

6100FR

Refrigerated Volatile Organic Sampler



Part #69-6103-045 of Assembly #60-6104-024
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ISCO[®]

FOREWORD

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

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

If the problem persists, call or email the Isco Customer Service Department for assistance. Contact information is provided below. Simple difficulties can often be diagnosed over the phone. If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by the Customer Service Department, including the use of the **Return Authorization Number** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

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

Contact Information

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

Figure 1. Model 6100FR Refrigerated Sampler



Chapter 1. Introduction

CAUTION

Never install the Model 6100FR controller where there is any possibility of submersion. The electronic components are environmentally sealed, but the mechanical components cannot be. The linkages and moving parts inside the controller can be damaged by submersion. Exposure of the mechanical parts to water will void the warranty. In addition, the refrigerator's lower compartment is not watertight. Never install in a location where even the lower compartment could become submerged.

1. How the Model 6100FR Works

The Model 6100FR Refrigerated Volatile Organic Sampler consists of two separate units connected by a double plastic tube. The larger unit is the refrigerator and contains the controller, bottle rack, air pump, and filling mechanism. The small metal cylinder is a bladder pump that mounts in the flow stream as far as 75 feet from the sampler. The double tube connecting the units supplies air to operate the pump and carries the sample from the pump to the controller.

Pump Operation

The bladder pump, when mounted in the flow stream, works as follows: The pump contains a bladder inside a stainless steel cylinder. The air pump on the refrigerator applies both vacuum and pressure to the space between the bladder and the pump wall to alternately fill and empty the bladder with the liquid sample. When the controller draws a vacuum around the bladder, a ball check valve allows entry of the sample from the flow stream through a strainer into the bladder. When the controller pumps air into the space between the bladder and the pump wall, the bladder compresses forcing the sample up the sample line to the controller. The check valve in the pump inlet prevents the sample from returning to the flow stream. Note that with this type of pump there is no contact between the air used to pressurize the pump and the liquid sample drawn from the flow stream.

Controller Operation

The microprocessor in the controller governs the operation of the air pump and the mechanism that selects, opens, fills, and closes the sample bottles. A motor rotates the bottle rack placing each bottle directly under the fill mechanism. The bottle rack is kept chilled by its location inside the refrigerator. When the filled rack is sent to a lab for analysis, it may

be kept cold by filling the inside of the rack with ice and placing in the styrofoam mailer to keep samples cool during the transport to the lab for analysis.

The fill operation consists of:

- Purging the sample line
- Rotating the bottle rack to place the bottle in position for filling
- Opening the valve on the sample bottle cap
- Lowering the fill needle into the sample bottle
- Filling the sample bottle with the liquid sample
- Withdrawing the fill needle from the sample bottle
- Closing the valve on the sample bottle

When filling the sample bottle, the Model 6100FR actually overflows the bottle by several sample volumes to comply with EPA protocol to fill and dump the sample bottle. This overfilling keeps residual air pockets from remaining between the bottle and the lid, thus providing a representative sample. The excess water drains out of the sampler through an overflow tube attached to the needle. The controller also determines, through programming, when and how the Model 6100FR takes its samples.

2. Quick-Start Operating Procedure

Note that the quick-start procedure assumes you have some familiarity with the unit. If you do not, please do not try to operate the unit without first reading this entire document.

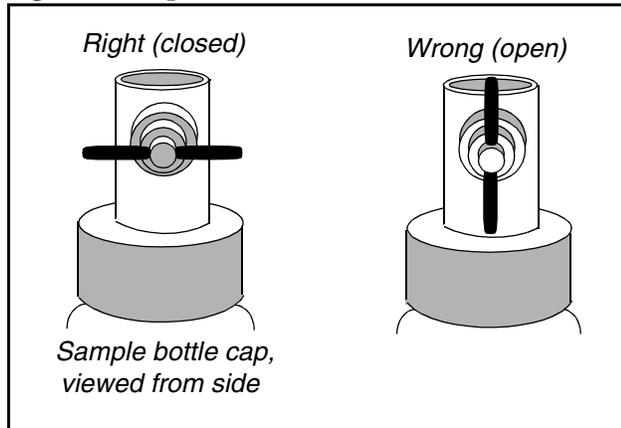
1. Put a new bottle rack in the unit. Make sure the handles on the bottles are all closed (turned sideways 90° to the bottles). See **Figure 2**. Improperly-oriented handles will jam the unit.
2. Turn the unit on by pressing the **On/Off** key on the keypad. When the unit is off, the display will be blank. When the unit is on, there will always be something on the display.
3. If you have not previously set up the sampler's operation or if you want to change the setup, press the **Setup** key to access the setup menus.
4. Press the **Program** key to select the type of sample pacing, number of sample events, start time, etc.
5. Place the pump in the flow stream and route the drain line from the sampler.

6. Press the **Run** key to start the sampling sequence you have programmed into the sampler. The sampler cannot run its own program until you press **Run**.
7. When the sampler completes the program you entered, the display will read:

DONE... XX SAMPLES
(time & date)

8. Press the **Rack Reset** key to move the rack to the home position so you can remove the rack from the sampler.
9. Remove the filled bottle rack from the sampler.
10. Turn the unit off with the **On/Off** key.
11. If you want to run another sampling routine, repeat the process from step 1.

Figure 2. Proper Valve Orientation



3. Sampler Unpacking and Setup

Isco ships the Model 6100FR in two separate packages, and we suggest keeping all packing materials in case returning the unit for service ever becomes necessary. The larger box contains the refrigerator.

1. The other box contains the pump, manual, tubing, and any other accessories you may have ordered. The smaller box also contains the bottle rack inside a styrofoam carrier.

Do not discard the styrofoam carrier or the smaller cardboard box.

2. You will use these items to transport the bottle rack and also to ship the samples to the lab for analysis. The bottle rack is shipped with all the bottles installed and held in place under a stainless steel cover.
3. Unpack the boxes carefully, checking for any possible shipping damage.

Under the Controller Cover

1. When you have opened the cover over the controller, the most prominent features inside are the keypad and display
2. You program the sampler using the keypad and prompts from the display.

Inside the Refrigerator-

Inside the refrigerator behind the sample bottle rack is a rectangular protrusion with a yellow warning label on it. This is the housing for the fill needle.

- When the sampler is in operation, the fill needle raises and lowers automatically to inject the liquid sample into the bottles in the rack.

The warning label is to warn you against putting your hand between the tower and the bottle rack. You can be seriously injured by the needle coming down when the sampler is in operation.

⚠ WARNING

Never place your hand or any other part of your body between the needle assembly and the bottle rack. If the sampler starts unexpectedly and lowers the needle to fill a bottle, you could be caught between the needle and the bottle rack. The needle comes down with enough force to cause serious bodily injury. In order to avoid damage, always make sure bottle rack is in place. Bottles are in all 24 positions and that the shut-off handles on all bottles are horizontal.

The Bottle Rack

Isco ships the bottle rack separately from the sampler for protection. Because of the carrier's insulating properties you can pack the bottle rack with ice (or **gel packs** if you are shipping) to keep the samples cool from when they are gathered to when they are analyzed at the laboratory. (Gel packs are a packaged cooling agent.)

It is very important to keep the samples cool to keep them representative; heat drives volatile organic compounds out of solution. If you don't keep the samples cool, they will degrade, and as a consequence will not be representative.

Note the metal plate holding the bottles inside the bottle rack. (See **Figure 3**). This cover keeps the bot-

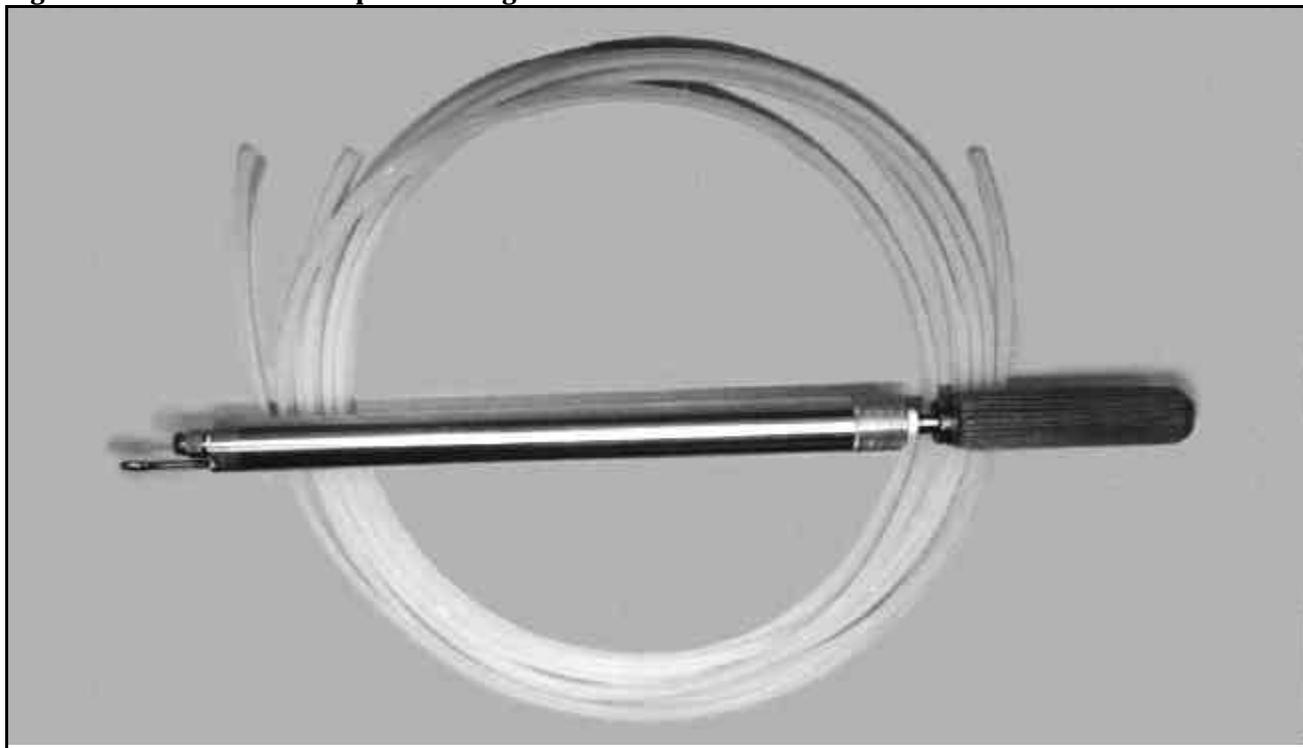
Figure 3. The Sample Bottle Rack



les in place during shipment and use, and prolongs the melting time of the gel packs. The knurled knob with the threaded shaft attaches the bottle rack to the controller. Never operate the sampler without the stainless steel cover in place and the knob securely tightened. Before installing the bottle rack, look at the tops of the bottles. Note the ends of the valve handles on the bottles. Make sure the handles are closed, turned so they are at right angles to the standing bottles, or facing 3 and 9 o'clock. (See **Figure 2**.)

This is important, not only for proper alignment for sampling, but also to ensure all the bottles are closed and free from contamination. During normal operation of the sampler, it may occasionally leak a small amount of sample around the O-ring on the tip of the needle. This is generally due to a misalignment between the needle and the bottle. The small leak does not affect sample integrity as it occurs outside the bottle before the valve is closed. If the leak condition persists or sample is being sprayed out of this connection consult Isco Customer Service. A leak around the valve stem on the top of the bottle indicates a worn valve. When this occurs the valve body must be replaced. You will notice that there is one bottle that does not have a valve on top. This is the blank, and you will also notice that the bottle rack looks different behind this bottle. There is no slot in the rack. This bottle marks the home position for the bottle rack. Bottle rack

Figure 4. Model 6100FR Pump and Tubing



Cleaning the Bottles (the First Time)

Isco assembles the racks with new clean bottles, as shipped from the bottle manufacturer. Normally, no further cleaning is necessary before first use of the bottles. However, these bottles and valves are not certified clean. If you wish to clean the bottles before using them the first time (for example if you are sampling for extremely low concentration volatile organic compounds), feel free to do so. Follow EPA guidelines for washing and drying the bottles. After you have used the bottles for samples, always wash and dry them according to EPA guidelines.

CAUTION

Always make sure the rack is in the "home" position before installing or removing the bottle rack. This places the blank bottle under the fill needle. If the rack is not in "home" position, press Rack Reset to return the rack before removing or installing the bottle rack. If you do this, the rack will always be in the right position when you reload it.

