 bottles to the second bottle group.

Sample distribution and sample volumes for the first and second bottle groups – STORM sampling supports sequential sampling as well as all three types of multiplexing: bottles-per-sample multiplexing, samples-per-bottle multiplexing, and multiple-bottle compositing. These distribution schemes are available for both bottle groups. Because STORM programming is part of the extended programming mode, the sample distribution displays used (Display #s 30 and 31) are identical to other extended mode programming routines. Refer to Example *Time-Paced Multiplexed (samples-per-bottle) Sampling* for samples-per-bottle multiplexing, Example *Extended Flow-Paced Multiplexed (bottles-per-sample) Sampling* for bottles-per-sample multiplexing, and Example *Flow-Paced Sampling / Time-Based Bottle Sets* for multiple-bottle compositing. To enter a sample volume for the first bottle group, enter the volume in Display #50.

3.12.2 Second Section: Second Bottle Group

The second section contains input displays for the second bottle group. It includes displays that:

- Set the pacing for the second bottle group.
- Determine when the sampler begins filling the second bottle group: during the same time period as the first bottle group or after it fills the first bottle group.
- Set the maximum flow interval.
- Determine the sample distribution for the second bottle group: samples-per-bottle multiplexing, bottles-per-sample multiplexing, or multiple-bottle compositing.

OBSOLETE

After you've completed the entries for the first bottle group, the sampler will present the following message:

```
-- BOTTLES, ----- ml  
AVAILABLE
```

This message marks the beginning of the second section. It reports the number of bottles allocated for the second bottle group and the total volume of their combined capacity. The sampler displays this information to help you enter the sample distribution scheme and sample volumes for the second bottle group. If the remaining number of bottles or the capacity is not satisfactory, reprogram the first section.

Pacing for the Second Bottle Group – The next display, Display #14, allows you to select time or flow pacing for the second bottle group.

```
[TIME, FLOW]  
SECOND BOTTLE GROUP
```

Display #14

Depending on your selection, the STORM sequence will follow one of the two paths shown for the second section in **Figure 3-10** or 3-11.

Time-Pacing – When you select “TIME” from Display #14, two time-pacing displays (#17 and #24) will follow.

```
----- MINUTE DELAY TO  
SECOND GROUP SAMPLES
```

Display #17

```
SAMPLE INTERVAL OF  
----- MINUTE (1 - 9999)
```

Display #24

Use Display #17 to set the delay to the second bottle group. Like the delay to the first group sample, the delay to the second group sample determines the period between the time the sampler is enabled and the first sample is deposited in the second bottle group. You can use this setting to fill the second bottle group *during* the same time the sampler fills the first bottle group or *after* the sampler fills the first bottle group. Figure 3-17 shows a time diagram for a STORM routine that uses time pacing for both the first and second bottle groups.

To fill the second bottle group after the first, be sure amount of time you enter for the delay to second group is equal to (or greater than, if necessary) the delay to the first group plus the total amount of time required to fill the first group. The sampler will begin timing both delays (delay to first and delay to second bottle group) at the same time. Refer to the lower diagram in Figure 3-17.

Entries made in Display #s 15, 23, and 24 (“-- MINUTE DELAY TO FIRST GROUP SAMPLE,” “TAKE -- TIMED EVENTS,” and “SAMPLE INTERVALS OF -- MINUTES”) determine the amount of time required to fill the first bottle group.

OBSOLETE

For example, if the delay to the first group were 0 and the routine required two timed sample events at 30-minute intervals, the sampler would take 30 minutes to fill the first bottle group. The first sample event would occur after the programmed delay to group sample; the second sample event would occur 30 minutes later.

Use Display #24 to enter the time interval for the second bottle group. You can use any interval; you do not have to use the same time interval for the second bottle group that you used for the first group.

Flow Pacing for the second bottle group – If you need a flow-paced sample for the second bottle group, select “FLOW” from Display #14. Three flow pacing displays (#16, #22, and #110) will follow.

```
[DURING, AFTER]
      TIME MODE
```

Display #16

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

Display #22

```
MAX FLOW INTERVAL OF
-- HOURS  -- MINUTES
```

Display #110

Use Display #16 to determine when the sampler will begin filling the second bottle group. Select “DURING” if you want the second bottle group filled during the same time period as the first bottle group.

Select “AFTER” to begin the flow pacing for the second bottle group after the sampler fills the first bottle group. If you select “DURING,” the sampler will begin counting flow pulses when it begins timing the delay to first group sample. The sampler will take the first sample of the second bottle group as soon as it counts a full flow-pulse interval. If you select “AFTER,” the sampler will begin counting flow pulses after the last sample event of the first bottle group. Use Display #22 to enter the flow-pulse interval for the second bottle group.

The third flow paced display allows you to enter the maximum flow interval. The acceptable range of values for the maximum flow interval is one minute to 99 hours and 59 minutes.

The sampler will terminate the sampling routine when the amount of time between flow-paced samples exceeds the limit set for the maximum flow interval. The maximum flow interval will terminate the routine even if all bottles of either bottle group have not been filled. Once the sampler terminates a routine, the sampler cannot be reenabled by the flow meter should the flow meter detect enable control conditions again.

Note: If the second bottle group requires flow-paced samples, the sampler may fill the second bottle group before it fills the first bottle group. This can occur when the flow rate monitored by the flow meter is higher than anticipated and the flow pulse interval

has not been adjusted to reflect the higher rate. If this occurs, the sampler will continue the first bottle group until all samples have been taken. You can adjust the pulse interval by

- Reprogramming the flow meter to change the number of flow pulses sent to the sampler by the flow meter.
- Reprogramming the sampler to change the flow pulse interval in the flow-pacing segment of the STORM routine.
- Reprogramming both the flow meter and the sampler.

STORM Key Times – The third section, STORM Key Times, contains the displays used to:

- Enter suction-head measurements
- Enable the calibration routine
- Enter a start time for the storm routine

The input displays of the STORM program sequence vary according to configure option settings. The first two displays (“SUCTION HEAD OF -- FEET” and “CALIBRATE SAMPLE VOLUME”) appear if the sampler is configured to add them to the storm program sequence. Entries in the Liquid Detector configure option and the Calibrate Sampler configure option add or exclude these displays from the sequence. Example *Storm Sampling* does not include these displays.

To enter a specific start time for the routine, select “YES” in Display #90 (illustrated in Step 17 of Example *Storm Sampling*). The sampler will prompt you to enter a start time with Display #93 (step 18). If you select “NO,” the start time will be delayed by the amount set in the Start Time Delay configure option.

After you’ve made these entries, the sampler will present the “PROGRAMMING SEQUENCE COMPLETE” message and return to standby.

Programmed start times, start time delays, and delays to group sample – Samplers programmed for storm sampling respond to start-time delays and programmed start times in the same way as samplers programmed for any other basic or extended mode routines.

The sampler will delay the storm routine until the start time entered in the third segment of the STORM sequence. (See Display #93.) If the sampler is enabled by the flow meter at the start time, the sampler will begin to time the delay to the first bottle group. If the sampler is disabled by the flow meter at the start time, the sampler will suspend the routine until it becomes enabled. Once the sampler is enabled by the flow meter, the sampler will begin the delay to first timed sample event and continue the STORM routine.

STORM sampling routine has four delay periods that vary slightly with the programming entries. Every STORM routine will have a delay to start time and delay to first group sample.

OBSOLETE

Depending on whether the second bottle group is time paced or flow paced, the third delay period will be either the delay to second group sample or the “During/After” delay.

- **Delay-to-Start Time.** The start time is simply the time the sampler begins the routine. The sampler begins timing the delay-to-start time when you press the start sampling key. The sampler will not check for an enable or disable signal from a flow meter, Liquid Level Actuator, or another sampler until the start time. The delay-to-start time is the amount of time between the time you press the start sampling key and the start time. The delay-to-start time is determined by the programmed start-time entry for the STORM routine (Display #93) or the Start Time Delay configure option. The Start Time Delay, set in the configure option, can be from 0 to 999 minutes long. A programmed start time can be any date within 30 days of the sampler’s current date.
- **Delay-to-First-Group Sample.** The delay-to-first-group sample is the period between the time the sampler is enabled (not the start time) and the time first sample volume is delivered to the first bottle group. Your entry in Display #15 determines the Delay to First Group.
- **Delay-to-Second-Group Samples.** The delay-to-second-group sample is the period between the time the sampler is enabled (not the start time) and the time the first sample volume is delivered to the second bottle group. This delay is determined by your entry in Display #17. You can enter a delay-to-second-group sample only for time-paced second bottle groups.
- **DURING/AFTER.** This delay affects flow-paced second bottle groups. Like the delay to second group sample, the during/after delay determines when the sampler begins sampling for the second bottle group. Because the flow-paced sampling can consume unpredictable amounts of time, the storm routine must use two specific events to mark the beginning of the flow intervals. These events are the time the sampler is enabled and the time the sampler completes the first bottle group. If you want the sampler to fill the second bottle group during the first bottle group, select “DURING” from Display #16. The sampler will begin counting flow pulses when the sampler is enabled. (If the sampler is enabled at the start time, the sampler starts counting flow pulses at the start time.)
If you want the sampler to fill the second group after the sampler fills the first bottle group, select “AFTER.” The sampler will begin counting flow pulses after it fills the first bottle group.

OBSOLETE

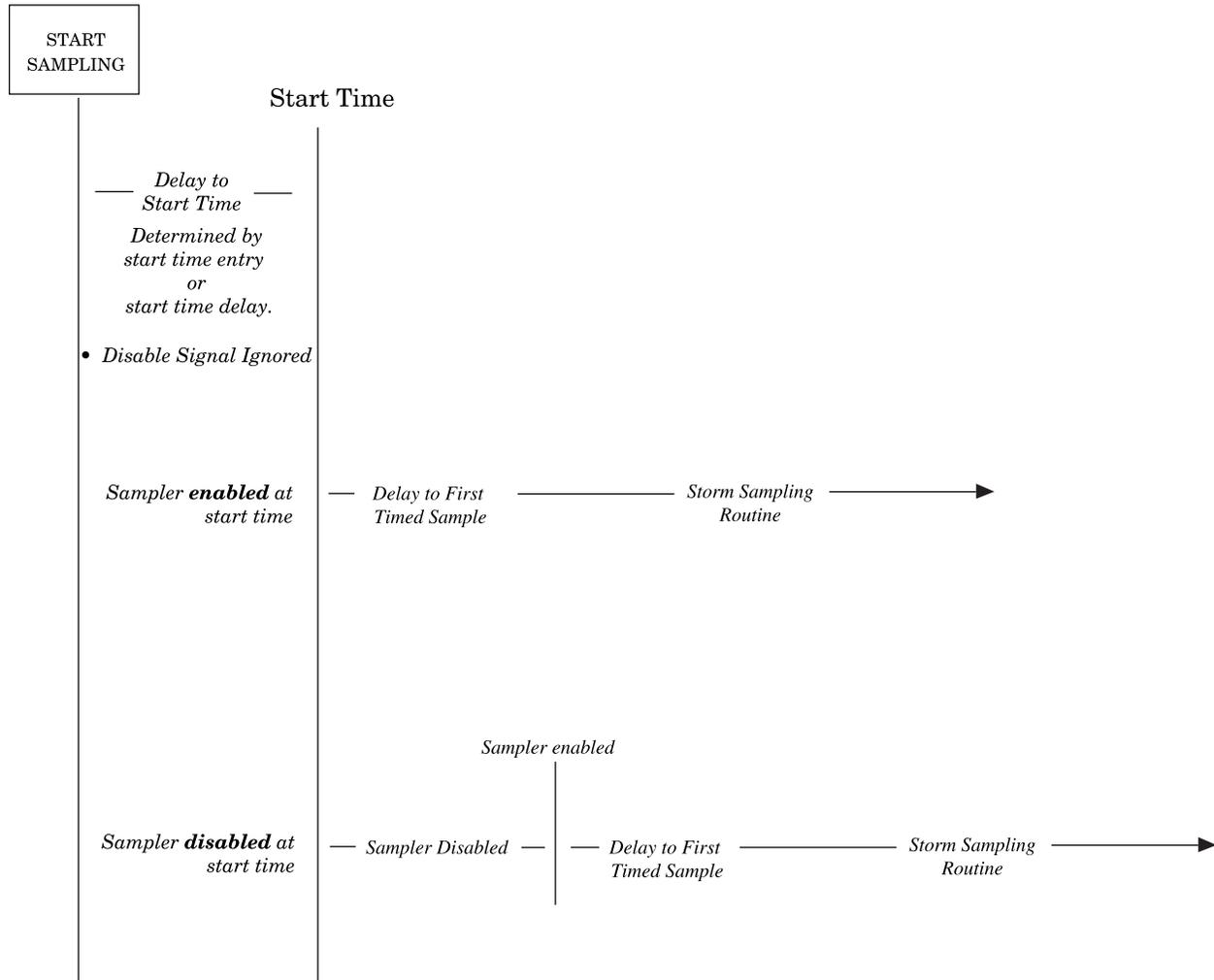


Figure 3-18 Start Time Diagram for STORM Routines

Note

Before programming a sampler in the extended programming mode, the sampler must be configured for extended programming. Refer to the section *Programming Mode* for a discussion of the Programming Mode configure option. Example *Checking the Configure Option Settings* shows the steps required to access the Programming Mode option.

OBSOLETE

3.13 Foreign Languages and Metric Units of Measure

The 3700FR Sampler provides displays in French, Spanish, and German. Additionally, the software 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 with English displays support either English or metric units for suction-line and suction-head measurements. (Always enter sample volumes in milliliters).

To program the sampler for foreign language displays, begin by placing the sampler in standby. Then, be sure the sampler is configured for extended programming. 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, a second input display will appear.

Select the units 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
```

OBSOLETE

3.14 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.

Example *Time-Paced Sampling: Uniform Intervals* shows how to program the sampler to take time-paced samples at uniform time intervals of 30 minutes starting at 8:00 AM tomorrow, placing one 500 ml sample in each bottle.

Example: Time-Paced Sampling: Uniform Intervals

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, NONUNIFORM  
TIME INTERVALS]
```
3. Select "TIME"

```
[TIME, FLOW STORM]  
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 "30" to set the minutes entry to 30.

```
SAMPLE EVERY  
0 HOURS, 30 MINUTES
```
7. Enter "1" to set the number of bottles per sample event to 1

```
1 BOTTLES PER  
SAMPLE EVENT (1-24)
```
8. Select "SAMPLES"

```
CHANGE BOTTLES BASED  
ON [TIME, SAMPLES]
```
9. Enter "1" to set the number of samples per bottle to 1.

```
CHANGE BOTTLES EVERY  
1 SAMPLES (1-8)
```
10. Enter "500" to set the sample volume at 500 ml.

```
SAMPLE VOLUMES OF  
500 ml (10-1000)
```
11. Select "YES"

```
ENTER START TIME  
[YES, NO]
```
12. Enter the start time and date: 8:00 tomorrow morning

OBSOLETE

Example: Time-Paced Sampling: Uniform Intervals (Continued)

```
TAKE FIRST SAMPLE AT  
8:00 20-06 JUN
```

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

```
PROGRAMMING SEQUENCE  
COMPLETE
```

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

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

14. To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here

```
BOTTLE 1  
AT 8:00 10:38:07
```

This display appears as the sampler counts down the time remaining to the start time. The first line reports the bottle which will receive the next sample volume. The second line reports the start time at the left and the current time on the right.

```
BOTTLE 1  
AT 8:00 10:38:07
```

When start time occurs, the sampler will take the first sample. Which will begins with a pre-sample purge. During the purge, the display indicates the bottle number which receives the sample volume.

```
BOTTLE 1
```

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

```
BOTTLE 1  
PUMPING 500 ml
```

This display appears when the post-sample purge from the previous sample is completed. It indicates the bottle number which is to receive the sample at 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.

```
BOTTLE 2  
AT 8:30 8:01:11
```

The cycle of displays is repeated for each bottle 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. . . 24 SAMPLES  
8:10:35 21-JUN-04
```

Example *Time-Paced Multiplexed (samples-per-bottle) Sampling* shows how to program the sampler to take time-paced samples at uniform time intervals of 15 minutes. At each sample event, one bottle will receive a sample volume of 75 ml. The bottles are to be switched every hour so that four sample volumes have been deposited into each bottle. The sampling routine will start according to the programmed start-time delay set in the Start Time Delay configure option.

OBSOLETE

Example: Time-Paced Multiplexed (samples-per-bottle) Sampling

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

```
. . . STANDBY . . .  
5:37:23 19-JUN-04
```

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

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

3. Select "TIME."

```
[TIME, FLOW, STORM]  
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, 30 MINUTES
```

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

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

7. Enter "1" to set the number of bottles per sample event to 1.

```
1 BOTTLES PER  
SAMPLE EVENT (1 - 24)
```

8. Select "SAMPLES." We recommend bottle set changes be based on samples for time-paced sampling routines.

```
CHANGE BOTTLES BASED  
ON [TIME, SAMPLES]
```

9. Enter "4" to set the number of samples per bottle to 4.

```
CHANGE BOTTLES EVERY  
4 SAMPLES (1 - 8)
```

10. Enter "75" to set the sample volume at 75 ml.

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

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

```
. . . STANDBY . . .  
5:39:25 20-JUN-04
```

13. To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.

```
START SAMPLING  
AT BOTTLE 1 (1-24)
```

OBSOLETE

Example: Time-Paced Multiplexed (samples-per-bottle) Sampling

This display is used with samples-per-bottle multiplexing. The first line indicate the number of the upcoming sample and the total number of samples each bottle is to receive. It also indicates the current bottle number. Thus, this display indicates that the upcoming sample is the first of four samples and bottle one is to receive the next sample. The second line indicates the scheduled time of the sample. The current time is shown in the right corner as the sampler counts down to the next sample event time.

```
1 OF 4, BOTTLE 1
AT 5:41 5:39:33
```

When the scheduled sample event time arrives, the second line will disappear while the sampler completes the pre-sample purge.

```
1 OF 4, BOTTLE 1
```

When the pump begins to pump forward to deliver the sample, the second line will indicate the sample delivery by displaying the word "PUMPING" and the sample volume being delivered. The message remains during the sample delivery and post-sample purge.

```
1 OF 4, BOTTLE 1
PUMPING 75 ml
```

When the sampling cycle is completed, the display will indicate the upcoming sample, shown here. This display indicates that the upcoming sample is the second of four samples; the current sample bottle is bottle 1. The sample event is scheduled for 6:15. The current time is just after 6:00.

```
2 OF 4, BOTTLE 1
AT 6:15 6:00:26
```

The next displays illustrated here show the displays as the sample volumes are deposited in bottle 1.

```
2 OF 4, BOTTLE 1
```

```
2 OF 4, BOTTLE 1
PUMPING 75 ml
```

```
3 OF 4, BOTTLE 1
AT 6:30 6:15:27
```



When the final sample has been deposited in the first bottle, the display changes to indicate the new sample bottle. This display indicates that the upcoming sample event will place the first of four sample volumes in bottle 2 at 7:00

```
1 OF 4, BOTTLE 2
AT 7:00 6:45:25
```

This display appears as the pump delivers the first sample to bottle 2.

```
1 OF 4, BOTTLE 2
```

The cycle of displays is repeated for each bottle 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 . . . 96 SAMPLES
6:10:35 21-JUN-04
```

OBSOLETE

Example *Extended Flow-Paced Multiplexed (bottles-per-sample) Sampling* shows how to program the sampler to take samples at intervals of 10 pulses. Samples will be multiplexed: 800 ml sample volumes will be placed into two bottles at each sample event. Each bottle is to receive one sample volume. The routine will use the start time delay.

Example: Extended Flow-Paced Multiplexed (bottles-per-sample) Sampling

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

```
. . . STANDBY . . .  
10:35:23 19-JUN-04
```

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

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

3. Select "FLOW."

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

4. Enter "10" to set the pulse interval to 10 pulses.

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

5. Enter "2" to set the number of bottles per sample event to 2.

```
2 BOTTLES PER  
SAMPLE EVENT (1 - 24)
```

6. Select "SAMPLES/BTL."

