

4700 Refrigerated Sampler

This pocket guide is not intended to replace the instruction manual. Read the instruction manual thoroughly before operating the sampler.

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Part #69-4703-085

Released: January 10, 2007

4700 Refrigerated Sampler

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4700 Refrigerated Sampler

Section 1 Introduction

1.1 Features

The 4700 Series sampler features are identified in Figures 1-1 through 1-3 and described in Table 1-1.

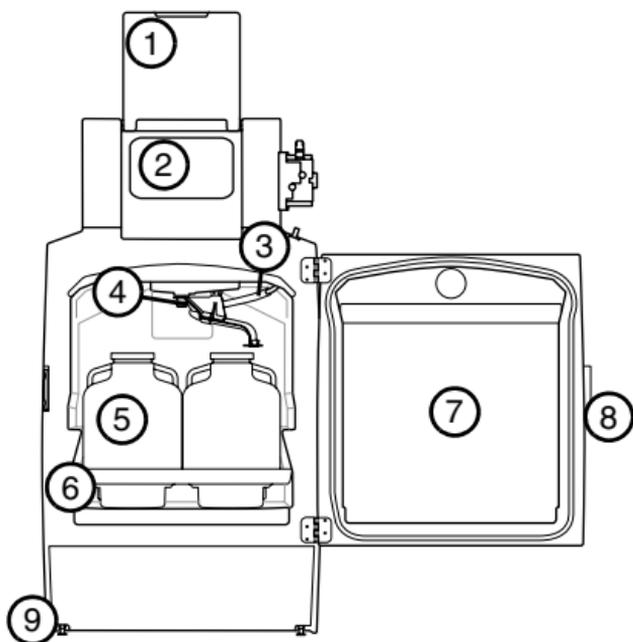


Figure 1-1 4700 Sampler features (Front)

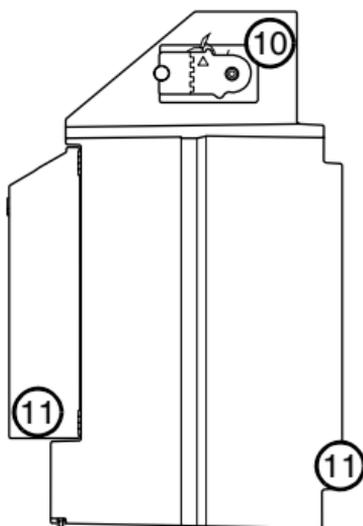


Figure 1-2 4700 Sampler features (Side)

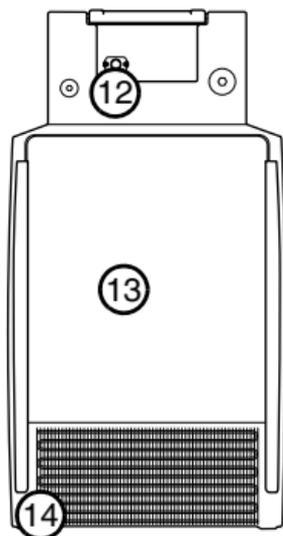


Figure 1-3 4700 Sampler features (Back)

Table 1-1 4700 Sampler Features

| Item | Name | Description |
|-------------|---------------------|---|
| 1 | Control Panel Cover | Protects the control panel display and keypad. |
| 2 | Control Panel | Supports user control and programming of sampler operation. |
| 3 | Discharge Tube | Carries liquid to the sample bottle. For 24, 4, 2, and 10 liter one-bottle configurations, the discharge tube is routed through the distributor arm. For the 20 liter one-bottle configuration the discharge tube is routed directly into the bottle. |
| 4 | Distributor Arm | Directs collected liquids to the bottle. Movement of the distributor is controlled by user-specified program settings. |
| 5 | Bottles | Hold the collected samples. |
| 6 | Bottle Locator Rack | Positions the bottles under the distributor. |
| 7 | Refrigerator Door | Protects the collected samples inside the refrigerated compartment. |

**Table 1-1 4700 Sampler Features
(Continued)**

| Item | Name | Description |
|-------------|--------------------------|---|
| 8 | Latch | Secures the door. The latch mechanism may be locked with a user-supplied padlock. |
| 9 | Level Adjustment Feet | The sampler includes two level adjustment feet at the front of the sampler. Use these to keep the bottle rack or locating deck level inside the refrigerated compartment. |
| 10 | Liquid Detector and Pump | The non-wetted liquid detector senses when the liquid is at the pump to determine head height and sample volumes. The peristaltic pump collects sample liquid and performs suction line rinses. |
| 11 | Lift Points | If you must lift the sampler, it can be safely handled at these points. Lifting must be done by two people, one on each side, with the door closed and latched. |

**Table 1-1 4700 Sampler Features
(Continued)**

| Item | Name | Description |
|-------------|----------------------------|--|
| 12 | External Device Connection | Supports connections to external devices such as a flow meter for sample pacing and enable signals, and connection to a personal computer for data collection. |
| 13 | Refrigeration Assembly | Modular, corrosion-resistant refrigeration assembly cools the refrigerated compartment to a user-selected temperature of 1 to 9°C (34 to 48°F). |
| 14 | AC Mains Line Cord | Connects to AC power source. |

1.2 Specifications

Table 1-2 Specifications

| General | |
|---------------------------|---|
| Size (H×W×D): | 130 × 72 × 84 cm 51 × 28 × 33 in |
| Weight (empty): | 72 kg 159 lb |
| Bottle Configurations: | 12 configurations available: 24, 1-liter PP or 350 ml glass; 4, 10-liter PE or glass; 2, 10-liter PE or glass; 1, 20-liter PE or glass; 1, 10-liter PE or glass; 24 ProPaks, 1-liter wedge; 1 ProPak, 10-liter round |
| Refrigerator Body: | Linear low-density polyethylene (LLDPE) |
| Power Requirements: | <i>100 VAC ±10%, 50 Hz:</i> Running current 1.4 amperes Stalled current 21.3 amperes <i>115 VAC ±10%, 60 Hz:</i> Running current 1.4 amperes Stalled current 21.3 amperes <i>230 VAC ±10%, 50 Hz:</i> Running current 0.82 amperes Stalled current 17 amperes |
| Installation Category: | II |
| Pollution Degree: | 3 |

Table 1-2 Specifications (Continued)

| | |
|---------------------------------------|--|
| Maximum Altitude: | 2,000 meters |
| Humidity: | 0 to 100% |
| Operational Temperature: | -29 to 49 °C -20 to 120 °F |
| Pump | |
| Intake Suction Tubing Length: | 1 to 30 m 3 to 99 feet |
| Material: | Vinyl or FEP-lined polyethylene |
| Inside Diameter: | 9 mm ³ / ₈ inch |
| Pump Tubing Life: | Typically 1,000,000 pump counts. |
| Maximum Suction Lift: | 8.5 m 28 feet |
| Typical Repeatability: | ±5 ml or ±5% of the average volume in a set. |
| Typical Line Velocity at Head Height: | 0.9 m: 0.91 m/s 3.1 m: 0.87 m/s 4.6 m: 0.83 m/s 3 ft: 3.0 ft/s 10 ft: 2.9 ft/s 15 ft: 2.7 ft/s |
| Liquid Presence Detector: | Non-wetted, non-conductive sensor detects when liquid sample reaches the pump to automatically compensate for changes in head heights. |

Table 1-2 Specifications (Continued)

| Controller | |
|------------------------------|---|
| Enclosure Rating: | IP67 NEMA 4X, 6 |
| Program Memory: | Non-volatile ROM (Flash) |
| Flow Meter Signal Inputs: | 5 to 15 volt DC pulse or 25 millisecond isolated contact closure for Isco flow meters. 4-20 mA input for non-Isco flow meters. |
| Digital Alarms: | 4 programmable outputs; 5 VDC, 100 mA |
| Number of Composite Samples: | Programmable from 1 to 999 samples. |
| Internal Clock Accuracy: | 1 minute per month, typical |
| Software | |
| Sample Frequency: | 1 minute to 99 hours 59 minutes, in 1-minute increments. 1 to 9,999 flow pulses. |
| Sampling Modes: | Constant Time, constant volume Variable time, constant volume Constant time, variable volume (Variable time and variable volume modes are controlled by an external flow meter signal) |
| Programmable Sample Volumes: | 10 to 9,990 ml in 1 ml increments. |

Table 1-2 Specifications (Continued)

| | |
|-------------------------|--|
| Sample Retries: | If no sample is detected, up to 3 attempts; user selectable. |
| Rinse Cycles: | Automatic rinsing of suction line up to 3 rinses for each sample collection. |
| Controller Diagnostics: | Tests for RAM, ROM, pump, display, and electrical components. |

4700 Refrigerated Sampler

Section 2 Installation

2.1 4700 Sampler Installation Overview

The following sections provide general instructions for placing the sampler into operation. In typical applications, the steps are:

1. Position the sampler. (Section 2.2)
2. Install a bottle kit. (2.3)
3. Attach the suction line. (2.4)
4. Attach a strainer. (2.5)
5. Route the suction line and strainer. (2.6)
6. Connect external instruments. (2.7)
7. Connect power. (2.8)
8. Configure and program the sampler. (2.9)
9. Lock the sampler. (2.10)

2.2 Positioning the Sampler

There are a few considerations when selecting a site for the sampler. The foremost concern should be personal safety.

The installation and use of this product may subject you to dangerous working conditions that can cause you serious or fatal injuries. Take any necessary precautions before entering the worksite. Install and operate this product in accordance with all applicable safety and health regulations, and local ordinances.



WARNING

If this product is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.



WARNING

This product has not been approved for use in hazardous locations as defined by the National Electrical Code.



WARNING

The sampler is heavy. When lifting, use a two-person lift at the points identified in Table 1-1. When possible, move the sampler using a two-wheeled hand cart from the left or right side. To prevent damage to the refrigeration system, do not tip the sampler more than 45°.

Dangerous locations – If you must enter a manhole, confined space, or other dangerous location to install the suction line and strainer, observe standard safety precautions. Refer to

Appendix B of the Installation and Operation guide for a discussion of safety considerations.

Support – The sampler should be installed on a surface capable of safely supporting the sampler, full liquid containers, and personnel.

AC Power – The mains line cord is the disconnect device should you need to remove power. Therefore, the electrical power outlet should be accessible.

Environmental – The sampler is designed for outdoor use. Refer to Table 1-2 for environmental specifications. When possible, avoid subjecting the sampler to chemical attacks and direct sunlight.

Avoid submersion – Although the control panel will resist damage (rated NEMA 4x, 6; IP 67), the refrigerator system and bottle compartment cannot prevent the liquid from entering. Liquid entering the refrigeration system might permanently damage the sampler; liquid entering the bottle compartment might contaminate the collected samples. Liquid entering the electrical compartment for the refrigeration system might result in a short circuit and possible shock hazard.

Liquid sample collection point – It is best to keep the distance between the sampler pump and the collection point as short as possible. The shorter distance will increase pumping efficiency and pump tubing life. Also, the pump inlet should be located above the liquid surface. Gravity will aid suction line rinses and allow

the line to drain, thereby reducing the possibility of sample cross-contamination. Refer to Table 1-2 for maximum suction line lengths and suction head heights.

Security – The location may need to provide some degree of security to prevent tampering or vandalism.

Accessibility – The sampler must be installed in a location where personnel can easily exchange bottles and perform routine service.

The sampler requires about 2600 square centimeters (925 in²) of floor space. Additional space must be allowed in front of the sampler, at its left and right sides, and above the sampler. Do not block access to these areas.

Obstructions will make routine servicing activities difficult or impossible.

The back of the sampler may be placed against a wall as long as air at the bottom of the refrigerator can flow freely to surrounding air.

Unrestricted air flow behind and around the sampler will keep the refrigeration system working efficiently.

Level surface – The sampler should be placed on a level surface and the feet on the refrigerator body should be adjusted to prevent tipping or spills. If the sampler is not level, the sample liquid may miss the bottle mouth.

To level the sampler, place a bubble level on the bottle rack or locating base, then adjust the feet. For one-bottle configurations, place the bubble level on the side rails of the refrigerated compartment.

**CAUTION**

Do not tip the sampler on its side or back. Tipping the sampler more than 45° might cause oil to run into the compressor inlet, which can permanently damage the sampler.

2.3 Installing a Bottle Kit

The 4700 sampler can hold 1, 2, 4, and 24 bottles. Each of these bottle configurations are supplied as a kit (see Table 2-1), which is normally ordered with the sampler or when you desire to change the bottle configuration.

Table 2-1 Bottle Kits

| Part Number | Description |
|-------------|---|
| 68-4700-003 | 24-bottle Configuration. Includes 24 polypropylene 1-liter wedge shaped bottles with caps, retaining ring, bottle rack and two discharge tubes. |
| 68-4700-004 | 24-bottle Configuration. Includes 24 glass 350-ml round bottles with PTFE lined caps, retaining rings, bottle rack and two discharge tubes. |
| 68-4700-017 | 24-Container ProPak Configuration. Includes 25 holders, 100 bags, retaining ring, bottle rack and instruction sheet. |

Table 2-1 Bottle Kits (Continued)

| Part Number | Description |
|--------------------|--|
| 68-4700-005 | 4-bottle Configuration. Includes four polyethylene 10-liter round bottles with caps, locating base and two discharge tubes. |
| 68-4700-006 | 4-bottle Configuration. Includes four glass 10-liter round bottles with PTFE lined caps, locating base and two discharge tubes. |
| 68-4700-007 | 2-bottle Configuration. Includes two polyethylene 10-liter round bottles, locating base, caps and two discharge tubes. |
| 68-4700-008 | 2-bottle Configuration. Includes two glass 10-liter round bottles with PTFE lined caps, locating base, and two discharge tubes. |
| 68-4700-009 | 1-bottle Configuration. Includes one polyethylene 2.5-gallon (10-liter) round bottle, locating base, two caps and two discharge tubes. |
| 68-4700-010 | 1-bottle Configuration. Includes on glass 2.5-gallon (10-liter) round bottle, two PTFE lined caps, locating base, and two discharge tubes. |

Table 2-1 Bottle Kits (Continued)

| Part Number | Description |
|-------------|---|
| 68-4700-018 | Single ProPak Configuration for 4700 and 6700 Series FR Refrigerated Sampler. Includes one composite ProPak holder with cap, 100 ProPak bags, two discharge tubes and an instruction sheet. |
| 68-4700-011 | 1-bottle Configuration. Includes one polyethylene 20-liter round bottle, two caps and two discharge tubes. |
| 68-4700-012 | 1-bottle Configuration. Includes one glass 20-liter round bottle, two PTFE lined caps and two discharge tubes. |

If you have selected a multi-bottle kit, first install the distributor arm and discharge tube (Section 2.3.1), then refer to the instructions for your selected bottle configuration:

- 24 Bottle configurations – section 2.3.2
- 4 Bottle configurations – section 2.3.3
- 2 Bottle configurations – section 2.3.4

If you have selected a single (composite) bottle kit, refer to the instructions in section 2.3.5.

For first-time use of the sampler, or if you have changed the bottle kit, be sure to configure the software for the new bottle kit (section 3.3.2).

2.3.1 Installing the Distributor Arm and Discharge Tube

The distributor arm ships with the sampler installed on its mounting shaft inside the refrigerator (Figure 2-1). It is generally easier to install the discharge tube with the arm removed, then you can reinstall the distributor arm. To do so:

1. Remove the knurled nut that secures the distributor arm.

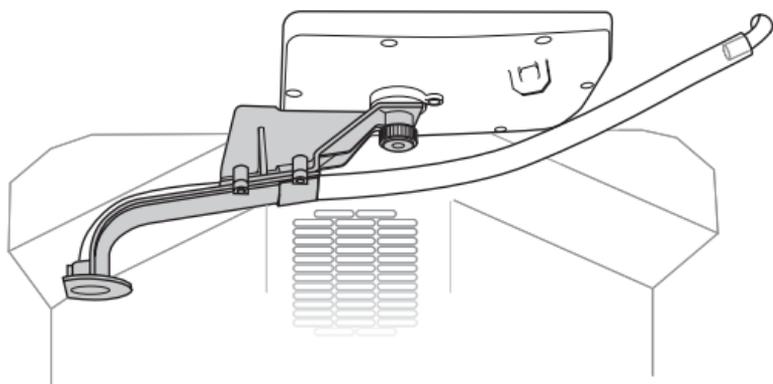


Figure 2-1 Installing the distributor arm and discharge tube

2. Pull the distributor arm downward to remove it from the keyed shaft.
3. Thread the discharge tube through the body of the distributor arm.
4. Insert the end of the discharge tube into the outlet hole on the distributor arm.