Installing the Bottle Rack

Notice the D-shaped steel shaft in the center of the triangle formed by the three knobs. This is the bottle rack shaft. Place the bottle rack over this shaft rotating it slowly until the D-shape of the shaft lines up with the same D-shape on the bottom of the bottle rack. The blank bottle should be under the needle in the home position.

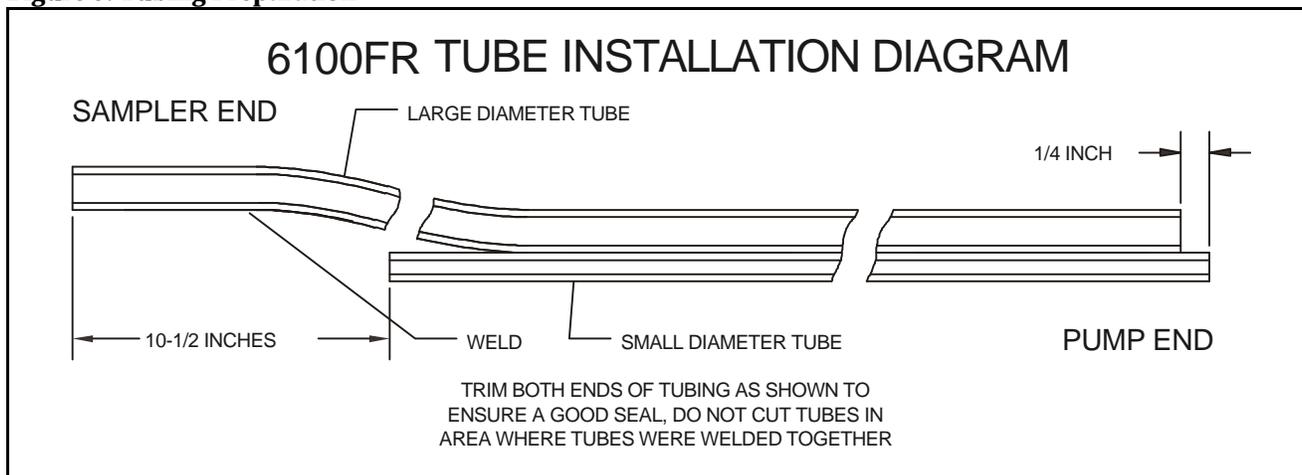
The rack will easily settle into place. Secure the rack in place by tightening the knurled knob and threaded shaft into the threaded hole on the D-shaped shaft on the controller base. The rack is now ready to take samples.

Connecting a Power Source

The 6100FR is powered by simple connection to a standard 120 VAC grounded wall outlet. It is strongly suggested by Isco that the outlet designated as the connection for the 6100FR be on a dedicated circuit; that is, it should have its own circuit breaker in the main breaker panel for the building. The load is not great, but the unit should not be connected to a circuit where other equipment is also connected, nor should the 6100FR ever be connected to an outlet that is switched. Location of the sampler in an area where there is much activity and use of other machinery should be avoided, to avoid accidental disconnection or interruptions in service.

To prevent accidental disconnection of the 6100FR, it is suggested that the breaker controlling the circuit feeding the 6100FR be labeled as to its use and the warning "Do not switch off" be applied. If there is any risk that someone may inadvertently unplug the 6100FR, a warning label should be placed on the line cord near the plug end.

Figure 5. Tubing Preparation



Attaching the Sample Tubing

The Model 6100FR uses two different sizes of tubing to run the sample pump. The tubing is skip-bonded together for easy installation. The larger tube carries air to the pump while the smaller tube brings the liquid from the pump to the sampler. Both tubes are polyethylene; however, the sample tube has a Teflon[®] liner to meet EPA sampling guidelines for inert surfaces contacting the sample. Connection of the tubing is very simple. Separate the tubes by pulling them gently apart. Locate the fittings on the refrigerator top. Figure 7 shows the location of the fittings and also shows the tubing installed. Cut as shown in Figure 5. You can't confuse the two fittings; each will only accept the correct size of tubing. Make sure the tubing has a clean, square cut on the ends. Use the cutter that is provided. Do not cut tubing in a welded area and do not leave any score marks on the tube; otherwise insertion and release of the tubing may be difficult. Leaks may occur.

The larger tube attaches to the fitting on the grey box just to the right of the control panel. The sample tube attaches to the fitting located just below and to the left of the keypad and display housing. Again, refer to Figure 7.

To attach the sample tube:

1. Use the groove tool provided to place a groove near the end of the tube; insert the tubing until it bottoms out, then tighten the fittings.
2. To attach the air tubing, simply push it in with your hand until it stops at the bottom of the fitting.
3. To get a good fit you will have to press the tubing in firmly.
4. To release the air tubing, press in on the outer red flange of either fitting with your finger, while pulling on the tubing in the direction away from the fitting.

[®]Teflon, trademark of du Pont de Nemours, Inc.

Attaching the Drain Tube

The drain tube is connected to a fitting on the back of the needle assembly and is routed through the back tower shell to a conduit in the left rear corner of the sampler deck, where it exits the sampler on the lower left hand side. Isco supplies the unit with a 20 foot length of 1/4" OD vinyl tubing installed. To remove the overflow liquid, route this tubing to any convenient place that gets the water out of the way. Typically, this would be back to the flow stream, but a nearby drain would also be satisfactory. The important thing is to get the overflow away from the base of the refrigerator.

Attaching and Mounting the Pump

The pump attaches to the other end of the twin tubing. Just press the tubing into the fittings at the end of the pump. It is possible to suspend the pump from the tubing and fittings, but Isco does not recommend this. For maximum safety and reliability you should attach a wire to the eyebolt on top of the pump to suspend it. Isco offers a special stainless steel wire for this purpose. You can mount the pump in the flow stream horizontally, if the stream is shallow, or vertically, if you are sampling from a well. Note the metal strainer on the bottom of the pump; this is the main filter for the entire system.

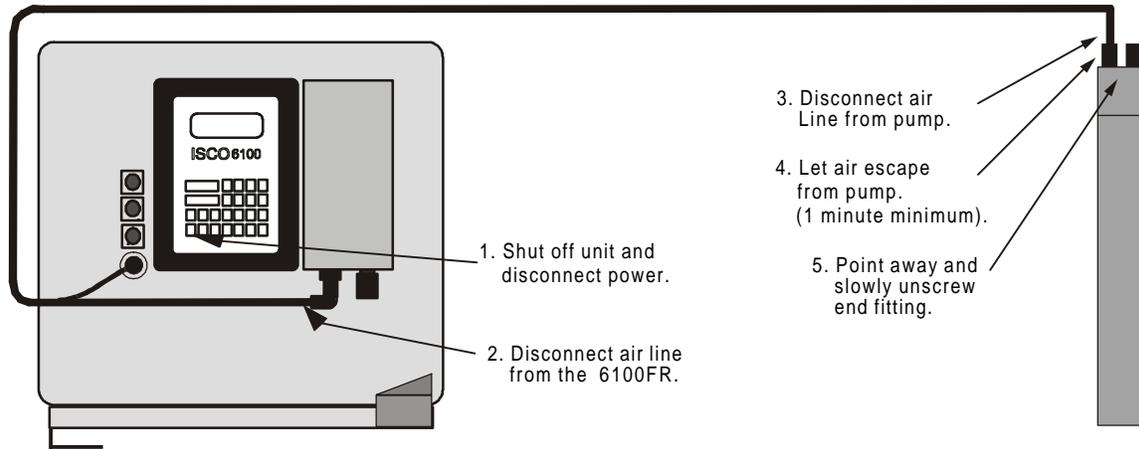
The air supply for the pumping system enters the pneumatic controller through the air inlet fitting at the upper right hand corner of the pneumatic controller. If the bladder were to fail during a sampling routine, water can get into the air system. From there, the water can be expelled from the air inlet. Inspect the bladder every ten racks. If sharp creases appear, replace it. Bladder life will be approximately 30 racks for tubing lengths of 25 feet or less and approximately 20 racks for lengths over 25 feet.

Figure 6. Pump Safety Warning

CAUTION

Use extreme caution when disassembling the bladder pump. This pump is powered by air under moderate pressure. Never attempt to disassemble the pump while it is still connected to the refrigerator-controller, as the pump's interior parts may still be pressurized. To avoid injury, follow in order the steps shown below to disassemble the bladder pump.

Your safety is very important to us. If you have questions, please contact Isco Customer Service at 1 (800) 228-4373.



⚠ WARNING

Do not attempt to disassemble the bladder pump without first turning off the sampler and disconnecting both tubes. Disassembly of the pump while it is pressurized could result in serious personal injury.

⚠ CAUTION

Never operate the Model 6100FR without the pump strainer in place. Operation without the strainer could result in pumping sediment or debris that could ruin the bladder pump and clog the fill needle, ruining it and making the sampler inoperable. Operation of the pump without the strainer will void the warranty.

4. Operation and Description of the Display and Keypad

After you have put the sampler together as described in the previous sections, you are ready to program the unit to run a sampling routine. But first you must familiarize yourself with the keypad and display. Program the Model 6100FR by pressing the buttons on the keypad to make appropriate selections from the choices that appear on the display.

The display is a two-line, 20 character-per-line liquid crystal. The display is alphanumeric, meaning it can show both letters and numbers. The display has a backlight feature that allows you to read it easily in conditions of low light.

1. Pressing any key will turn the backlight on for a minute or so. Each time you press a key, the backlight timer is restarted, so the light will stay on throughout programming.

When you are programming, generally you will select a choice from the menus appearing on the display. In some instances you will have to enter a number. The display will provide you with a range of appropriate values. The sampler will reject entry of any numbers outside this range. When you program the sampler, one option for each program step will always be flashing on and off. This flashing indicates the selection currently valid, the one that is held in memory.

2. Pressing either of the **Arrow** keys will cause the option flashing to move to the left or right of the currently selected option.
3. Pressing the **Enter** key on the keypad will cause this new choice to be entered into the sampler's memory. The keypad lets you enter menu choices into the sampler's memory.

Various keys also control specific sampler operations. Following is a description of the function for each key on the keypad.

Sampler Operation When Turned On

When you press the **On/Off** key to turn on the Model 6100FR, the unit can respond in several different ways depending on what was happening when the unit was last turned on. Following are the possible operations the unit can do when you press the **On/Off** key:

1. The sampler may test the tower assembly. The sampler will move the fill head assembly a short distance and then back up again, coming to rest near the top stop.
2. The sampler may test the driver that turns the valve handles on the sample bottles to open and close them. This sequence consists of four movements clockwise and counterclockwise with short pauses between them. You can see the valve actuator if you look on the inside of the tower, about the height of the bottle rack. It is round and has two pins protruding from it.

3. The sampler may move the bottle rack to the next bottle position. If the bottle rack is somehow stopped so a bottle is not directly under the fill head, the rack will rotate a few degrees to position a sample bottle directly under the fill head.
4. The sampler may reset the bottle rack. This consists of rotating the bottle rack until the "home" position of the rack is under the fill head. If the home position of the rack is close to the fill head, the rack may make more than one complete revolution the first time power is applied before the rack stops on the home position.

When you turn the sampler on with the **On/Off** key, it may do some of these things or none of them, and this is normal. When you turn the unit on for the very first time, or if you have done a **hard reset** (see **Chapter 6 Section 4**), the sampler will move the bottle rack if necessary. It will then do a tower test and if that works correctly, it will do a valve driver test and if that passes, it will reset the bottle rack, in that order.

Otherwise, when you turn the sampler on, what happens will depend on the condition it was in

Figure 7. 6100FR Top Showing Tubing Connections



when you turned it off. First, it will check the positioning of the bottle rack to see that there is a bottle directly under the fill head. If not, the unit will move the bottle rack.

Then the sampler will check the condition of the tower drive (the up and down motion of the fill head). If the tower is not in the "home" position (fully up), or the sampler detected a tower jam on the last attempt to move the tower, it will do a tower test. If the tower was in the "home" position or successfully passes the tower test, the sampler will then look at the condition of the valve driver. If the valve driver is not in the "home" position or if the sampler detected a valve driver jam the last time it tried to rotate the driver, it will do a valve driver test. The unit will not reset the rack at this time.

If the sampler was in the process of running a sampling program when it was shut down, a message will appear on the display saying that the program was aborted and cannot be resumed. You will have to restart a new program if sampling is to continue. After the sampler runs these tests, it will be in the standby state, and the standby message will display on the screen.

At other times when the sampler moves the bottle rack, such as when you press the **Rack Reset** key, or the sampler is taking a sample and must advance the rack to a new bottle, it may do the tower test or the valve driver test if the associated mechanism is not in the home position as described above, or a jam in that mechanism was detected on the previous attempt to move that mechanism. (See Figure 8 for a detailed view of the 6100FR keypad and display.)