```
CHANGE SETS BASED  
ON [TIME, SAMPLES/BTL]
```

7. Enter "1" to set the number of samples per bottle to 1.

```
CHANGE SETS EVERY  
1 SAMPLES (1 - 8)
```

8. Enter "800" to set the sample volume at 800 ml.

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

9. 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
```

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

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

11. To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.

```
START SAMPLING  
AT BOTTLE 1 (1-23)
```

OBSOLETE

Example: Extended Flow-Paced Multiplexed (bottles-per-sample) Sampling (Continued)

This display appears after you press the start sampling key to start the routine. It reports the scheduled start time on the first line. The second line reports the current time and date.

```
START FLOW COUNT AT  
10:37:23 20-06 JUN
```

When the scheduled start time arrives, the sampler will begin to count flow pulses. This display indicates the bottles which will receive sample volumes at the upcoming sample event. (If the bottle set consisted of four bottles, the first line of the display would read, "BOTTLES 1 - 4.") The number of flow pulses remaining to the sample event is displayed on the second line.

```
BOTTLES 1- 2  
AFTER 10 PULSES
```

The second line of the display changes as each flow pulse is received.

```
BOTTLES 1- 2  
AFTER 9 PULSES
```



This display shows one pulse remaining until the sample event.

```
BOTTLES 1- 2  
AFTER 1 PULSES
```

When the tenth pulse is received, the display will show the current bottle number, only.

```
BOTTLE 1
```

When the pump begins to run forward to deliver the sample volume, the second line appears. After the pump completes the sample delivery, it reverses to purge the liquid from the pump tube past the liquid detector. The suction line is not completely purged; instead, the liquid is pumped just past the liquid detector. At the end of the pump tube purge, the distributor moves to the next bottle of the set. The display remains unchanged until the distributor relocates to the next bottle of the set.

```
BOTTLE 1  
PUMPING 800 ml
```

As the distributor moves to the next bottle, the bottle number reported in the display changes to indicate the bottle number. The message, "PUMPING 800 ml," will remain on the display. When the distributor reaches the correct position over the current bottle, the pump runs forward to deliver the sample volume. When the delivery is completed, the pump reverses to complete the post-sample purge.

```
BOTTLE 2  
PUMPING 800 ml
```

At the end of the post-sample purge, the display changes to indicate the bottle numbers of the next bottle set. The display will change as it receives each flow pulse.

```
BOTTLES 3- 4  
AFTER 10 PULSES
```

The cycle is repeated until the sampling routine is completed.



When the routine is complete, the display will indicate the status of the routine ("DONE"), the number of sample events, and the current time and date.

```
DONE . . . 12 SAMPLES  
6:10:35 21-JUN-04
```

OBSOLETE

In Example *Flow-Paced Sampling / Time-Based Bottle Sets*, samples are to be taken at intervals of 1,000 flow pulses. Samples will be multiplexed by placing 100 ml sample volumes into two bottles at each sample event. To avoid missing any samples, the sampling routine starts immediately after you press the start sampling key. To place the bottle set changes at the top of the hour, the sampler will be allowed to take samples until 12:00, the time of the first bottle set change. After the first change, bottle sets will change every two hours.

NOTE: The number of samples in each bottle set will vary as the flow rate varies. If at least one sample is desired in each bottle, the sampler should be directed to take a sample at the start and switch times. See the section Flow Mode Sampling, which describes this option.

Example: Flow-Paced Sampling / Time-Based Bottle Sets

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 "FLOW."

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

4. Enter "1000" to set the pulse interval to 1000 pulses.

```
SAMPLE EVERY  
1000 PULSES (1 - 9999)
```

5. Enter "2" to set the bottles per sample event to 2. Each bottle set will consist of two bottles.

```
2 BOTTLES PER  
SAMPLE EVENT (1 - 24)
```

6. Select "TIME."

```
CHANGE SETS BASED  
ON [TIME, SAMPLES/BTL]
```

7. Enter "2" to switch bottle sets every two hours. Press the ENTER/PROGRAM key to advance to the minutes entry

```
CHANGE SETS EVERY  
2 HOURS0 MINUTES
```

8. Press ENTER/PROGRAM to accept an entry of "0" for minutes.

```
CHANGE SETS EVERY  
2 HOURS0 MINUTES
```

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

```
SAMPLE VOLUMES OF  
100 ml EACH (10 - 330)
```

10. Select "NO."

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

11. Select "YES."

OBSOLETE

Example: Flow-Paced Sampling / Time-Based Bottle Sets (Continued)

```
ENTER FIRST SWITCH  
TIME? [YES, NO]
```

12. Enter the time at which you want the sampler to move to the second bottle set. At the first bottle set change, 12:00, the bottle set changes will be placed on schedule.

```
FIRST SET CHANGE AT  
12:00 19-06 JUN
```

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

```
PROGRAMMING SEQUENCE  
COMPLETE
```

13. When the sampler has been correctly installed, press the START SAMPLING key to run the program.

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

14. To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.

```
START SAMPLING  
AT BOTTLE 1 (1-23)
```

This display appears after you press the START SAMPLING key to start the routine. The scheduled start time is reported on the first line. The second line reports the current time and date

```
START FLOW COUNT AT  
10:39 19-06 JUN
```

This display alternates with the display illustrated below. The first line indicates the sample event number and the bottle numbers of the current bottle set. The second line is used to indicate the number of flow pulses remaining until the sample event is initiated.

```
SAMPLE 1, BTLS 1- 2  
AFTER 1000 PULSES
```

This display indicates the time and date of the next bottle set change.

```
NEXT SET CHANGE  
AT 12:00 19-JUN
```

This display appears when the sample event is initiated. It reports the sample number and the receiving bottle number on the first line during the pre-sample purge.

```
SAMPLE 1, BOTTLE 1
```

When the pump begins to run forward to deliver the sample, the second line appears; it reports the sample volume.

```
SAMPLE 1, BOTTLE 1  
PUMPING 100 ml
```

When the sample delivery has been completed for the first bottle of the set, the distributor moves to the second bottle.

```
SAMPLE 1, BOTTLE 2  
PUMPING 100 ml
```

After the bottles of the set have each received a sample volume, the alternating pair of displays reappear.

```
SAMPLE 2, BTLS 1- 2  
AFTER 1000 PULSES
```

```
NEXT SET CHANGE  
AT 12:00 19-JUN
```

OBSOLETE

Example: Flow-Paced Sampling / Time-Based Bottle Sets (Continued)

When the next sample event occurs, this display reports the current sample event and the current bottle. When the sample delivery is completed, the distributor will move to the next bottle of the set and the following display will appear.

```
SAMPLE 2, BOTTLE 1
```

```
SAMPLE 2, BOTTLE 1  
PUMPING 100 ml
```

This cycle will be repeated, as samples are deposited in the bottles of the set. The sample number will increase with each sample deposited until the set change.

```
SAMPLE 2, BOTTLE 2  
PUMPING 100 ml
```

When the bottle sets are changed, the sample event number is reset to one. The bottle numbers of the new current set is reported.

```
SAMPLE 1, BTLS 3- 4  
AFTER 1000 PULSES
```

```
SAMPLE 1, BTLS 3- 4  
AFTER 1000 PULSES
```

The cycle of displays is repeated for each bottle 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 . . . 96 SAMPLES  
6:10:35 21-JUN-04
```

Example *Time-Paced Samples at Nonuniform Intervals* shows how to program the sampler to take time-paced samples at non-uniform time intervals. This example assumes the sampler is configured for extended programming and that it connected to a Liquid Level Actuator. The actuator will inhibit the sampler until the liquid level rises to contact the actuator probe.

The sampler is to take 24 samples: the first samples are to occur at 10-minute intervals for an hour, the next samples at 20-minute intervals for an hour, and the remaining samples at 30-minute intervals. One 500 ml sample is to be placed in each bottle. 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.

OBSOLETE

Example: Time-Paced Samples at Nonuniform Intervals

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, STORM]  
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: "24." This entry should always include the sample taken at the start time.

```
TAKE 24 SAMPLES  
(1-999)
```

7. Enter the number of samples to occur at the first interval. The sampler is to take samples at 10-minute intervals for an 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 interval.

```
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, "15" samples at "30" minutes.

```
2. 3 AT 20 MINUTES  
3. 15 AT 30 MINUTES
```

10. Enter "1" to set the number of bottles per sample event to 1.

```
1 BOTTLES PER  
SAMPLE EVENT (1 - 24)
```

11. Select "SAMPLES."

```
CHANGE BOTTLES BASED  
ON [TIME, SAMPLES]
```

12. Enter "1" to set the number of samples per bottle to 1.

```
CHANGE BOTTLES EVERY  
1 SAMPLES (1 - 50)
```

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

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

14. Select "NO."

OBSOLETE

Example: Time-Paced Samples at Nonuniform Intervals (Continued)

```
ENTER START TIME?  
[YES, _NO]
```

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

```
PROGRAMMING SEQUENCE  
COMPLETE
```

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

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

16. To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here

```
START SAMPLING  
BOTTLE 1 (1-24)
```

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

```
SAMPLER INHIBITED!  
10:35 20-JUN-04
```

This display appears when the sampler becomes enabled and counts down the time remaining to the start time. The first line reports the bottle which will receive the next sample volume. The second line reports the start time at the left and the current time on the right.

```
BOTTLE 1  
AT 11:26 11:25:47
```

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 receiving bottle number.

```
BOTTLE 1
```

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

```
BOTTLE 1  
PUMPING 500 ml
```

This display appears when the post-sample purge from the previous sample event is completed. It indicates the bottle number which is to receive the sample at 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.

```
BOTTLE 2  
AT 11:36: 11:26:11
```

The cycle of displays is repeated for each bottle 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 . . . 24 SAMPLES  
8:10:35 21-JUN-04
```

OBSOLETE

Nonuniform times can be entered in either the method shown in Example *Time-Paced Samples at Nonuniform Intervals*, or by specifying a clock time and date for each sample. On the following page, Example *Time-Paced Samples at Nonuniform Clock Times* 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 in that configure option.

Example: Time-Paced Samples at Nonuniform 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-JUN
```

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-JUN
2. 07:00 19-JUN
```

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

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

4. Continue to enter times and dates for each sample event. After all sample event times have been entered, the sample distribution section of the programming sequence will appear.



Example *Sampling with Stops and Resumes* shows how to program the sampler to take time-paced samples at uniform time intervals of 15 minutes starting at 6:00 AM on the following day. One 500 ml sample is to be placed in each bottle. The sampling is to continue from 6:00 AM until 8:00 AM. The sampling will resume again at 11:00 AM and continue until 1:30 PM. It will pause until 4:00 PM and continue again until 6:00 PM. When the sampling stops at 6:00 PM, fewer than 24 samples may have been taken. Note that the Sampling Stop and Resumes configure option has settings that allow you to take a sample at the stop and resume times. See the section *Sampling Stop/Resume*.

OBSOLETE

Example: Sampling with 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, STORM]  
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 "1" to set the number of bottles per sample event to 1.

```
1 BOTTLES PER  
SAMPLE EVENT (1 - 24)
```

8. Select "SAMPLES."

```
CHANGE BOTTLES BASED  
ON [TIME, SAMPLES/BTL]
```

9. Enter "1" to set the number of samples per bottle to 1.

```
CHANGE BOTTLES EVERY  
1 SAMPLES (1 - 8)
```

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

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

11. Select "YES."

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

12. Enter the start time and date of the sampling program: 6:00 AM tomorrow.

```
TAKE FIRST SAMPLE AT  
06:00 19-JUN
```

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

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

14. Enter the time and date of the first stop time: 8:00 AM.

```
STOP SAMPLING AT  
1.08:0019-JUN
```

15. Enter the time and date the program should resume: 11:00 AM.

OBSOLETE

Example: Sampling with Stops and Resumes (Continued)

```
RESUME SAMPLING AT  
1.11:0019-JUN
```

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

```
STOP SAMPLING AT  
2.13:3019-JUN
```

17. Enter the time and date the program should resume: 4:00 PM or 16:00 in military time.

```
STOP SAMPLING AT  
2.13:3019-JUN
```

18. Enter the time and date the program should resume: 4:00 PM or 16:00 in military time.

```
STOP SAMPLING AT  
3.18:0019-JUN
```

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

```
PROGRAMMING SEQUENCE  
COMPLETE
```

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

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

20. To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.

```
START SAMPLING  
BOTTLE 1 (1-24)
```

This display appears as the sampler counts down the time remaining to the start time. The first line reports the bottle which will receive the next sample volume. The second line reports the start time at the left and the current time on the right.

```
BOTTLE 1  
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. During the purge, the display indicates the bottle number which will receive the sample volume.

```
BOTTLE 1
```

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.

```
BOTTLE 1  
PUMPING 500 ml
```

This display appears when the post-sample purge from the previous sample event is completed. It indicates the bottle number which is to receive the sample at 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.

```
BOTTLE 2  
AT 6:15 8:01:11
```

The cycle of displays is repeated for each bottle 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.

OBSOLETE

Example: Sampling with Stops and Resumes (Continued)

```
DONE . . . 18 SAMPLES  
18:10:35      21-JUN-04
```

Example *Storm Sampling* illustrates how to program a 24-bottle sampler to allocate six bottles to the first bottle group. The remaining 18 bottles, allocated to the second bottle group, will be used for flow-weighted samples. The sampler delays the first group 25 minutes after it is enabled.

For the first bottle group, the sampler will take two samples with a 5-minute interval between each sample event. At the first sample event, bottles 1 through 3 will each receive 900 ml each (bottles-per-sample multiplexing). At the second timed event, bottles 4 through 6 will receive 900 ml each.

The sampler will fill the second bottle group with flow-paced samples during the same time as the second bottle group. At each sample event, a single bottle in the second bottle group will receive a 400 ml sample. Each bottle will receive samples from two sample events (samples-per-bottle multiplexing).

Example: Storm Sampling

1. Press ENTER/PROGRAM to access the interactive state

```
. . . STANDBY . . .  
10:34:50  12-JUN-04
```

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

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

Display 1

3. Select "STORM."

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

Display 12

After displaying this message briefly, the sampler will automatically advance to the next display.

```
TIME MODE  
FIRST BOTTLE GROUP
```

4. Enter "25" to delay the first group sample 25 minutes. (Acceptable range of values: 0 to 999.)

```
25 MINUTE DELAY TO  
FIRST GROUP SAMPLE
```

Display 15

5. Enter "2" to take two timed samples.

```
TAKE 2 TIMED  
EVENTS ( 1 - 50 )
```

Display 23

6. Enter "5" to set the time interval between samples to five minutes.

```
SAMPLE INTERVALS OF  
5 MINUTES (1 - 999)
```

Display 24

7. Enter the number of bottles per sample event: "3."

```
3 BOTTLES PER  
SAMPLE EVENT (1-23)
```

Display 30

OBSOLETE

Example: Storm Sampling (Continued)

8. Enter "1" to place one sample in each bottle.

```
1 SAMPLES PER  
BOTTLE (1 - 2)
```

Display 31

9. Enter the sample volume of "900" ml.

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

Display 50

The sampler will display this message before automatically advancing to the next display.

```
18 BOTTLES, 18000 ml  
AVAILABLE
```

10. Select "FLOW."

```
[TIME, FLOW]  
SECOND BOTTLE GROUP
```

Display 14

11. Select "DURING" to fill the second bottle group at the same time as the first bottle group.

```
[DURING, AFTER]  
TIME MODE
```

Display 16

12. Enter "5" as the flow-pulse interval. The sampler will take a sample every fifth flow pulse.

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

Display 22

13. This display requires two entries. Enter "2" hours and "0" to set the maximum amount of time between flow-paced sample events.

```
MAX FLOW INTERVAL OF  
2 HOURS 0 MINUTES
```

Display 110

14. Enter the number of bottles filled at each sample event: "1."

```
1 BOTTLES PER  
SAMPLE EVENT (1-22)
```

Display 30

15. Enter "2" to set the number of samples delivered to each bottle.

```
2 SAMPLES PER  
BOTTLE (1 - 50)
```

Display 31

16. Enter the sample volume of "400" ml.

```
SAMPLE VOLUMES OF  
400 ml (10 - 990)
```

Display 50

17. Select "YES" to enter a start time in the following step.

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

Display 90

18. This display requires two entries. Enter a time of "06:00" and a date of "20-06" to start the storm routine at 6:00 AM on June 20.

```
STORM ENABLED AFTER  
06:00 20-09
```

Display 93

After displaying this message, the sampler will automatically return to the standby state.

```
PROGRAMMING SEQUENCE  
COMPLETE . .
```

19. This display appears when you press START SAMPLING.

```
START STORM PROGRAM  
AT 6:00 5:33:07
```

OBSOLETE

Example: Storm Sampling (Continued)

The displays shown in step 22 alternate as the sampler's clock approaches the start time. The first line reports the bottles which will receive the first sample volumes for each bottle group. The second line reports the start time at the left and the current time on the right.

```
BOTTLE 1
AT 6:25      5:38:07
```

```
1 of 2, BOTTLE 3
AFTER      5 PULSES
```

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.

```
BOTTLE 1
PUMPING 900 ml
```

The sampler will continue to alternate displays until the routine terminates

```
BOTTLE 2
AT 6:30      6:26:1
```

```
1 of 2, BOTTLE 3
AFTER      5 PULSES
```

The cycle of displays is repeated for each bottle 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 . . . 42 SAMPLES
18:10:35      25-JUN-04
```

3.15 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 in the following sections.

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      16-JUN-04
```

OBSOLETE

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

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-JUN-04
```

3.15.1 Operable Keys in Standby State

Keypad operations valid in Standby state are discussed below. For additional keypad descriptions, see **Keypad Description** on Page 3-13.

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

Pump Forward and Pump Reverse – While in the standby state, pressing the PUMP FORWARD or PUMP REVERSE key will cause the pump to run continuously in the chosen direction. The pump will run until you press the STOP key. See Page 3-13 for more details.

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 to the bottle currently under the distributor. 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.

While the sample is being delivered, the sampler displays a message similar to that illustrated 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
```

Next Bottle - Pressing the NEXT BOTTLE key will cause the distributor to move to the next bottle. If the distributor is positioned over the last bottle, it will move to bottle position 1. The sampler will display the distributor's location as illustrated below. After a short time, the display will revert to standby.

```
NOW ON BOTTLE      2
```

OBSOLETE

Start Sampling – Once you have programmed and configured the sampler, use the START SAMPLING key to run the sampling program. The first display you'll see after pressing the START SAMPLING key is illustrated below.

If you want to have the sampling program begin with a bottle other than Bottle 1, enter the first bottle number here. If "1" is acceptable, press the ENTER/PROGRAM key to place the sampler into the run state. If you do not press a key within 60 seconds, the sampler will automatically enter the run state and will begin the sampling routine with Bottle 1.

```
START SAMPLING
AT BOTTLE 1 (1 - 24)
```

There are three instances where the sampler will not be able to run the program immediately. These occur when the program has been started after: 1) the programmed start time, 2) the first switch time, and 3) one or more programmed stop times. The sampler responds to these situations as discussed in Examples: *Program Started Later Than Programmed Start Time*, *Program Started Later Than Programmed 1st Switch Time*, and *Program Started Later Than Programmed Stop Time*.

Resume Sampling – To resume the program, press the RESUME SAMPLING key. When you press RESUME SAMPLING, 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 illustrated below. The sampler will initiate one sample event if it missed one or more sample events.

```
2 SAMPLES WILL BE
SKIPPED
```

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 advance 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

OBSOLETE

Example: Program Started Later Than Programmed Start Time

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      Display 93
 12:30      19-JUN
```

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      Display 9
 12:30      19-JUN
```

Example: Program Started Later Than Programmed 1st Switch Time

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

```
PAST SWITCH TIME . . .
```

1. Select "YES" to change the switch time. Select "NO" to continue the routine.

```
CHANGE SWITCH TIME?      Display 143
 [YES, NO]
```

2. This display appears when you select "YES" in display #143 and the bottles-per-sample event is set at "1." Enter the new switch time.

```
FIRST BOTTLE CHANGE      Display 46
 AT 5:30      19-JUN
```

3. This display appears when you select "YES" in display #143 and the bottles-per-sample event is set to a number greater than one. Enter the new switch time

```
FIRST SET CHANGE AT      Display 47
 5:30      19-JUN
```

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
```

3.16 Displayed Selections and Messages

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. 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 by presenting the display illustrated below.