CAUTION

The discharge tube should not extend below the hole in the distributor arm. This could cause the distributor to fail if the excess tubing catches a bottle.

5. Pull on the loose end of the discharge tube to remove any slack. The tube should follow the contour of the distributor arm.
6. Push the distributor arm up onto the keyed shaft and secure it with the knurled nut.
7. Push the loose end of the discharge tube onto the bulkhead fitting in the top-front corner of the refrigerator.
8. Inspect the discharge tube:



CAUTION

An incorrectly installed discharge tube can cause the distributor arm to fail. It can also cross-contaminate samples. To prevent these problems, inspect the discharge tube as described in the following steps.

- a. Manually rotate the arm to make sure that the tube does not obstruct its movement. If the tube obstructs arm movement, re-route the discharge tubing.
- b. The discharge tube must slope downward from the bulkhead fitting to the arm throughout the range of arm motion. Otherwise, liquid might pool in

the tube and cross-contaminate samples. Note that the discharge tube has a natural curve. Should the tube create a low spot where liquid can pool, twist the end of the tube connected to the bulkhead fitting so that the natural curve holds the tube in a downward sloping position. Then, retest the tube at other arm positions.

2.3.2 24 Bottles

The 24 bottle configurations use a rack to hold and align the containers. To install the bottles in the refrigerator using the rack:

1. Place the uncapped bottles in the rack.
2. If you are using 350 ml glass bottles, compress the retaining ring and place it in the center of the bottles. Release the ring and the outward force of the ring will secure the bottles. (The polypropylene and ProPak[®] bottles do not use a retaining ring.)

| |
|---|
|  Note |
|---|

Bottles caps can be stored in the center of the bottle rack.

3. Locate the back of the rack (arrow, Figure 2-2). This end has a notch that fits a key on the rear wall of the refrigerator.
4. Lift and insert the back of the rack into the refrigerated compartment.

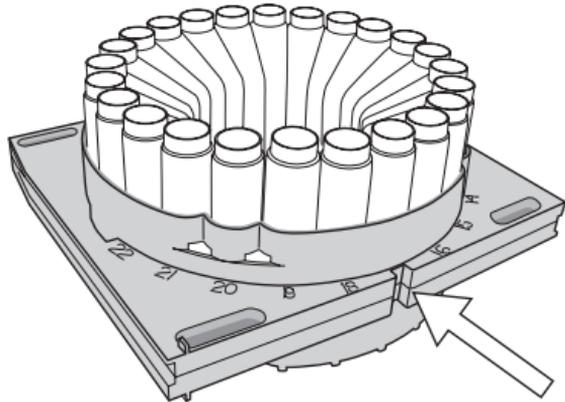


Figure 2-2 Insert the keyed end first so that it faces the back of the refrigerated compartment

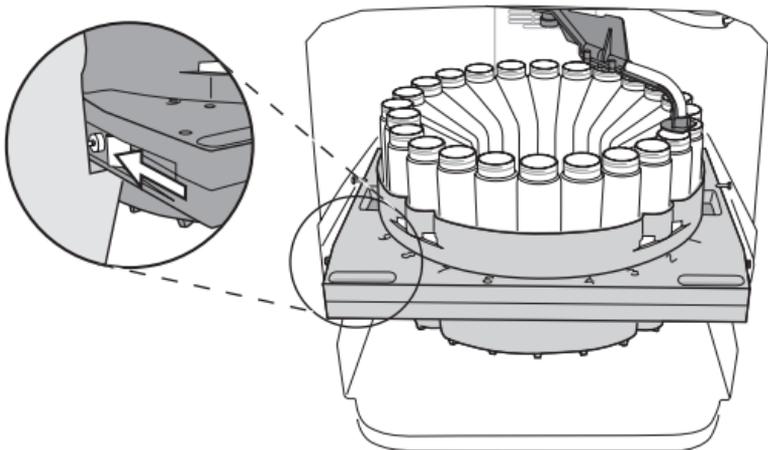


Figure 2-3 The 24-bottle rack is held in place by a latch on the left side

 **Note**

There are four metal guides along the sidewall of the refrigerator, two on each side. The front two guides fit along the left and right sides of the rack. The back two guides run along the top of the rack to prevent the rack from tipping forward.

5. Slide the rack along the guides. Push the rack in until the left-side latch (inset, Figure 2-3) secures the rack.

2.3.3 4 Bottles

The four bottle configuration uses a locating base to hold and align the bottles. To install the base and bottles:

1. Slide the locating base into the bottom of the refrigerated compartment (Figure 2-4). Note that the arrow must be pointing toward the back of the refrigerator.
2. Insert the four uncapped bottles into the numbered holes in the locating base.

 **Note**

Bottle caps can be stored between the bottles.

2.3.4 2 Bottles

The two bottle configuration uses a locating base to hold and align the bottles. To install the base and bottles:

1. Slide the locating base into the bottom of the refrigerated compartment (Figure 2-4). Note that the arrow must be pointing toward the back of the refrigerator.

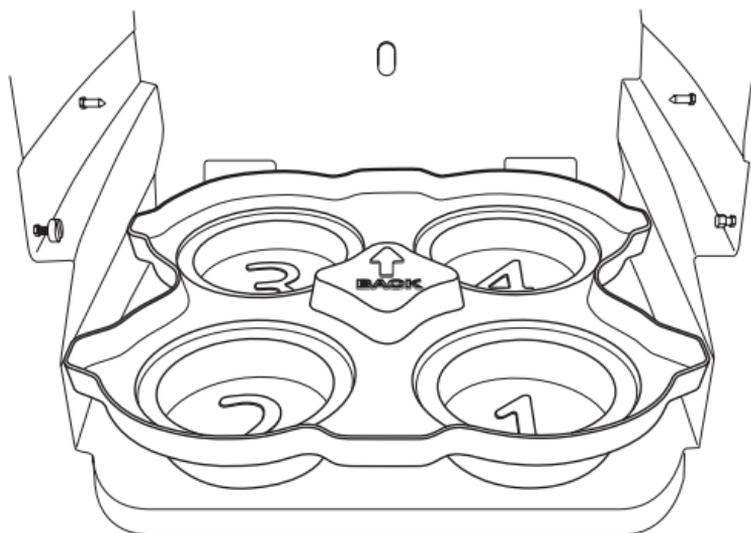


Figure 2-4 Installing the locating base

2. Insert the two uncapped bottles into the holes numbered “1” and “2” in the locating base.

Note

When the sampler controller is configured for two bottles (section 3), samples will only be distributed to bottles 1 and 2. If you place the bottles in positions 3 or 4 the liquid will miss the bottle.

Note

Bottle caps can be stored between the bottles.

2.3.5 1 Bottle

If your one-bottle configuration has a 10 liter (2.5 gallon) polyethylene, glass, or ProPak bottle, use a locating base to hold and align the bottle. If your one-bottle configuration has a 20 liter (5 gallon) glass or polyethylene bottle, simply place the bottle in the center of the refrigerator; no rack or locating base is required.

Refer to the instructions for your bottle size.

10 liter bottle – To install the locating base and 10 liter bottle:

1. Slide the locating base into the bottom of the refrigerated compartment (Figure 2-4). Note that the arrow must be pointing toward the back of the refrigerator.
2. Insert the bottle into the hole numbered “1” in the locating base.

| |
|--|
|  Note |
|--|

When the sampler controller is configured for a single 10 liter bottle (section 3), samples will only be distributed to bottle 1. If you place the bottle in any other position liquid will miss the bottle.

20 liter bottle – To install the 20 liter bottle:

The distributor arm should be removed to prevent it from being an obstruction while you replace the bottle. To remove the arm:

1. Remove the knurled nut that secures the distributor arm.
2. Pull the distributor arm downward to remove it from the keyed shaft.

3. Store the arm in a safe location for future use.

Then install the bottle:

4. Screw the cap with a hole onto the bottle.
5. Place the bottle in the center of the refrigerator.
6. Feed the discharge tube into the hole (see Figure 2-5).
7. Connect the other end of the discharge tube to the bulkhead fitting at the top-front corner of the refrigerator.

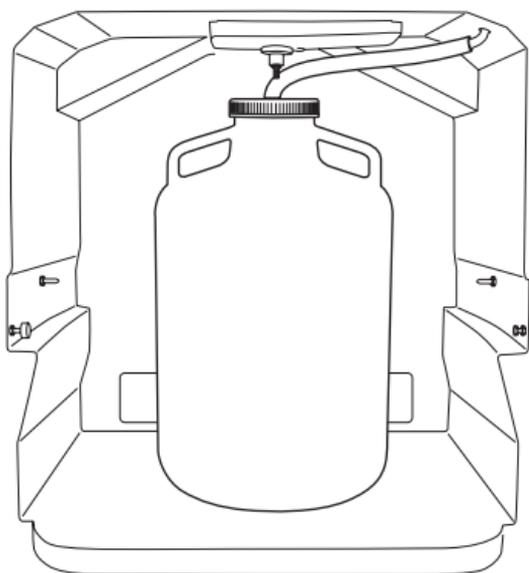


Figure 2-5 One 20 liter bottle configuration with discharge tube through the bottle cap

The discharge tube must slope downward from the bulkhead fitting to the bottle. Otherwise, liquid might pool in the tube and cross-contaminate samples.

Note that the discharge tube has a natural curve. Should the tube create a low spot where liquid can pool, twist the end of the tube connected to the bulkhead fitting so that the natural curve holds the tube in a downward sloping position.

2.4 Attaching the Suction Line

The suction line is the tubing from the sampling point to the pump tube inlet. The sampler uses a $\frac{3}{8}$ -inch ID suction line of lengths from 3 to 99 feet. Teledyne Isco offers vinyl or FEP-lined suction lines. The FEP-lined tubing has a polyethylene jacket to protect it from kinks and abrasions.

| |
|---|
|  Note |
|---|

The vinyl suction line contains a very low parts-per-million level of phenols. If phenol content affects your sample analysis, use the FEP-lined suction line.

Teledyne Isco ships suction line in standard lengths of 3.0 m (10 ft) or 7.6 m (25 ft). Either length should be cut to the shortest length feasible for the installation. When installed, the line should run the shortest possible distance from the collection point to the pump, preferably with a gradual upward slope. Excess suction line should be cut, not coiled. Coiled

suction line will hold liquid between sample events which could cross-contaminate samples or freeze in cold climates. If the standard lengths are too short, or if you are cutting compatible $\frac{3}{8}$ -inch ID suction line from a bulk spool, you can use lengths up to 30 m (99 ft).

When accurate, repeatable sample volumes are important, use care to cut the suction line to the correct increments:

- When the sampler is using metric units of measure, cut the line in 0.1 m increments. For instance, cut 4.2 m, not 4.26 m.
- When using English units of measure, cut the line in increments of 1 foot.

Record this cut length. Later, you will enter this value in the SUCTION LINE configuration option (section 3).

2.4.1 Vinyl Suction Line

To attach vinyl suction line to the pump tube (refer to Figure 2-6):

1. Locate the end of the tubing coupler with the black clamp. Push this end of the coupler into the upper pump tube (inlet).
2. Secure the tubing coupler by wrapping the black clamp around the pump tube and squeezing the finger pads together.
3. Push the vinyl suction line onto the other end of the tubing coupler.

4. Secure the vinyl suction line connection by wrapping the white clamp around the tube and squeezing the finger pads together.

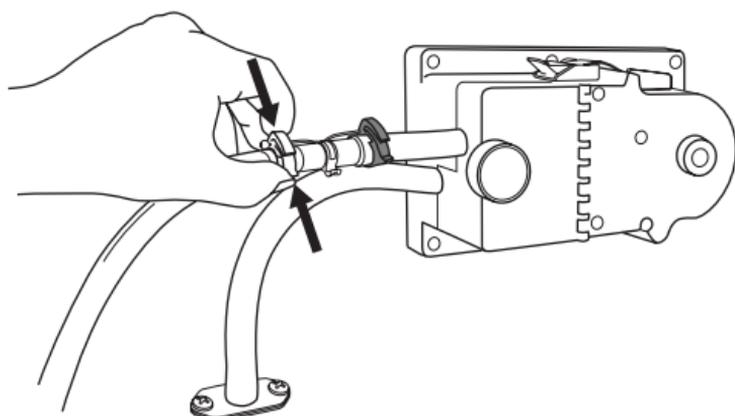


Figure 2-6 Attaching the vinyl suction line with a tube coupler

✓ Note

Release clamps by sliding the finger pad ends in opposite directions until the teeth disengage (Figure 2-7).

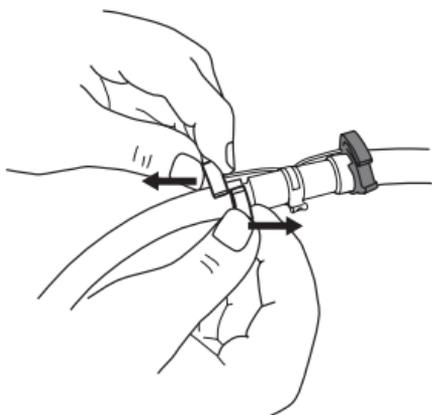


Figure 2-7 Releasing a tube coupler clamp

2.4.2 FEP-lined Suction Line

Inserting a tube coupler into FEP-lined suction line will damage the thin lining. Instead, refer to Figure 2-8 and the instructions below to attach FEP-lined suction line to the pump tube:

1. Slide a suitable clamp over the pump tube inlet.
2. Push about 20 mm of the FEP-lined suction line into the end of the pump tube.
3. Slide the clamp over the union and tighten. Do not overtighten; this might cause the tubing to collapse or restrict the flow.

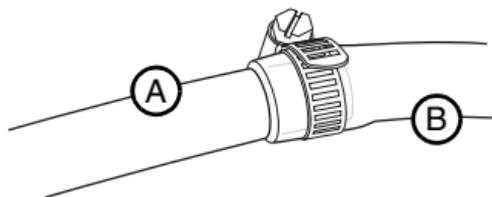


Figure 2-8 Connecting FEP-lined suction line (A) to pump tube (B)

2.5 Attaching a Strainer

To select the right strainer for your application, see Table 2-2 and Figure 2-9.

To attach the strainer to the suction line, carefully screw the strainer's threaded connector into the suction line. If attaching the strainer to an FEP-lined suction line, heat the end before threading the strainer into the line. Warming FEP-lined tubing will make it more pliable to avoid damage.