On/Off

This key is the master control for the entire system. When you turn the sampler off, no other key will have any effect, even if you are in the middle of a sampling routine. However, any program choices you have made and entered for the sampler setup and sampling routine will be retained by the unit in battery-backed memory. Note that turning on the sampler does not make it run a program. Turning the sampler on just puts it in the "Standby" state, where it is ready to receive programming and configuration commands from the keypad.

Program and Setup Keys

These keys both control programming of the sampler. **Setup** configures the sampler (defines how the sampler will work) while **Program** defines the specifics of the sampling routine.

Program

This key puts you into the programming mode for

the sampler. For the Model 6100FR, "program" refers specifically to the sampling routine the unit will run. If you use the sampler at more than one job site, you will very likely change the sampling routine. You do that with the **Program** key. Note that you may change the Program without changing the Setup.

Setup

This key programs the sampler for functions that differ from the sampling routine controlled by Program. **Setup** performs the "housekeeping" functions of the sampler. In **Setup** you determine the length of tubing line to the pump, set the internal clock, establish a site identification number, etc. Note that you may change **Setup** without changing items selected in **Program**.

Run

After you have programmed the sampler with both the Program and Setup menus, you must press **Run** for the sampler to run its program, regardless of when you programmed the routine to begin. The **Run** key starts the program.

Clear/Exit

Pressing this key allows you a way to revert to a previous entry for a menu choice, or to exit the Setup or Program menus.

Enter

You must press the **Enter** key to step through the menu for either the Program or Setup functions. While programming, pressing **Enter** will store the choice or value displayed on the screen and move you to the next choice.

Display Status

The Model 6100FR keeps a record in memory of programming and sampling activity called the **History Log**. It is possible to view this record screen by screen on the display. If you press this key when the sampler is turned on and in the Standby operating mode it will allow you to view this log. More information on the History Log, with several representative screens can be found in this manual in **Chapter 2, Section 7**.

Rack Reset

Pressing this key when the sampler is in the normal operating state will return the bottle rack to the "home" position. This is when the blank bottle is directly under the fill needle. If the sampler previously detected a fault in the tower, it will test the tower before it rotates the rack. The same will occur if the sampler previously detected a fault in the valve actuator, and the valve actuator must be returned to the normal position if it is not. Also if the needle is not fully raised, the sampler will raise it before rotat-

ing the rack. The sampler raises the needle and returns the valve actuator to the normal position so they will not interfere with the rotation of the rack.

Cycle Pump

Pressing this key tests the bladder pump. Its primary use is to purge the pump. It draws fluid as if taking a sample but does not put the fluid in a bottle. This key is primarily a setup aid, but you can use it whenever you need to purge the pump or break in a new bladder.

Manual Sample

This key allows you to take a sample anytime you want without interrupting a sampling routine or reprogramming the system. When you press this key, the unit will place a sample in the next bottle.

Always make sure that a bottle rack is installed before starting a manual sample.

Figure 8. Keypad of the Model 6100FR

⚠ CAUTION

The sampler may be damaged if there is no bottle rack installed when you try to take a sample.

After pressing the **Manual Sample** key, the following screen will appear:

BOTTLE RACK LOADED?
YES NO

NO will always be flashing. To proceed with the manual sample, select YES with the ARROW key and then press **Enter**. This screen reminds you to make sure that a bottle rack is in place before you start to take a manual sample.



Table 1: Specifications for the 6100FR Refrigerated Sampler

General		
Height	47 in.	117 cm
Width	26 in.	66 cm
Depth	26 in.	66 cm
Weight (Dry)	190 lb.	86 kg
Refrigerator Body Material	Fiberglass-reinforced plastic with UV-resistant gel coat.	
Power Requirements	120 Volts, 60 Hz	
Operational Temperature Range	32° to 120° F	0° to 50° C
Controller		
Enclosure Rating (CPU and motor controller only; does not include refrigerator)	Self-certified NEMA 4X and IP67.	
Interfacing	6-pin connector; data output at 2400 baud in ASCII RS-232 format allows transfer of Program Settings Report, Sampling Results Report, and history log.	
Diagnostics	Tests RAM, ROM, all mechanical drives, display, flow meter interface, and printer interface.	
Clock Accuracy	1 minute per month, typical.	
Internal Battery	Lithium, 5 year life expectancy, stores programming routines and sample data.	
Controls:	22 button keypad, momentary contact.	
Indicators:	Alphanumeric LCD 2 rows, 20 characters per row, backlit when key pressed.	
Connectors:	Power (2-pin male M/S) Flow Meter (6-pin male M/S) Computer (6-pin female M/S) Air Pump Connector (9-pin)	
Sample Data Storage:	1,000 records	
Flow Meter Signal Format (Flow Pulse):	5 to 15 volt DC pulse or isolated contact closure of at least 25 milliseconds duration. (A 4-20 mA control signal or pulse of other duration can be converted with an optional interface unit.)	
Sample Collection		
Sample Line Distance:	75 feet maximum.	
Pump Tubing (External):	Polyethylene twin-tube, skip-bonded 1/4" and 3/8" outside diameter.	
Sample (Vial) Volume Vial Capacity	40 ml (fixed volume). 24 vials with Teflon valves. 1 vial reserved as blank for procedural use.	
Rinse Cycles	All wetted surfaces automatically rinsed prior to each sample collection.	
Sample Pacing	Time or flow. Flow mode paced by pulses from an external flow meter.	

6100FR**Table 1: Specifications for the 6100FR (continued)**

Sample Frequency Time Mode Flow Pacing	10 minutes to 99 hours 59 minutes, in one minute increments. Selectable, 1-9,999 pulses in single pulse intervals.
Multiplexing	Multiple vial per sample event only. As many as 24 vials can be filled by one sample initiation.
Sample Line	TPE Teflon® lined tubing.
Sample Source	Open Channel.
Sample Source Temp.	85°C maximum.
Sample Filter	Stainless steel in-line cartridge style.
Sample Pre-cooling	Sample pre-cooled to 25°C (for 85° sample source, 40° ambient temperature, and 2 - hour sampling interval).

Chapter 2. Programming

1. Introduction

In the following section, the words printed in capital letters represent messages the Model 6100FR displays as you work your way through the **Setup** and **Program** routines. Note that you do not have to work through **Setup** if all you want to change is something in **Program**. Likewise, it is not necessary to work all the way through **Program** to change something in **Setup**. You will notice some lines with XXs or other capital letters in them. These letters represent variables, such as amounts, times, and dates. When the sampler is in the standby state, not running a program, the following message will appear on the display:

```
... STANDBY ...
HH:MM:SS DD MMM YY
```

There are two programming sequences for the Model 6100FR. One sequence controls the operation of the sampler and is called **Setup**. The other sequence is called **Program**; in **Program** you define the sampling program you want to run. The first time you use the sampler, you need to work through both sequences to correctly program the sampler to run a sampling routine. After that you may never need to reprogram the **Setup** section. As the various screens appear, the selected entry (the option currently held in memory) will flash. Use the **Arrow** keys to move from one entry to another. Where the display requests a numeric value, use the **Number** keys to enter the appropriate value. Use the **Enter** key to move to the next menu item. The unit must be turned on to function.

2. The SETUP Sequence

1. If you are in standby and have the standby message shown above, press the **Setup** key. This step requests entry of the length of the air and liquid lines between the Model 6100FR and the bladder pump submerged in the flow stream.

Note

Selection of the sample line length is limited to either 25 or 75 feet. If you have excess tubing left after the installation, do not cut it "to fit" or sampler accuracy will be compromised. Coil and tie the excess tubing as necessary and secure it safely near the refrigerator.

Select the length closest to what is needed for your installation. The controller calculates air and liquid volumes necessary to purge the lines and take the samples based on the length you enter.

```
SELECT LINE LENGTH
25 75 (FT)
```

2. The pump head entry compensates for the vertical lift the sampler must raise the sample as opposed to the line length. The maximum pump head allowed will depend on the line length selected from the previous screen. The lift is defined as the vertical distance from the top of the bladder pump to the inlet to the sampler.

Note

The pumping head for the Model 6100FR is measured differently from other Isco samplers. Isco samplers measure the pumping head as the vertical distance from the sampler to the liquid level of the sampled liquid. The 6100FR sampler's vertical distance is measured from the inlet to the sampler to the top of the bladder pump.

```
ENTER PUMPING HEAD
(0 - 25) 10 FT
```

3. The SITE I.D. NUMBER screens allows you to assign a number to provide an identity for the sampling site for later reference in analyzing results. The number can be anything you select that gives meaning to the sampling site up to 10 digits. This number will print out on all records.
4. Selecting Enter in Step 3 will display the following screen:

```
SITE ID NUMBER
1234567890
```

5. This step lets you set the Model 6100FR internal clock. This clock runs all the time, even when the sampler is turned off, as it is powered by a lithium battery. To set the clock, enter the correct time and date with the **Num-**

ber keys. The digit that is flashing is the one you can change. Enter the correct number from the keypad and press **Enter**. The flashing cursor will move one number to the right of the display with each press of **Enter**. To accept a current entry, press **Enter**. NO allows you to skip the clock option and work through other aspects of the Setup menu. You generally won't have to set the clock again (except for the change to and from daylight savings time).

SET CLOCK
YES NO

6. If you select YES for setting the clock, the following screen will appear:

HH:MM MM/DD/YY
HH:MM

7. A "purge" cycle is a cycle where the bladder pump completely fills, and then completely empties. These "purge" pump cycles force liquid through the pump, suction line, pre-cooler and the needle assembly; but not through the sample bottle. The purge cycles occur before the sampler inserts the needle assembly into the bottle. These cycles insure that the liquid from previous sampling is washed out of the system, thus, eliminating cross-contamination. When NO is selected, see Step 9.

EXTRA LINE PURGE
YES NO

Note

Purged fluid goes through the pre-cooler and will reduce the pre-cooling of the sample.

8. If YES is selected in the EXTRA LINE PURGE step, then the following screen appears:

EXTRA LINE PURGE
1 PUMP CYCLE (1 - 9)

9. If NO is selected in step 7, the "standard" number of cycles will be used. The standard is one purge cycle for 25 feet of line and 2 purge cycles for 75 feet of line. For Manual samples and the first sample after pressing **Run**, the standard purge cycles are increased: two purge cycles for the 25-foot line length and

four cycles for 75-foot lines.

RUN DIAGNOSTICS
YES NO

10. In normal operation, you would select NO. You would RUN DIAGNOSTICS only if you suspected a problem. NO will always be flashing. If you select NO, the sampler advances to Step 22.

The ENABLE MANUAL DIAGS menu gives you the capability of manually controlling some of the mechanical functions of the sampler as a diagnostic aid. It provides **special functions** to some keys on the control panel for a limited period of time. Selecting YES will let you move the **tower** up and down with the **arrow** keys. It will also let you move the **valve driver** (opens and closes the valves on the sample bottles) through a sequence with the **0** key and it also enables you to move the **bottle rack** through a variable number of bottle positions (1-24) by entering the number of positions desired with the **number** keys on the keypad and then pressing **Enter** and **Rack Reset**. Selection of this option (YES) allows you access to these capabilities for **only 15 minutes**. You will have to reenter the selection if you wish to continue access to the manual diagnostics.

11. If you need to access the manual diagnostics, select YES at the following menu:

ENABLE MANUAL DIAGS
YES NO

12. If you select YES from the ENABLE MANUAL DIAGS, the unit will ask for a pass-number on the next screen.

However, if you have entered the pass-number within approximately the last 20 minutes, ENTER PASSNUMBER screen will not appear.

13. The correct pass-number (which is also the model number, 6100) should be entered with the number keys at this time. An incorrect pass-number will cause the machine to again ask for the pass-number unless you press the **Clear/Exit** key.

ENTER PASSNUMBER
0000

⚠ CAUTION

Some of these manual tests can cause damage to the unit if not done properly such as running the tower down without having a bottle rack in place or running the tower down without first opening the valve on a bottle. Because of this danger, manual testing should only be done by qualified personnel.

14. Selecting of YES will cause the sampler to run the following six diagnostic routines and advance to Step 22. If you don't want to run one of the routines, just select NO, the sampler will then allow you to select each diagnostic individually.

RUN ALL DIAGNOSTICS
YES NO

15. Selecting YES causes the machine to test the RAM (Random Access Memory) by loading and reading back various values.

TEST RAM
YES NO

16. Selecting YES for TEST ROM causes the sampler to test the ROM (Read Only Memory) by adding all the locations and checking the result.