```
[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 reinitialize the display-status memory.

3.16.1 Additional Displays

There are three additional displays used in the run state:

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-JUN-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 3-second intervals until you press any key.

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

Float/Weight Tripped – 3700 Samplers set up for composite sample use the display below to notify you that the program finished because the liquid-level float (float cage) was tripped. This display alternates with the “DONE” display at approximately 3-second intervals.

```
FLOAT/WEIGHT TRIPPED
```

3.16.2 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.

OBSOLETE

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 a laptop computer running Teledyne Isco's Samplink software. Two reports are produced, containing 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!
```

Items Reported – 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

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

OBSOLETE

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 and right arrows, 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.

Note

The Isco Field Printer has been discontinued and is no longer sold by Teledyne Isco. These instructions are for customers who still have Field Printers.

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 informing 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!

OBSOLETE

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
```

6. This display reports the bottle number(s) for 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, BOTTLE: 1  
SOURCE: START
```

7. 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
```

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



9. Press ENTER/PROGRAM to return to the "REVIEW PROGRAM" display.

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

10. Select "NO" to return to standby.

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

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

3.16.3 Source of Sample Event

The display illustrated in step 6 of Example *Reviewing the Sampling Results* shows the sample event number, the bottle(s) used, 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. Nine sources are tracked and reported:

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 a 4200 Series Flow Meter, a 4100 Series Flow Logger, 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.

Time Switch – The sample event was initiated at the programmed switch time. This event is controlled by the Sample at Time Switch setting in the Flow Mode Sampling configure option. This option is available for flow-paced sampling only.

Disable – The sample event was initiated when the sampler became disabled by a device connected to pin F of the flow meter connector, generally a 4200 Series Flow Meter, a 4100 Series Flow Logger, or a Liquid Level Actuator. 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.

OBSOLETE

3.16.4 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!
```

Twelve 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 a flow meter or a liquid level actuator.

Distributor Jammed! – The sampler was unable to take the sample because the distributor jammed.

Probable Overflow! – Overflow is determined by comparing the bottle volume to the product of the sample volume and the number of samples. If the product exceeds the bottle volume, the sampler will not pump a sample for that sample event and will record the "Probable Overflow!" message.

Float/Weight Tripped! – 3700 Samplers that are set up for single-bottle compositing 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.

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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 several displays that allow you to monitor the sampler's progress. The displays are listed with a brief explanation in Examples: *Run State Displays: Time-Paced Sampling*, *Run State Displays: Flow-Paced Sampling*, and *Run State Displays: Composite Sampling*.

If you encounter a problem while running a sampling routine that results in missed samples, an asterisk will appear in the lower right corner of the display, as illustrated below.

```
BOTTLE 11
AT 6:00      5:42:33 *
```

There is one condition under which the 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 flow meter, 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 that the sampler is inhibited.

```
SAMPLER INHIBITED!
10:32      19-JUN
```

**Sampler Inhibited
Display**

Example: Run State Displays: Time-Paced Sampling

Indicates the bottle number of the next sequential sample. The second line reports the scheduled sample event time followed by the current time.

```
BOTTLE 5
AT 5:44      5:42:33
```

Indicates the scheduled time and receiving bottle numbers for an upcoming sample event. The sampling program requires four bottles per sample event.

```
BOTTLES 1- 4
AT 6:00      5:55:33
```

Indicates the number of the upcoming sample, the total number of samples each bottle is to receive, and the current bottle number. The program requires four samples per bottle.

```
1 OF 4, BOTTLE 1
AT 6:00      5:55:33
```

Indicates the sample and bottle numbers of the next sample event. The bottle set consists of four bottles. The sampling program requires that four samples be placed in each bottle of the set.

```
1 OF 4, BTLS 1- 4
AT 6:00      5:55:33
```

Indicates the sample and bottle number of the next sample event. The current time appears in the lower right corner. The sampling program requires that you use one bottle per sample event and that you switch the bottles on a time basis. This display alternates with the display illustrated in item 6 at 3-second intervals.

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Example: Run State Displays: Time-Paced Sampling (Continued)

```
SAMPLE 3, BOTTLE 1  
AT 6:00 5:42:33
```

Indicates the time of the next bottle switch.

```
NEXT BOTTLE CHANGE  
AT 10:00 19-JUN
```

Indicates the sample and bottle numbers of the next sample event. The current time is shown in the lower right corner. The sampling program requires four bottles per sample event and that the bottle sets be switched on a time basis. This display alternates with the display illustrated in item 8 at 3-second intervals.

```
SAMPLE 2, BTLS 1 - 4  
AT 6:00 5:42:33
```

Indicates the time of the next bottle-set switch.

```
NEXT SET CHANGE  
AT 8:00 19-JUN
```

Indicates a sample in progress.

```
BOTTLE 1  
PUMPING 200 ml
```

Example: Run State Displays: Flow-Paced Sampling

Indicates the programmed start time of a flow-paced sampling program when no sample is to be taken at the start time. The first line reports the programmed start time and date, the second line reports the current time and date.

```
START AT 6:00 19-JUN  
5:42:43 19-JUN
```

Indicates the programmed start time of a flow-paced sampling program when a sample is to be taken at the start time. The current time appears in the lower right corner. The sampling program requires one bottle per sample event.

```
BOTTLE 1  
AT 6:00 5:42:33
```

Indicates the bottle number of the next sequential sample. The second line reports the number of flow pulses remaining until the next sample event.

```
BOTTLE 1  
AFTER 5 PULSES
```

Indicates the bottles that will receive samples at the next sample event. The second line reports the pulses remaining until the next sample event. The sampling program requires three bottles per sample event.

```
BOTTLES 5- 7  
AFTER 25 PULSES
```

Indicates the number of the upcoming sample, the total number of samples each bottle is to receive, and the current bottle number. This display indicates that four samples are to be deposited in each bottle.

```
1 OF 4, BOTTLE 1  
AFTER 10 PULSES
```

Indicates the sample and bottle numbers of the next sample event. The bottle set consists of four bottles. The sampling program requires that four samples be placed in each bottle of the set.

```
1 OF 4, BTLS 1- 4  
AFTER 1000 PULSES
```

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Example: Run State Displays: Flow-Paced Sampling (Continued)

Indicates the sample and bottle number of the next sample event. The sampling program requires that you use one bottle per sample event and that you switch the bottles on a time basis. Alternates with the display illustrated in item 8 at 3-second intervals.

```
SAMPLE 2, BOTTLE 1  
AFTER 10 PULSES
```

Indicates the time of the next bottle switch.

```
NEXT BOTTLE CHANGE  
AT 10:00 19-JUN
```

Indicates the time of the next bottle switch.

```
SAMPLE 2, BTLS 1 - 4  
AFTER 10 PULSES
```

Indicates the time of the next bottle-set switch.

```
NEXT SET CHANGE  
AT 10:00 19-JUN
```

Indicates a sample in progress.

```
BOTTLE 1  
PUMPING 200 ml
```

Example: Run State Displays: Composite Sampling

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.

```
SAMPLE 1 OF 12  
AT 6:00 5:43:33
```

Indicates the sample number of the next sample and the total number of samples for flow-paced routines.

```
SAMPLE 1 OF 12  
AFTER 10 PULSES
```

Indicates a sample in progress.