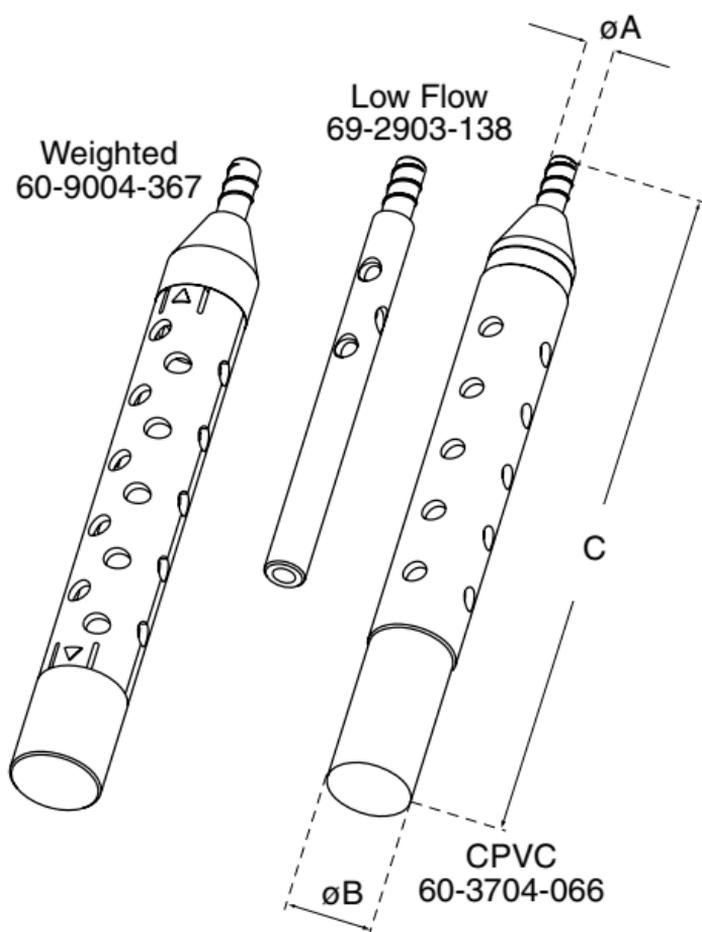


Figure 2-9 Strainers

Table 2-2 Strainers

| Part Number | Strainer | Application | dia. A | dia. B | length C | Maximum Unanchored Depth | |
|-------------|--|--|------------------|-------------------|-------------------|-----------------------------|----------------|
| | | | | | | Vinyl | FEP-lined |
| 60-9004-367 | Weighted Strainer- stainless steel ends, polypropylene center | Routine | 10 mm 0.40 in | 32 mm 1.25 in | 267 mm 10.5 in | 6.7 m 22 ft | 4.5 m 15 ft |
| 69-2903-138 | Low Flow Strainer- Stainless Steel | Low flow | 10 mm 0.40 in | 14 mm 0.562 in | 178 mm 7.0 in | 6.7 m 22 ft | 4.5 m 15 ft |
| 60-3704-066 | CPVC Strainer | Highly acidic liquids, metals | 10 mm 0.40 in | 33 mm 1.31 in | 292 mm 11.5 in | 1.2 m 4 ft | N/A |

2.5.1 Alternative to Strainers

When sampling from high velocity streams with heavy suspended solids, some field investigations suggest that more representative samples are obtained without the strainer. Consider attaching a short piece of thin walled aluminum tubing to the end of the suction line; anchor the tubing so that the inlet opens upstream. The aluminum tubing's thin wall will not disturb the flow stream, and most sample analyses disregard aluminum ions. Under most conditions, the pre-sample line rinse removes any debris over the tubing entrance.

2.5.2 Maximum Unanchored Depth

Table 2-2 lists maximum unanchored depths for each type of suction line. During a pre- or post-sample line rinse, the suction line is filled with air which might cause the suction line and strainer to float. If the depth of the strainer exceeds the listed value, securely anchor the strainer.

Even if the maximum depth is not exceeded, it is a good idea to anchor the suction line and strainer when sampling from high velocity or turbulent flow streams.

2.6 Routing the Suction Line and Strainer

Route the suction line so that it has a continuous slope from the liquid source to the sampler. This helps to drain the line during pre- and post-sample line rinses. If a suction line exposed to freezing climates does not fully drain, there is a risk of liquid in the suction line becoming frozen. Frozen liquid will cause the sample collection to fail. A warm sampling source can usually prevent this, provided there are no loops in the suction line. Some extreme situations may require more protective measures, such as insulating the suction line, or applying heat tape.

For representative samples, place the strainer in the main current of the flow stream, not in an eddy or at the edge of flow. Placing a strainer at the bottom may produce samples with excess heavy solids and no floating materials, while placing it at the top may produce the opposite conditions.

2.7 Connecting the Sampler to External Devices

You can connect the sampler to an external instrument (Figure 2-10) for a variety of reasons. Typical reasons include:

- Receiving flow pulses from a flow meter device for variable time or variable volume sample collection.

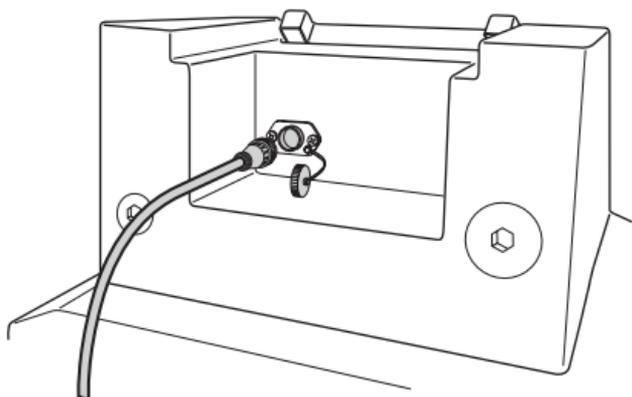


Figure 2-10 External device connection at rear of sampler

- Receiving an enable pin signal to enable sampler operation once site conditions warrant sample collection.
- Sending a three-second event mark at the beginning of every sample collection event.
- Receiving a linear 4-20 mA analog representation of the flow rate for variable time or variable volume sample collection.
- Sending alarm signals when user-specified sampler events occur.

These types of connections can be categorized as Standard Isco device connections or other device connections. Each type is discussed in sections 2.7.1 and 2.7.2, respectively.

This rear-panel connection may also be used for communicating with a computer for the purpose of collecting reports. Please refer to the

Installation and Operation Guide for more information about this feature.

2.7.1 Standard Isco Instrument Connections

You can connect the sampler to an Isco 4100 Series flow logger or a 4200 Series flow meter. With these Isco instruments you can:

- Receive flow pulses for variable time or variable volume sample collection.
- Receive an enable pin signal to enable sampler operation once site conditions warrant sample collection.
- Send a three-second event mark at the beginning of every sample collection event.
- Power the flow measurement device.

To connect either of these instruments, use the optional 7.6 m (25 ft) connect cable, 69-4704-043 (Figure 2-11).

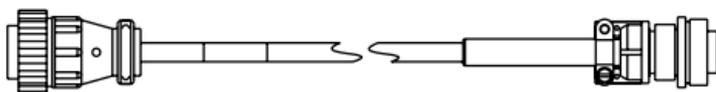


Figure 2-11 4700 Sampler to Isco flow meter cable

2.7.2 Other Device Connections

You can connect the sampler to receive a 4-20 mA signal from an external device, including Isco's 2108 and accQcomm™ analog output modules. You can also connect the sampler to a non-Isco device to receive flow pacing and

enable pin signals, to send sample event marks and alarm signals, or to supply 12 VDC power. All of these types of connections use the optional unterminated connect cable, P/N 68-4700-020 (Figure 2-12). This 3 m (10 ft) cable is unterminated at the device end to allow wired connections to compatible circuits. Refer to Table 2-3 for wire identification and connection details.

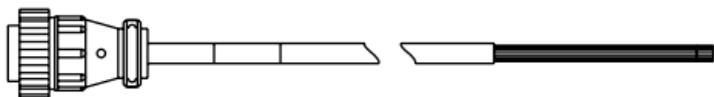


Figure 2-12 4700 Sampler unterminated connect cable

 **CAUTION**

Risk of equipment damage. Only experienced electronic technicians should make the connections to an external device using cable 68-4700-020.

To connect the external device, refer to Table 2-3 and select the appropriate wires. Splice the wires by soldering or using crimped connectors. Trim back the tinned ends of any unused wires and provide appropriate electrical insulation. To complete the connection, be sure to protect it from the environment. Running the cables through conduit and making the connections inside a watertight electrical box generally provides adequate protection.

The Isco Quick Disconnect (Q.D.) box, P/N 60-2004-228, can provide a convenient, watertight connection to wiring from a non-Isco device. The sealed IP67 (NEMA 4x) enclosure contains seven terminal blocks and is equipped with a mounting plate. The hazardous location rating of Q.D. box does not apply when used with an Isco sampler.

Table 2-3 Unterminated Connect Cable^a

| Pin | Wire Color ^b | Signal Name | Parameters/ Comments |
|-----|-------------------------|--------------|--|
| 1 | Black | 12 VDC Power | Output: +12.5 VDC, 1 ampere maximum |
| 2 | White | Ground | Common ground |
| 3 | Green | Flow Pulse | Input: 25 millisecond (minimum) pulse, +5 to +15 VDC |
| 4 | Blue | Serial Data | Output: For use with PC connections. Cable 69-4704-042 is recommended. See the Installation and Operation guide. |
| 5 | Orange | Event Mark | Output: 3 second, +12 VDC pulse at beginning of sample collection |

**Table 2-3 Unterminated Connect Cable^a
(Continued)**

| Pin | Wire Color ^b | Signal Name | Parameters/ Comments |
|-----|-------------------------|-------------------------|---|
| 6 | Red | Enable Pin ^c | Input: Ground this input (short to pin 2) to disable sampler operation. Leave this input open (floating) to collect samples. |
| 7 | White/Black | 12 VDC | Output: +12.5 VDC, 1 ampere maximum |
| 8 | Red/Black | Alarm 1 ^d | Output: 0 to +5 VDC, 100 mA maximum |
| 9 | Red/White | Alarm 2 ^d | Output: 0 to +5 VDC, 100 mA maximum |
| 10 | Orange/Black | Alarm 3 ^d | Output: 0 to +5 VDC, 100 mA maximum |
| 11 | Green/Black | Alarm 4 ^d | Output: 0 to +5 VDC, 100 mA maximum |
| 12 | Green/White | Analog 4-20 mA (+) | Input: Linear current loop signal representing minimum flow rate at 4 mA, maximum flow rate at 20 mA. This input is paired with pin 13. |

**Table 2-3 Unterminated Connect Cable^a
(Continued)**

| Pin | Wire Color ^b | Signal Name | Parameters/ Comments |
|-----|-------------------------|--------------------------|----------------------------------|
| 13 | Blue/White | Analog 4-20 mA (-) | Input: See pin 12. |
| 14 | Blue/Black | Ground | Common ground. Same as pin 2. |
| 15 | Black/White | N/A | Not used |
| 16 | Bare | N/A | Not used |

- a. All voltage levels are referenced to common ground on pins 2 and 14.
- b. For color pairs, the first named color is the predominant color; the second named color is the spiral stripe around it.
- c. This pin is also used as the Serial Data Input for use with PC connections. Cable 69-4704-042 is recommended instead for a serial data connection. See the Installation and Operation guide.
- d. See section 3.3.8 to configure alarm conditions.

2.8 Connecting Power



Before connecting the sampler to an AC power source, be familiar with the Electrical Requirements listed at the front of the Installation and Operation manual.

The factory assembles the sampler for either 100VAC/50 Hz, 115 VAC/60 Hz, or 230 VAC/50 Hz. The serial number label located inside the refrigerator identifies the AC power configuration of your sampler. You cannot convert the sampler in the field without purchasing a replacement refrigeration module.

The mains power cord for 115 VAC samplers is equipped with a NEMA 5-15P plug for standard North American outlets. The mains power cord for 230 VAC samplers is equipped with an EU-16P plug for standard CEE-7 European outlets. For other types of outlets that supply compatible AC power, convert the mains power cord plug with a locally-purchased adapter.

Plug the mains power cord into the outlet. The sampler control panel will briefly show the start up displays.

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2.9 Configuring and Programming the Sampler

To complete the installation, the sampler software should be configured and programmed. Refer to Section 3 for instructions.

Configure the sampler to make sure that it “knows” what bottle configuration is installed, the length of the suction line, etc. Program the sampler to specify how and when the sampler should collect liquid samples.

2.10 Locking the Sampler

Locking the sampler is an optional step that can prevent tampering with the sampler operation or collected samples.

To prevent tampering with the sampler operation, the sampler has a PROGRAM LOCK. When enabled, this software feature requires a numeric password to access most of the control panel functions. Refer to section 3.3.10 to enable this option.

To prevent tampering with the collected samples, place a padlock on the refrigerator door latch.

4700 Refrigerated Sampler

Section 3 Programming

3.1 Control Panel Description

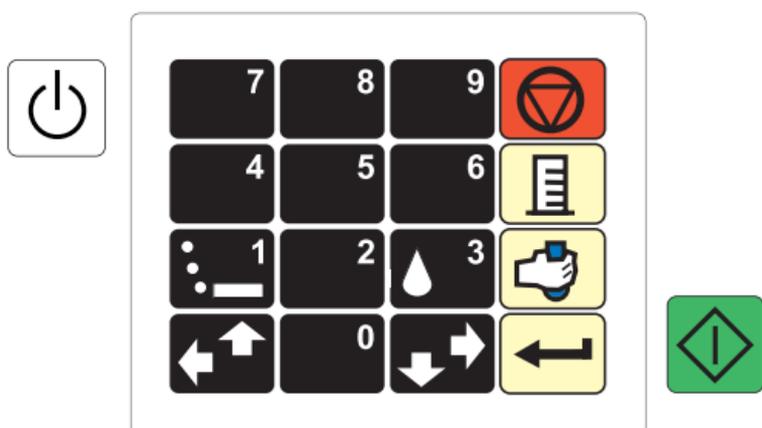


Figure 3-1 Control Panel Buttons

Table 3-1 Control Buttons

| Icon | Name | Description |
|---|-------|---|
|  | Power | Places the sampler in the On or Standby modes. Note: In either mode, mains power is always connected to the refrigeration system. |

Table 3-1 Control Buttons

| Icon | Name | Description |
|---|----------------------|---|
|  | Run Program | Press this button to start the sampling program. |
|  | Number Buttons | Types a number. |
|  | Pump Reverse (Purge) | At the Main menu, press this button to run the pump in the reverse direction to purge the suction line. In other menus, press this button to type the number 1. |
|  | Pump Forward (Fill) | At the Main Menu, press this button to run the pump in the forward direction to fill the suction line. In other menus, press this button to type the number 3. |
|  | Previous | Selects the previous menu option left or above the current choice. |
|  | Next | Selects the next menu option right or below the current choice. |

Table 3-1 Control Buttons

| Icon | Name | Description |
|---|-----------------------|--|
|  | Stop, Cancel, or Exit | Stops the pump or distributor. Pauses a running sampling program. In programming screens, returns to the previous programming level. |
|  | Calibrate | Press this button from the Main Menu to enter the Calibration mode. |
|  | Grab Sample | Press this button from the Main Menu or the Paused state to take a grab (manual) sample. |
|  | Enter | Accepts a menu choice or number entry and goes to next screen. |

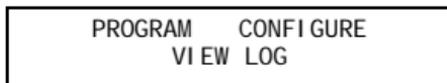
3.2 Getting Started

Apply power to the sampler (see section 2.8). The start-up screens appear on the LCD display.

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4700 SAMPLER

After completing the start-up routine, turn the sampler on by pressing the Power button. The control panel displays the Main Menu screen and waits for your input.



The Main Menu screen displays three menu options. The active option blinks. To change the active option, use the Next and Previous buttons. Press the Enter button to choose the blinking active option.

If you have just installed the sampler, you will first need to configure the sampler (section 3.3). Next, you will need to program it for operation (section 3.5). The View Log option (section 4.3.1) will not contain meaningful data until you have run a sampling program.

3.3 Configuring the Sampler

Before operating the 4700 Sampler, configure the sampler software. Doing so will set the time and date, and allow the sampler controller to correctly use the hardware and external connections.

To begin from the Main Menu, press the Next or Previous button until the CONFIGURE option blinks. Then, press the Enter button. The sampler displays the first configuration setting.

You can step through the Configure options using the Next or Previous buttons. To review

or change the settings for the displayed option, press the Enter button.

The sampler will return to the SELECT OPTION <- -> screen when there are no more settings for the selected option. To return to the SELECT OPTION <- -> screen sooner, press the Stop button. Pressing the Stop button at any input screen will exit the current screen without saving changes. You can press the Stop button again to exit the sampler configuration screens and return to the Main Menu screen.