TEST ROM
YES NO

17. This option causes the sampler to test the LCD readout, first blanking the display and then displaying various characters.

TEST DISPLAY
YES NO

☑ Note

You must have a special plug that loops the transmit and receive signals together to run the "TEST PRINTER" diagnostic.

18. This option tests the sampler's serial printer port by sending and receiving data.

TEST PRINTER PORT
YES NO

19. This option causes the sampler to test the flow meter serial port by sending and receiving data. Just the same as for the preceding diagnostic, you must have a special plug to connect the appropriate pins.

TEST FLOW METER PORT
YES NO

20. This option tests the mechanical operations of the sampler by moving the tower up and down, operating the valve driver, and rotating the bottle rack one full revolution.

TEST OPERATION
YES NO

21. If time-paced sampling was selected:

SELECT DISABLE MODE
ERROR SKIP DELAY

☑ Note

The Select Disable Mode choice only appears if the 6100FR is programmed for *time-paced* sampling. It determines operation if samples are missed either because of the unit being disabled, or because of power failure. It does not cover samples missed because the unit has been shut down. Note that for units programmed to take flow-paced samples, the sampler will take a sample on enable and reset the flow pulse counter.

- If you select SKIP, the sampler will maintain the time intervals as setup at start time. The log will show the event as an error, and the sampler will skip the bottle(s) allocated to that time and advance to the next bottle position so that following samples will be placed in the scheduled bottles.
- Selecting ERROR means that the sampler will log an error. The time interval will reset. If it is programmed for sample intervals of one hour and the sampler is disabled at one o'clock, it will "skip" the one o'clock sample and reset the timer with one hour and take the next sample at two (if the sampler is then enabled). The sample event will be logged as an error.
- Selecting DELAY means that if the sampler enable is set to delay and is disabled when the time for taking a sample occurs, it will delay the collection of the sample until the

sampler becomes enabled. At that time it will reset the timer so that the succeeding sample will be one sampler interval after the time the delayed sample was actually collected.

3. The PROGRAM Sequence

Note

You must have a flow meter connected to the Model 6100FR if you want to program the sampler with flow pacing. The flow meter supplies the flow pulses, signals to the sampler that indicate volumes of flow.

- To begin the Program sequence, Press the **Program** key. Sample pacing refers to the way the sampler determines the interval between samples.
 - Selecting TIME means you will take a sample after a specific period of time has past.
 - Selecting FLOW means you will take a sample only after a specific flow volume has past. If the flow is variable, the time interval may vary considerably between samples.

SAMPLE PACING	
TIME	FLOW

- If you select TIME, the sampler will ask you to enter an interval of time. The smallest amount of time that can be entered is ten minutes. The following screen will appear:

SAMPLE EVERY	
XX HOURS	XX MINUTES

- If you selected FLOW, the sampler will ask you to enter the number of flow pulses between samples.

SAMPLE EVERY	
XX PULSES	(1-9999)

Note

The following option, *Sample at Start Time*, will only appear if you have selected *Flow Pacing* in the *Time/Flow Pacing* menu.

- When you program the sampling routine, the choice you make here will determine whether the Model 6100FR takes a sample at the time the sampling routine starts. If you select NO,

the Model 6100FR will not take the first sample until the interval you select between the start time and the first sample has elapsed.

SAMPLE AT START TIME	
YES	NO

- A sample event occurs each time the flow or time interval elapses. This is the number of bottles that will be filled for each sample event. The following display will appear:

BOTTLES/SAMPLE EVENT	
XX	(1-24)

- The number YY will be 24 if you are entered "1" in step 5. Otherwise YY will be 24 divided by the number entered in Step 5 rounded down. For example if you fill two bottles each time, YY will be 12. If you fill four bottles YY will be 6. If you fill 5 bottles, YY will be 4, etc.

# OF SAMPLE EVENTS	
XX	(1-YY)

- Selecting NO on the ENTER START TIME, the sampling program will start immediately after you press the **Run** key. If you prefer to start the program at a specific time, select YES.

ENTER START TIME	
YES	NO

- START TIME is the time the sampling routine starts. It does not necessarily mean that the Model 6100FR will take a sample then, but the sampler will begin to time out or wait for flow pulses to take the first sample. It will only take a sample at the START TIME if you enabled that option in the **Program** programming sequence and **flow pacing** is selected.

START TIME	
HH:MM	MM/DD

Note

When you finish programming the Model 6100FR, you must press RUN for the sampler to run its program. Otherwise, the program will never run, even after the start time passes.

4. The RUN Key

1. If you want to start at the beginning of the rack (bottle 1) and the rack is not in home position, press **Rack Reset** before pressing **Run**. After you press the **Run** key, the following display will appear:

```
START AT BOTTLE
      X
```

The value of *X* will be the next available bottle. If the bottle rack is in the “home” position, this will be bottle 1. If the rack is on the last bottle (number 24), the sampler will reset the rack to the “home” position and the display will show the bottle “1.”

Pressing **On/Off** will turn the sampler off. Pressing **Clear/Exit** will return the sampler to the standby state; the **Run** key must be pressed again to operate the sampler.

You can press **Enter** to select the displayed bottle to start the sampling routine, or you may enter a higher bottle number. The highest number you can enter is 24. You cannot enter a smaller number than that displayed.

If no entry is made, the sampler will time out. The bottle number will default to the number displayed.

If you chose not to enter a start time in the **Program** sequence, the sampling program will start immediately after you enter the bottle to start on. The sampler may or may not take a sample at this time depending on whether you selected a sample at the **START TIME** in the **SET UP** sequence. **See Section 5, Active State Displays.**

If you chose to enter a start time in the **Program** sequence and the time you entered has not passed when you press the **Run** key, the program will start at the time you entered.

If you chose to enter a start time in the **Program** sequence but the start time has passed by the time you pressed the **Run** key, the **PAST START TIME** screen will appear, followed by **CHANGE START TIME** screen. The following display will appear:

```
*PAST START TIME*
```

2. If you select **NO**, the start time will become the present time and the program will start immediately. **See Section 5, Active State Displays.** Again, whether a sample is actually taken at this time depends on earlier choices you made in programming.

3. If you select **YES**, the sampler will ask you to enter a new start time.

```
CHANGE START TIME?
      YES   NO
```

4. The sampler will advance the hour to the next hour after the present time. The day and month will be the current day and month. You can accept this time by pressing the **Enter** key or enter the start time you choose. After a valid time has been entered, the sampler will start. **See Section 5, Active State Displays.**

```
START TIME
HH:MM DD MM
```

5. If you enter a time that has passed, the **MUST BE LATER THAN** screen appears. Enter the desired time constraints. The sampler then will return to Step 4 above to ask for the start time.

```
MUST BE LATER THAN
HH:MM DD MMM
```

5. Active State Displays (Run Mode)

After you have programmed the sampler and pressed **Run** to begin the sampling routine, any of the following messages, depending on how you programmed the sampler, can appear during the sampling routine.

There are four possible combinations that you can program for **START TIME** (under the **PROGRAM** menu) .

If no start time has been programmed, the sampler will start immediately, (Step 2 below will show the display that appears).

However, if the sampler has been programmed with a start time, the display that appears will depend on whether the start time is in the current day or not.

1. If the start time is not in the current day, the following display will appear:

```
START AT HH:MM DDMMM
HH:MM:SS DD MMM YY
```

2. When the day of the start time is reached, (or the start time is in the current day), the following display will appear:

START AT HH:MM
HH:MM:SS DD MMM YY

3. When the sampler starts (or the start time is reached), the action depends on whether you programmed the sampler to take a sample at the start time (only available with flow pacing).

If the sampler was programmed for flow pacing and to take a sample at START TIME, it will proceed to take the first sample. Step 4 shows the display that will appear. If the unit is programmed for flow pacing but *not* to take a sample immediately, the sampler will start its interval counter so the first sample will occur one interval past the start time.

One interval refers to the number of flow pulses you programmed to elapse between sample events. When the start time is reached, the display will change to the following:

IF in the **flow mode**:

SAMPLE X
AFTER XX PULSES

4. When the Model 6100FR is taking a sample, during the purging of the air and water lines, the display will show:

TAKING SAMPLE
PURGING LINES

5. While the sampler is filling the bottle, if you entered a number greater than 1 for **bottles/sample event**, the display will show:

TAKING SAMPLE 1
BOTTLE 1 OF X

6. While the sampler is filling the bottle, if you entered **1** for the number of **bottles/sample event**, the display will show:

TAKING SAMPLE 1
BOTTLE 1

7. Between samples, if you selected **time pacing**, the display will show:

SAMPLE X AT HH:MM
HH:MM:SS DD MMM YY

8. Between samples, if you selected **flow pacing**, the display will show:

XX (the number of flow pulses) will decrease as the sampler receives each flow pulse from the flow meter.

SAMPLE X
AFTER XX PULSES

When the sampler is done with its sampling routine, the rack will not be in the home position.

If you want to remove the bottle rack, press **Rack Reset** to move the rack to the home position so you can remove it.

If you are going to run another sampling program to fill more bottles in the rack, press the **Clear/Exit** key to return to the STANDBY display. The rack will stay where it stopped for the last sample of the program you just ran.

9. When the sampler completes the routine you programmed, the display will show:

DONE. . .XX SAMPLES (up to 24)
HH:MM:SS DD MMM YY

If you press the **On/Off** key before a program has finished, **the sampler will terminate that program**. When you turn the sampler back on a message will appear to remind you of this. The display PREVIOUS SAMPLING PROGRAM ABORTED will show:

PREVIOUS SAMPLING
PROGRAM ABORTED

It is **not possible to halt** a program and resume it later.

However, the program is still in memory just as you entered it and you can run it again. The program will not change until you reprogram. While you cannot resume the program where you terminated it, you can press the **Run** key and the sampler will rerun the same program starting from the beginning, but placing the samples in the next available bottle as outlined in the beginning of this section.

Error Messages

The possible **ERROR** types are:

RACK JAM TOWER JAM/RACK FULL

VALVE JAM POWER FAILURE

If the **RACK JAM** message appears, try to clear the problem by pressing the **Rack Reset** key. If **TOWER JAM** appears, call customer service. **RACK FULL** means the sampler has filled all 24 bottles, and you will need to replace the bottle rack with a new one. **VALVE JAM** indicates the sampler was unable to open the valve on the sample bottle. Check the bottle in question and make changes as necessary.

POWER FAILURE means that the power was disconnected during the sampling routine. If the sampler remains inoperative, determine the cause of the failure, and re-establish the power connection. Check the circuit breaker and make sure the sampler has not been connected to a switched outlet.

Note

If the sampler loses power for an extended period of time, (six hours or longer), the interior of the refrigerator will warm considerably, and the integrity of the samples contained in the sample rack may well have been compromised. Samples taken before the outage should be discarded. (The sampler cannot take any samples during the time power has failed.)

If there is some problem and the unit is unable to take a sample two times in a row because of the same error, an **ERROR** message will appear on the display:

SAMPLING ERROR
(error type)

6. The Display Status Key and the History Log

1. When you press the **Display Status** key, the sampler will show you a log of events it has recorded in memory. The first display will ask you to choose from the following:
2. If you select **LAST SAMP**, the display will only show you the record for the last program the Model 6100FR has run.
3. If you choose **BEGINNING**, the log will go as far back as the internal memory allows. It will either go to the first entry made or to the oldest entry in memory. (When memory allocated to the log is full, the log will begin overwriting the oldest entries with new ones.)

If you choose **BEGINNING** and the entries are too long or not what you want, you can leave the log by pressing the **Clear/Exit** key.

DISPLAY STARTING AT
BEGINNING LAST SAMP

Note

In general, **LAST SAMP** is the better choice for viewing the log. Do not select **BEGINNING** unless you need to look over the entire log. There may be a large number of entries. If the sampler has been running for some time, the log can have as many as 1,000 entries, going back several months. Trying to make sense of all this when you can only see two lines at a time could be difficult. You can use the **Clear/Exit** key to leave the log at any point.

You can move backwards and forward through the log with the arrow keys. The **Left Arrow key** (<) moves backwards and the **Right Arrow key** (>) moves forwards. If you press the **Left Arrow key** to go backwards and the display is in a sequence that has two different messages to display, the display will still advance to the second message before reversing and moving through previous displays.

Quick Method to View Sampling Sequences Only

If you are viewing the log and want to move to the next sampling sequence, press the **Right Arrow** key and then press the **Enter** key. The display will advance to the next sampling sequence. Continuing to press **Enter** will move the log forward through each successive sampling sequence. If you want to revert to the previous sampling sequence, press the **Left Arrow** key and then press **Enter**. The display will return to the first screen of the previous sampling sequence. Using this method you can quickly move through the log, stopping only at the beginning of each sampling sequence.