```
BOTTLE 1  
PUMPING 200 ml
```

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Section 4 Options and Interfacing Equipment

This section discusses major options available with the Isco 3700FR.

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

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.

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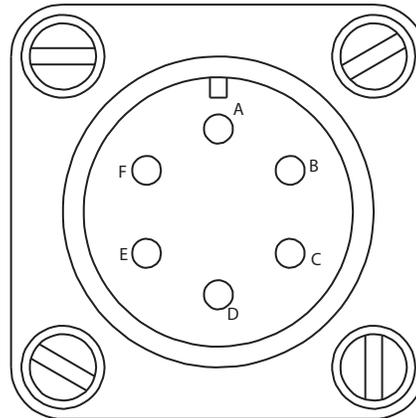


Figure 4-1 6-pin Connector Diagram

Table 4-1 Flow Meter Connector Wiring

A	+12 VDC
B	Common
C	Flow Pulses In
D	Bottle Number Out
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 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 3700 (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 3700 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 3700 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 3700 Sampler.

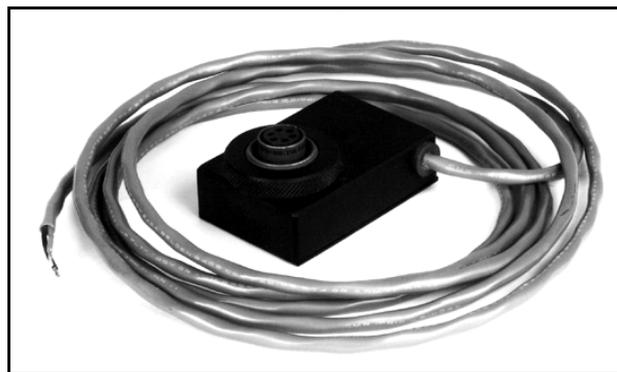


Figure 4-2 4-20 mA Sampler Input Interface

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.

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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 on the rear of the sampler. Refer to the Liquid Level Actuator Instruction Manual provided with the actuator for additional information. You can use the actuator with an Isco flow meter if you have the Y-Connect Cable.

You must configure the sampler to respond to the actuator. Information configuring the sampler for use with the actuator can be found in the discussion of the *Enable Pin* configure option in Section 3.8.18.

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Section 5 Routine Maintenance

The 3700FR/3720, 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 3700FR/3720 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 sample 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.

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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.

5.3.1 Cleaning Examples

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 as follows 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.

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

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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 Bottle Locating Base and Sample 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 3700FR 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 cases 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.
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 following steps outline the procedure needed to install a new pump tube.

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 **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. 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 will prolong the life of the pump tube and assures efficient operation and accurate sample volumes.
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 detector. See Figure 5-2.
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. The thumbscrews must be tightened securely for the liquid detector to operate correctly.
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.
8. Reset the Pump Tube count to zero. Refer to the discussion of the Tubing Life configure option in Section 3.8.21.

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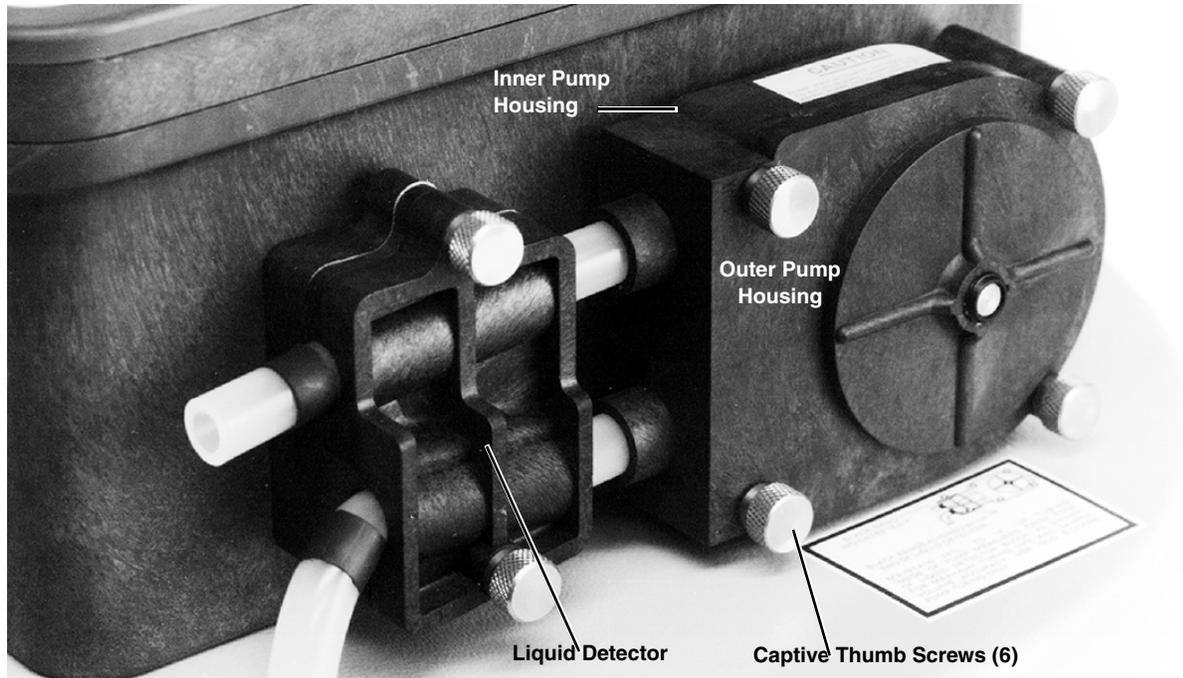


Figure 5-1 Liquid Detector and Pump Case

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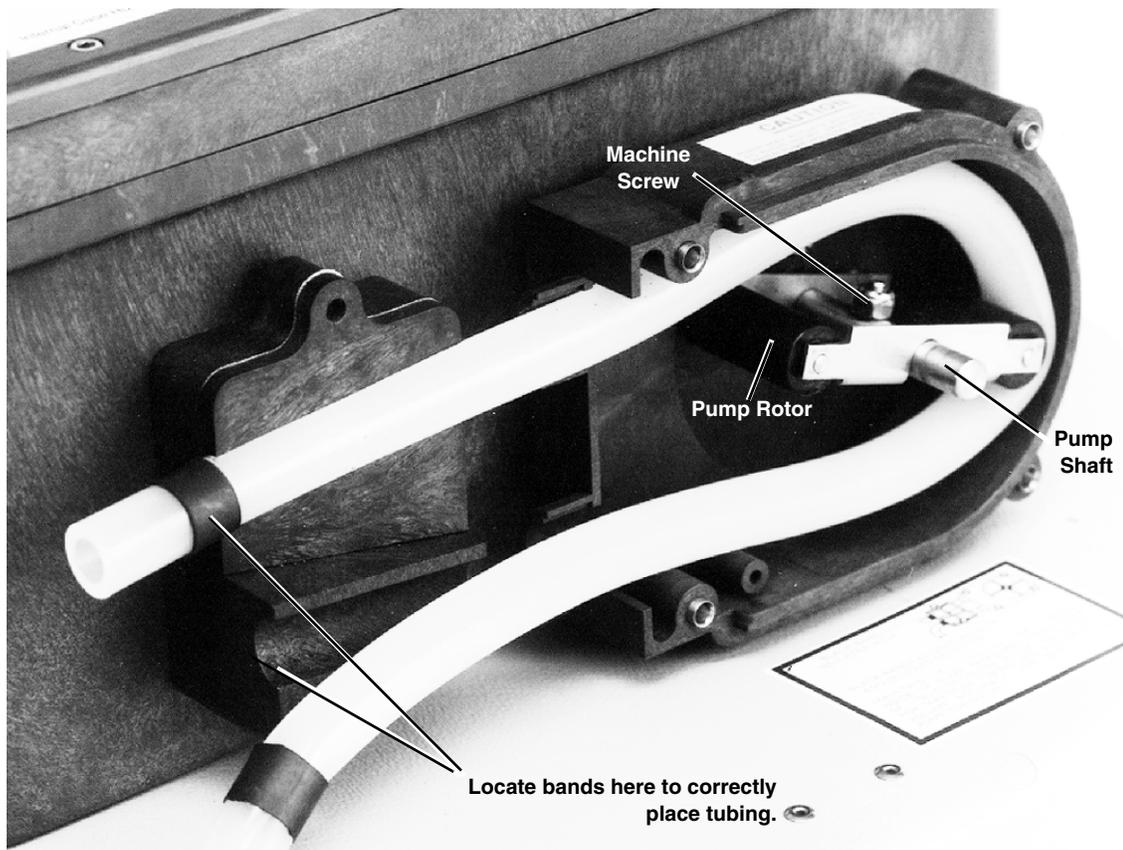


Figure 5-2 Interior of Liquid Detector and Pump Tube

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.

5.6.1 Cleaning Suction Line

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

5.6.2 Replacement Vinyl Line

Replacement vinyl suction lines are available from Teledyne Isco in two forms. First, a complete suction line, with weighted 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-foot rolls (see Appendix B).

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- 5.6.3 Replacement PTFE 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 $\frac{1}{4}$ and $\frac{3}{8}$ Inch ID Vinyl Suction Line** The following sections discuss the replacement of the complete suction line-strainer assemblies, the sizing of the suction line, and the assembly and installation of the bulk tubing. The suction line is removed from the pump tubing by detaching the tube coupling, as described in Section 2.2. If a complete new suction line-strainer assembly of the standard 10- or 25-foot length is used, it should be installed as described in Section 2.2.1.
- 5.7.1 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 1-foot increments and that the line length is correctly entered in the Suction Line configure option. Screw the strainer into the new suction line. The new suction line can now be installed as described in Section 2.2.
- 5.8 $\frac{3}{8}$ Inch ID PTFE Suction Line** The suction line is removed from the pump by loosening the clamp securing the line to the pump tube and pulling the suction line out of the pump tube. If a new suction line (either with or without the optional stainless steel strainer) is to be used, it is installed as described in Section 2.2. 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.
- 5.9 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. To do this, unscrew the 10 screws around the outer rim of the control box bezel, and carefully lift the cover off the control box and bezel. The control box contains electronic circuitry that may be damaged by static discharge. Open the control box only in a static-free environment.

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5.9.1 Renewing the Desiccant

The desiccant is renewed by first removing the bags of desiccant from the control box, as shown in Figure 5-4. Then 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 a vented, circulating forced air, convection oven in a well ventilated room. Allow two inches of air space between the top 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 desiccant bag may require replacement. Replacement bags of desiccant are available from Teledyne Isco; refer to Appendix B.

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 frame in place using an even cross-torquing pattern.



Figure 5-3 3700 Control Box Lid

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3700FR/3720 Refrigerated Sampler
Section 5 Routine Maintenance

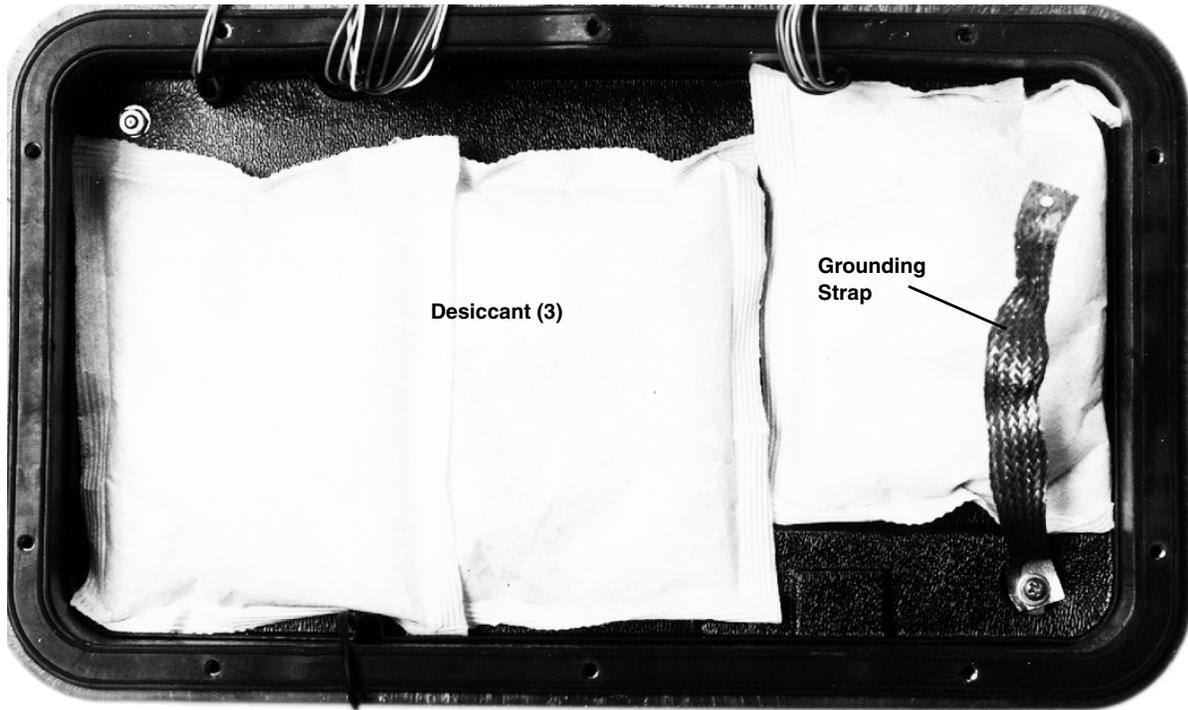


Figure 5-4 Control Box Internal Desiccant (control box lid removed)

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3700FR/3720 Refrigerated Sampler
Section 5 Routine Maintenance

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3700FR/3720 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 Replacement Parts List and a list of Accessories available for the 3700FR Sampler appear in Appendices A and B.