3.3.1 Set Clock

Select this option to set the sampler's internal clock to your local time and date. The sampler uses this internal clock to start and stop sample programs, and to time stamp events in the log.

1.

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

Press Enter.

2.

| |
|--|
| ENTER TIME AND DATE: HH: MM DD-MON-YY |
|--|

Press the Number buttons to type the hours (using 24-hour format). Then, press Enter to accept the hours and move to the minutes. Repeat for all settings and the display will return to the SELECT OPTION <- -> screen.

3.3.2 Bottle and Sizes

Select this option to specify the installed bottle configuration (section 2.3). The sampler uses this setting to determine available bottle

options and control the operation of the distributor.

1.

| |
|--|
| SELECT OPTION: (<-->) BOTTLES AND SIZES |
|--|

Select the BOTTLES AND SIZES option and press Enter.

2.

| |
|--------------------------------|
| NUMBER OF BOTTLES: 1 2 4 24 |
|--------------------------------|

Press the Previous or Next buttons to highlight the installed bottle configuration. Press Enter to select it.

3.

| |
|--------------------------------------|
| BOTTLE VOLUME: ___ ml (300-30000) |
|--------------------------------------|

Press the Number buttons to enter the bottle volume in milliliters. For multi-bottle samplers, enter the bottle volume of one bottle, not the total volume of all bottles.

If you enter a non-standard bottle volume, the sampler will ask "ARE YOU SURE?". Answer NO to re-enter a standard volume or answer YES to confirm the non-standard volume.

3.3.3 Suction Line

Select this option to enter the suction line length (section 2.4). The sampler uses this input along with the pump tables it creates to determine the duration of the pump fill and purge cycles and to calculate sample volumes.

To set the suction line length:

1.

| |
|---------------------------------------|
| SELECT OPTION: (<-->) SUCTION LINE |
|---------------------------------------|

Select the SUCTION LINE option and press Enter.

2.

| |
|--------------------------------------|
| SUCTION LINE LENGTH: __ ft (3-99) |
|--------------------------------------|

Press the Number buttons to enter the suction line length.

3.

| |
|--------------------------------------|
| PLEASE WAIT! CREATING PUMP TABLES |
|--------------------------------------|

The sampler creates pump tables before returning to the SELECT OPTION <--> screen.

When accurate, repeatable sample volumes are important, use care to cut the suction line and enter the correct measurement.

If using English units of measure, cut the suction line to the nearest whole foot. When using metric units of measure, cut the suction line to the nearest 0.1 meter. The sampler displays units of measure appropriate for the selected language (see section 3.3.11).

3.3.4 Liquid Detector

Select this option to turn liquid detection on or off. This setting also allows you to configure suction line rinses and sample retries.

1.

| |
|--|
| SELECT OPTION: (<-->) LIQUID DETECTOR |
|--|

Select the LIQUID DETECTOR option and press Enter.

2.

| |
|--------------------------------|
| USE LIQUID DETECTOR? YES NO |
|--------------------------------|

Select YES (the factory default) for improved sample volume accuracy, and to enable Rinse Cycles and Sampling Retries. Select NO to turn off all of these features and return to the SELECT OPTION <- -> screen.

3.

__ RINSE CYCLES
(0-3)

Press a Number button to specify how many rinse cycles should be performed before collecting a sample.

4.

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

If the sampler fails to detect liquid, it can try again to collect the sample. Press a Number button to specify how many retries the sampler should attempt.

For most sampling applications you should use Liquid Detection. Selecting NO may adversely affect sample volume repeatability and will turn off Rinse Cycles and Sampling Retries.

You can use Rinse Cycles to condition the suction line and strainer before collecting a sample. Rinse Cycles may also improve sample volume repeatability by ensuring the suction line is wetted before each sample. One rinse cycle draws liquid through the suction line until it reaches the Liquid Detector. Then, the pump reverses direction and to clear the suction line.

Note that Rinse Cycles add to the Pump Counts (section 3.3.9) and requires more frequent pump tube changes.

3.3.5 Flow Mode Sampling

Select this option to indicate whether or not the sampler should take a sample when the Run Program button is pressed. The Sample At Start option is only applicable to Flow Paced programs.

1.

```
SELECT OPTION: (<-->)
FLOW MODE SAMPLING
```

Select the FLOW MODE SAMPLING option and press Enter.

2.

```
SAMPLE AT START?
YES NO
```

Select YES to take the first sample when the start time is reached. Select NO to wait until the flow count triggers the first sample.

If you select YES, when you run the program the sampler takes the first sample immediately (if NO DELAY TO START, see section 3.5.18) and starts counting flow pulses for the next interval.

3.3.6 Enable Pin

Select this option to specify which actions the sampler controller should take when the Enable Pin state changes. The Enable Pin feature allows an external device (section 2.7) to control the running programs.

1.

| |
|-------------------------------------|
| SELECT OPTION: (<-->) ENABLE PIN |
|-------------------------------------|

Select the ENABLE PIN option and press Enter.

2.

| |
|------------------------------|
| REPEATABLE ENABLE? YES NO |
|------------------------------|

Select YES for unlimited enable/disable. Select NO to allow only one enable, after which the sampler will remain enabled until the end of the program sequence.

3.

| |
|-----------------------------|
| SAMPLE AT ENABLE? YES NO |
|-----------------------------|

If your application requires a sample when the sampler becomes enabled, select YES. Otherwise, select NO and the sampler will take the first sample at the programmed interval.

4.

| |
|----------------------------------|
| RESET SAMPLE INTERVAL? YES NO |
|----------------------------------|

Select YES to reset the time or flow pacing interval to zero at the moment the sampler becomes enabled. Select NO and the sampler will continue with the current count.

The sampler controller is disabled when pin 6 of the External Device connector is held at ground potential. Isco devices do this by shorting pins 6 (Enable) and 2 (GND) together. A non-Isco device can disable the sampler by using a relay contact closure to short these two pins together. The sampler is enabled when pins 6 and 2 are no longer shorted, that is, pin 6 is open or allowed to float.

3.3.7 Refrigeration

Select this option to set the target temperature of the refrigeration system. The sampler will operate the cooling or heating systems as needed to maintain this target temperature.

1.

| |
|--|
| SELECT OPTION: (<-->) REFRIGERATION |
|--|

Select the REFRIGERATION option and press Enter.

2.

| |
|---------------------------------|
| TARGET TEMPERATURE — C (1-9) |
|---------------------------------|

Use the Number buttons to set the target temperature as degrees Celsius. Press Enter to save the setting.

3.

| |
|-------------------------------------|
| QUICK COOL FOR FIRST DAY? YES NO |
|-------------------------------------|

Single Bottle Only – Select YES to enable the Quick Cool mode, NO to disable it.

Quick Cool lowers the target temperature by 2.5°C for the first 24 hours. This feature can be

quite useful when collecting warm liquids or larger sample volumes to draw down the temperature quickly. To prevent the sample from freezing, Quick Cool will not lower the target temperature below 0.5°C.

3.3.8 Output Pins

Select this option to configure the four alarm outputs. An alarm output is based one of the following events:

- **PROGRAM STARTED** – This event occurs when the Start Time is met. For programs using **NO DELAY TO START**, this will occur immediately when you press the Run Program button. The alarm output signal lasts three seconds.
- **PROGRAM COMPLETED** – This event occurs when a running sampling program has finished. This alarm output stays on as long as the run time display reads **PROGRAM COMPLETED**.
- **PUMP FAILURE** – This event occurs when the sampler has detected a pump failure. This condition must be corrected before the sampling program can resume. This alarm output stays on until the pump is successfully operated.
- **DISTRIBUTOR JAMMED** – This event occurs when the sampler has detected a distributor failure. This condition must be corrected before the sampling program can resume. This alarm output stays on

until the distributor is successfully operated.

- **3-WAY VALVE CONTROL** – This event occurs whenever a sample is initiated and controls the optional Three-way Valve. This sampler option is useful when collecting samples from a pressurized line. For more information about the optional Three-way valve option and sampling from pressurized lines, contact your Isco dealer or the Teledyne Isco factory.

To configure the alarm output pins:

1.

SELECT OPTION: (<-->)
OUTPUT PINS

Select the OUTPUT PINS option and press Enter.

2.

SET OUTPUT _: (<-->)
PROGRAM COMPLETED

Press the Previous or Next buttons to select an event type for the displayed output channel.

Press the Enter button to select the event type and advance to the next output channel. Repeat until all four alarm outputs are programmed.

Refer to section 2.7 for details on connecting the alarm output pins to external devices.

3.3.9 Tubing Life

Select this option to view and reset the pump counts. The Tubing Life feature serves as a reminder so you can replace the pump tube at regular intervals before its wall cracks and ruptures. Several problems may arise from a weak or ruptured pump tube:

- The sampler will not pump the liquid
- Pump jams
- Inaccurate sample volumes
- Faulty liquid detection

To set the Tubing Life reminder:

1.

| |
|--------------------------------------|
| SELECT OPTION: (<-->) TUBING LIFE |
|--------------------------------------|

Select the TUBING LIFE option and press Enter.

2.

| |
|--|
| ___ PUMP COUNTS, WARNING AT __00000 |
|--|

The sampler displays the current pump count. The display automatically advances in four seconds or press Enter to continue.

3.

| |
|-------------------------------|
| RESET PUMP COUNTER? YES NO |
|-------------------------------|

If you have replaced the pump tube, select YES, then press Enter. Otherwise, select NO.

4.

| |
|-----------------------------------|
| __00000 PUMP COUNTS TO WARNING |
|-----------------------------------|

Type an interval and press Enter. (The default value is "5.")

The sampler counts pump revolutions in both the forward and reverse cycles with a resettable counter. When the counter reaches the default of 500,000 counts, the sampler displays an alert message, "WARNING! REPLACE PUMP TUBE." After replacing the pump tube (see section 5.1.2), reset the count to zero so the sampler can begin tallying the pump counts for the new tube.

Opening the pump housing and replacing the pump tube will not reset the counter.

The default count of 500,000 represents the average interval at which the pump tube should be inspected. Because liquid properties and site conditions affect the life of the pump tube, you can change this interval to better suit your application. If a pump tube inspection (section 5.1.1) at 500,000 counts reveals little or no wear, this value can be increased to avoid needless replacements. Conversely, if an inspection reveals significant wear at 500,000 counts, this value should be reduced to prevent a pump tube failure. Pump tubes wear out sooner when the sampled liquid contains a high percentage of suspended or abrasive solids. Pump tubes typically last 1,000,000 counts when pumping relatively clean liquids at normal temperatures.

✓ 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 enter the pump housing. Over time, this abrasive material may degrade the sample collection performance.

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 years of reliable service that is expected of a Teledyne Isco Sampler.

3.3.10 Program Lock

Select this option to turn the Program Lock feature on or off, and to change the password. When this security feature is enabled, the sampler requires a numeric password before a user can configure, program, calibrate, run a program, or grab a sample.

1.

| |
|---------------------------------------|
| SELECT OPTION: (<-->) PROGRAM LOCK |
|---------------------------------------|

Select the PROGRAM LOCK option and press Enter.

2.

| |
|-----------------------------|
| USE PROGRAM LOCK? YES NO |
|-----------------------------|

Select YES to turn on the Program Lock feature or NO to turn it off, then press Enter. If YES, the CHANGE PASSWORD option is displayed.

3.

| |
|---------------------------------|
| CHANGE PASSWORD? YES NO |
|---------------------------------|

Select YES to change the password or NO to exit and leave the password unchanged.

4.

| |
|------------------------------|
| ENTER NEW PASSWORD: _____ |
|------------------------------|

If YES was selected, enter a numeric password, up to four characters, then press Enter.

5.

| |
|----------------------------|
| REENTER PASSWORD: _____ |
|----------------------------|

Re-enter the password to confirm it. The sampler will alert you if the passwords do not match and allow you to enter them again.

Should you forget the password, contact Teledyne Isco's Customer Service department for assistance.

3.3.11 Language

Select this option to change the display language and display units for length measurements.

1.

| |
|-----------------------------------|
| SELECT OPTION: (<-->) LANGUAGE |
|-----------------------------------|

Select the LANGUAGE option and press Enter.

2.

SELECT LANGUAGE (<-->)
ENGLISH

Press the Next or Previous buttons to scroll through the options. Press the Enter button when the desired option is displayed.

If you select a language other than English, the sampler automatically displays length or distance units as meters and returns to the SELECT OPTION <--> screen. If you select English, the sampler displays length or distance units as feet and returns to the SELECT OPTION <--> screen.

3.3.12 System IDs

Select this option to view the system IDs. This function reports the unique ID for the sampler, and its hardware and software versions. These IDs are factory set.

1.

SELECT OPTION: (<-->)
SYSTEM IDs

Select the SYSTEM IDs option and press Enter.

2.

4700 SAMPLER
ID: _____

The first line lists the Model Number. The second line lists the unique ID for the sampler. Press Enter to continue.

3.

| |
|-----------------|
| HARDWARE: __ |
| SOFTWARE: _._ |

This screen lists the version numbers of the installed hardware and software. Press the Enter button to return to the SELECT OPTION <- -> screen.

3.3.13 Run Diagnostics

Select this option to enter the sampler diagnostics mode to test the sampler memory, display, keypad, pump, distributor, and various inputs and outputs.

For more information about this service-related feature, refer to the Installation and Operation guide.

3.3.14 Exit Configuration

Select this option to exit the configuration mode and return to the Main Menu screen.

3.4 Sampling Program Overview

The sampling program controls how often sample events occur and what should take place at each event. A sample event may happen when:

- you start a flow paced program that is programmed to Sample at Start (section 3.3.5).
- a time paced program reaches the First Sample time and date,
- your programmed time interval has elapsed,

- your programmed number of flow pulses has been reached, or
- a disabled sampler becomes enabled (section 3.3.6).

At each event, the sampler:

1. Resets the programmed flow or time pacing interval.
2. Moves the distributor arm over the next bottle. (This step does not occur for samplers configured with the 20 liter composite bottle.)
3. Rinses the suction line (see section 3.3.4).
4. Sends a three-second event mark signal that begins at forward pumping. The sampler deposits the programmed sample volume into the bottle.

If programmed to deposit a sample volume in more than one bottle, the sampler:

- a. Moves the distributor arm over the next bottle.
 - b. Deposits the programmed sample volume into the bottle.
 - c. Repeats steps 4a and 4b until the programmed number of bottles per event is reached.
5. Rinses the suction line (see section 3.3.4).

There are four categories of sampling program instructions that control the above actions in an event:

- Pacing instructions define what controls the sample collection interval and its frequency.
- Distribution instructions define where the collected liquid sample is placed. Single-bottle samplers can only distribute the sample to the composite bottle therefore skip the steps in this category.
- Volume instructions define how much liquid is collected at each interval, and the total volume to collect.
- The Start Time tells the sampler when to begin operation.

These categories and their related programming screens are illustrated in Figures 3-2 and 3-3 for time paced sampling programs and Figures 3-4 and 3-5 for flow paced sampling programs. Each screen includes a section number that you can refer to should you need a detailed explanation of the step.