7. The Display Status Screens

The log displays times in the military format. One to eleven p.m. will appear as 13:00 to 23:00. Dates appear as day, month, and year. "Day" will be one or two digits. "Month" will appear as a three-letter abbreviation, as "JAN" for January. "Year" will be two digits as "98."

At the start of the log:

START OF HISTORY LOG
HH:MM DD MMM YY

1. When you applied power to the unit, the following display will appear on the log:

```
POWER RESTORE AT
HH:MM DD MMM YY
```

2. If you removed power from the unit, the following display will appear on the log:

```
POWER FAIL AT
HH:MM DD MMM YY
```

3. When you use the **On/Off** key, the following will appear:

```
UNIT ON AT
HH:MM:SS DD MMM YY
```

Or:

```
UNIT OFF AT
HH:MM DD MMM YY
```

4. When you activate a sampling program by pressing the **Run** key, the following display will appear on the log:

```
PROGRAM ACTIVATED
HH:MM DD MMM YY
```

When the sampling sequence actually begins, the following display will appear on the log:

```
PROGRAM STARTED AT
HH:MM DD MMM YY
```

The following log entry will display for a sampling event:

```
SAMPLE: 1 HH:MM
BOTTLE: 1 DD MMM
```

5. If you press the **Right Arrow** key again, the following log entry will appear:

```
SOURCE: FLOW
```

The possible SOURCES are: TIME, FLOW, START,

MULTIPLE, and MANUAL.

If there was some sort of problem and the unit was unable to take a sample at that time, this message would appear instead:

```
SOURCE: FLOW
ERROR: RACK JAM (example)
```

The possible errors are: RACK JAM, TOWER JAM, RACK FULL, UNIT OFF, HALTED, VALVE JAM, DISABLED, and POWER FAIL.

When the sampling sequence ends, the log will display:

```
PROGRAM FINISHED AT
HH:MM DD MMM YY
```

When the sampling program has finished (or was stopped) and the Model 6100FR has returned to the standby state, the log will display:

```
STANDBY STATE AT
HH:MM DD MMM YY
```

6. If you changed the SETUP section of the program at some point, the log will display the following:

(First screen):

```
SETUP CHANGED AT
HH:MM DD MMM YY
```

(Second screen):

```
LINE LENGTH
XX FT
```

(Third screen):

```
SITE ID NUMBER:
12345678980
```

(Fourth screen):

```
SET CLOCK
YES NO
```

(Fifth screen, if clock was changed):

<p>NEW TIME HH:MM DD MMM YY</p>

(Sixth screen):

<p>RUN DIAGNOSTICS YES NO</p>

(Seventh screen):

<p>SELECT DISABLE MODE ERROR SKIP DELAY</p>

7. If you changed the PROGRAM section of the program at some point, the log will display the following:

(First screen):

<p>PROGRAM CHANGED AT HH:MM DD MMM YY</p>

(Second screen):

<p>SAMPLE PACING: (flow or time)</p>
--

(Third screen *[flow pacing]*):

<p>FLOW INTERVAL: XXXX PULSES</p>

(Fourth screen): (Appearance of this screen depends on choice of flow in the *Pacing* menu; it will not appear if *Time Pacing* has been selected.)

<p>SAMPLE AT START TIME YES NO</p>
--

(If *time pacing*):

<p>TIME INTERVAL: XX HOURS XX MINUTES</p>

(Fifth screen):

<p>BOTTLES/SAMP EVENT: X</p>

(Sixth screen):

<p># OF SAMPLE EVENTS X (number)</p>
--

8. If a start time was entered:

(First screen):

<p>START TIME: HH:MM DD MMM YY</p>
--

9. If no start time was entered:

<p>NO START TIME</p>

End of log:

<p>END OF HISTORY LOG HH:MM DD MMM YY</p>

Chapter 3. Installation of the Sampler

1. Installation Guidelines

CAUTION

Never install the Model 6100FR where there is any possibility of submersion. Water could seriously damage mechanical components inside the controller as well as parts of the refrigeration system. Isco will not honor the warranty for any Model 6100FR that shows evidence of submersion.

Other than this, there are no serious restrictions on the installation of the sampler. You must locate the refrigerator no further than 75 feet from the pump installation. Place the refrigerator upright and as level as possible, in a stable location so it will not be tipped over. Route the drain hose away from the sampler far enough so the area around the base won't get wet. Avoid placing the controller in very hot locations, Make the installation in a secured location so it will not be at risk of vandalism or damage from other activity going on in the area.

2. Connection to a Flow Meter

If you want to run the sampler in the flow-paced mode (that is, taking samples after a specific volume of flow has passed, rather than after a particular period of time), you **must** use a flow meter to pace the sampler. The flow meter is designed to send signals to the sampler called **flow pulses** that indicate a specific volume of flow has passed through the flow stream. You program the flow meter to send one flow pulse to the sampler for whatever volume of flow you have selected. If you don't know how to do this, consult the flow meter instruction manual for information on programming the flow meter. When you have programmed the sampler to take a sample after so many volumes of flow have passed, the sampler will count the flow pulses from the flow meter and take the sample when the proper number has been tallied. (Of course, if you want, you can also take a sample after only one flow pulse.) When the sampler takes a sample, it too, will send a signal back to the flow meter indicating a sample event has occurred and also the bottle number of the sample.

Connecting the Model 6100FR to an Isco flow meter is quite simple. The flow meter should be any Isco Model 3000, 4100, or 4200 series.

A **flow meter-to-sampler cable** terminated with two, six-pin M/S connectors is available from Isco for this purpose. Make sure you have the **newer** flow

meter-to-sampler cable. The newer cables have the F pins on the two M/S connectors wired together. Do not use a cable you may have from an earlier application without first checking for continuity between the F pins. Connect either end of the cable to the male six-pin M/S connector on the top of the refrigerator. This connector has an outline drawing of a flow meter beside it. Connect the other end of the cable to the six-pin connector labeled "sampler" on the flow meter.

Connection to a Non-Isco Flow Meter

You can connect certain non-Isco flow meters directly to a Model 6100FR for flow-paced sampling. The flow meter must have an **isolated contact** closure of at least **25 milliseconds** to provide acceptable flow pulses to the sampler. The frequency of the contact closure must be directly proportional to total flow. Connect the flow meter pulse output to the A and C pins of the Flow Meter connector on the Model 6100FR. Isco has an interface kit with a six-pin M/S connector that mates with the connector on the sampler. Wire connections from the non-Isco flow meter to the six-pin connector and plug it into the sampler. Isco also has a six-pin M/S connector wired to a 22 foot cable terminated in two wires. The **black** wire connects to pin A and the **white** wire connects to pin C. The following table shows the connections for the Flow Meter connector on the sampler.

Pin	Signal
A	+12 VDC
B	Common
C	Flow Pulses In
D	Bottle Number Out
E	Event Mark Out
F	Inhibit In

Note that you will be unable to communicate anything other than the flow pulse contact closure with a non-Isco flow meter. The non-Isco flow meter will not be able to interpret event and bottle number information. If the flow pulse generated by the contact closure on the flow meter is not compatible with Isco's standard, the **Type A Interface** is available to convert incompatible flow pulses into the proper duration for the Model 6100FR.

Flow Meters with Non-Pulsed Flow Outputs - You can also use the Model 6100FR with flow meters that have outputs other than a flow pulse. One

common output type is the 4-20 mA current loop used for many types of industrial control equipment. Of course, you cannot use the 4-20 mA current output directly. You must use the **4-20 mA Sampler Input Interface**. This device converts the constant 4-20 mA current into flow pulses acceptable to the Model 6100FR.

If you use the Model 6100FR with other manufacturers' flow meters, please note that Isco cannot assume any liability for operation or results obtained with the Model 6100FR and other manufacturers' equipment.

3. Event Mark and Bottle Number Timing

The event mark and bottle number are digital signals the sampler generates to send to an Isco Flow Meter. This digital information is converted by the flow meter to marks and text on the flow meter's plotter chart. Thus, when you review the chart generated by the flow meter, you have a "hard copy" record not only of level and total flow, but of when the samples were taken (the event marks) and into which bottles the samples were placed (the bottle number).

Sample Considerations

There are certain conditions that can affect the quality of the samples gathered by the Model 6100FR. Most of these are items of common sense, but they will be discussed here to help ensure that your installation takes accurate and representative samples.

As much as possible, samples should be free of air other than what is normally dissolved in the stream. Avoid situations that cause the sample to be unrepresentative by either adding or removing air from the stream.

Always install the pump in a place where the flow is "normal" or "tranquil"; that is to say, neither stagnant nor overly turbulent. Where flow is stagnant, the sample will not be representative. Where flow is too turbulent, the sample will contain much entrained air (not dissolved), that will bubble out of the solution after the sample is taken.

An example of stagnant water would be a sample from the bottom of the channel directly behind a weir. An example of excessive turbulence would be the outfall from a weir, or any other discharge situation where the water is falling with enough force to create bubbles where it hits the stream.

Always install the pump so the inlet is completely submerged throughout the pumping cycle, or it will pump air along with the sample.

The sample bottles have Teflon[®] caps. Teflon typically cannot be wetted by liquids with high surface tension. An example of this type of liquid would be laboratory-grade deionized water.

If the sample cannot wet the Teflon caps, bubbles of air may remain on the surface.

Chapter 4. Accessories for the Model 6100FR

1. The Model 1640 Liquid Level Actuator

The Model 1640 Liquid Level Actuator (Figure 11) is a water-sensitive switch that mounts above the flow stream. It turns the sampler or flow meter on whenever the liquid level reaches the switch.

2. 4-20 mA Sampler Input Interface

This device is used with non-Isco flow meters that provide output signals of 4-20 mA directly proportional to flow rate. This interface converts the 4-20 mA signals into flow pulses that the 6100FR can recognize.

Figure 9. Model 1640 Liquid Level Actuator



Figure 10. 4-20 mA Sampler Input Interface



Chapter 5. Handling the Samples

1. Cooling the Samples

When you have finished a sample routine and all 24 bottles are full, you will need to ship the rack to the laboratory for analysis. To preserve the integrity of the samples, you must keep them cold until they reach the lab. Heat readily drives volatile organics from solution. If you intend to transport the bottle rack to the lab yourself, Remove the stainless steel cover and fill the cavity between the bottles with chipped ice; then replace the cover to hold the ice in place. Put the bottle rack in the styrofoam carrier and pack ice chips in the area between the bottle rack and the inside walls of the styrofoam carrier.

2. Shipping the Bottle Rack

To ship the bottle rack to the testing laboratory, follow the same procedure as described for “Cooling the Samples” above except for the use of ice. After the samples are collected, remove the stainless steel cover plate. Pack the inside of the bottle rack with gel-packs, a product that absorbs heat like ice, but is packaged in plastic bags, that remain flexible and leak-free. Place the bottle rack inside the styrofoam carrier and pack more gel-packs between the bottle rack and the walls of the styrofoam carrier. Replace the stainless steel bottle rack cover. Put the lid on the styrofoam carrier. Place the carrier, with the bottle rack inside, in the cardboard shipping carton Isco originally shipped the carrier in.

Note

Do not pack the bottle rack with ice if you need to ship it to a laboratory. The styrofoam carrier cannot be adequately sealed, and the cardboard shipping carton is not waterproof. Use only gel-packs for cooling. Additional bottle racks, styrofoam carriers, and shipping cartons are available from Isco.

3. Cleaning the Bottles

After the bottle rack has been returned from the testing laboratory, you will need to clean the bottles and reload the rack. Cleaning the bottles is an easy procedure but you must disassemble them first.

1. Remove the bottles from the bottle rack.
2. Remove the stainless steel valve stem from each bottle. (Hold the bottle in one hand and pull the stem firmly toward you with the other hand. Turn the handle back and forth while you are pulling it toward you.

3. Unscrew the cap from the bottle to free the valve body.
4. Push the valve body out of the cap and remove the O-ring.

Note

The construction of the cap keeps the O-ring from ever contacting the sample. In this application the O-ring serves as a spring to help seal. It is not necessary to sterilize the O-ring. Also, some solvents and detergents could attack the O-ring.

5. Clean all parts in an autoclave or with appropriate detergents.

Note

If you use detergent or solvent to clean the bottles, make sure the detergent or solvent is non-residual. Non-residual means that no trace of the detergent will remain on the glass after rinsing and air-drying. Cleaning agents that leave any residues could cause misleading results when you use the bottles to take future samples.