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.

6.1 Electrical System ⚠️⚡️

Access to the electrical and refrigeration components can be gained by removing the nine screws on the back of the refrigerator.

⚠️ WARNING

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

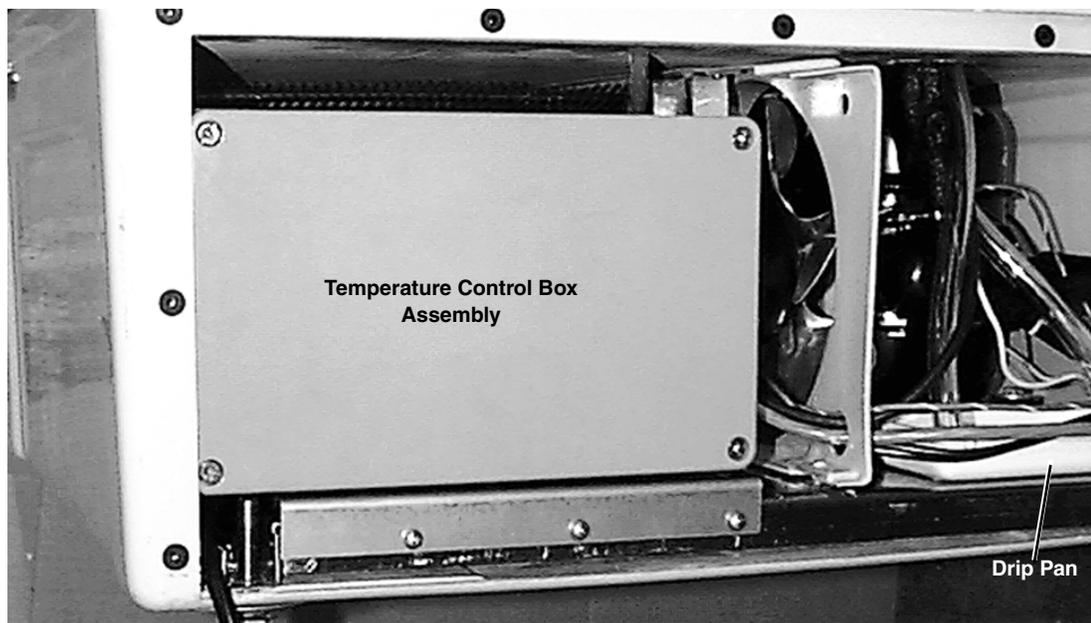


Figure 6-1 Rear View of the 3700FR/3720

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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.

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

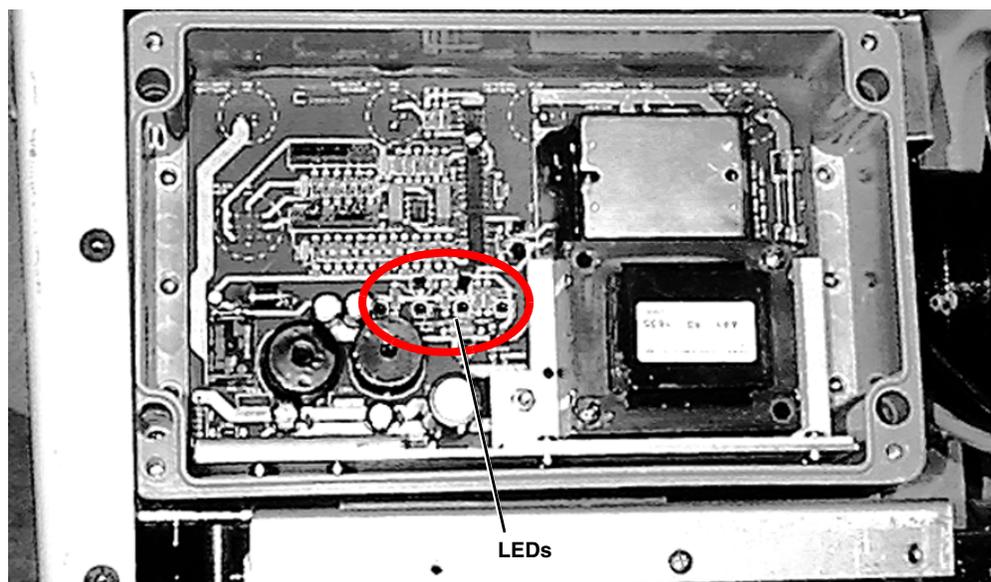


Figure 6-2 Thermostat Logic Circuit Board



Figure 6-3 Control Box Wiring

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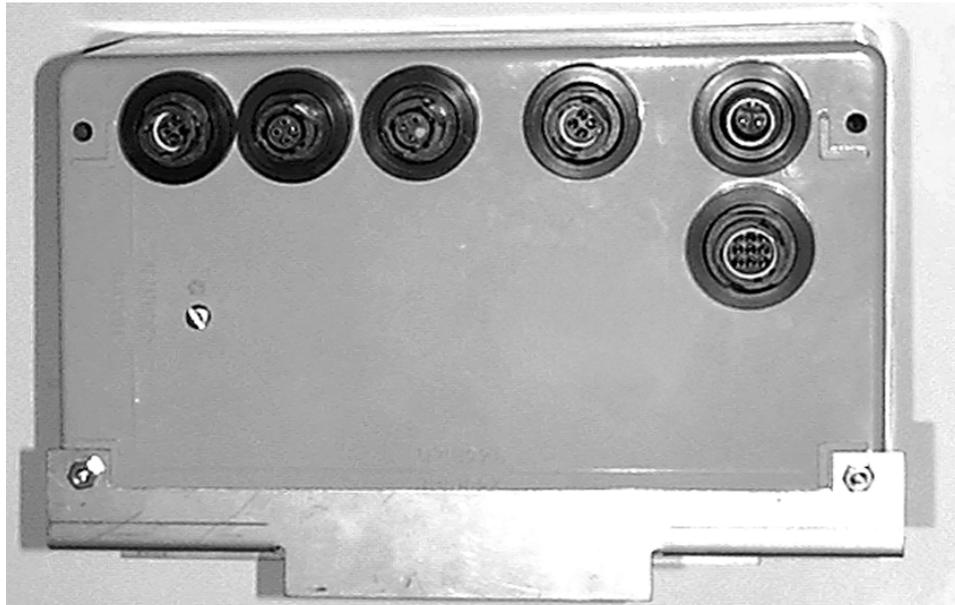


Figure 6-4 Control Box Connectors

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.

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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.

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Section 6 Servicing

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.

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.

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3700FR/3720 Refrigerator Service Section 6 Servicing

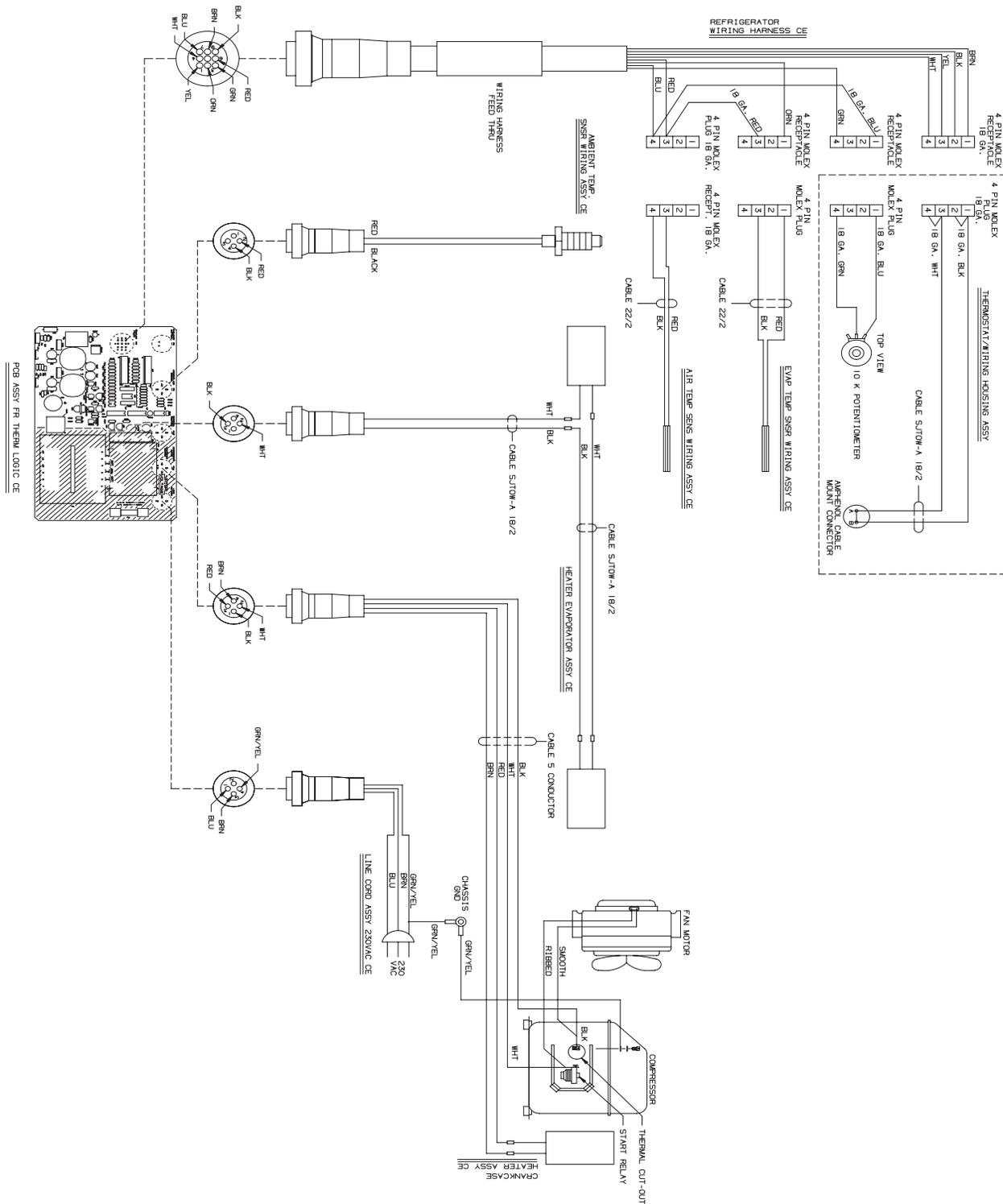


Figure 6-5 3720 Refrigerator Wiring Diagram

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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.

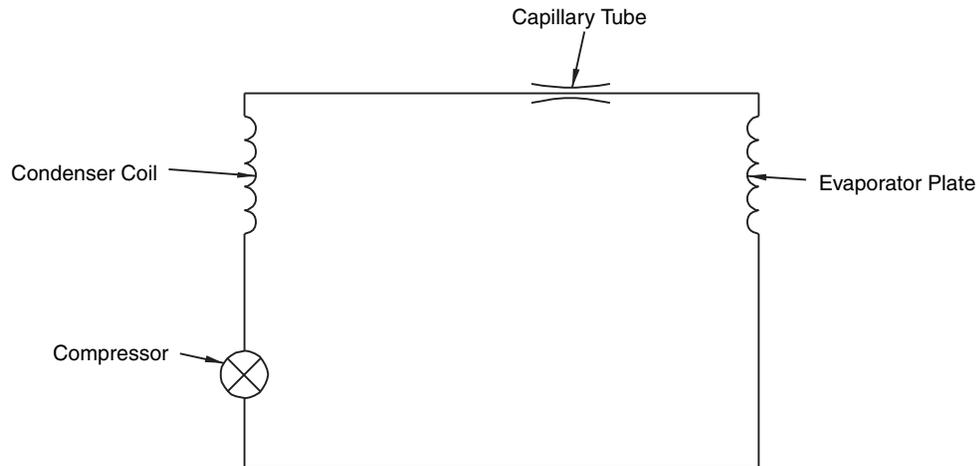


Figure 6-6 Refrigeration Schematic Diagram

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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.

1. Make sure the operating voltage (120 or 230 V \sim) is present across pins 1 and 3 of circuit board connector P12.
2. Is the compressor running?
 - NO
 - a. Is the compressor-run LED (on the circuit board) lit?
NO – Check the circuit board for a malfunction.
YES – Continue.
 - b. Is there 12 V $\overline{\text{---}}$ across pins 4 and 4 of the compressor fan relay?
NO – Check the circuit board for a malfunction.
YES – Continue.
 - c. Is there 120 or 230 V \sim across pins 1 and 2 of the circuit board connector P11?
NO – Replace the compressor/fan relay.
YES – Continue.
 - d. Is there 120 or 230 V \sim across the start relay and compressor common?
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.
 - YES
 - a. Is the fan running?
NO – Replace the fan.
YES – Continue.
 - b. Check the refrigerant in the refrigeration system.

Problem: Samples freezing.

1. Is the Heaters LED (on the circuit board) lit?
NO – Check the circuit board for a malfunction. If the board is good, replace the ambient air sensor.
YES – Continue.
2. Is there 5 V $\overline{\text{---}}$ across pins 3 and 4 of heater relay K2?
NO – Check Q4 on the circuit board for a malfunction.
YES – Continue.
3. Is there 120 or 230 V \sim across pins 1 and 2 of heater relay K2?
NO – Replace heater relay.
YES – Continue.
4. Is there 120 or 230 V \sim across pins 2 and 3 on PCB connector P10?
NO – Replace heater fuse F2. Refer to the replacement parts listing for the correct part number.
YES – Check heater wiring.

Table 6-1 Refrigerator Troubleshooting Table

Problem: Sampler has no power.

1. Is there 12 V⁻⁻⁻ at the sampler connector?

NO – Continue.

YES – Troubleshoot the sampler controller.

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.

6.4 Servicing the 3700 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 3700 Series Controller on the 3720 Refrigerator

The 3720 Sampler Refrigerator is available to convert a 3700 Portable Sampler into a 3700FR Refrigerated Sampler. To do this, remove the control box from the portable sampler following the instructions in the *3700 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.

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. 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.

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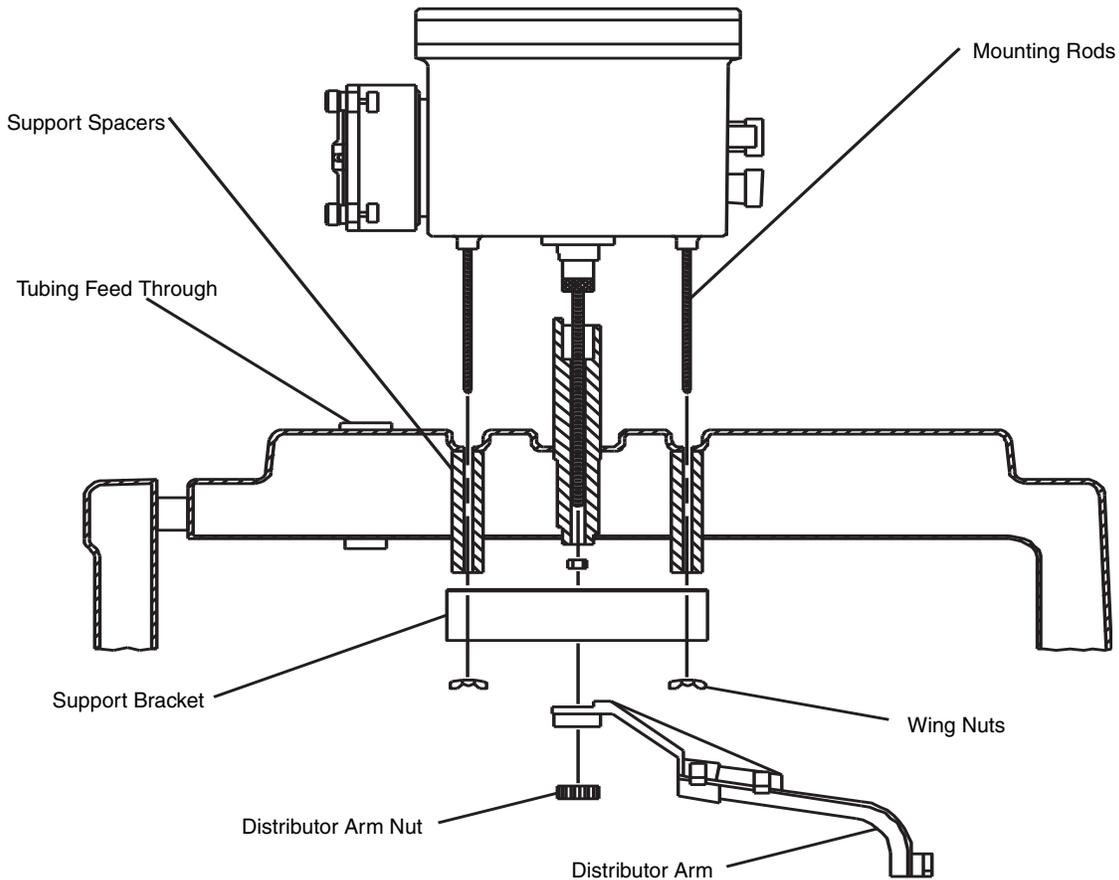


Figure 6-7 Mounting the Control Box

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).
4. The main circuit board assembly of the 3700 Sampler is protected by an aluminum shield. To remove this shield,

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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.

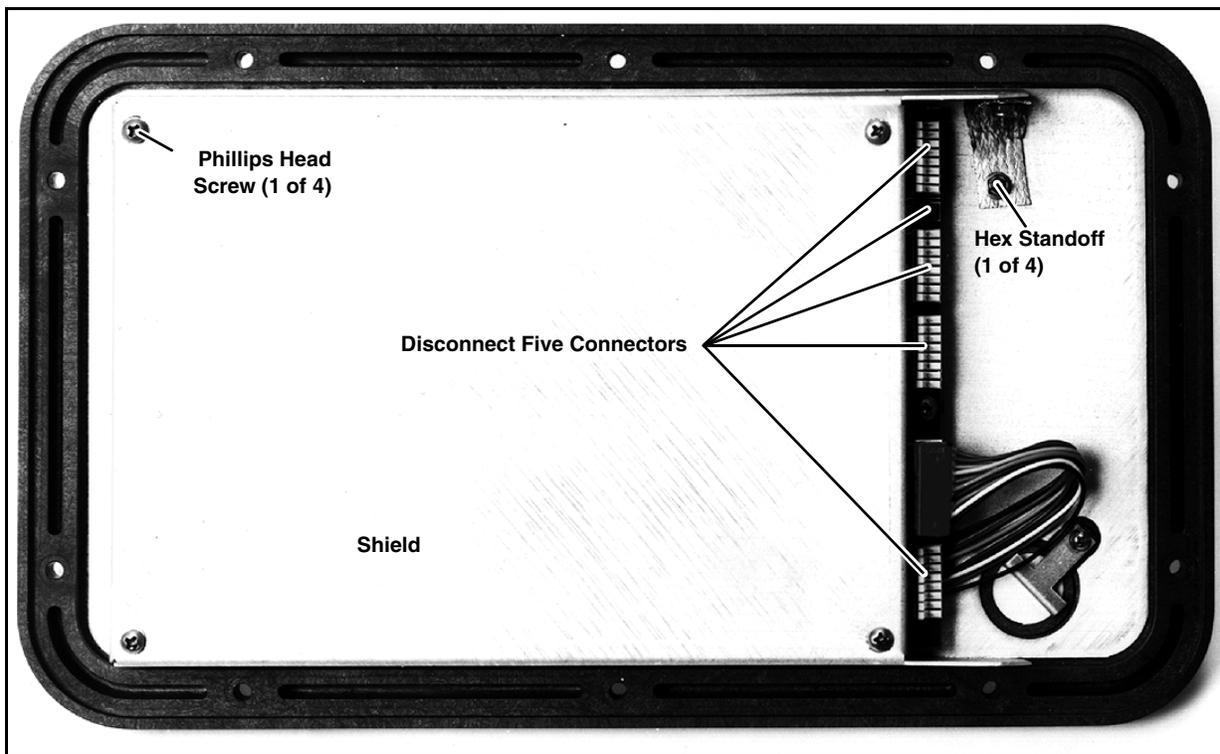


Figure 6-8 Underside of the Control Box Cover

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3700FR/3720 Refrigerated Sample
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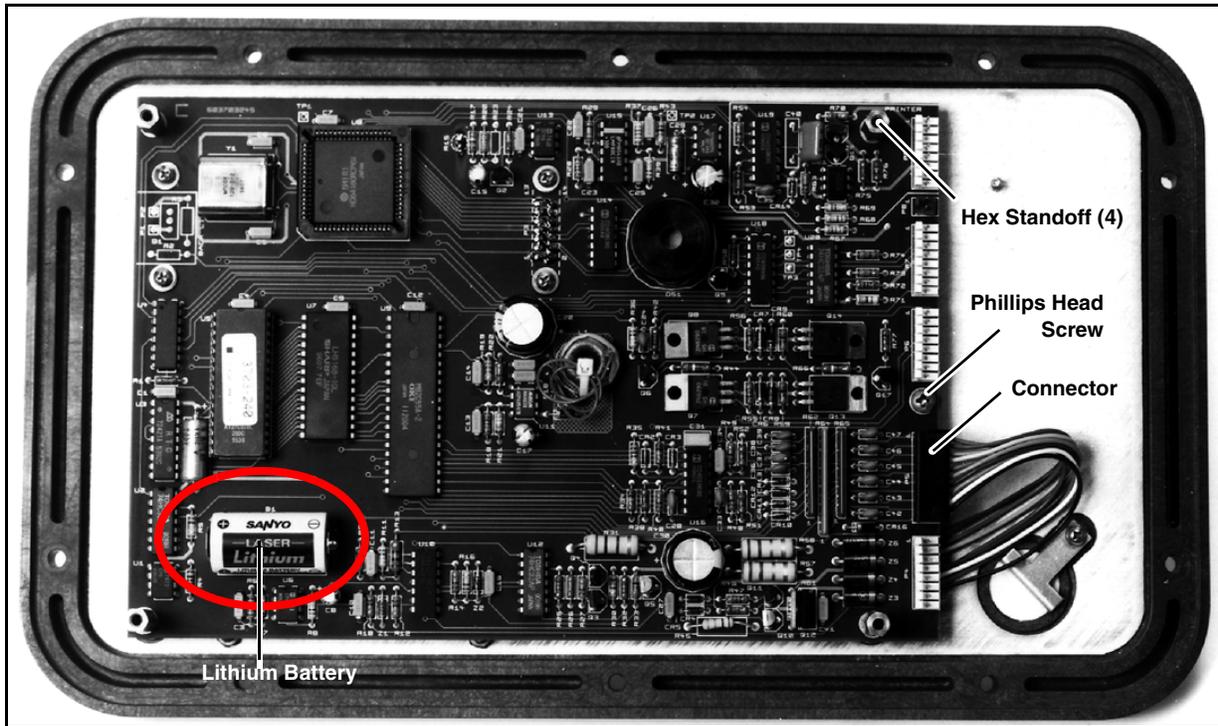


Figure 6-9 Main Circuit Board

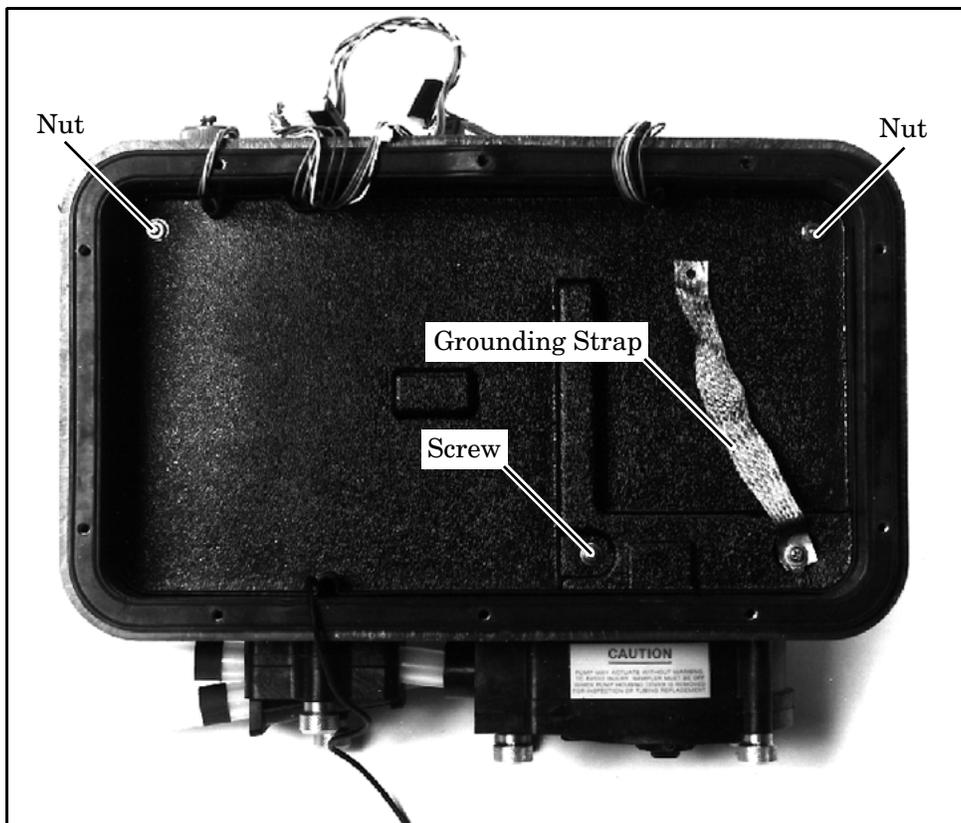


Figure 6-10 Control Box Tray Removal

6.7 Removal of the Distributor Gear Case Assembly

CAUTION

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

The distributor 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 6.6. Use the steps below to gain access to these and other components in the control box lower section:

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. The distributor gear case can be removed from the control box by unscrewing the four screws at the base of the distributor, and disconnecting the two grounding straps.

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

6.8 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 6.6. 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 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 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.

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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.

6.9 Precautions for Servicing CMOS Circuitry

Most of the circuitry in the 3700 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.

6.10 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.

6.10.1 Circuit Boards

The following is a general description of the 3700 electronic circuitry. While reading this description, refer to the pictorial views of the circuit boards (Figures 6-11 and 6-12).

The 3700FR 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 $\overline{\text{---}}$ source. A 3.75 Amp PTC device provides circuit protection.

The 3700FR 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.

6.10.2 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 3700FR 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 3700FR 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, advance the distributor, count pump counts, and so on.

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 3700FR Sampler enter the system through the keypad.

The 3700FR 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.