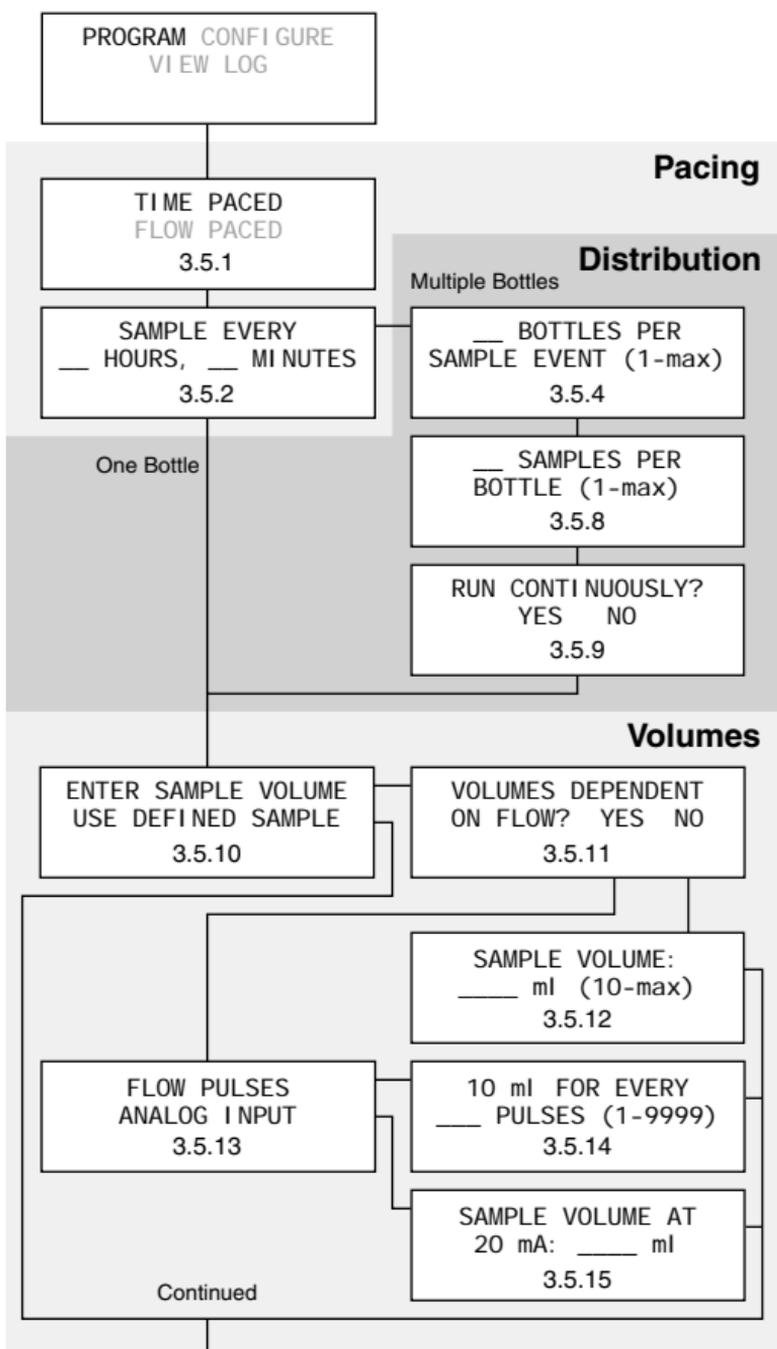


Figure 3-2 Time paced sampling program flow chart

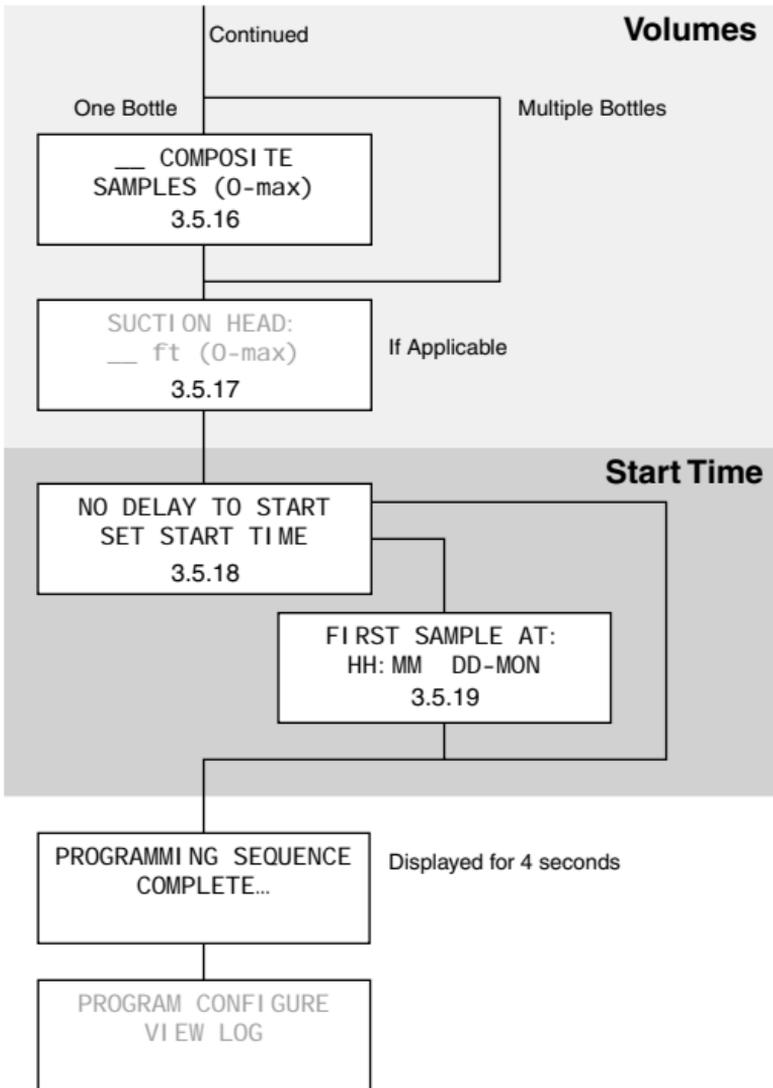


Figure 3-3 Time paced sampling program flow chart, continued

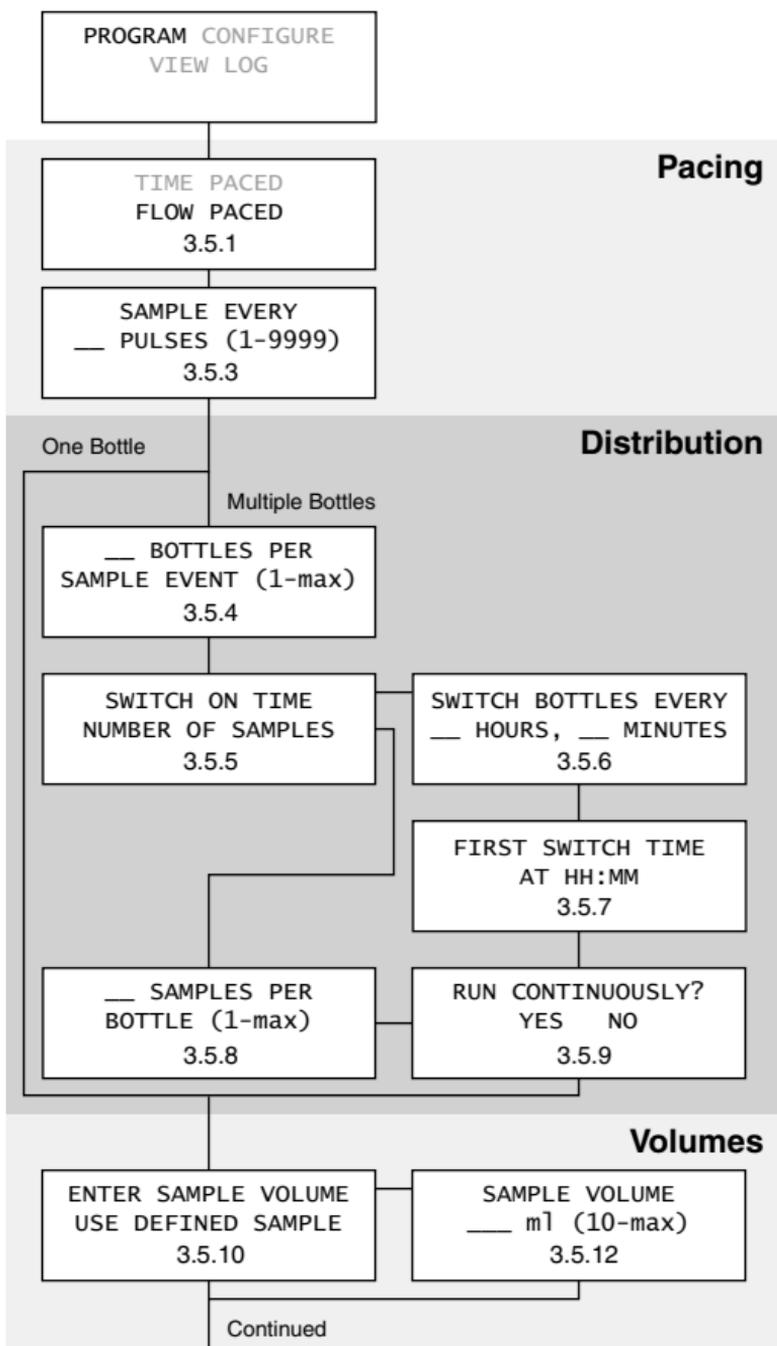


Figure 3-4 Flow paced sampling program flow chart

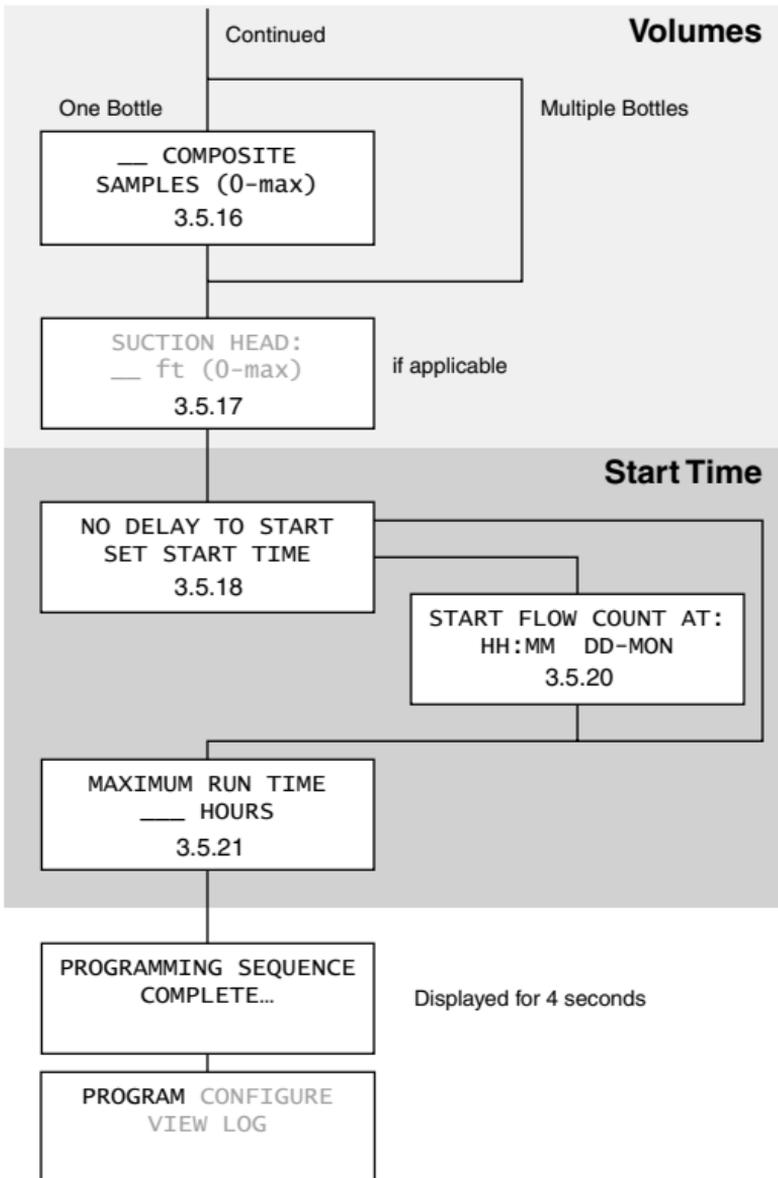


Figure 3-5 Flow paced sampling program flow chart, continued

3.5 Programming Steps

To begin programming from the Main Menu screen, use the Next or Previous button to select PROGRAM. Press the Enter button to display the first programming screen. Refer to Figures 3-2 through 3-5 and the following descriptions.

3.5.1 Pacing

There are two pacing methods for sampling programs:

Time paced sampling programs use the sampler's internal clock to collect samples at a constant time interval. When you program the sampler for time pacing, the sampler will prompt you to enter the time between sample events in hours and minutes.

Flow paced sampling programs require an electronic signal from a flow measurement device. This electronic signal is typically a pulse that indicates some user-programmed volume interval has passed through the flow channel. Because each pulse represents a volume interval, flow pacing rates are proportional to the volume of water flowing through the channel. This is sometimes called "Constant Volume Variable Time (CVVT) sampling."

When you program the sampler for flow pacing, the sampler will prompt you to enter the number of pulses to count before collecting a sample.

All Isco flow meters provide a compatible flow pulse. Non-Isco flow measurement devices may be used to paced the sampler. Refer to section 2.7, *Connecting the Sampler to External Devices* for more details.

Use the Next or Previous buttons to select the time or flow option, then press the Enter button.

3.5.2 Sample Every __ Hours, __ Minutes

Time Paced Only – Use the Number buttons to enter the time interval in hours and minutes. The sampler collects a sample each time this interval elapses while the program is running.

3.5.3 Sample Every __ Pulses

Flow Paced Only – Use the Number buttons to enter the flow interval as a number of pulses. While the program is running the sampler counts the flow pulses until this number is reached. At this time the sampler collects a sample and resets the interval to begin counting again.

The volume that each flow pulse represents is determined by the flow measurement device. With some instruments this volume is user-defined; others use a fixed volume. Refer to the instruction manual of the flow measurement device.

For example, consider an Isco 4250 Flow Meter programmed to send a flow pulse every 100 gallons. If you are required to collect a sample

every 10,000 gallons, you would enter 100 flow pulses.

$$10,000 \text{ gallons} \div 100 \text{ gallons} = 100 \text{ pulses}$$

If the flow measurement device sends flow rate data via a 4-20 mA current loop instead of flow pulses, the sampler converts this analog current to flow pulses representative of a volume. The sampler assumes that the current is linear from 4 mA at zero flow to 20 mA at the full-scale flow rate. This factory-calibrated conversion produces one pulse every 12 seconds (5 flow pulses per minute) at 20 mA and scales the pulse intervals until there are no pulses at 4 mA. See Table 3-2 for flow pulse intervals at various currents.

To calculate the number of flow pulses to enter in this sampler programming screen, follow the steps below.

1. Determine the full scale flow rate (Q_{\max}) that is represented by the flow measurement device at 20 mA.
2. Divide Q_{\max} by a time factor (F_{time}) to find the volume represented by a single flow pulse. The time factor you choose is determined time unit on which the flow rate is based:

| Time Unit | F_{time} Factor |
|--------------------------|--|
| seconds (cfs, m3s, etc.) | 0.08333 |
| minutes (gpm, l/m, etc.) | 5 |
| hours (gph, m3h, etc.) | 300 |
| days (mgd, m3d, etc.) | 7200 |

Table 3-2 Flow Pulse Intervals at Various Input Currents

| Input Current (mA) | Seconds Between Pulses | % of Full Scale Flow Rate |
|---------------------------|-------------------------------|----------------------------------|
| 4 | ∞ (no pulses) | 0 |
| 5 | 192 | 6.25 |
| 6 | 96 | 12.5 |
| 7 | 64 | 18.75 |
| 8 | 48 | 25 |
| 9 | 38.4 | 31.25 |
| 10 | 32 | 37.5 |
| 11 | 27.4 | 43.75 |
| 12 | 24 | 50 |
| 13 | 21.3 | 56.25 |
| 14 | 19.2 | 62.5 |
| 15 | 17.4 | 68.75 |
| 16 | 16 | 75 |
| 17 | 14.8 | 81.25 |
| 18 | 13.7 | 87.5 |
| 19 | 12.7 | 93.75 |
| 20 | 12 | 100 |

3. Divide the sample interval (I_{samp}) by the result of step 2. The final value is the number of pulses you enter in this screen.