6. After cleaning, allow the bottles, caps, valve bodies, and stems to air dry in a clean, dry environment.
7. Reassemble the bottles, lids, and valves while you are wearing rubber gloves, to avoid contaminating them.
8. Put the O-ring on the top of the valve body.
9. Put the cap over the valve body.

Note

The O-ring must be between the cap and the valve body. Do not place the O-ring between the valve body and the bottle.

10. Screw the cap down onto the bottle. Make sure the cap is snug, but do not over-tighten.
11. Reinsert the valve stem into the valve body by pressing and twisting the valve stem into the valve body at the same time. Turn the valve stems so their final position is perpendicular (90°) to the bottle.
12. Reassemble the bottle rack with the cleaned bottles. Make sure all the valves are closed. It is very important to keep the valve stems closed to prevent contamination.

☑ Note

The bottles used in the Model 6100FR are borosilicate (hard) glass. Borosilicate glass is also known by the trade name of Pyrex[®]. The bottles' capacity is 40 ml. Isco does not recommend the use of bottles other than those supplied by Isco to ensure conformity with the original equipment dimensions. If you use bottles from a source other than Isco, the bottles must have identical length, diameter, and cap thread as those supplied with the sampler. For safety reasons they should also be made of hard glass. Failure to use identical bottles may result in crushed bottles or a damaged needle assembly, and will result in an inoperable sampler.

Chapter 6. Maintenance and Special Features

1. Pump Bladder Replacement

The bladder used in the 6100FR pump will eventually break from the repeated pressurization and decompression. You can field-replace the bladder with a special tool available from Isco to release the two metal bands that clamp the bladder to the pump body. The special tool is called the **Oetiker tool** and it resembles a pair of pliers or crimping tool with a very fine point at the end of each jaw. No other tools should be necessary.

1. Make sure the unit is turned off.
2. Retrieve the pump from the flow stream.
3. Disconnect the steel support cable from the pump.
4. Remove the tubing from the two fittings on the top of the pump by pulling on each tube, one at a time, as you press in on the outer red flange of each fitting.
5. Wash the pump housing if it is greasy or coated with sediment. Dry it so you can get a good hand grip on the pump body and the two knurled ends.

WARNING

Never attempt disassembly of the pump while it is connected. If the pump is still pressurized, disassembly could result in serious personal injury. Compressed air remaining inside the pump could make internal parts burst out of the end of pump end with great force. Always point the pump away from you when disassembling it.

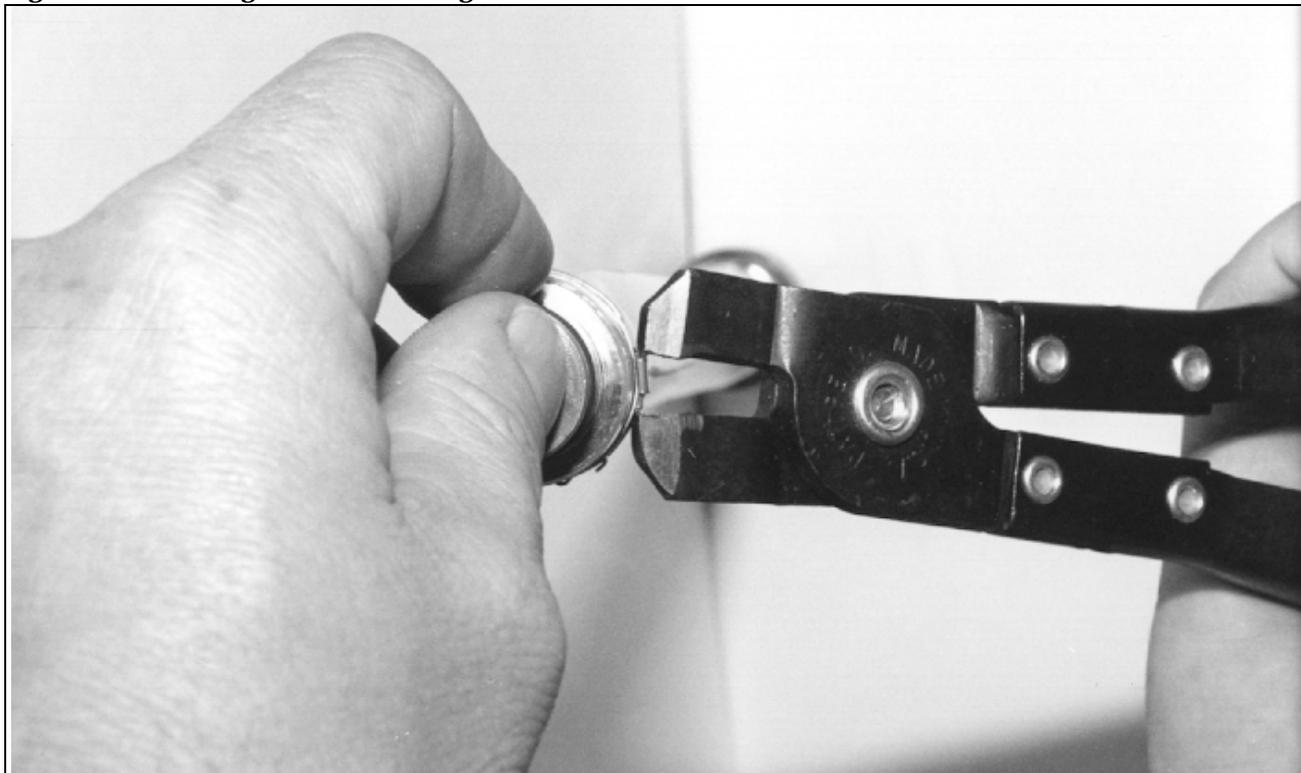
6. Holding the pump by the body, unscrew the bottom end. The end pieces are knurled to help you get a firm grip. The ends should only be hand-tightened. There are O-rings that form a seal between the ends of the pump and the body. If sediment or scale have made the ends too tight to break free with hand pressure, you can use a pair of adjustable pliers to release them, but normally this should not be necessary. If you must use tools to disassemble the pump, it means the pump was assembled too tightly in the first place. **When reassembling the pump, never use tools to tighten the ends.**
7. When you remove the bottom piece, note the light coil spring and ball inside.

8. If the strainer is clean, there is no need to remove the ball and spring. Set the bottom piece aside, upright, with the ball and spring inside. **Do not lose the ball and spring; the pump cannot work without them.** (The ball and spring form the check valve that keeps water from escaping back into the flow stream when the pump is repressurized.)
9. You can clean the strainer, if that is necessary, by back-flushing it with hot water through the lower end of the pump. In extreme cases, a grease-dissolving detergent might be helpful. It is not necessary to unscrew the strainer from the bottom end piece of the pump.
10. Unscrew the top end of the pump (pump head) and pull the bladder assembly and pump head out of the pump body. Separate the pump head from the bladder assembly noting the position of the spring between the bladder assembly and the pump head.
11. Two stainless steel straps hold the bladder in place at either end of the pump. Use the Oetiker tool to release the two clamps. This is done by locating a point on the strap where the inner and outer sections of the strap overlap, about 1¼ inches from end of the outer section of the strap. See **Figure 11**.

Find a raised cylindrical bump on the inner strap that is slid part way under a similar bump on the outer strap. The jaws of the tool fit into the two holes at the ends of these bumps. This is the only place where the tool jaws will fit properly. If the tool doesn't seem to fit, you haven't found the right place. Fit the tool into the two holes and gently move the tool handles close together. You will see the bump on the inner strap slide further under the bump on the outer strap.

Close the handles of the tool and the outer end of the strap will release from the catch that secured it to the inner section. To reattach the strap, hold the strap open with the tool and press the loose end back down over the catch on the inner strap with your finger. Practice this a few times to become familiar with opening and closing the strap.

Figure 11. Removing the Retainer Ring with the Oetiker tool



12. After you have released both straps, slide the old bladder off the lower end of the bladder assembly. This may require slicing the bladder to remove it from the upper and lower ends of the assembly. Care should be taken not to damage the O-rings on the bladder ends and not to separate the center tube from the bladder ends. To reassemble the bladder slide the new bladder over the lower end of the center tube assembly until it is flush with the shoulder on the lower end. There is no top or bottom to the bladder, it will work correctly either way. Reinstall the clamps with the Oetiker tool over the top of the O-rings. Trim any excess bladder material that extends beyond the upper shoulder on the bladder end.
13. Slide the repaired bladder assembly back inside the pump body. Install the spring in the upper end of the bladder assembly and screw the pump head into the pump body. Check the bottom end of the pump to see that the check ball and spring are in place. The ball goes over the hole in the bottom section and the spring goes over it. Screw the bottom end into the pump body. **Do not use any tools to tighten the ends of the pump!** The O-rings make this unnecessary. The reassembled pump is now ready to be put back into the flow stream.

CAUTION

When reinserting the bladder assembly, avoid scraping the bladder on the threads of the body. Also, keep the bladder from being twisted during reassembly.

14. If you have replaced the bladder after a bladder failure, purge all water out of the air system before resuming operation. Drain the lines. Then, with the air line attached only to the 6100, use the cycle pump control to purge any water that was trapped in the air pump.
15. After reinstalling the pump, run five pump cycles to get the new bladder broke-in and ready for service.

2. Replacing the Needle Assembly

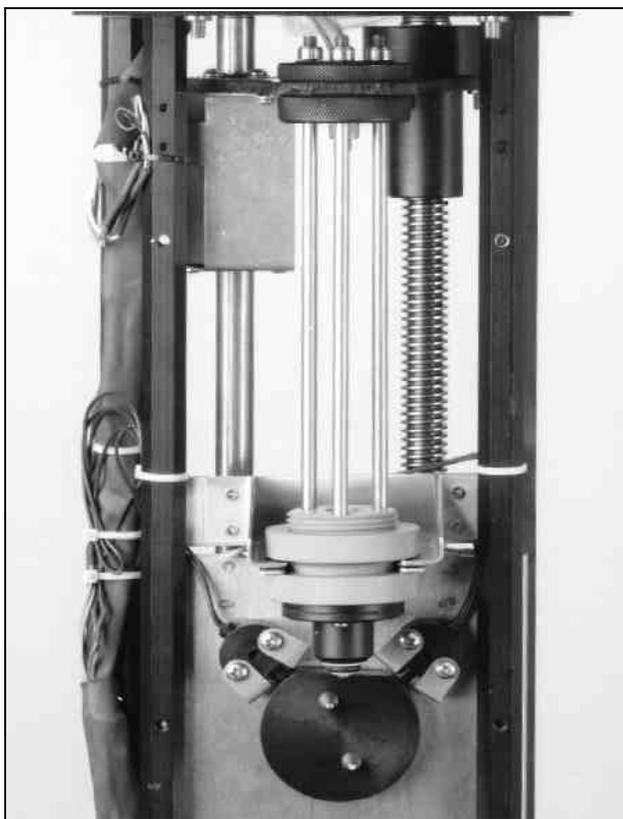
It is possible to replace the needle assembly in the field, if that should become necessary. **Before attempting this please read the following warning:**

WARNING

Disconnect power completely before attempting needle replacement. The needle drive mechanism will cause serious injury to your hand if the sampler starts while you are working on it.

1. Note that the tower housing consists of two pieces that fit together like a clam shell. Remove the front half of the tower housing. The two sections of the tower housing fit together inside an H-shaped molding. There are four thumbscrews that hold the front on. You should be able to see the needle assembly clearly after removing the housing.
2. The needle assembly consists of the needle, a heavy coil spring, three long slide rods, and four plastic rings. The plastic rings are knurled (lines on their surface). These rings are the needle mounts.

Figure 12. Tower Mechanism Showing Location of the Needle Assembly. (Housing Removed.)



See also the illustrations on the following page.

3. To remove the needle assembly, loosen the guide nut, the top gray plastic nut in the middle of the assembly.
4. Remove the drain hose from the bottom of the assembly.
5. Push up on the ball on the lower end of the needle assembly to compress the spring and remove the top remaining nut. When pressure is released, disconnect the sample tube from the top of the needle and remove the assembly from the tower.

Note

There is spring pressure on the assembly forcing it down. Hold the assembly up while removing the nut, then release slowly to prevent damage to the needle assembly.

6. Remove the needle from the assembly by removing the three screws holding the guide rods to the needle on the bottom. **DO NOT** loosen the retaining nuts on the top end of the slide rods. Pliers may be required to hold the slide rods while removing the screws. Remove the slide rods and unscrew the needle from the top needle mount, then remove the guide and spring.
7. Reassemble in the reverse order. Assure the needle assembly is seated against the top mount before tightening the nut. Align the drain tube fitting with the hose slot and make sure the slide rods are not twisted. Tighten the gray guide nut in the middle of the needle assembly until it contacts the mount. The assembly should still be able to move with light pressure applied to it.