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A collection of transistors, resistors, and diodes are used to control the distributor motor. The motor control circuitry connects to the distributor through P6 and can drive the distributor in either direction. As the distributor moves, its position is monitored by an optical device mounted to the distributor assembly. IC U20 supplies the necessary current for the optical device.

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.

6.10.3 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.

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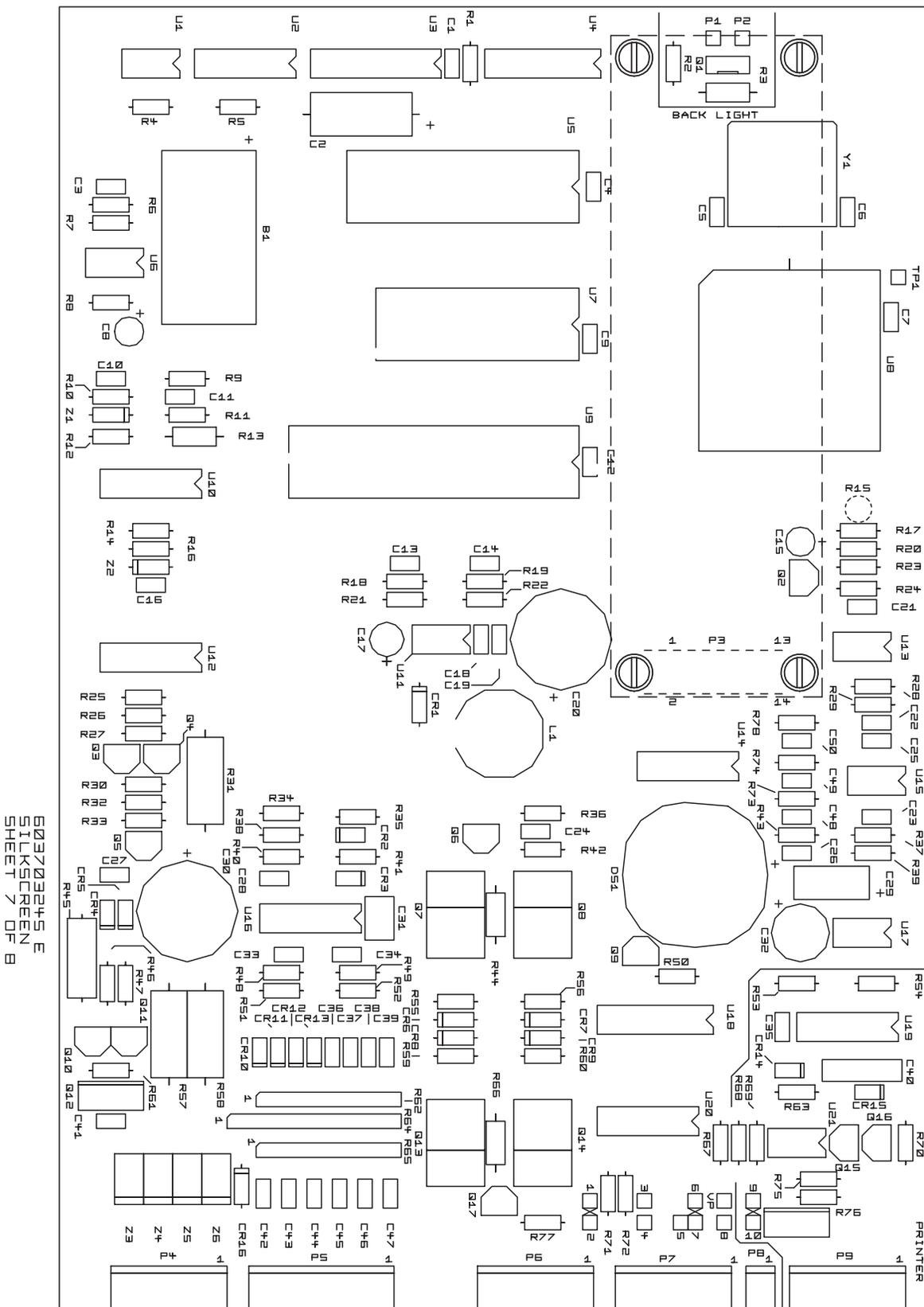


Figure 6-11 Main Circuit Board Component Layout

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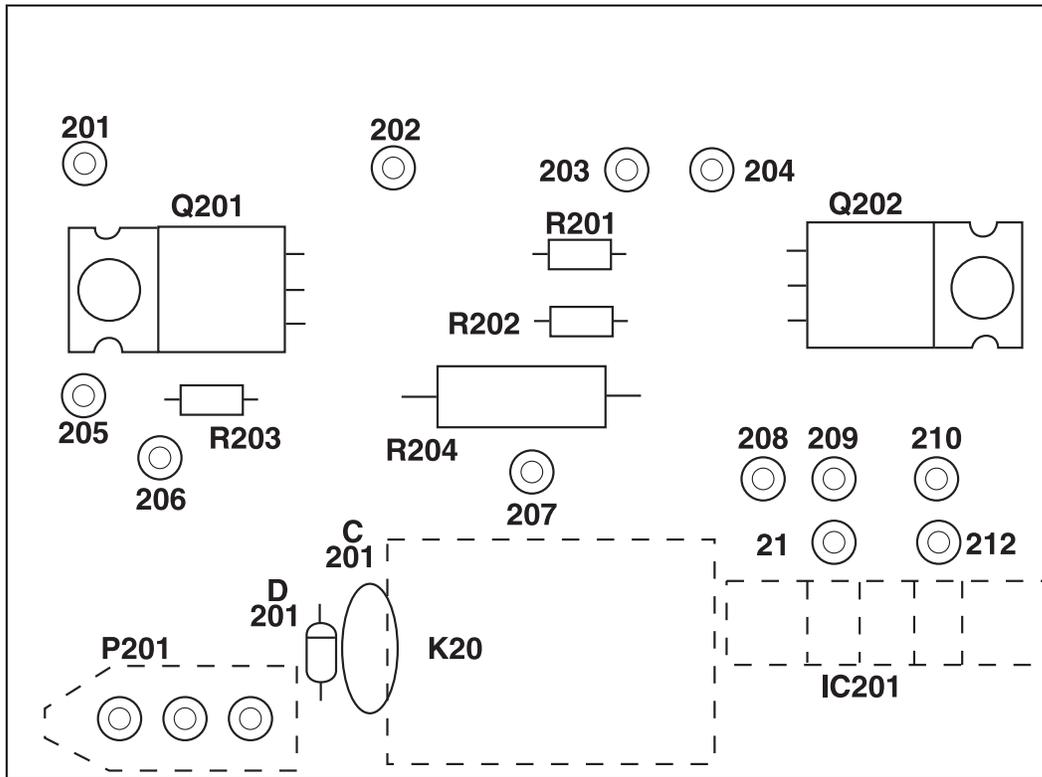


Figure 6-12 Optical Counter PCB Component Layout

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.

6.11 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.

6.11.1 Peristaltic Pump

The following is a brief description of the method by which the sample volume is determined. The 3700FR 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.

6.11.2 Volumetric Determination

The 3700FR 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 3700 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.

6.11.3 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 3700FR, 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.

An illustrated list of common replacement parts for the 3700FR/3720 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.

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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

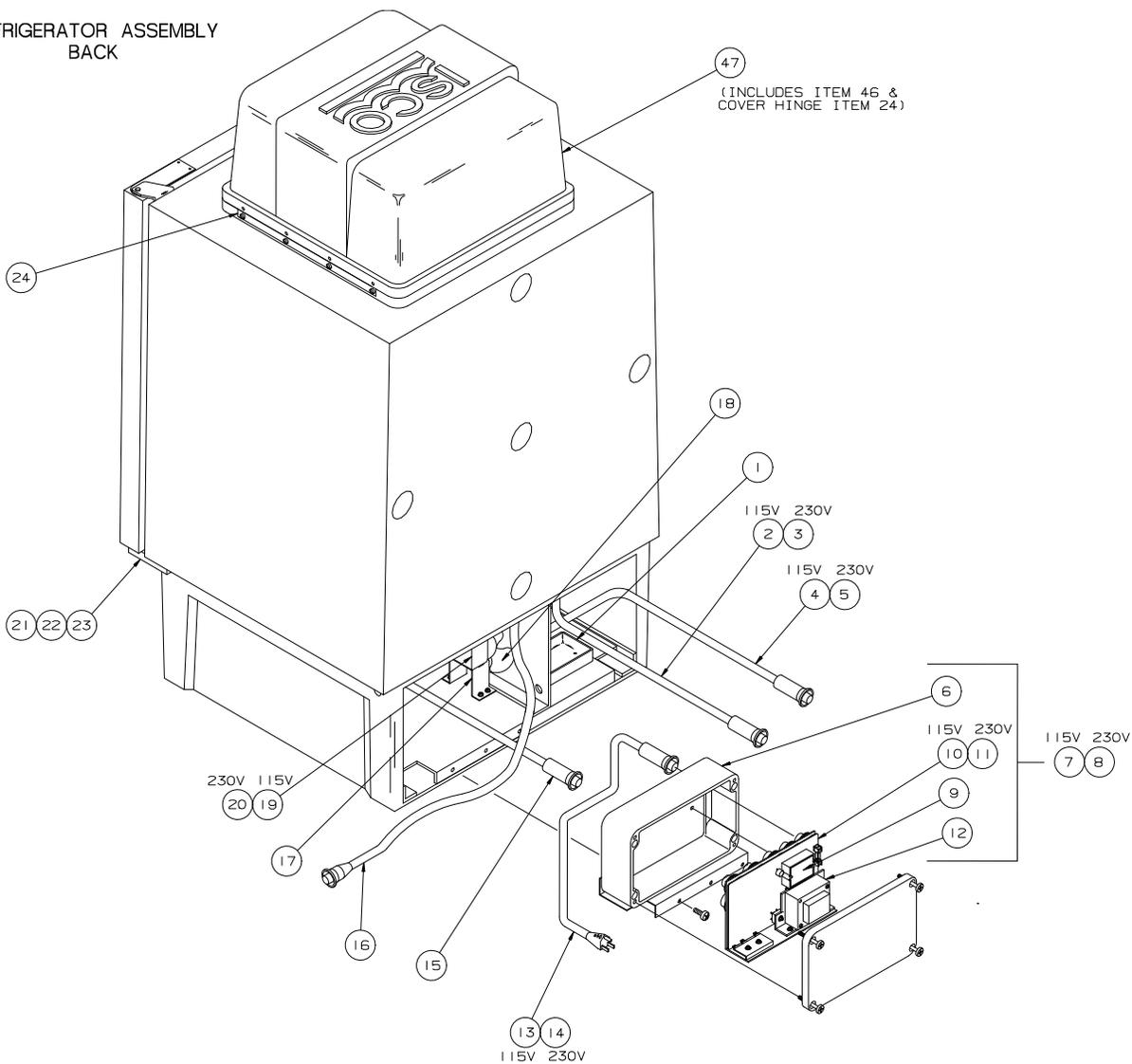
Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3022

E-mail: IscoInfo@teledyne.com

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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists

REFRIGERATOR ASSEMBLY BACK



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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists

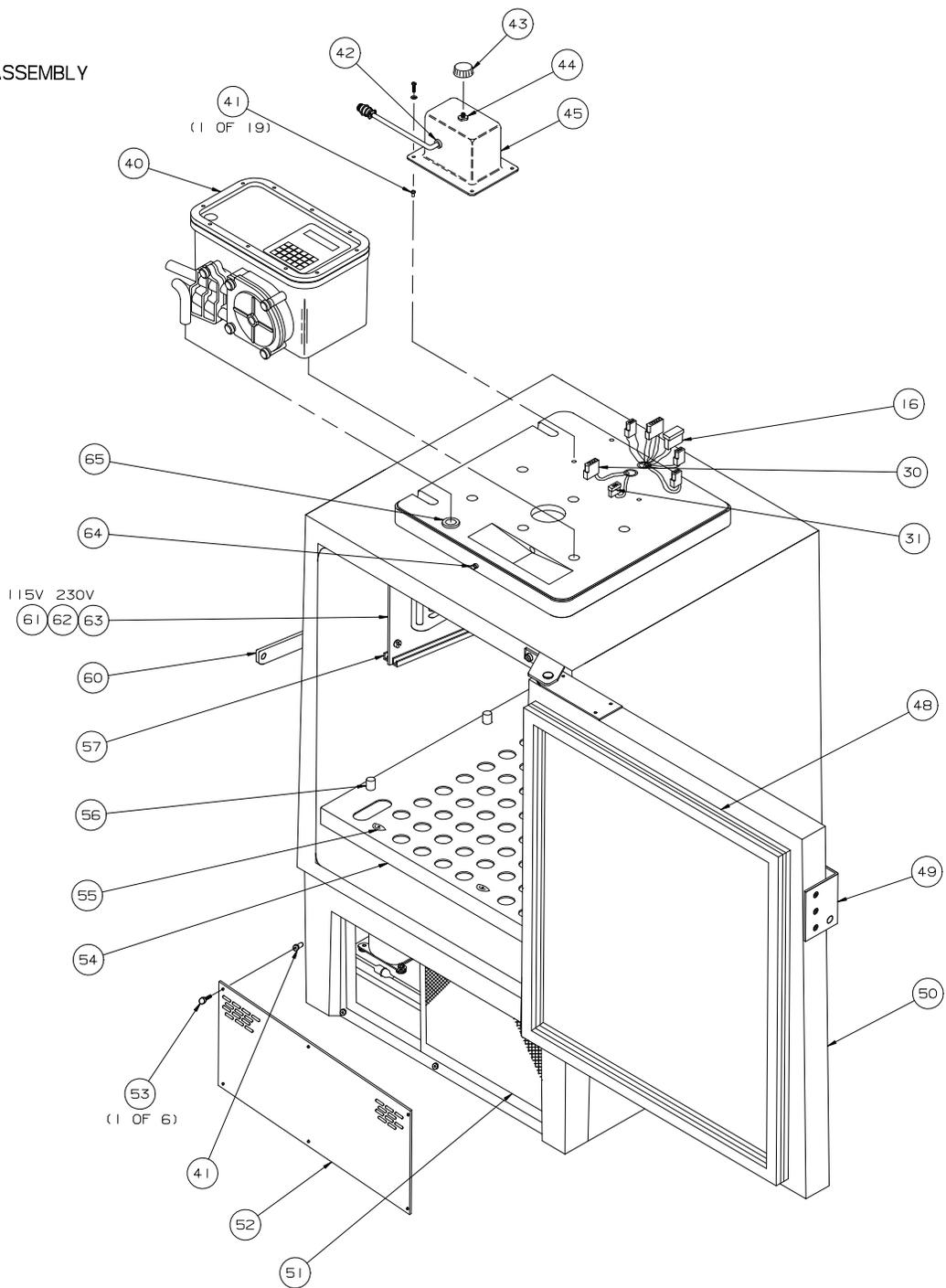
ITEM	INVENTORY NO.	DESCRIPTION
1	60-2723-068	DRIP PAN
2	60-9004-260	EVAPORATOR HEATER ASSY. 115 VAC
3	60-9004-204	EVAPORATOR HEATER ASSY. 230 VAC
4	60-9004-256	CRANKCASE HEATER ASSY. 115 VAC
5	60-9004-228	CRANKCASE HEATER ASSY. 230 VAC
6	60-9003-479	TEMPERATURE CONTROL BOX
7	60-9004-208	TEMPERATURE CONTROL BOX ASSY 115 VAC
8	60-9004-225	TEMPERATURE CONTROL BOX ASSY 230 VAC
9	366-0001-00	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	60-2723-001	FAN MOUNT
18	209-0195-03	FAN BLADE
19	304-2300-21	MOTOR FAN 115 VAC
20	304-2300-31	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	60-2723-002	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

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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists

REFRIGERATOR ASSEMBLY
FRONT



OBSOLETE

3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists

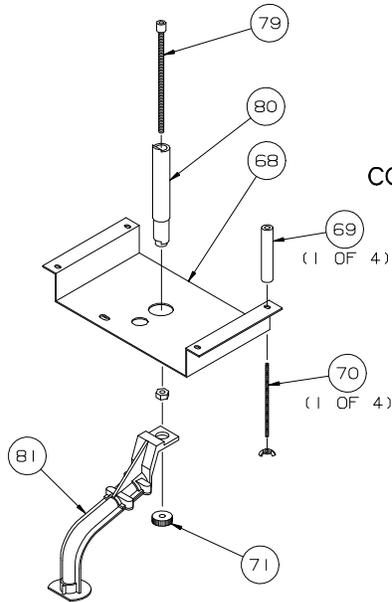
ITEM	INVENTORY NO.	DESCRIPTION
40	60-3704-001	MODEL 3700 CONTROLLER
41	239-0908-32	WELL-NUT FASTNER 8-32
42	209-0075-05	BSHG SR NYL
43	180-0012-01	KNOB PKG-100B-1/4
44	380-9510-70	POT 10K 2W 3/4 TURN
45	60-2723-150	THERMOSTAT HOUSING
*46	109-0800-00	OVER CENTER DRAW LATCH
47	60-2724-063	TOP COVER
48	60-2723-005	GASKET, REFRIGERATOR DOOR
49	61-2723-042	DOOR HANDEL POWDER COATED
50	60-2724-062	REFRIGERATOR DOOR
51	60-9003-182	FILTER FOR REFRIGERATOR
52	60-2723-032	GRILLE FOR REFRIGERATOR
53	60-2724-021	THUMBSCREW ASSY
54	60-2723-028	WIRE RACK PLATE
55	60-2723-041	WIRE RACK STOP
56	60-2724-065	ADJ POST REPLACEMENT KIT
57	60-9003-487	DRIP RAIL (LEFT)
*58	60-9003-489	DRIP TRAY (RIGHT)
*59	60-2723-034	DRIP TRAY
60	60-2723-043	DOOR LATCH POWDER COATED
61	60-9004-259	EVAPORATOR PLATE, COP. TUBING, & HTR. ASSY 115 VAC
62	60-9004-222	EVAPORATOR PLATE, COP. TUBING, & HTR. ASSY 230 VAC
63	60-2723-035	EVAPORATOR PLATE MOD.
64	60-2723-054	KEEPER, TOP COVER LATCH
65	60-2723-165	TUBE FEED THRU

NOTE: * ITEM IS NOT SHOWN IN ILLUSTRATION

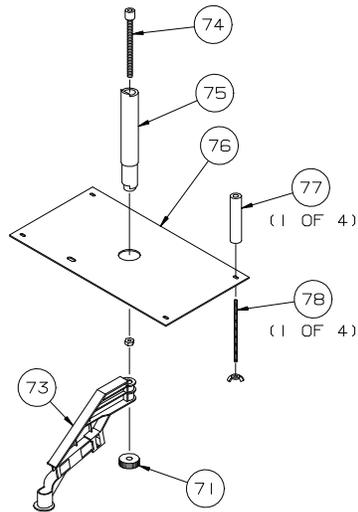
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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists

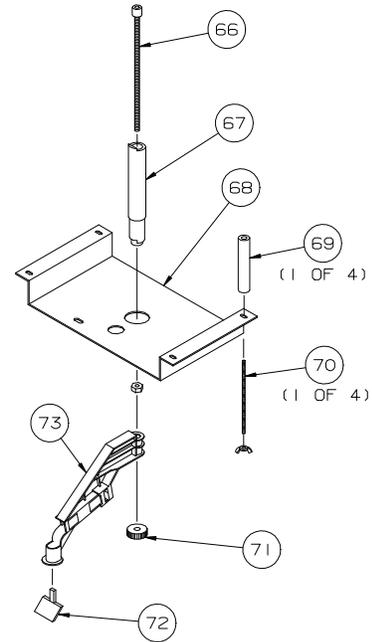
CONTROLLER MOUNTING KIT
1 OR 24 BOTTLE



CONTROLLER MOUNTING KIT
2 BOTTLE



CONTROLLER MOUNTING KIT
8 BOTTLE



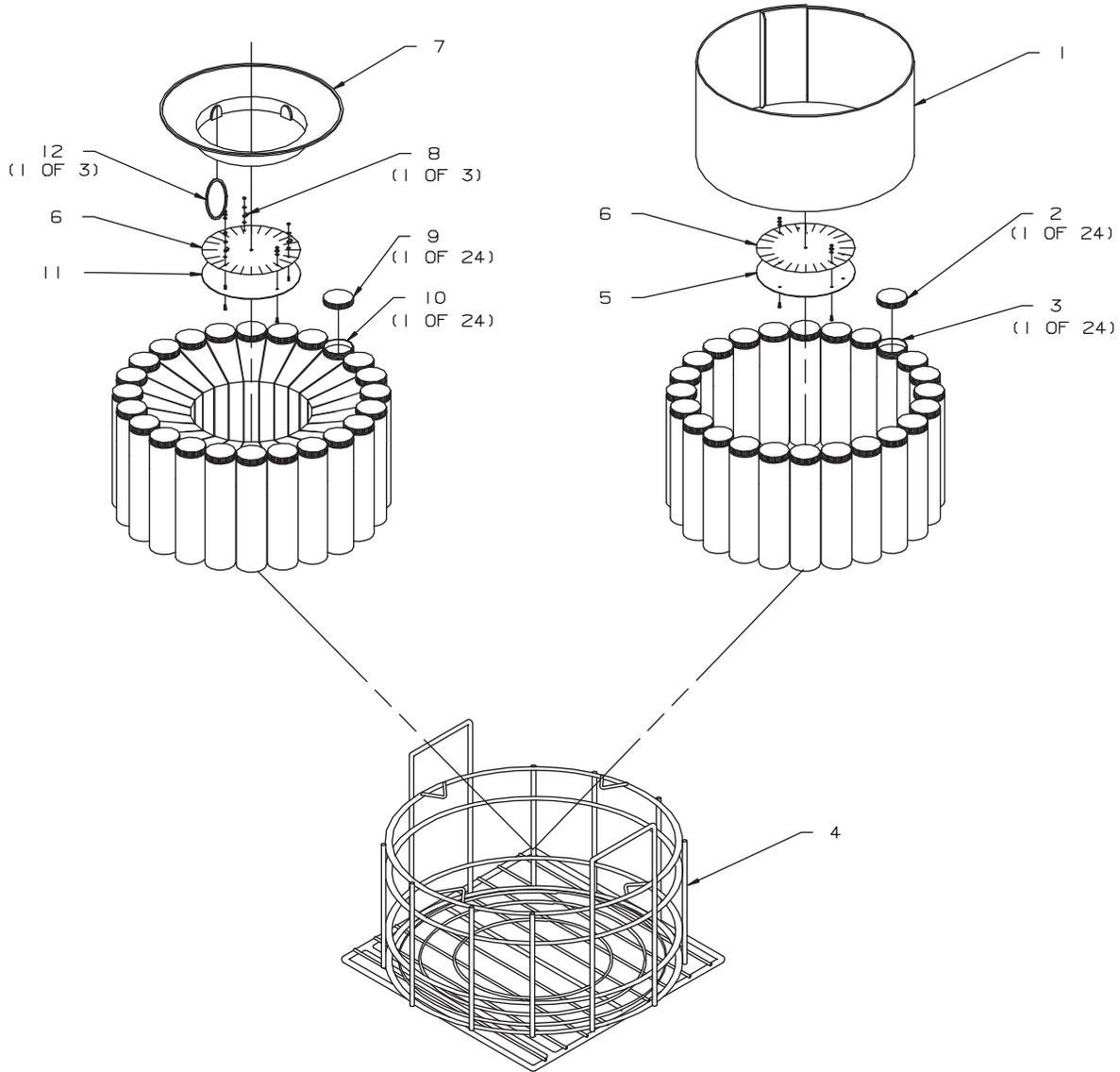
ITEM	INVENTORY NO.	DESCRIPTION
66	60-2724-041	DRAW BOLT ASSY, 8 BTL
67	60-2723-098	DIST SHAFT EXTENSION, 8 BTL
68	61-2743-009	SUPPORT BRACKET CLR ANDZD
69	60-2723-064	SPCR 3/4 RND DELRN .19ID X 3-9/16
70	60-2723-065	THD ROD SST 8-32 X 4-3/4LG
71	60-2923-007	DISTRIBUTOR ARM NUT
72	61-2743-039	LIQUID DEFLECTOR PTFE COATED
73	60-2903-008	DISTRIBUTOR ARM
74	60-2724-040	DRAW BOLT ASSY, 2 BTL
75	60-2723-097	DIST SHAFT EXTENSION, 2 BTL
76	61-2743-037	SUPPORT BKT 2 BTL CLR ANDZD
77	60-2733-010	SPCR 3/4RND DELRIN .19ID X 2-3/4
78	60-2733-009	CONTROLLER MOUNTING ROD
79	60-2724-019	DRAW BOLT ASSY, 24 BTL
80	60-2723-057	DIST SHAFT EXTENSION, 24 BTL
81	60-2744-028	DISTRIBUTOR ARM ASSY

OBSOLETE

3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists

BOTTLE RACK ASSEMBLY
24 PLASTIC BOTTLES

BOTTLE RACK ASSEMBLY
24 GLASS BOTTLES



(DWG 60-3703-266 Rev B)

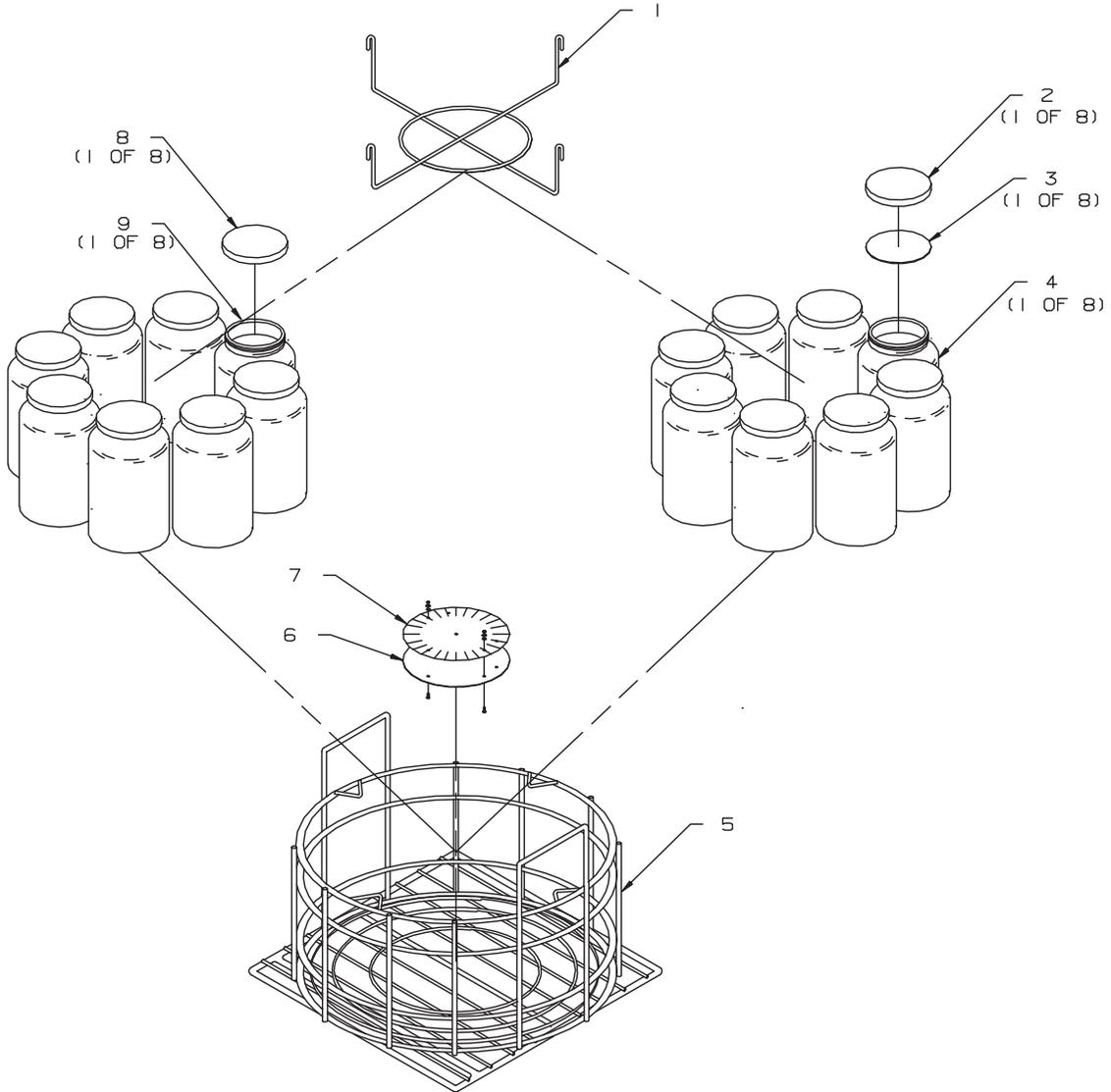
ITEM	INVENTORY NO.	DESCRIPTION
1	602724020	EXPANDER ASSY GLS BTL
2	299048406	CAP POLYPRO 48MM W/TEF LINER
3	601683132	BOTTLE GLS 2100/2700
4	602723006	BOTTLE WIRE RACK
5	612723009	WIRE RACK PLATE IRR
6	602723010	LABEL BOTTLE LOCATION
7	609003242	RETAINING RING 24 1L BTL
8	489000200	CLAMP CBL .25 NYL
9	299048407	CAP W/POLYETHYLENE FOAM LINER
10	602103095	1L BOTTLE POLYPROPYLENE
11	602724022	BASE PLATE ASSY
12	603704111	BOTTLE HOLD DOWN CORD ASSY

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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists

BOTTLE RACK ASSEMBLY
8 PLASTIC BOTTLES

BOTTLE RACK ASSEMBLY
8 GLASS BOTTLES



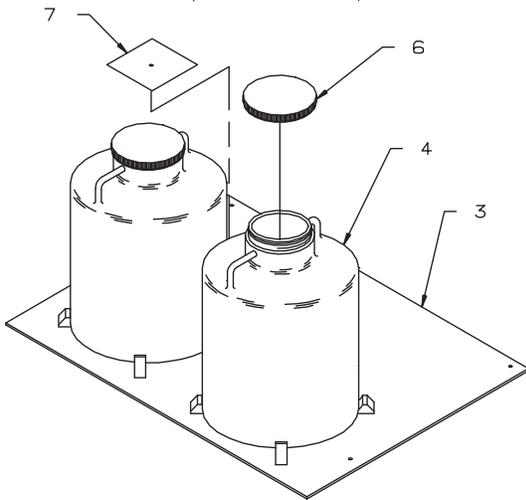
DWG 60-3703-266 Rev B)

ITEM	INVENTORY NO.	DESCRIPTION
1	602743024	EIGHT BOTTLE ADAPTER
2	291000002	CAP POLYPRO LNRLS 83MM
3	299008900	LNRL - TEF 83MM X .020 THK
4	291000800	JAR GLS 1/2 GAL BALL
5	602723006	BOTTLE WIRE RACK
6	612723009	WIRE RACK PLATE IRR
7	602723010	LABEL BOTTLE LOCATION
8	291000003	CAP POLYPRO LNRLS 100MM
9	299001902	JAR POLYETH 4 PT JAR WD MOUTH

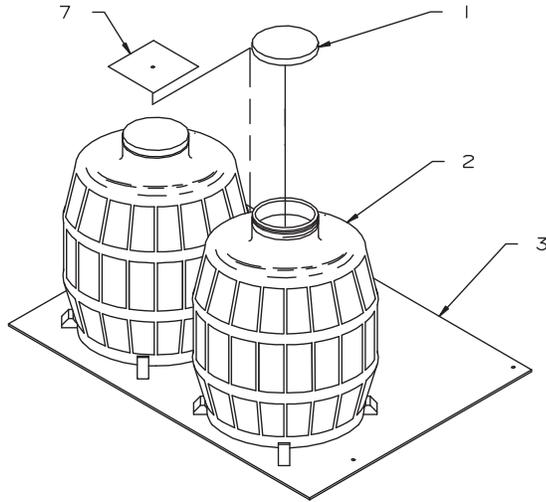
OBSOLETE

3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists

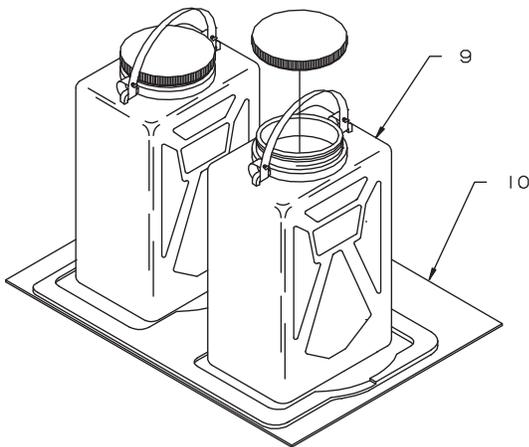
BOTTLE RACK ASSEMBLY
2 PLASTIC BOTTLES
(3700R ONLY)



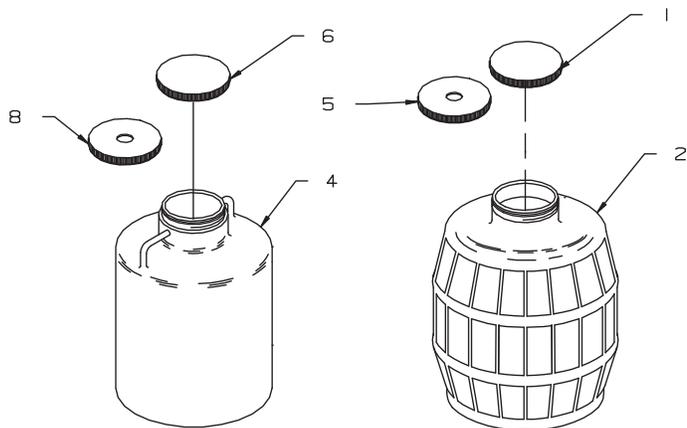
BOTTLE RACK ASSEMBLY
2 GLASS BOTTLES



BOTTLE RACK ASSEMBLY
2 PLASTIC BOTTLES
(3700FR ONLY)



SINGLE BOTTLE SAMPLING