The steps can be summarized in the equation below.

$$I_{\text{samp}} \div (Q_{\text{max}} \div F_{\text{time}}) = \text{Number of pulses}$$

✓ Note

The equation requires similar units for Q_{max} and I_{samp} . That is, the volume and flow rate units must use the same basic unit (cubic feet and cubic feet per second, gallons and gallons per minute, etc.). If they are dissimilar, convert the units before applying them to the equation.

Example 1 – Consider a flow meter programmed to output 20 mA at 1,000 liters per minute, the peak flow rate of the channel. If you are required to collect a sample every 10,000 liters, you would enter 50 flow pulses according the equation.

$$10000 \text{ liters} \div (1000 \text{ liters/min} \div 5) = 50 \text{ pulses}$$

Example 2 – Consider a flow meter programmed to output 20 mA at 20 cubic feet per second. If you are required to collect a sample every 2400 cubic feet, you would enter 10 flow pulses according the equation.

$$2400 \text{ cu ft} \div (20 \text{ cfs} \div 0.08333) = 10 \text{ pulses}$$

Example 3 – Consider a flow meter programmed to output 20 mA at 8 mgd (million gallons per day) and you are required to collect a sample every 10,000 gallons. Because the base units are dissimilar, you first must convert

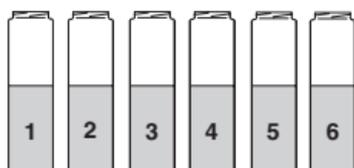
either the flow rate to gallons per day or your sample interval to millions of gallons. (The example below shows the flow rate converted to gallons per day.) After completing the equation you would enter 9 flow pulses.

$$10000 \text{ gal} \div (8000000 \text{ gal/day} \div 7200) = 9 \text{ pulses}$$

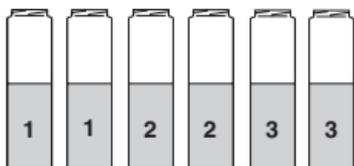
3.5.4 __ Bottles per Sample Event

Multiple Bottles Only – The sampler places a sample volume in one bottle or sets of bottles at each sample event. Use this screen to enter the number of bottles to repeat the sample volume at each sample event. The effect of this number is illustrated below.

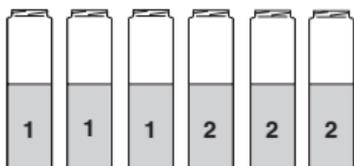
Distribution scheme with one bottle per sample event. *Sample events are numbered.*



Distribution scheme with two bottles per sample event.



Distribution scheme with three bottles per sample event.



3.5.5 Switch on Time or Number of Samples

Flow Paced, Multiple Bottles Only – The sampler can switch bottles at regular time intervals or switch after a specified number of samples. Use the Next or Previous buttons to select your choice.

3.5.6 Switch Bottles Every __ Hours, __ Minutes

Flow Paced, Multiple Bottles Only – If you selected Switch on Time (section 3.5.5), use the Number buttons to enter the desired time interval for bottle or bottle set switches.

3.5.7 First Switch Time

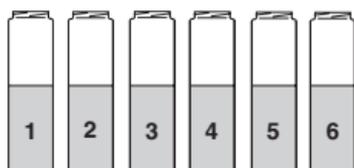
Flow Paced, Multiple Bottles Only – If you are switching bottles by time intervals, use this screen to specify the first switch time. All other bottle or bottle set switches will be relative to this time. Press the Number buttons to enter the time of day in 24-hour format.

3.5.8 __ Samples per Bottle

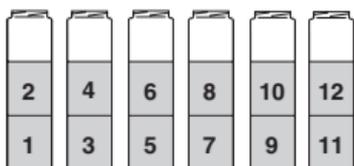
Multiple Bottles Only – The sampler places a sample volume from one or more sample events in a bottle. Use this screen to enter the number of sample volumes to place in a bottle. The

following diagrams illustrate the effect of this number.

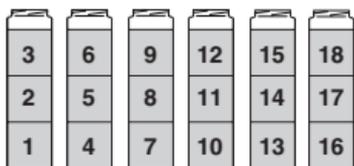
Distribution scheme with one sample per bottle. *Sample events are numbered.*



Distribution scheme with two samples per bottle.

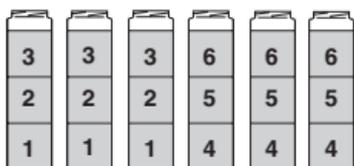


Distribution scheme with three samples per bottle.



This Samples per Bottle feature can be combined with the Bottles per Sample Event (section 3.5.4) to build more complex distribution schemes, sometimes known as multiple bottle compositing. An example is illustrated below.

Distribution scheme with three bottles per sample event and three samples per bottle. *Sample events are numbered.*



3.5.9 Run Continuously?

Multiple Bottles Only – Sample programs can run indefinitely by selecting YES at the RUN CONTINUOUSLY? screen. Continuous sampling resets the distribution when the distribution sequence is complete. That is, when the last bottle/set is reached, the next bottle/set is the first bottle/set.

In this mode, the sampler assumes that any filled bottles are replaced and ready to receive samples while the program is running, thus the pacing interval is never interrupted.

If you select NO, the sampler will run until it completes the distribution sequence, at which time it stops the program and reports PROGRAM DONE. The sampler will wait in this state until the bottles have been emptied and the program is restarted.

If your sampler is configured for composite sampling, refer to section 3.5.16 for instructions on continuous sampling.

3.5.10 Enter Sample Volume Use Defined Sample

At this screen you have the option to enter a sample volume (factory default is 200 ml) or use a manually defined sample volume based on pump counts.

If you choose ENTER SAMPLE VOLUME, the programming displays will step through a series of screens that let you enter the sample volume. When running a program, the sampler

will use these settings and vary the sample collection cycle to deliver the entered sample volume at any suction head height.

To view or change the entered sample volume, use the Next or Previous button to select ENTER SAMPLE VOLUME. Then, press the Enter button to advance to the next screen (section 3.5.12).

If you choose USE DEFINED SAMPLE, the sample collection cycle is always a fixed number of pump counts. This option can be beneficial when collecting samples from pressurized lines whenever exceptional sampling conditions make it difficult to detect liquids and collect accurate sample volumes. To USE DEFINED SAMPLE, press the Next or Previous button to select this option. Then, press the Enter button.

 **Note**

When using defined samples, be sure to DEFINE SAMPLE using the calibrate button. See section 3.6.1.

 **Note**

Selecting USE DEFINED SAMPLE will disable bottle overflow detection.

3.5.11 Volumes Dependent on Flow?

Time Paced Only – The sampler can vary the sample volume according to an input from an external flow rate measurement device, or use a fixed volume at every time interval. To use variable sample volumes, sometimes called Constant Time Variable Volume (CTVV)

sampling, select YES. To use fixed sample volumes, select NO.

3.5.12 Sample Volume __ ml

This screen displays the defined sample volume. Use the Number buttons to enter the sample volume. Press the Enter button to accept the displayed value.

3.5.13 Flow Pulses, Analog Input

Time Paced Only – If you are collecting sample volumes dependent on flow (section 3.5.11), select which type of flow rate input is provided by the external flow measurement device (see section 2.7).

3.5.14 10 ml for Every __ Pulses

Time Paced Only – If you selected FLOW PULSES to determine the sample volume (section 3.5.13), use the Number buttons to enter the number of pulses required to deliver 10 ml of liquid. This value establishes the ratio of flow rate to the sample volume at each event. For example, consider a time-paced sampler programmed to collect a sample every hour and you entered “10 ml for every 5 pulses.” If the sampler records 100 pulses over the hour, it will collect a 200 ml sample ($100 \text{ pulses} \div 5 \text{ pulses} \times 10 \text{ ml} = 200 \text{ ml}$).

3.5.15 Sample Volume at 20 mA: __ ml

Time Paced Only – If you selected ANALOG INPUT to determine the sample volume (section 3.5.13), use the Number buttons to enter the sample volume to be collected at the maximum flow rate, 20 mA. The sampler will linearly scale sample volumes at flow rates less than maximum.

3.5.16 __ Composite Samples

Single Bottle Only – Use the Number buttons to type the number of composite samples to take. Press the Enter button to accept the value.

The sampler calculates the maximum possible number of samples by dividing the configured bottle size (section 3.3.2) by the size of each sample volume (section 3.5.12).

If you enter zero, the sampler collects samples without regard for the total number of samples. If you enter zero, keep in mind that the sampler might overflow the bottle.

3.5.17 Suction Head

This screen is displayed only if the liquid detector is turned off (section 3.3.4). Use the Number buttons to type the suction head height. Press the Enter button to accept the value.

Suction head height is the vertical distance from the liquid surface to the pump inlet. To measure the suction head height, refer to Figure 3-6.

For most applications, Teledyne Isco recommends that you turn on the liquid detector (section 3.3.4). The sampler will automatically calculate the suction head height, typically resulting in more accurate and repeatable sample volumes.

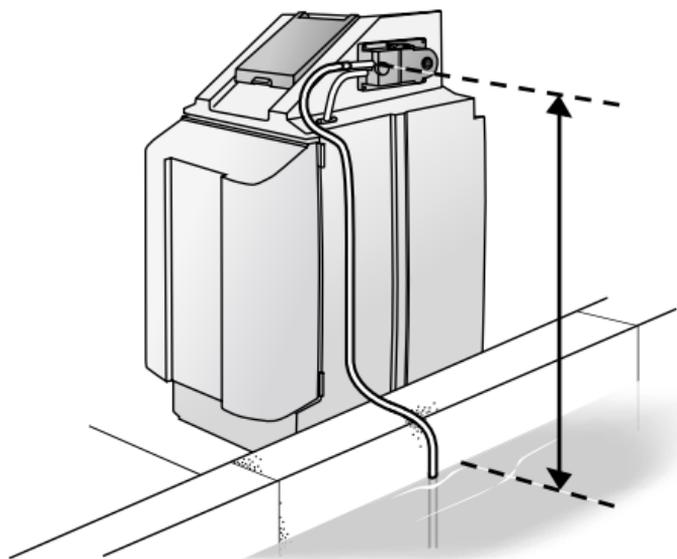


Figure 3-6 Suction Head Height

Applications that collect samples from a pressurized line are an exception. Teledyne Isco offers a pressurized line option for the sampler. Contact the factory for more information.

When using Teledyne Isco's pressurized line option, disable liquid detection and enter "1" at the suction head screen. Sample volumes should use the DEFINED SAMPLE option. Refer to section 3.5.10.

3.5.18 No Delay to Start Set Start Time

At this screen you have the option to start the sampling program immediately when you press the green Run Program button, or delay the sampling program until user-defined start time is met.

To program the sampler to start immediately, use the Next and Previous buttons to select the NO DELAY TO START option and press the Enter button.

To set a start time and date, use the Next and Previous buttons to select the SET START TIME option. Then, press the Enter button to advance to the next screen (section 3.5.20).

If you enter a "First Sample At" or Start Flow Count At" month less than the current month, the sampler interprets the start time as next year's date.

3.5.19 First Sample At:

Time Paced Only – Use the Number buttons to set the start time hours. Press the Enter button to accept the value and advance to the minutes. Repeat to complete the minutes, date, and month.

3.5.20 Start Flow Count At:

Flow Paced Only – Use the Number buttons to set the start time hours. Press the Enter button to accept the value and advance to the minutes. Repeat to complete the minutes, date, and month.

3.5.21 Maximum Run Time __ Hours

Flow Paced Only – Use the Number buttons to set the maximum run time. The sampler will stop the running sampling program when this time has elapsed.

This feature is useful for applications that require the collection of a total sample volume proportional to the flow volume over a specific duration. An example of this would be a flow-weighted composite sample representative of the total daily flow volume (24 hours). If your application does not limit the sample collection to a specific duration, enter zero.

3.6 Programming Examples

Sections 3.6.1 through 3.6.4 provide programming examples.

3.6.1 Defining the Sample Volume

If you have programmed the sampler to USE DEFINED SAMPLE (section 3.5.10), follow the steps in this example to define the volume using pump counts.

1.

| |
|----------------------------------|
| PROGRAM CONFIGURE VIEW LOG |
|----------------------------------|

At the Main Menu display, press the Calibrate button.

2.

| |
|-----------------------------------|
| CALIBRATE VOLUME DEFINE SAMPLE |
|-----------------------------------|

The sampler displays the Calibrate Volume or Define Sample option screen. Use the Next or Previous buttons to select DEFINE SAMPLE. Then press the Enter button.

3.

| |
|--|
| ___ COUNT PRE-PURGE HOLD '1' TO PURGE |
|--|

The sampler displays the pre-purge screen to define number of counts needed to purge the suction line. To simply review the pump count values, press the Next button to advance through the screens.

To change the pump counts, use the Number buttons to type the pre-purge counts. Or, press and hold the “1” button to reset the count to zero and start the pump in reverse to purge the line. Hold the 1 button until the line is sufficiently purged.

When you release the 1 button the sampler reports the number of purge counts that elapsed while you held down the button. Press the Enter button to save the value and continue.

4.

| |
|---------------------------------------|
| ____ COUNT SAMPLE HOLD '3' TO PUMP |
|---------------------------------------|

The sampler displays a screen to define number of counts needed to deliver the desired volume. Use the Number buttons to type the sample counts. Or, press and hold the “3” button to reset the count to zero and start the pump. The pump will draw the liquid through the suction line and pump, then deposit it into the bottle. To measure the delivered volume, you can replace the bottle with a graduated cylinder for this step.

Release the button when the desired volume has been collected. Press the Enter button to save the value and continue.

5.

```
___ COUNT POSTPURGE  
HOLD '1' TO PURGE
```

The sampler displays the post-purge screen to define number of counts needed to purge the suction line. Use the Number buttons to type the post-purge counts. Or, press and hold the “1” button to reset the count to zero and start the pump in reverse to purge the line. Hold the 1 button until the line is sufficiently purged.

When you release the 1 button the sampler reports the number of purge counts that elapsed while you held down the button. Press the Enter button to save the value and finish defining the sample.

```
___ COUNT POSTPURGE
```

```
PROGRAM   CONFIGURE  
VIEW LOG
```

Repeat these steps as needed until the desired sample volume is collected.

You may find it easiest to press and hold the 1 and 3 buttons the first time through to roughly define the sample volume. Then, repeat these steps and enter the pump count values to finely adjust the sample volume. You can check the defined sample volume using the Grab Sample feature (section 4.4) and selecting USE DEFINED SAMPLE.

3.6.2 Time Paced Sampling Program

This example shows how to program the sampler to collect a 500 ml sample every hour for twenty-four hours. The sampler will place each discrete sample in a separate bottle. The sampling program should take the first sample at 8:00 am on the current day.

This program example assumes that the sampler has been configured with 24 bottles (sections 2.3.2 and 3.3.2) and the liquid detector is turned on. It also assumes that the current time is before 8:00 am.

1.

| |
|----------------------------------|
| PROGRAM CONFIGURE VIEW LOG |
|----------------------------------|

Begin programming by selecting the PROGRAM option from the Main Menu screen.

2.

| |
|--------------------------|
| TIME PACED FLOW PACED |
|--------------------------|

The sampler displays the Time or Flow pacing option screen. Use the Next or Previous buttons to select TIME. Then press the Enter button.

3.

| |
|---|
| SAMPLE EVERY ___ HOURS, ___ MI NUTES |
|---|

The sampler displays the pacing interval screen. Use the Number buttons to type the pacing interval in hours and minutes (1 hour, 0 minutes). Press the Enter button.

4.

| |
|---|
| ___ BOTTLES PER SAMPLE EVENT (1-max) |
|---|

The sampler displays the Bottles Per Sample Event screen. Because our program requires one bottle for each sample event, type "1" using the Number button and press Enter.

5.

| |
|-----------------------------------|
| ___ SAMPLES PER BOTTLE (1-max) |
|-----------------------------------|

The sampler displays the Samples Per Bottle screen. Our program requires discrete samples in each bottle. Therefore, type "1" using the Number button and press Enter.