Note

When reassembling the needle and tower, do not use tools to tighten the plastic mounting rings. You only need to finger-tighten them. You can use pliers to tighten the needle into the top mounting ring, but do not apply excessive force.

3. Needle Alignment

When replacing the needle it is necessary to make sure that the needle aligns with the bottle to guarantee proper sealing and operation of the mechanism. Use the following procedure to ensure alignment.

1. With the front shell still removed and the sample power supply disconnected, visually align the needle over the bottle rack, both side-to-side and front-to-back leaving the gray nut at the needle support loose. Set the sampler to run a single bottle manual sample with no extra purge.
2. Initiate the sample. As the needle moves downward onto the bottle, manually guide it into the bottle.

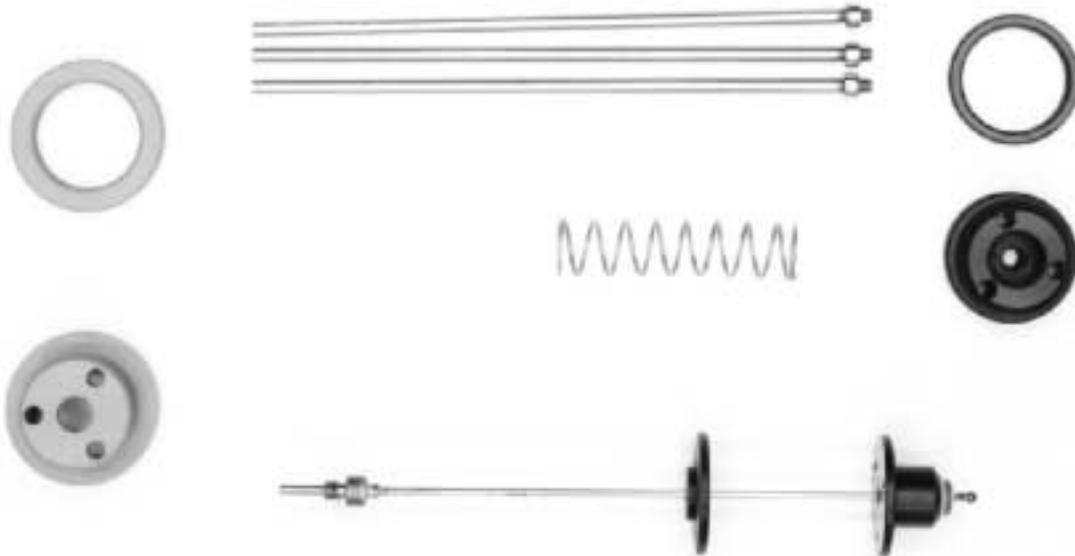
WARNING

In performing the needle alignment, be very careful to keep your fingers out from under the needle tip and away from any other moving parts. **Never** put your fingers between the needle tip and top of the bottle.

Figure 13. Needle Assembly Completed



Figure 14. Needle Assembly Parts



3. When the needle has seated on the top of the bottle, jiggle it slightly to make sure it is centered. The top of the bottle valve is conical. While the needle is still seated on the bottle, tighten the gray nut only enough to provide resistance to movement. **Do not overtighten.** Run one more sample and visually verify the alignment.
4. After needle alignment is complete, replace the front shell.

4. Hard Reset

The term **Hard Reset** refers to a feature that allows you to de-program the 6100FR to the factory-installed default program. The usual reason for doing a hard reset is when the microprocessor locks up and you cannot access the program to make changes or run an existing program.

CAUTION

Hard reset will erase all programming selections you have made. It will also erase all entries made to the history log. Do not perform a hard reset casually or without good reason.

To **Hard Reset** the 6100FR:

1. Turn the unit off with the **On/Off** key.
2. Press and hold the **9** and **Right Arrow** keys at the same time.
3. While still holding the **9** and **Right Arrow** keys down, press and hold the **On/Off** key until the sampler starts to beep.
4. Release the **On/Off** key.
5. Release the other keys.
6. Turn the unit back on with the **On/Off** key.

5. Replacing the Desiccant Bags

The Model 6100 has two desiccant containers inside to protect the electronics from moisture damage. One is located inside the sampler motor housing. The other is located beneath the control panel assembly.

Both units are deep inside the unit and will generally last a long time. There is an indicator on the base by the tower, with a window and numbers inside that shows the condition of the desiccant. The numbers refer to the relative humidity inside

the enclosure, with 20 standing for 20%, 30 standing for 30%, etc. As long as the window looks blue, the desiccant is still functioning.

When the window turns pink around all three numbers, the desiccant needs to be replaced, as humidity inside the enclosure has exceeded 40%. Replacement desiccant bags are available from Isco.

CAUTION

You must disassemble the control panel to access the desiccant. Mechanical and electrical components will be exposed in the process. Do not disturb the wiring or change the mechanical linkages in any way or you may cause substantial damage to the sampler.

Isco suggests replacing both desiccants at the same time. To replace the desiccant in the motor housing do the following:

1. Disconnect the power source.
2. Note the sampler motor housing under the unit inside the refrigerator. This enclosure houses the electronics.
3. The desiccant cartridge is located on the left side of the sampler motor housing opposite the electrical connections. Remove the desiccant cartridge by unscrewing the large hex nut.
4. The cartridge can be regenerated by removing the desiccant and replacing it with new or regenerated desiccant. Remove the desiccant by unscrewing the plastic tube from the hex nut. Never try to regenerate the desiccant while it is still inside the plastic cartridge.
5. Reassemble the cartridge and the sampler in the reverse order.

Regenerating Bulk Desiccant

To replace the desiccant bag under the keypad, do the following:

1. Remove the ten screws attaching the bezel to the keypad.
2. Remove the plastic bezel.
3. Lift the keypad assembly out of the tower housing. Do not disconnect any of the wiring.
4. The desiccant bag is in the well beneath the keypad. Remove and replace the bag.
5. Reassemble the unit in reverse order.

Isco supplies two different chemicals in the cartridges. Before regenerating them, you must identify the chemical used with your unit. Both chemicals are blue when activated and pale pink to amber when saturated.

- One chemical looks like irregular chips or flakes of tinted plaster. This is anhydrous calcium sulfate and you regenerate it by heating at 400° to 440°F (200°-225°C)
- The other chemical looks like glassy beads or pellets. This is silica gel, and you also regenerate it by heating, but at a lower temperature, 212° to 350° (100° to 175°C)

MSDS (Material Safety Data Sheets) for these chemicals are available from Isco or the manufacturers. They are also presented at the back of this manual.

Regenerating the Desiccant Bags

You should recharge the desiccant bag when the area marked “30” on the paper humidity indicator on the base turns pink.

1. Remove the bag from the 6100FR as described in the previous section.
2. Place a sheet of brown paper on a flat metal sheet. You can use a brown grocery sack and an ordinary cookie sheet.
3. Place the bags on the brown paper. Do not stack the bags on top of each other, nor allow them to touch.
4. Place the tray in a vented, circulating forced air, convection oven in a well-ventilated room. Allow two inches of air space between the top of the bags and the next metal tray above the bags.
5. Keep the tray a minimum of 16 inches from the heating element. Heat the bags at a temperature of 240° to 250 °F (116° to 121°C) for 12 to 16 hours.
6. At the end of the time period, remove the bags and place them immediately in an airtight container for cooling.
7. The desiccant will recharge to 80 – 90% of its previous capacity. After several recharges, the desiccant bag may have lost enough capacity to require replacement.
8. Some bags can have the temperature and the recharging time for the desiccant printed on the bag. If the values printed on the bag differ from those given above, use the temperature and time printed on the bag.

SAFETY INFORMATION

1. Safety Considerations

In field installations of 6100FR Samplers and associated equipment, the safety of the personnel involved should be the foremost consideration. No project is so important or deadline so critical as to justify the risk of human life. The following sections provide safety procedures for working in and around manholes and sewers. The first section offers general safety advice; the second section deals with the special problem of poisonous gases found in sewers.

Note

The 6100FR Sampler has *not* been approved for use in hazardous locations as defined by the National Electrical Code.

CAUTION

The 6100FR refrigerator's lower compartment is not watertight. Never install in a location where the lower compartment could become submerged.

CAUTION

Before any sampler is installed, the proper safety precautions must be taken. The following discussions of safety procedures are only general guidelines. Each situation in which you install a sampler varies. You must take into account the individual circumstances you are in. Additional safety considerations, other than those discussed here, may be required.

1. General Safety Procedures

The following procedures are those used by Black & Veatch, a respected consulting firm, and are published here by their kind permission.

“Field personnel must keep safety uppermost in their minds at all times. When working above ground, rules of common sense and safety prevail. However, when entering manholes, strict safety procedures must be observed. Failure to do so could jeopardize not only your own life, but also the lives of other crew members.”

1. **Hazards.** There are many hazards connected with entering manholes. Some of the most common hazards are:

“**Adverse Atmosphere.** The manhole may contain flammable or poisonous gases or the atmosphere may be deficient in oxygen. Forced ventilation may be necessary.

“**Deteriorated Rungs.** Manhole steps may be cor-

roded and not strong enough to support a man.

“It may be difficult to inspect the rungs because of poor lighting.

“**Traffic.** Whenever manholes are located in the traveled way, barricades and warning devices are essential to direct traffic away from an open manhole.

“**Falling Object.** Items placed near the manhole opening may fall and injure a worker in the manhole.

“**Sharp Edges.** Sharp edges of items in or near a manhole may cause cuts and bruises.

“**Lifting Injuries.** Unless proper tools are used to remove manhole covers, back injuries or injuries to hands and feet may result.

2. **Planning.** Advance planning should include arrangements for test equipment, tools, ventilating equipment, protective clothing, traffic warning devices, ladders, safety harness, and adequate number of personnel. Hasty actions may result in serious injuries. Time spent in the manhole should be kept to a minimum.

3. **Adverse Atmosphere.** (Refer to Table 2 on the following pages) Before entering a manhole, tests should be made for explosive atmosphere, presence of hydrogen sulfide, and oxygen deficiency. Since combustible or toxic vapors may be heavier than air, the tests on the atmosphere must be run at least $\frac{3}{4}$ of the way down the manhole.

“Whenever adverse atmosphere is encountered, forced ventilation must be used to create safe conditions. After the ventilating equipment has been operated for a few minutes, the atmosphere in the manhole should be retested before anyone enters the manhole.

“When explosive conditions are encountered, the ventilating blower should be placed upwind to prevent igniting any gas that is emerging from the opening. When a gasoline engine blower is used, it must be located so that exhaust fumes cannot enter the manhole.

“If testing equipment is not available, the manhole should be assumed to contain an unsafe atmosphere and forced ventilation must be provided. It should never be assumed that a manhole is safe just because there is no odor or the manhole has been entered previously.

4. **Entering Manholes.** Since the top of the manhole is usually flush with the surrounding surface, there may not be anything for the person who is entering the manhole to grab on to steady himself.