PLASTIC OR GLASS

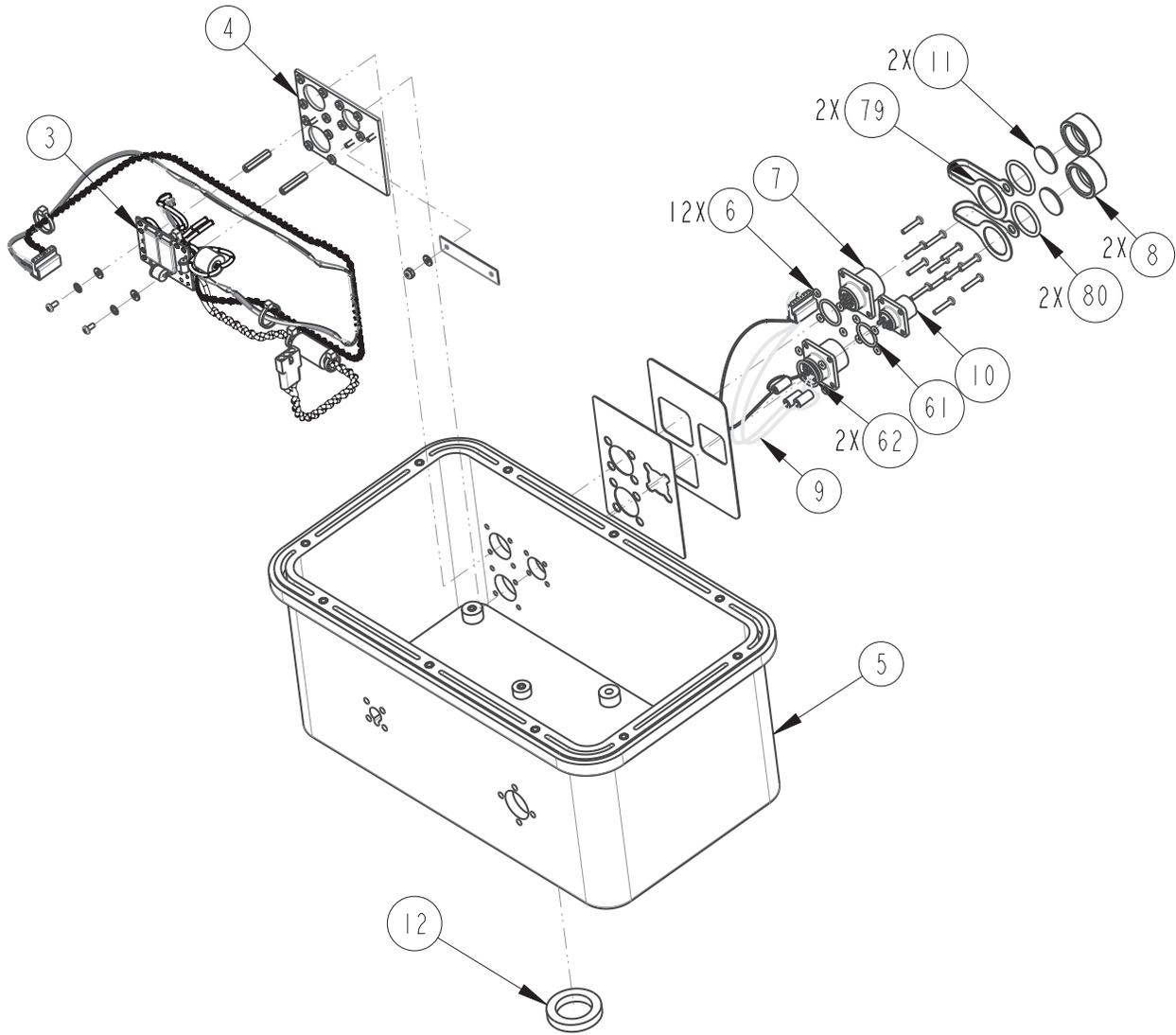


(DWG 60-3703-266 Rev B)

ITEM	INVENTORY NO.	DESCRIPTION
1	603004193	LID & LINER ASSY
2	291000000	BTL GLS 2-1/2 GAL W/CAP BALE
3	602743038	LOCATING BASE - 2 BOTTLE
4	299001304	BTL NALGENE 2-1/2 GAL W/CAP
5	603004184	LID & LINER MOD ASSY 120MM
6	299001303	CAP BOTTLE LID
7	602743040	LOCATING BASE RETAINER - 2 BOTTLE
8	601623027	LID MOD PLS BTLs
9	299001307	BTL NALGENE 2 GAL REC W/CAP
10	602723102	LOCATING BASE, 2 BTL

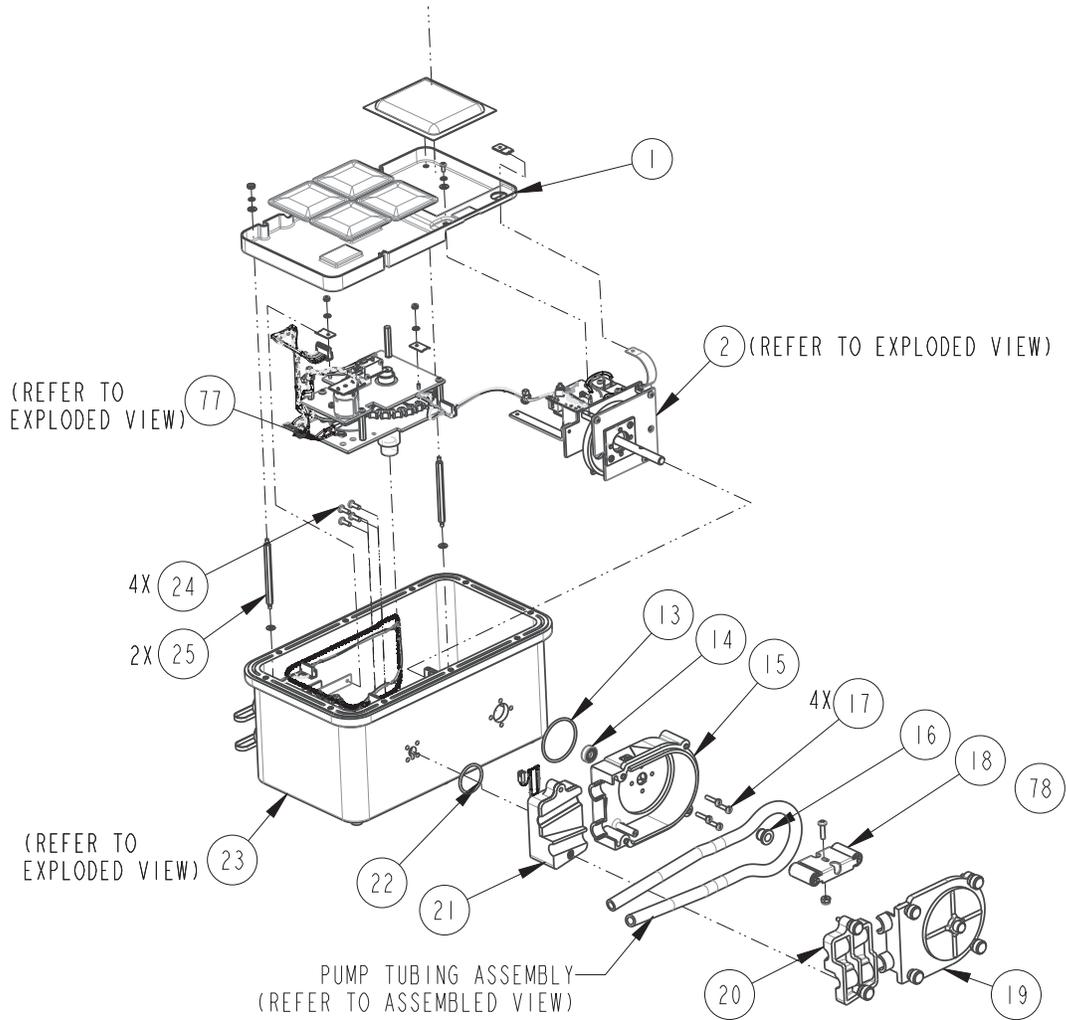
OBSOLETE

3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists



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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists



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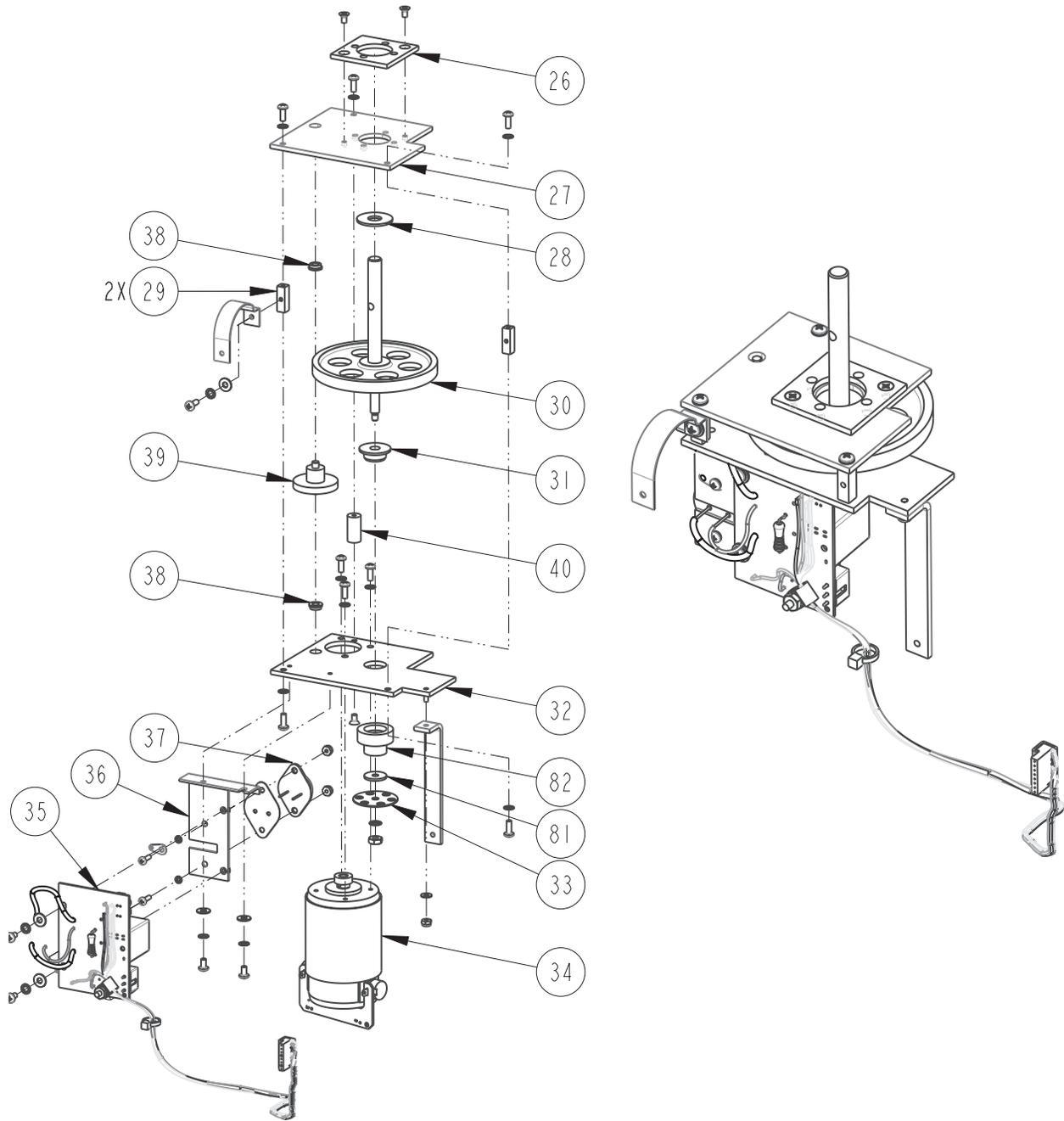
3700FR/3720 Refrigerated Sample Processor
Appendix A Replacement Parts Lists

REPLACEMENT PARTS LIST			603703268
TELEDYNE ISCO			SHEET: 3 OF 10
ITEM NO.	PART NUMBER	DESCRIPTION	REV: U DATE: 081111
1	603703252	DESICCANT TRAY, CE	
2	603704154	PUMP GEAR CASE ASSEMBLY, CE	
3	603704151	CIRCUIT BOARD ASSEMBLY, CE	
		POWER SUPPLY CONNECTIONS	
4	603704149	BACK PLATE STUD ASSEMBLY, CE	
5	603704089	CONTROL BOX MODIFICATION ASSEMBLY	
6	202907010	O RING, .100 ID, .070 CROSS SECTION,	
7	140100600	PLUG, PANEL MOUNT, 6 PIN	
8	603113024	CONNECTOR PROTECTOR CAP, MEDIUM	
9	603704091	PRINTER CONNECTOR ASSEMBLY	
10	1401002001	PLUG PANEL MOUNT 4 PIN W/ANGLE BRACKET	
11	603113032	CONNECTOR CAP GASKET, MEDIUM	
12	202999904	LIP SEAL, 1.000 ID X 1.500 OD	
13	202100135	O RING, 1.925 ID, .103 CROSS SECTION,	
14	202999903	LIP SEAL, .375 ID X .750 OD	
15	603704019	PUMP HOUSING ASSEMBLY, INSIDE	
16	603703012	PUMP HOUSING BUSHING	
17	231914512	SCREW, MACHINE, 8-32 X 3/4, PAN HEAD, SLOTTED, SST, SELF SEALING, O-RING	
18	602704019	PUMP ROTOR ASSEMBLY	
19	603704017	PUMP HOUSING ASSEMBLY, OUTSIDE	
20	603704021	DETECTOR LID ASSEMBLY	
21	603704022	DETECTOR BASE ASSEMBLY	
22	202401237	O RING, 1.237 ID, .103 CROSS SECTION, SILICONE	
23	603704152	CONTROL BOX SUB-ASSEMBLY, CE	

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.

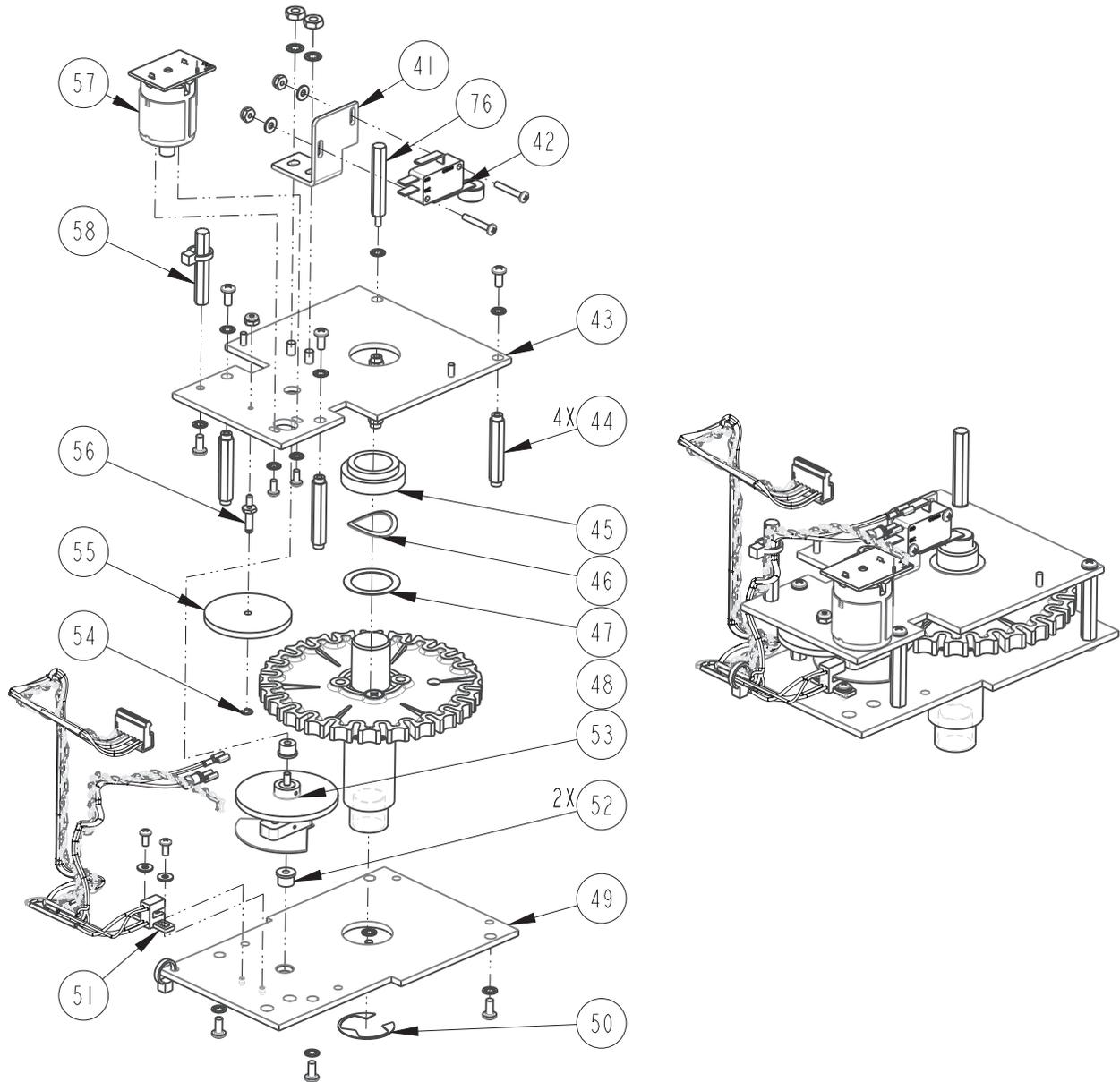
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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists



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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists



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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists

603703268

REPLACEMENT PARTS LIST

SHEET: 8 OF 10

TELEDYNE ISCO

REV: U

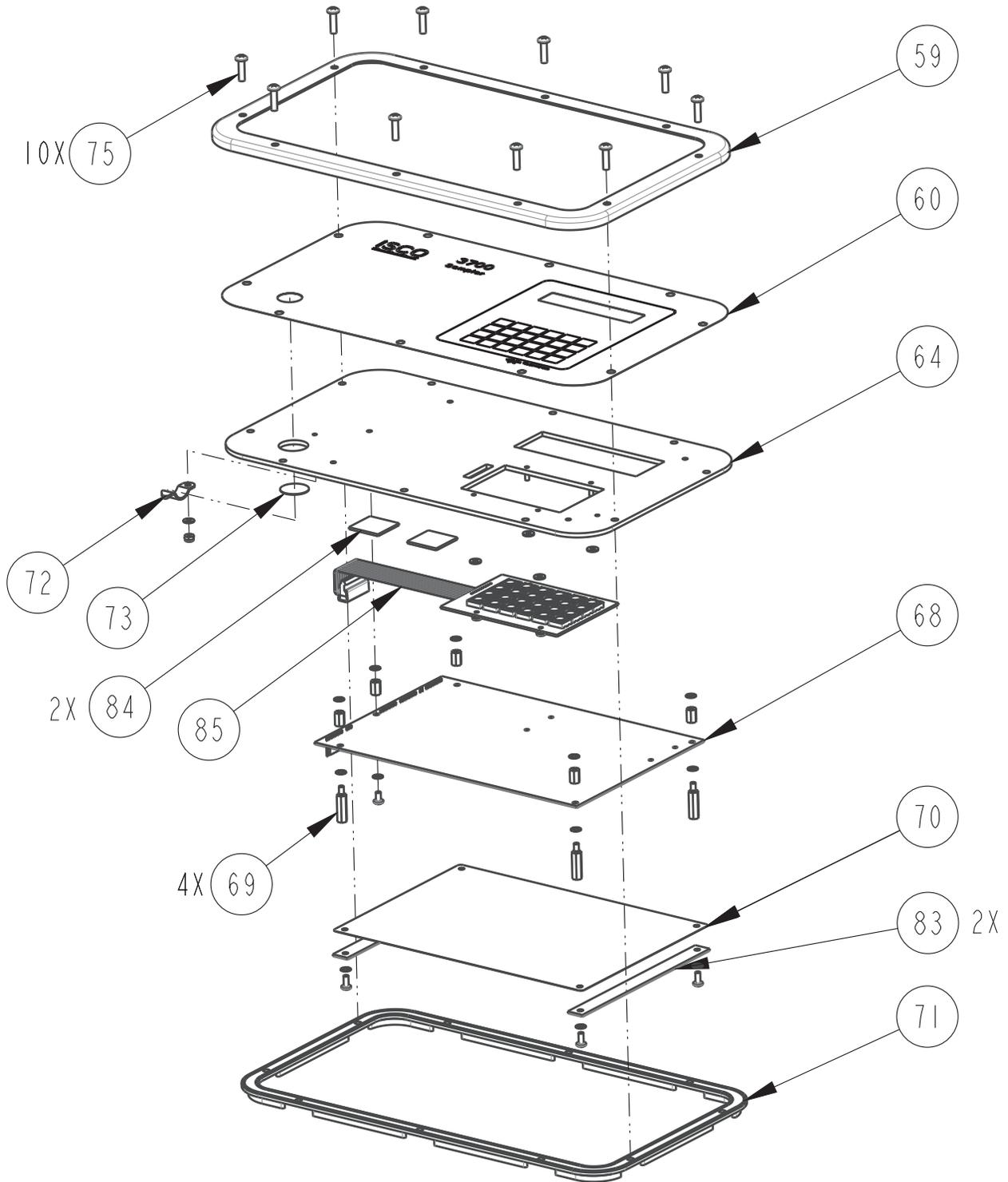
DATE: 081111

ITEM NO.	PART NUMBER	DESCRIPTION
41	603703016	MICROSWITCH MOUNTING PLATE
42	601484033	MICROSWITCH ASSEMBLY, SHUT-OFF
43	603704163	DISTRIBUTOR TOP PLATE ASSEMBLY, CE
44	603703038	DISTRIBUTOR DRIVE STANDOFF
45	603703009	TOP SUPPORT BUSHING
46	233609000	FINGER SPRING WASHER, .81 ID X 1.10 OD
47	233019000	WASHER, FLAT, .770 ID X .969 OD, SST
48	603704174	DISTRIBUTOR SHAFT ASSEMBLY
49	603703250	DISTRIBUTER BASE PLATE, CE
50	209001710	RETAINING RING, EXTERNAL, 1.00 SHAFT, STEEL
51	603704164	DISTRIBUTOR WIRING HARNESS, CE
52	201311300	FLANGED CYLINDRICAL BEARING, BRONZE, .127 ID X .315 OD X .250 LONG
53	603704011	GENEVA DRIVE SHAFT ASSEMBLY
54	209000501	RETAINING RING, EXTERNAL, .125 SHAFT, SST
55	602703062	GEAR MODIFICATION, COMBINATION, N48-12-80
56	602703151	IDLER SHAFT
57	603704165	DISTRIBUTOR MOTOR ASSEMBLY, CE
58	603703036	STANDOFF, 6-32 X .25 HEX X 1.560 LONG, AL
76	603703260	STANDOFF, 6-32 X .250 HEX X 1.50 LONG, AL

NOTE: 1. For current prices and quotations on parts, contact Teledyne Isco Service Department.
2. This list is subject to change without notice.

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3700FR/3720 Refrigerated Sampler
Appendix A Replacement Parts Lists



3700FR/3720 Refrigerated Sampler

Appendix B Accessories

The following appendix contains the most commonly ordered accessories for the 3700FR 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

Extra Silastic pump tubing, 46" length	60-3704-044
Model 3700FR Sampler controller	68-3720-025
Extra Pocket Guide, Model 3700R/3700FR	60-3703-178
Plastic graduated cylinder, 1000 ml, for sample volume calibration	299-0020-00

B.2 Bottles and Caps

Sample bottles, 1000 ml polypropylene without caps, case of 100	68-2100-008
Caps for 1000 ml polypropylene bottles, with polyethylene foam liners, case of 100	68-2100-010
Sample bottles, 350 ml glass without caps, case of 100	68-2100-002
Caps for 350 ml glass bottles with PTFE liners, case of 100	68-2100-003
1000-ml polypropylene sample bottles Set of 24, includes polyethylene foam lined caps	68-2100-007
350-ml glass sample bottles Set of 24, includes PTFE lined caps	68-2100-001
2.5 gallon polyethylene container with cap	299-0013-04
2 gallon polyethylene container with cap	299-0013-07
2.5 gallon glass container with cap and PTFE liner	68-2700-005
4 gallon polyethylene container with cap	299-0013-05

B.3 Suction Lines, Pump Tubing, and Strainers

3/8" ID x 10' vinyl suction line with standard weighted polypropylene strainer	60-9004-378
3/8" ID x 25' vinyl suction line with standard weighted polypropylene strainer	60-9004-379
3/8" ID x 10' PTFE suction line with protective coating, without strainer	60-1683-146
3/8" ID x 25' PTFE suction line with protective coating, without strainer	60-2703-114
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 line)	68-3700-007
3/8" Standard weighted polypropylene strainer	60-9004-367
1/4" stainless steel low flow strainer only	69-2903-139
3/8" stainless steel low flow strainer only	69-2903-138
3/8" weighted strainer, CPVC-coated	60-3704-066
Extra Silastic pump tubing, bulk 10' length.	68-6700-046
Extra Silastic pump tubing, bulk 50' length.	68-6700-047

B.4 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.5 Interfacing Equipment

1640 Liquid Level Actuator	60-1644-000
Extra Instruction Manual, 1640	60-1644-009
Sampler to flow meter cable, 6-conductor.	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 for Windows Software - New License	call factory

Flowlink for Windows Software - Upgrade	call factory
Samplink Sampler Interrogation Software	60-3774-013
Computer connect cable, 9-pin	60-2544-044
Computer connect cable, 25-pin	60-2544-040
Interrogator communications line kit - 9 pin (connects laptop computer with 9 pin serial port to sampler)	68-3770-001
Interrogator communications line kit - 25 pin (connects laptop computer with 25 pin serial port to sampler)	68-3770-002

3700FR/3720 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.

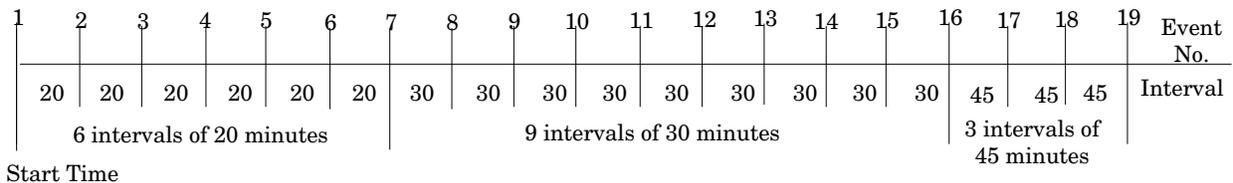


Figure C-1 Time Line

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
```