6.

| |
|-----------------------------|
| RUN CONTINUOUSLY? YES NO |
|-----------------------------|

The sampler displays the Run Continuously screen. Select NO to stop the sampling program after the last bottle.

7.

| |
|---|
| ENTER SAMPLE VOLUME USE DEFINED SAMPLE |
|---|

The sampler displays the option to enter a sample volume or use the defined volume. Select ENTER SAMPLE VOLUME and press Enter.

8.

| |
|--------------------------------------|
| VOLUMES DEPENDENT ON FLOW? YES NO |
|--------------------------------------|

The sampler displays the Volume Dependent On Flow screen. Select NO using the Next or Previous buttons and press Enter.

9.

| |
|-----------------------------------|
| SAMPLE VOLUME: ___ ml (10-max) |
|-----------------------------------|

The sampler displays the Sample Volume input screen. Type "500" using the Number buttons and press Enter.

10.

| |
|-------------------------------------|
| NO DELAY TO START SET START TIME |
|-------------------------------------|

The sampler displays the Start Time option screen. Select SET START TIME and press Enter.

11.

| |
|-----------------------------------|
| FIRST SAMPLE AT: HH: MM DD-MON |
|-----------------------------------|

The sampler displays the First Sample At screen. Type the hours "08" using the Number buttons and press the Enter button. Type the minutes "00" and press Enter. Then, type the number for today's day and press Enter. Finally, type the number(s) that correspond to the current month.

12.

| |
|---------------------------------------|
| PROGRAMMING SEQUENCE COMPLETE. . . |
|---------------------------------------|

| |
|-------------------------------|
| PROGRAM CONFIGURE VIEW LOG |
|-------------------------------|

The sampler displays the Programming Sequence Complete screen for four seconds, then advances to the Main Menu screen.

To run the sampling program, press the green Run Program button.

3.6.3 Flow Paced Sampling Program

This example shows how to program the sampler to collect a 100 ml sample every 10,000 gallons of liquid that has passed the sampling point. The sampler will composite the samples in one of its two 10-liter bottles. The sampling program should begin counting the elapsed flow at midnight and run continuously.

Because the program runs continuously, the sampler will fill one bottle in a day, then fill the other bottle the next day. Daily, an operator would only need to exchange the completed bottle with an empty one and the program could run indefinitely. However, service intervals should be planned to replace worn pump tubes.

This example assumes that the sampler has been configured with 2 bottles (sections 2.3.4 and 3.3.2). It also assumes the flow meter connected to the sampler (sections 2.7) sends a flow pulse every 1,000 gallons.

1.

| |
|--|
| PROGRAM CONF I G U R E V I E W L O G |
|--|

Begin programming by selecting the PROGRAM option from the Main Menu screen.

2.

| |
|--------------------------|
| TIME PACED FLOW PACED |
|--------------------------|

The sampler displays the Time or Flow pacing option screen. Use the Next or Previous button to select FLOW PACED. Then press the Enter button.

3.

SAMPLE EVERY
___ PULSES (1-9999)

The sampler displays the pacing interval screen. Type "10" using the Number buttons. Given that the flow meter sends one flow pulse every 1,000 gallons, this would equate to a sample event every 10,000 gallons. Press the Enter button.

4.

___ BOTTLES PER
SAMPLE EVENT (1-max)

The sampler displays the Bottles Per Sample Event screen. Because our program requires one bottle for each sample event, type "1" using the Number button and press Enter.

5.

SWITCH ON TIME
NUMBER OF SAMPLES

The sampler displays the Bottle Switch screen. Our program requires a bottle switch every 24 hours. Select SWITCH ON TIME and press Enter.

6.

SWITCH BOTTLES EVERY
___ HOURS, ___ MI NUTES

The sampler displays the Switch Bottles Every screen. Type "24" for the hours and press Enter. Then, type "0" for the minutes and press Enter.

7.

| |
|--------------------------------|
| FIRST SWITCH TIME AT HH: MM |
|--------------------------------|

The sampler displays the First Switch Time screen. Our program must switch bottles at midnight. Type "0" for the hours and press Enter. Then, type "0" for the minutes and press Enter.

8.

| |
|-----------------------------|
| RUN CONTINUOUSLY? YES NO |
|-----------------------------|

The sampler displays the Run Continuously screen. Select YES.

9.

| |
|---|
| ENTER SAMPLE VOLUME USE DEFINED SAMPLE |
|---|

The sampler displays the option to enter a sample volume or use the defined volume. Select ENTER SAMPLE VOLUME and press Enter.

10.

| |
|-----------------------------------|
| SAMPLE VOLUME: ___ ml (10-max) |
|-----------------------------------|

The sampler displays the Sample Volume input screen. Type "100" using the Number buttons and press Enter.

11.

| |
|-------------------------------------|
| NO DELAY TO START SET START TIME |
|-------------------------------------|

The sampler displays the Start Time option screen. Select SET START TIME and press Enter.

12.

START FLOW COUNT AT:
HH: MM DD-MON

The sampler displays the Start Flow Count screen. Type "00" and press Enter, then type "00" and press Enter again (12:00 am in 24-hour time format). Type the number for tomorrow's day and press Enter. Repeat for the current month.

13.

MAXIMUM RUN TIME:
___ HOURS

The sampler displays the Maximum Run Time screen. Type "0" using the Number buttons.

14.

PROGRAMMING SEQUENCE
COMPLETE. . .

PROGRAM CONFIGURE
VIEW LOG

The sampler displays the Programming Sequence Complete screen for four seconds, then advances to the Main Menu screen.

To run the sampling program, press the green Run Program button.

3.6.4 Flow-proportional Constant Time Variable Volume Program

This example shows how to program the sampler to collect flow-proportional samples volumes at fixed time intervals. This program will collect a sample every 15 minutes. The sample volume will be dependent on a 4-20 mA flow rate input signal, which will collect a 100 ml sample at $1.0 \text{ m}^3/\text{s}$. The sampler will collect the samples over a 24-hour period and place them in a single bottle.

This example assumes that the sampler has been configured with a single 10 liter bottle (sections 2.3.5 and 3.3.2). It also assumes a 20 mA signal represents the channel's maximum flow rate of $1.0 \text{ m}^3/\text{s}$.

When determining the sample volume, you must consider the bottle capacity and the peak and average flow rates. Note that in this example flow at the maximum rate over a full day would yield a composite sample of 9600 ml—nearly the capacity of the bottle. However, flow rates at the collection point average 60% of the maximum which would result in a bottle roughly 60% full.

1.

| | |
|---------|-------------|
| PROGRAM | CONF I GURE |
| VI EW | LOG |

Begin programming by selecting the PROGRAM option from the Main Menu screen.

2.

| |
|--------------------------|
| TIME PACED FLOW PACED |
|--------------------------|

The sampler displays the Time or Flow pacing option screen. Use the Next or Previous button to select TIME PACED. Then press the Enter button.

3.

| |
|---|
| SAMPLE EVERY ___ HOURS, ___ MI NUTES |
|---|

The sampler displays the pacing interval screen. Use the Number buttons to type the pacing interval in hours and minutes (0 hours, 15 minutes). Press the Enter button.

4.

| |
|---|
| ENTER SAMPLE VOLUME USE DEFINED SAMPLE |
|---|

The sampler displays the option to enter a sample volume or use the defined volume. Select ENTER SAMPLE VOLUME and press Enter.

5.

| |
|--------------------------------------|
| VOLUMES DEPENDENT ON FLOW? YES NO |
|--------------------------------------|

The sampler displays the Volume Dependent On Flow screen. Select YES and press Enter.

6.

| |
|-----------------------------|
| FLOW PULSES ANALOG INPUT |
|-----------------------------|

The sampler displays a screen to select the flow rate input. Our sampler is connected to a 4-20 mA input signal. Therefore, select ANALOG INPUT and press Enter.

7.

| |
|-----------------------------------|
| SAMPLE VOLUME AT 20 mA: ___ ml |
|-----------------------------------|

The sampler displays a screen to set the sample volume to collect at the maximum flow rate. Type "100" and press Enter.

8.

| |
|----------------------------------|
| ___ COMPOSITE SAMPLES (0-max) |
|----------------------------------|

The sampler displays the Composite Samples screen. To finish the program after a 24-hour period, type "96" (4 samples per hour × 24 hours) and press Enter.

9.

| |
|-------------------------------------|
| NO DELAY TO START SET START TIME |
|-------------------------------------|

The sampler displays the Start Time option screen. Select NO DELAY TO START and press Enter.

10.

| |
|---------------------------------------|
| PROGRAMMING SEQUENCE COMPLETE. . . |
|---------------------------------------|

| |
|----------------------------------|
| PROGRAM CONFIGURE VIEW LOG |
|----------------------------------|

The sampler displays the Programming Sequence Complete screen for four seconds, then advances to the Main Menu. To run the sampling program, press the green Run Program button.

4700 Refrigerated Sampler

Section 4 Operation

This section describes how to operate the sampler. These instructions assume that the sampler has been correctly installed (section 2), configured, and programmed (section 3).

4.1 Start a Sampler Program

Before starting a program:

- Verify that the pump tube is in good condition. Refer to section 5.1.1.
- Place empty bottles in the rack or locating base.

To start the program from the Main Menu screen, press the green Run Program button.

If a sampler configured for multiple bottles was previously halted (see section 4.2), the sampler will display a start bottle option when you press the Run Program Button. This start bottle option only appears if no programming changes were made after halting the program.

| |
|------------------------------------|
| ENTER START BOTTLE: ___ (1-max) |
|------------------------------------|

Using the Number buttons, enter the starting bottle. Then press the Enter button.

4.1.1 Start Time Delay

If the program is set for NO DELAY TO START (section 3.5.18), The sampler immediately begins to operate according to its Configure and Program settings.

If the program is set to use a start time, the sampler will wait for the specified time and date. During this delay, the display for time paced programs will show:

| |
|--------------------------------------|
| FIRST SAMPLE AT: HH: MM DD-MON-YY |
|--------------------------------------|

Or, for flow paced programs:

| |
|--|
| START FLOW COUNT AT: HH: MM DD-MON-YY |
|--|

When the programmed start time and date matches the sampler's time and date the sampler program begins to run.

Should you press the green Run Program button and the programmed start time has already passed, the sampler program starts immediately.

4.1.2 The Run State

Because the sampler operation is fully automated, no user intervention is required. Should there be a need to check on the running program, you can view the sampler display. It always reports the current state or operation and the refrigerator temperature.

Typically, the display will count down to the next sample event. This countdown screen may alternate with other messages:

- If the sampler is disabled by an external device, the display will show **PROGRAM DISABLED**.
- If the sampler is currently taking a sample the display will show **TAKING SAMPLE (number)**.
- If the sampler has encountered error conditions during the running program, the display will show **ERRORS HAVE OCCURRED**.
- If the sampler is programmed for time-switched bottles (section 3.5.5), the display will show **NEXT BOTTLE AT: HH:MM:SS DD-MON-YY**.
- If any programmed sampler operations are based on the sampler's internal clock, the display will show the current time and date.

4.1.3 Completed Program

When the program is complete, the display will show PROGRAM DONE and list the number of samples.

If the sampler encounters an error at any time during the running program, this display will alternate with an “ERRORS HAVE OCCURRED” message. Error messages are listed in Table 4-1.

4.2 Pause or Stop a Running Program

Press the red Stop button to pause a running program. The sampler will display:

| |
|----------------------------------|
| RESUME IN MM:SS VIEW LOG HALT |
|----------------------------------|

The top line of the display shows a five minute count down timer. If no buttons are pressed, the sampler program will automatically resume when the count reaches 0:00.

While paused, you can:

- View the log (see section 4.3.1)
- Collect a Grab Sample (see section 4.4)
- Halt the program — Press the Next or Previous buttons to select the HALT option. Then, press the Enter button.
- Resume the program — Press the Next or Previous buttons to select the RESUME IN M:SS option. Then, press the Enter button. Or, you can press the Stop button

to exit the paused state and resume the program.

During the pause, you can reset the countdown timer to five minutes by pressing the Number, Next, or Previous buttons.

| |
|---|
|  Note |
|---|

While paused, the sampler skips sample events that would have occurred otherwise. These are reported in the Log as MISSED SAMPLES (number): PROGRAM PAUSED.

4.3 Post Sampling Activities

Post-sampling activities include:

- Viewing the Log (section 4.3.1)
- Retrieving the Refrigerator Temperature Log (refer to the Installation and operation guide)
- Removing the sample bottles (section 4.3.2)

4.3.1 View the Log

The sampler records events during the running program and summarizes them in a log. This log is held in the sampler memory until the next program is started.

To view the log after the completion of a program, press the Stop or Enter button to return to the Main menu. Then, press the Next or Previous buttons to select the VIEW LOG option and press the Enter button. You can also view the log while a program is paused.

While viewing the log, you can:

- Step forward through the screens by pressing the Next or Enter buttons.
- Step backward by pressing the Previous button.
- Exit the log by pressing the Stop button.

The log generally contains the following information:

1.

| |
|---------------------------------|
| COLLECTED ___ OF ___ SAMPLES |
|---------------------------------|

The log reports the number of successful samples out of the total number programmed.

2.

| |
|---|
| MISSED SAMPLES: ___ NO LIQUID DETECTED |
|---|

If samples were not collected, the log reports the number of missed samples and the error message. If there are multiple reasons, this screen will be repeated for the other error messages. Error messages are described in Table 4-1.

3.

| |
|-------------------------------------|
| PROGRAM STARTED HH: MM DD-MON-YY |
|-------------------------------------|

The log reports the time and date the program was started.

4.

| |
|---------------------------------------|
| PROGRAM COMPLETED HH: MM DD-MON-YY |
|---------------------------------------|

If the program was allowed to finish, the log reports the time and date the program was completed.

5.

| |
|------------------------------------|
| PROGRAM HALTED HH: MM DD-MON-YY |
|------------------------------------|

If the program was halted before the programmed completion time, the log reports the time.

6.

| |
|--------------------------------------|
| PROGRAM PAUSED ___ SAMPLES REMAIN |
|--------------------------------------|

If you are viewing the log while the program is paused, the log displays the number of samples that remain.

7.

| |
|--------------------------------|
| POWER LOST HH: MM DD-MON-YY |
|--------------------------------|

If power was lost during the program, the log reports the time of the most recent power failure event and the time that power was restored.

8.

| |
|-------------------------------------|
| REFRIG TEMP DATA: AVERAGE: ___ C |
|-------------------------------------|

The log reports the average refrigerator temperature and the most recent time of the minimum and maximum recorded temperatures.

9.

| |
|-------------------------------------|
| LAST CALIBRATED HH: MM DD-MON-YY |
|-------------------------------------|

The log reports the time and date of the last sample volume calibration (see section 4.5), or the last DEFINE SAMPLE (section 3.6.1).

10.

| |
|-------------------------------------|
| LAST PROGRAMMED HH: MM DD-MON-YY |
|-------------------------------------|

The log reports the last time the program was modified.

11.

CLOCK SET AT
HH: MM DD-MON-YY

The log reports the last time the clock was set.

12.

4700 SAMPLER
ID: _____

The log reports the unique ID for the sampler control panel. This identifier is assigned at the factory.

13.

HARDWARE: ____
SOFTWARE: _._

The log reports the hardware and software revision of the control panel.

14.

TEXT TRANSLATION
REVISION: ____

If the sampler displays a language other than English, the translation revision is displayed.

15.

WARNING:
CHANGE PUMP TUBE

If the pump tubing count is exceeded the log will display a warning. For more information on the pump tube warning see sections 3.3.9 and 5.1.2.