Table C-1 Display Index (Continued)

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

This display appears after you select "PROGRAM" in Display #1. It appears only when the sampler is configured for the extended programming mode and for 4, 12, or 24 bottles with the 3700 Portable, and 12 or 24 bottles with the 3700 Compact. Select "TIME" for time-paced sampling. Select "FLOW" for flow-paced sampling, and "STORM" for storm sampling.

Display 12 [TIME, FLOW, STORM]
PACED SAMPLING

This display appears after you select "STORM" in Display #12. Use to select time- or flow-pacing for the second bottle group of a storm routine. Select "TIME" for time-pacing or "FLOW" for flow-pacing

Display 14 [TIME, FLOW]
SECOND BOTTLE GROUP

This display appears after you select "STORM" in Display #12. Enter the amount of time between the sampler's enabling and the first sample event for the first bottle group occurs.

Display 15 ___ MINUTE DELAY TO
FIRST GROUP SAMPLE

This display is the first input display of the flow segment of a storm program. Select "DURING" to collect samples for the first and second bottle groups concurrently. Select "AFTER" to collect samples for the second bottle group after the sampler has filled the first bottle group.

Display 16 [DURING, AFTER]
FIRST GROUP

This display appears after you select "STORM" in Display #12. Enter the amount of time between the time the sampler is enabled and the first sample event for the second bottle group.

Display 17 ___ MINUTE DELAY TO
SECOND GROUP SAMPLE

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)

Table C-1 Display Index (Continued)

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.

Display 27 QUANTITY AT INTERVAL
1. -- AT --- MINUTES

This display appears for samplers configured for 2, 8, and 24 bottles (Display #s 221 or 222) with the 3700 Portable or 24 for the 3700 Compact (Display #22X). It does not appear for samplers configured for a single bottle. In the basic programming mode, it follows Display #36. In the extended programming mode, it follows one of the four sample-interval entry displays (Display #s 21, 22, 26, 27). Enter the number of bottles to receive a sample volume at each sample event.

Display 30 -- BOTTLES PER
SAMPLE EVENT <1 - MAX>

In the basic programming mode, this display appears when you have selected "SAMPLES PER BOTTLE" in Display #36. In the extended programming mode, it appears when the sampler is configured for 2, 8, or 24 bottles and there is only one bottle set. Enter the number of samples you want deposited in each bottle.

Display 31 -- SAMPLES PER
BOTTLE <1 - MAX>

Select "YES" if you want the routine to perform bottles-per-sample or samples-per-bottle multiplexing. Select "NO" if you want the routine to perform sequential sampling.

Display 35 MULTIPLEX SAMPLES?
[YES, NO]

This display appears when you have selected "YES" in Display #35. Select "BOTTLES PER SAMPLE" if you want the sampler to perform bottles-per-sample multiplexing. Select "SAMPLES PER BOTTLE" if you want the sampler to perform samples-per-bottle multiplexing.

Display 36 [BOTTLES PER SAMPLE,
SAMPLES PER BOTTLE]

This display appears only in the extended programming mode when you have set the number of bottles per sample event to "1" in Display #30. Select "TIME" if you want the bottles to be switched after a specified period of time. Select "SAMPLES" if you want the bottles to be switched after a specified number of samples have been placed in a bottle. We recommend using "SAMPLES" for time-paced sampling routines.

Display 40 CHANGE BOTTLES BASED
ON [TIME, SAMPLES]

This display appears when the number of bottles per sample event is set to a number greater than one and less than half the number of bottles in the tub. Select "TIME" to switch bottle sets after a specified period of time. Select "SAMPLES/BTL" to switch bottle sets after a specified number of samples have been placed in a set of bottles. Teledyne Isco recommends using "SAMPLES/BTL" for time-paced sampling routines.

Display 41 CHANGE SETS BASED
ON [TIME, SAMPLES/BTL]

Table C-1 Display Index (Continued)

This display appears if you select "TIME" in Display #40. Enter the amount of time each bottle is to receive samples.

Display 42 CHANGE BOTTLES EVERY
 -- HOURS -- MINUTES

This display appears if you select "TIME" in Display #41. Enter the amount of time each bottle set receives samples.

Display 43 CHANGE SETS EVERY
 -- HOURS -- MINUTES

This display appears after you select "SAMPLES" in Display #40. Enter the number of samples each bottle receives.

Display 44 CHANGE BOTTLES EVERY
 -- SAMPLES

This display appears after you select "SAMPLES/BTL" in Display #41. Enter the number of samples each bottle set is to receive.

Display 45 CHANGE SETS EVERY
 -- SAMPLES

This display appears when you select "yes" in Display #95. Enter the time of the first bottle switch. The remaining bottle changes will occur according to settings entered in Display #42. The display will also appear if you have started the routine after the programmed switch time.

Display 46 FIRST BOTTLE CHANGE
 AT HH:MM MM/DD

This display appears when you select "YES" in Display #95. Enter the time of the first-bottle set switch. The remaining bottle-set changes will occur according to settings entered in Display #43. The display will also appear if you start the routine after the programmed switch time.

Display 47 FIRST SET CHANGE AT
 HH:MM MM/DD

This display appears when the sampler is configured for 2-, 4-, 8-, 12-, or 24- bottle configurations under uniform time, flow, or nonuniform time modes of sample pacing. Select "YES" to sample continuously. Select "NO" to stop the sampling routine after the last set of bottles has been filled.

Display 48 SAMPLE CONTINUOUSLY?
 [YES, NO]

Enter the size of the sample volume. MAX will vary according to the number of samples per bottle and bottle size.

Display 50 SAMPLE VOLUMES OF
 --- ml EACH <10 - MAX>

This display appears when you have configured the controller for composite sampling by selecting "1" in Display #221 or #222. 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>

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]

Table C-1 Display Index (Continued)

This display is part of the calibration sequence. Press the MANUAL SAMPLE key when a collection bottle is underneath the distributor 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

```
--- m1 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

```
---m1! 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 is the last display of the storm branch. It appears when you select "YES" in Display #90. Enter the start time for the storm-sampling routine. The sampler will disregard enable or disable signals from the flow meter until the start time you enter here.

Display 93

```
STORM ENABLED AFTER
HH:MM DD-MM
```

This display appears when you have selected "TIME" in either Display #40 or 41. Select "YES" if you want to specify a clock time for the first bottle or bottle set switch. Select "NO" if you want to begin the switch interval at the routine's start time.

Display 95

```
ENTER FIRST SWITCH
TIME? [YES, NO]
```

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
```

Table C-1 Display Index (Continued)

This display follows Display #22. Enter the maximum amount of time you want between flow-paced sample events in a storm program. If the time between flow pulses exceeds this entry, the sampler will terminate the routine.

Display 110

MAX FLOW INTERVAL OF
 -- HOURS, -- MINUTES

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 142

CHANGE START TIME?
 [YES, NO]

This display appears when you have started a routine after the programmed first switch time. Select "YES" to enter a new switch time. Selecting "NO" will switch one bottle set and start the routine immediately.

Display 143

CHANGE SWITCH 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 "PORTABLE" when you are using a 3700 Compact or Standard Sampler. Select REFRIG only if you have a refrigerated base unit.

Display 220

[PORTABLE, REFRIG]
 SAMPLER

Table C-1 Display Index (Continued)

Bottles and Sizes configure option. This display appears when you select "PORTABLE" in Display #220. Select the number of bottles in the bottle base.

Display 221 [1, 4, 12, 24]
BOTTLES

Bottles and Sizes configure option. This display appears when you select "REFRIG" in Display #220. Select the number of bottles in the base.

Display 222 [1, 2, 4, 8, 12, 24]
BOTTLES

Bottles and Sizes configure option. Enter the bottle volume in milliliters.

Display 223 BOTTLE VOLUME IS
----- ml

Bottles and Sizes 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]

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."

Table C-1 Display Index (Continued)

<p>Display 250</p>	<p>[BASIC, EXTENDED] PROGRAMMING MODE</p>
<p>Load Stored Program configure option. Select the sampling program you want to use. Select "NONE" to exit the display without loading a program.</p>	
<p>Display 255</p>	<p>LOAD PROGRAM [#1, #2, #3, NONE]</p>
<p>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.</p>	
<p>Display 260</p>	<p>SAVE PROGRAM AS [#1, #2, #3, NONE]</p>
<p>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.</p>	
<p>Display 270</p>	<p>TAKE SAMPLE AT START TIME? [YES, NO]</p>
<p>Flow Mode Sampling configure option. This setting affects flow-paced, time-switched sampling routines only. Select "YES" to take a sample at switch times. Select "NO" if you do not want a sample event at the switch times.</p>	
<p>Display 271</p>	<p>TAKE SAMPLE AT TIME SWITCH? [YES, NO]</p>
<p>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).</p>	
<p>Display 280</p>	<p>ENTER INTERVALS IN [CLOCK TIME, MINUTES]</p>
<p>Calibrate Sampler configure option. Select "ENABLE" to add calibration displays to the program sequence. Select "DISABLE" to omit the calibration displays.</p>	
<p>Display 290</p>	<p>[ENABLE, DISABLE] CALIBRATE SAMPLE</p>
<p>Sampling Stop/Resume configure option. Select "ENABLE" to add the Sampling Stop/Resume settings to the program sequence. Select "DISABLE" to omit the settings.</p>	
<p>Display 300</p>	<p>[ENABLE, DISABLE] SAMPLING STOP/RESUME</p>
<p>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.</p>	
<p>Display 301</p>	<p>SAMPLE AT STOP? [YES, NO]</p>
<p>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.</p>	
<p>Display 302</p>	<p>SAMPLE AT RESUME? [YES, NO]</p>
<p>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.</p>	
<p>Display 310</p>	<p>---- MINUTE DELAY TO START (<0 - 9999>)</p>
<p>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.</p>	
<p>Display 321</p>	<p>SAMPLE UPON DISABLE? [YES, NO]</p>

Table C-1 Display Index (Continued)

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]

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)

Table C-1 Display Index (Continued)

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 run the distributor test. Select "NO" to skip the test. Test the distributor by moving it to Position 24 then back to Position 1.

Display 370

```
TEST DISTRIBUTOR?  
[YES, NO]
```

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]
```

3700FR/3720 Refrigerated Sampler

Appendix D Calculating Flow Increment Between Samples

The 3700FR Sampler will accept flow-proportional inputs from an external flow meter 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.

3700FR/3720 Refrigerated Sampler

Appendix E Glossary

Bottles per sample – Bottles per sample is the number of bottles receiving sample volumes at each sample event.

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 its recording chart. Marking the recording chart cross-references the charted flow with the sample events.

Multiplexing – There are two types of multiplexing: samples per bottle and bottles per sample. In samples per bottle multiplexing, a bottle receives samples from more than one sample event. In bottles per sample multiplexing, equal sample volumes are placed in more than one bottle at each sample event.

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.

Samples per bottle – Samples per bottle is the number of discrete sample volumes placed in each bottle.

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.

3700FR/3720 Refrigerated Sampler

Appendix F Material Safety Data Sheets

This appendix provides Material Safety Data sheets for the internal desiccant used in the 3700FR 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

SÜD-CHEMIE
Performance Packaging



ISO 9002

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%.

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



ISO 9002

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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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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SECTION IX -- SPECIAL PRECAUTIONS

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

* No Information Available

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

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

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

Material Safety Data Sheet

Indicating Silica Gel

Identity (Trade Name as Used on Label)

Manufacturer : MULTISORB TECHNOLOGIES, INC. (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"/> Skin Absorption	<input type="checkbox"/> Ingestion <input type="checkbox"/> Not Hazardous	CARCINOGEN LISTED IN	<input type="checkbox"/> NTP <input type="checkbox"/> IARC Monograph	<input type="checkbox"/> OSHA <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

3700FR/3720 Refrigerated Sampler

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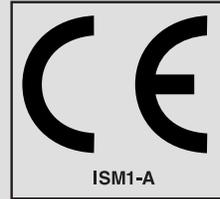
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DECLARATION OF CONFORMITY



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*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Fax: (402) 465-3001

Email: IscoService@teledyne.com



February 28, 2012 P/N 60-1002-040 Rev G