Table 4-1 4700 Errors

| Message | Description |
|--------------------|--|
| No Liquid Detected | The sampler was unable to detect liquid. |
| No More Liquid | After the sampler detected liquid and while the sample was being taken, the liquid detector stopped detecting liquid. |
| Power Failed | The power was interrupted at the sample event time. |
| User Stopped Pump | The Stop button was pressed during the sample event. |
| Program Paused | The program was paused at the time of the sample event. |
| Pump Failure | The pump did not operate correctly. The sampler reports this error when some obstruction has stopped the pump rotor from turning, or when the pump band is open. |
| Program Halted | The program was halted. |
| Probable Overflow | The sampler did not deliver the sample because it would have over-filled the bottle. |

4.3.2 Remove Sample Bottles

After the program is complete, the bottles can be removed and prepared for the laboratory. Gain access to the bottles by releasing the door latch and swinging the door open. The bottles can then be removed from the rack or locating base. Push the distributor arm out of the way if needed.

If you are using the 24-bottle rack, you can slide it out to easily reach the bottles in the back. When sliding the rack out, observe the rack guides (Figure 4-1). The back two guides run along the top of the rack to prevent the rack from tipping forward. Do not pull the rack out beyond these guide pins unless you are securely holding the rack.

Removed bottles should be capped and labeled according to the protocol established by your laboratory.

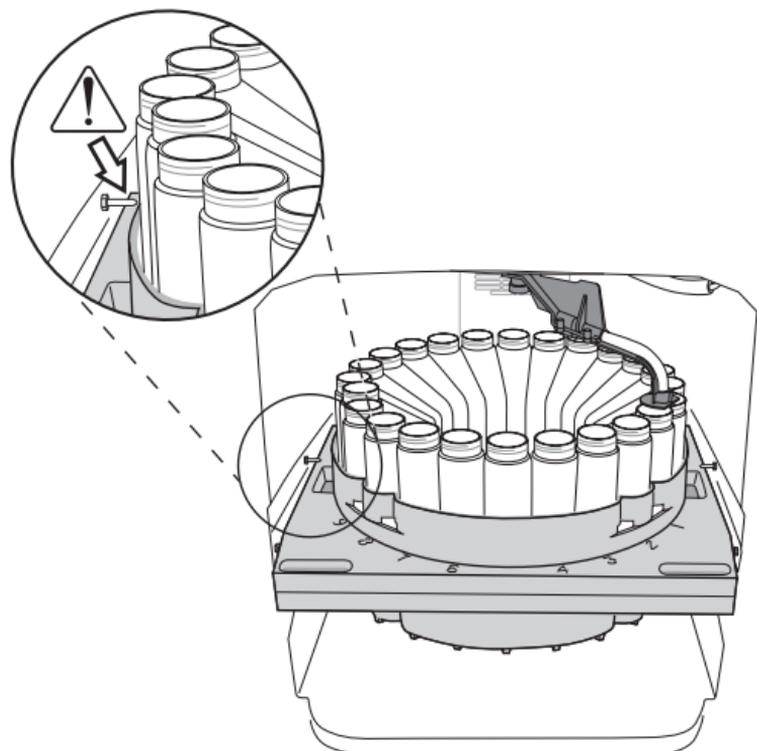


Figure 4-1 Sliding the 24-bottle rack out

4.4 Grab Samples

Grab samples let you take a single sample on demand and collecting it in an external container. You can collect a grab sample while the sampler is running a program, paused, or at the Main Menu screen.

To collect a grab sample:

1. Press the GRAB SAMPLE button.
2. The sampler asks how much liquid to collect. To collect a sample volume defined by pump counts, select USE DEFINED SAMPLE. To collect a different volume,

select the ENTER SAMPLE VOLUME, then use the Number buttons to enter the desired grab sample volume.

 **Note**

If you selected the USE DEFINED SAMPLE option, the sampler will collect the sample volume according to the DEFINED SAMPLE calibration setting. For more information on this feature see section 3.6.1.

3. The sampler displays GRAB SAMPLE PRESS (enter) WHEN READY and waits for you to prepare to collect a grab sample. Pull the lower pump tube from the bulkhead fitting. Hold the end of the tube over a container. Press the Enter button when you are ready.
4. The sampler goes through a complete sample collection cycle and deposits the requested amount of liquid in the container.
5. Return the pump tube to the bulkhead fitting.

 **Note**

If a grab sample is taken while a program is running, it is not counted as part of the number of samples.

4.5 Calibrate Sample Volumes

The sampler can deliver sample volumes repeatable to ± 5 ml or $\pm 5\%$ of the average volume in a set. For accurate sample volumes, the sampler uses the suction line length (section 3.3.3) to generate pump tables. The pump tables along with the liquid detector are

used to determine the suction head height and measure the liquid volume. By calculating the suction head, the delivered volumes are not affected by varying liquid levels.

Incorrect suction line values, disabling the liquid detector, and worn pump tubes may adversely affect the sample volume accuracy. Calibrating the sampler can enhance sample volume accuracy. To calibrate sample volumes, follow the steps below. These steps assume that the sampler has been correctly installed (section 2) and the suction line has been cut and its length entered in the sampler configuration (section 3.3.3). These steps also require a graduated cylinder to measure the delivered sample volume. Teledyne Isco offers a 1000 ml graduated cylinder. Order part number 299-0020-00.

To calibrate the sample volume:

An alternative method using manually defined sample volumes may be helpful for difficult applications. See section 3.5.10.

1. At the Main Menu, press the Calibrate button.

2.

| |
|-----------------------------------|
| CALIBRATE VOLUME DEFINE SAMPLE |
|-----------------------------------|

Select the CALIBRATE VOLUME option and press Enter.

3. CALIBRATE VOLUME:
PRESS ↓ WHEN READY!

4. Pull the lower pump tube from the bulkhead fitting. Hold the end of the tube over the graduated cylinder. Press the Enter button when you are ready.

5. TAKING ___ ml
CALIBRATE SAMPLE

Hold the graduated cylinder while the sampler collects the sample.

6. VOLUME DELIVERED:
___ ml

Measure the sample volume collected in the graduated cylinder and enter it in the VOLUME DELIVERED screen.

7. ___! ARE YOU
SURE? YES NO

If there is a large difference between the expected volume and your entered volume, the sampler asks you to confirm the entered volume. If the volume you entered is correct, select YES. Otherwise, select NO and re-enter the measure sample volume.

8. Return the pump tube to the bulkhead fitting.

4.6 Operate the Pump Manually

The sampler pump can be operated manually from the Main Menu display.

To operate the pump:

1. Press the “1” Number button to prepare the pump for reverse operation (line purge).

PRESS ↵ TO
PUMP REVERSE

Or, press the “3” Number button to prepare the pump for forward operation (sample).

PRESS ↵ TO
PUMP FORWARD

2. Press the Enter button to start the pump in the selected direction.
3. Press the Stop button to stop the pump and return to the Main Menu.

4700 Refrigerated Sampler

Section 5 Maintenance

This section describes how to maintain your sampler. If you think your sampler requires repair, or if you have questions concerning its operation or maintenance, contact your authorized Isco service facility or Teledyne Isco's Technical Service Department:

Phone: (800) 228-4373

(402) 464-0231 (international)

FAX: (402) 465-3001

E-mail: IscoService@teledyne.com

5.1 Periodic Maintenance Checklist

Before each use:

- Inspect the pump. Service as necessary.
- Inspect the pump housing and rollers.
- Clean or replace the wetted parts (bottles, suction line, strainer, pump tube, and discharge tube).
- Clean the sampler as necessary.

5.1.1 Pump Inspection

Inspect the pump before each use. Inspections are especially important when pumping large sample volumes over long distances or when the sample liquid contains a high percentage of suspended or abrasive solids. Pumps in need of service might experience performance problems such as:

- Faulty liquid detection
- Inaccurate sample volumes
- The sampler will not pump any liquid
- Pump jams.

To inspect the pump:

1. Press the On/Off button to place the sampler controller in the Standby state. This ensures that the sampler will not attempt to operate the pump.



CAUTION

The sampler has a safety interlock that prevents the pump from operating when the pump housing band is open. **DO NOT** tamper with the pump housing and band. The pump is extremely powerful. The pump can injure you severely if the sampler activates the pump while you are working on it. Place the sampler controller in the Standby state before opening the pump housing.

2. Refer to Figure 5-1. Release the latch (H) securing the metal pump housing band (K).

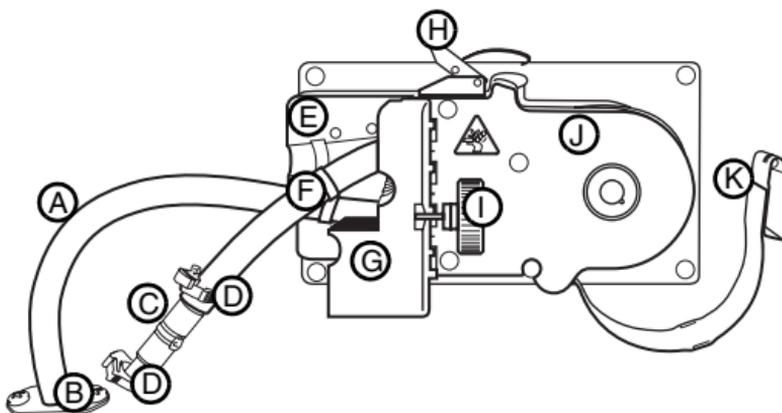


Figure 5-1 4700 Pump

- A. Pump Tube
- B. Bulkhead Fitting
- C. Tubing Connector
- D. Clamps
- E. Alignment Notches
- F. Alignment Collars
- G. Liquid Detector Cover
- H. Latch
- I. Knob
- J. Pump Housing
- K. Pump Housing Band

3. Swing the pump housing band away from the pump housing.

4. Inspect the following:

Pump tube – Look for excessive wear caused by the pump rollers and for cracks along the sides of the tube. Cracks might not be appar-

ent unless you flex or squeeze the tubing. If cracks or excessive wear are evident, replace the pump tube (section 5.1.2).

Pump Rotor – Look for debris build-up on the pump roller or guide surfaces (Figure 5-2). Clean when needed (section 5.1.3).

Housing – Look for debris inside the pump housing. Clean as necessary (section 5.1.4). (Debris inside the housing is usually evidence that a pump tube failed.)

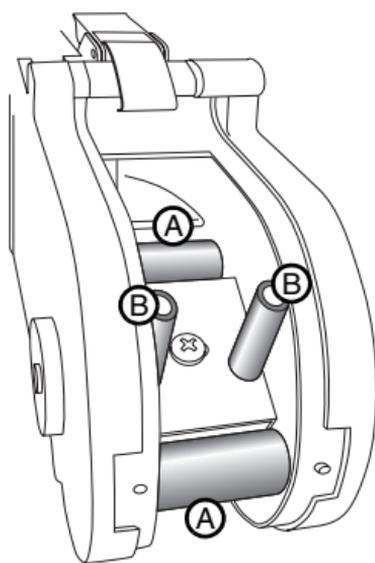


Figure 5-2 Rollers (A) and guides (B) on the pump rotor

5.1.2 Pump Tube Replacement

The correct sampler pump tubing is easily recognized by the blue alignment collars. Pump tubing from non-Isco vendors and tubes designed for other types of samplers should not

be used. Incorrect pump tubing may result in poor pump performance or even cause parts to fail prematurely. Also note that the discharge tube is not the same as the pump tube.

Refer to Figure 5-1 and the following steps to replace the pump tube.

1. Press the On/Off button to place the sampler in the Standby state. This ensures that the sampler will not attempt to operate the pump.



CAUTION

The sampler has a safety interlock that prevents the pump from operating when the pump housing band is open. **DO NOT** tamper with the pump housing and band. The pump is extremely powerful. The pump can injure you severely if the sampler activates the pump while you are working on it. Place the sampler controller in the Standby state before opening the pump housing.

2. Loosen the Liquid Detector Cover (G) by unscrewing the large black knob (I).
3. Unlatch the Pump Housing Band (K).
4. Pull the tube (A) away from the bulkhead fitting (B) and disconnect the tubing connector and suction line.
5. Pull the old pump tube through the pump.
6. Thread the new pump tube through the pump. Note that the short end (inlet) should extend from the top opening.

7. Align the blue collars with the alignment notches.
8. Close the liquid detector cover and secure it tightly with the large knob.
9. Close the pump housing band and secure it with the latch.
10. Reset the pump-tube counter. (Follow the steps in section 3.3.9 and select YES when asked “RESET PUMP COUNTER?”.)
11. Take a “dry” grab sample (section 4.4) to test the new tube.
12. Reconnect the suction line.

Pump Tube Life – Several factors shorten the pump tube life. Among them are:

- Incorrect installation.
- Abrasive materials suspended in sample liquid.
- Frequent line rinses.
- Long purge cycles, such as those used with long suction lines.

To extend the life of the pump tubes:

- Always use Isco pump tubes.
- Install the tube properly, aligning the blue collars correctly in the notches.
- Follow the natural curve of the tube when wrapping the tube around the pump rollers.

- Minimize the line rinses and sampling retries in the sampling programs.
- Use the shortest possible suction line.

5.1.3 Cleaning the Pump Rollers

Debris should be removed from the rollers and guides to keep the pump operating efficiently and to extend tubing life. Remove loose debris from the pump rollers and guides with a stiff nylon-bristle brush. If debris has built up and cannot be removed with the brush, scrape the rollers or guides with a plastic or wooden tool to loosen the debris.



CAUTION

Do not use a metal tool. This might damage the plastic rollers and guides.

5.1.4 Cleaning the Pump Housing

Remove loose debris from the pump housing with a stiff nylon-bristle brush. If needed, flush debris from the housing with water. Do not forcefully spray with water. This might force water through the seals and bushings and damage internal components.

5.1.5 Cleaning or Replacing Wetted Parts

For general cleaning, you can wash the strainer and sample bottles with a brush and soapy water, then rinse with clean water. You can clean the liquid path through the wetted parts (Figure 5-3) by placing the strainer in a cleaning solution and pumping it through the

delivery system. Next, place the strainer in clean water and pump it through the delivery system to rinse it. If these items are severely contaminated, replace them.

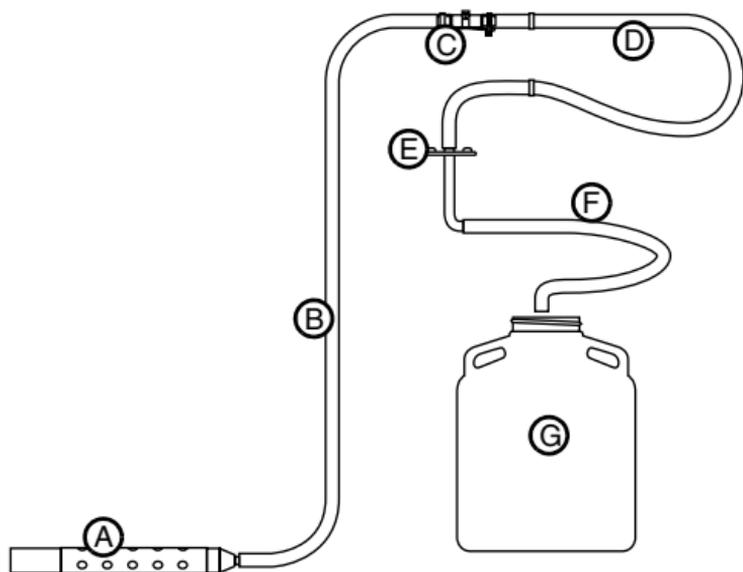


Figure 5-3 Wetted Parts

- A. Strainer (316 stainless steel, polypropylene, or CPVC)
 - B. Suction Line (vinyl)
 - C. Tubing Connector (316 stainless steel)
 - D. Pump Tube (silicone)
 - E. Bulkhead Fitting (316 stainless steel)
 - F. Discharge Tube (silicone)
 - G. Bottle (glass, polypropylene, or polyethylene)
-

For application-specific requirements, consult with your laboratory to establish cleaning or replacement protocols.

5.1.6 Sampler Cleaning Guidelines

Keeping the sampler clean and protected from harsh elements may extend the usable life of the sampler. When necessary, clean the exterior and interior of the sampler with warm soapy water and brush, then rinse with water. Be sure to use a detergent that is compatible with low-density polyethylene and polystyrene. Avoid using strong solvents and acids.