Table 1: Hazardous Gas

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air = 1	Physiological Effect*	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air.) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Ammonia	NH ₃	Irritant and poisonous. Colorless with characteristic odor.	0.60	Causes throat and eye irritation at 0.05%, coughing at 0.17%. Short exposure at 0.5% to 1% fatal.	300 to 500	85	16 25	Near top. Concentrates in closed upper spaces	Sewers, chemical feed rooms.	Detectable odor at low concentrations
Benzene	C ₆ H ₆	Irritant, colorless anesthetic	2.77	Slight symptoms after several hours exposure at 0.16% to 0.32%. 2% rapidly fatal.	3,000 to 5,000	25	1.3 7.1	At bottom.	Industrial wastes, varnish, solvents.	Combustible gas indicator
Carbon Bisulfide	CS ₂	Nearly odorless when pure, colorless, anesthetic. Poisonous.	2.64	Very poisonous, irritating, vomiting, convulsions, psychic disturbance.	—	15	1.3 44.0	At bottom	An insecticide	Combustible gas indicator
Carbon Dioxide	CO ₂	Asphyxiant. Colorless, odorless. When breathed in large quantities, may cause acid taste. Non-flammable. Not generally present in dangerous amounts unless an oxygen deficiency exists.	1.53	Cannot be endured at 10% more than a few minutes, even if subject is at rest and oxygen content is normal. Acts on respiratory nerves.	40,000 to 60,000	5,000	— —	At bottom; when heated may stratify at points above bottom.	Products of combustion, sewer gas, sludge. Also issues from carbonaceous strata.	Oxygen deficiency indicator
Carbon Monoxide	CO	Chemical asphyxiant. Colorless, odorless, tasteless. Flammable. Poisonous.	0.97	Combines with hemoglobin of blood. Unconsciousness in 30 min. at 0.2% to 0.25%. Fatal in 4 hours at 0.1%. Headache in few hours at 0.02%.	400	50	12.5 74.0	Near top, especially if present with illuminating gas.	Manufactured gas, flue gas, products of combustion, motor exhausts. Fires of almost any kind.	CO ampoules.
Carbon Tetrachloride	CCl ₄	Heavy, ethereal odor.	5.3	Intestinal upset, loss of consciousness, possible renal damage, respiratory failure.	1,000 to 1,500	100	— —	At bottom.	Industrial wastes, solvent, cleaning	Detectable odor at low concentrations.
Chlorine	Cl ₂	Irritant. Yellow-green color. Choking odor detectable in very low concentrations. Non-flammable.	2.49	Irritates respiratory tract. Kills most animals in a very short time at 0.1%.	4	1	— —	At bottom.	Chlorine cylinder and feed line leaks.	Detectable odor at low concentrations.
Formaldehyde	CH ₂ O	Colorless, pungent suffocating odor.	1.07	Irritating to the nose.	—	10	7.0 73.0	Near bottom.	Incomplete combustion of organics. Common air pollutant, fungicide.	Detectable odor.
Gasoline	C ₃ H ₁₂ to C ₉ H ₂₀	Volatile solvent. Colorless. Odor noticeable at 0.03%. Flammable.	3.0 to 4.0	Anesthetic effects when inhaled. Rapidly fatal at 2.4%. Dangerous for short exposure at 1.1 to 2.2%.	4,000 to 7,000	1,000	1.3 6.0	At bottom.	Service stations, garages, storage tanks, houses.	1. Combustible gas indicator. 2. Oxygen deficiency indicator.**
Hydrogen	H ₂	Simple asphyxiant. Colorless, odorless, tasteless. Flammable	0.07	Acts mechanically to deprive tissues of oxygen. Does not support life.	—	—	4.0 74.0	At top.	Manufactured gas, sludge digestion tank gas, electrolysis of water. Rarely from rock strata.	Combustible gas indicator.
Hydrogen Cyanide	HCN	Faint odor of bitter almonds. Colorless gas	0.93	Slight symptoms appear upon exposure to 0.002% to 0.004%. 0.3% rapidly fatal.	—	10	6.0 40.0	Near top.	Insecticide and rodenticide.	Detector tube

*Percentages shown represent volume of gas in air.

**For concentration over 0.3%.

6100FR

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air = 1	Physiological Effect*	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air.) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Hydrogen Sulfide	H ₂ S	Irritant and poisonous volatile compound. Rotten egg odor in small concentrations. Exposure for 2 to 15 min. at 0.01% impairs sense of smell. Odor not evident at high concentrations. Colorless Flammable.	1.19	Impairs sense of smell, rapidly as concentration increases. Death in few minutes at 0.2%. Exposure to 0.07 to 0.1% rapidly causes acute poisoning. Paralyzes respiratory center.	200 to 300	20	4.3 45.0	Near bottom, but may be above bottom if air is heated and highly humid.	Coal gas, petroleum, sewer gas. Fumes from blasting under some conditions. Sludge gas.	1. H ₂ S Ampoule. 2. 5% by weight lead acetate solution.
Methane	CH ₄	Simple asphyxiant. Colorless, odorless, tasteless, flammable.	0.55	Acts mechanically to deprive tissues of oxygen. Does not support life.	Probably no limit, provided oxygen percentage is sufficient for life.	—	5.0 15.0	At top, increasing to certain depth.	Natural gas, sludge gas, manufactured gas, sewer gas. Strata of sedimentary origin. In swamps or marshes.	1. Combustible gas indicator 2. Oxygen deficiency indicator.
Nitrogen	N ₂	Simple asphyxiant. Colorless, tasteless. Non-flammable. Principal constituent of air. (about 79%).	0.97	Physiologically inert.	—	—	— —	Near top, but may be found near bottom.	Sewer gas. sludge gas. Also issues from some rock strata.	Oxygen deficiency indicator.
Nitrogen Oxides	NO	Colorless	1.04	60 to 150 ppm cause irritation and coughing.	50	10	— —	Near bottom.	Industrial wastes. Common air pollutant.	NO ₂ detector tube.
	N ₂ O	Colorless, sweet odor.	1.53	Asphyxiant.						
	NO ₂	Reddish-brown. Irritating odor. Deadly poison	1.58	100 ppm dangerous. 200 ppm fatal.						
Oxygen	O ₂	Colorless, odorless, tasteless. Supports combustion.	1.11	Normal air contains 20.8% of O ₂ . Man can tolerate down to 12%. Minimum safe 8 hour exposure, 14 to 16%. Below 10%, dangerous to life. Below 5 to 7% probably fatal.	—	—	— —	Variable at different levels.	Oxygen depletion from poor ventilation and absorption, or chemical consumption of oxygen.	Oxygen deficiency indicator.
Ozone	O ₃	Irritant and poisonous. Strong electrical odor. Strong oxidizer. Colorless. At 1 ppm, strong sulfur-like odor.	1.66	Max. naturally occurring level is 0.04 ppm. 0.05 ppm causes irritation of eyes and nose. 1 to 10 ppm causes headache, nausea; can cause coma. Symptoms similar to radiation damage.	0.08	0.04	— —	Near bottom.	Where ozone is used for disinfection.	Detectable odor at 0.015 ppm.
Sludge Gas	—**	Mostly a simple asphyxiant. May be practically odorless, tasteless.	Variable	Will not support life.	No data. Would vary widely with composition.		5.3 19.3	Near top of structure.	From digestion of sludge.	See components.
Sulfur Dioxide	SO ₂	Colorless, pungent odor. Suffocating, corrosive, poisonous, non-flammable.	2.26	Inflammation of the eyes. 400 to 500 ppm immediately fatal.	50 to 100	10	— —	At bottom, can combine with water to form sulfurous acid.	Industrial waste, combustion, common air pollutant.	Detectable taste and odor at low concentration.
Toluene	C ₇ H ₁₂ to C ₉ H ₂₀	Colorless, benzene-like odor.	3.14	At 200-500 ppm, headache, nausea, bad taste, lassitude.	200	100	1.27 7.0	At bottom.	Solvent.	Combustible gas indicator.
Turpentine	C ₁₀ H ₁₆	Colorless, Characteristic odor.	4.84	Eye irritation. Headache, dizziness, nausea, irritation of the kidneys.	—	100		At bottom.	Solvent, used in paint.	1. Detectable odor at low concentrations. 2. Combustible gas indicator.
Xylene	C ₈ H ₁₀	Colorless, flammable	3.66	Narcotic in high concentrations. less toxic than benzene.	—	100	1.1 7.0	At bottom.	Solvent	Combustible gas indicator.

* Percentages shown represent volume of gas in air.

**Mostly methane and carbon dioxide with small amounts of hydrogen, nitrogen, hydrogen sulfide, and oxygen; occasionally traces of carbon monoxide.

“Persons who are entering manholes should not be permitted to carry anything in their hands as they enter the manhole, to ensure that their hands are free to hold on or grab if they slip. A good method for entering a manhole is to sit on the surface facing the manhole steps or ladder, with the feet in the hole and the arms straddling the opening for support. As the body slides forward and downward, the feet can engage a rung, and the back can rest against the opposite side of the opening. If there is any doubt about the soundness of the manhole steps, a portable ladder should be used.

“A person should never enter a manhole unless he is wearing personal safety equipment, including a safety harness and hard hat. Two persons should be stationed at the surface continuously while anyone is working inside a manhole, to lift him out if he is overcome or injured. One man cannot lift an unconscious man out of a manhole.

“The persons stationed at the surface should also function as guards to keep people and vehicles away from the manhole opening. To avoid a serious injury, a person should not be lifted out of a manhole by his arm unless it is a dire emergency.

“When more than one person must enter a manhole, the first person should reach the bottom and step off the ladder before the second one starts down. When two men climb at the same time, the upper one can cause the lower one to fall by slipping or stepping on his fingers.

5. **“Traffic Protection.** In addition to traffic cones, markers, warning signs, and barricades, a vehicle or heavy piece of equipment should be placed between the working area and oncoming traffic. Flashing warning signals should be used to alert drivers and pedestrians. Orange safety vests should be worn by personnel stationed at the surface when the manhole is located in a vehicular traffic area.
6. **“Falling Object.** All loose items should be kept away from the manhole opening. This applies to hand tools as well as stones, gravel and other objects.
7. **“Removing the Covers.** Manhole covers should be removed with a properly designed hook. Use of a pick ax, screwdriver, or small pry bar may result in injury. A suitable tool can be made from ¾-inch round or hex stock. Two inches of one end should be bent at a right angle and the other end should be formed into a D-handle wide enough to accommodate both hands. Even with this tool, care must be exercised to prevent the cover from being dropped on the toes. The two inch projection should be inserted into one of the holes of the

cover, the handle grasped with both hands, and the cover lifted by straightening the legs, which have been slightly bent at the knees.

8. **“Other Precautions.** Other precautions that should be taken when entering a manhole are:

Wear a hard hat.

Wear coveralls or removable outer garment which can readily be removed when the work is completed.

Wear boots or nonsparking safety shoes.

Wear rubberized or waterproof gloves.

Wear a safety harness with a stout rope attached.

Do not smoke.

Avoid touching yourself above the collar until you have cleaned your hands.

9. **“Emergencies.** Every member of the crew should be instructed on procedures to be followed in cases of an emergency. It is the duty of each crew chief to have a list of emergency phone numbers, including the nearest hospital and ambulance service, police precinct, fire station, and rescue or general emergency number.

10. **“Field Equipment.** The following equipment will be available for use:

Blowers	Manhole Irons
Breathing Apparatus	Safety Vests
Coveralls	Hard Hats
Emergency Flashers	Traffic Cones
First Aid Kits	Ropes
Flashlights	Mirrors
Gas Detectors	Pick Axes
Gas Masks	Rain Slickers
Gloves	Waders”

2. Lethal Atmospheres in Sewers

The following is an article written by Dr. Richard D. Pomeroy, and published in the October 1980 issue of *Deeds & Data* of the WPCF. Dr. Pomeroy is particularly well known for his studies, over a period of nearly 50 years, in the field of the control of hydrogen sulfide and other odors in sewers and treatment plants. He has personally worked in a great many functioning sewers. In the earlier years he did so, he admits, with little knowledge of the grave hazards to which he exposed himself.

“It is gratifying that the subject of hazards to people working in sewers is receiving much more attention than in past years, and good safety procedures are prescribed in various publications on this subject. It is essential that people know and use correct procedures.

“It is less important to know just what the hazardous components of sewer atmospheres are, as safety precautions should in general be broadly applicable, but there should be a reasonable understanding of this subject. It is disturbing to see statements in print that do not reflect true conditions.

“One of the most common errors is the assumption that people have died from a lack of oxygen. The human body is able to function very well with substantially reduced oxygen concentrations. No one worries about going to Santa Fe, New Mexico, (elev. 2100 m), where the partial pressure of oxygen is equal to 16.2 percent (a normal atmosphere is about 21 percent) oxygen. When first going there, a person may experience a little ‘shortness of breath’ following exercise. People in good health are not afraid to drive over the high passes in the Rocky Mountains. At Loveland Pass, oxygen pressure is 13.2 percent of a normal atmosphere. At the top of Mt. Whitney, oxygen is equal to 12.2 percent. Many hikers go there, and to higher peaks as well. After adequate acclimation, they may climb to the top of Mt. Everest, where oxygen is equal to only 6.7 percent.

“The lowest oxygen concentrations that I have observed in a sewer atmosphere was 13 percent. It was in a sealed chamber, near sea level, upstream from an inverted siphon on a metropolitan trunk. A man would be foolish to enter the chamber. Without ventilation, he might die, but not from lack of oxygen.

“It seems unlikely that anyone has ever died in a sewer from suffocation, that is, lack of oxygen. Deaths have often been attributed to ‘asphyxiation’. This is a word which, according to the dictionary, is used to mean death from an atmosphere that does not support life. The word has sometimes been misinterpreted as meaning suffocation, which is only one kind of asphyxiation.

“In nearly all cases of death in sewers, the real killer is hydrogen sulfide. It is important that this fact be recognized. Many cities diligently test for explosive gases, which is very important, and they may measure the oxygen concentration, which usually is unimportant, but they rarely measure H_2S . Death has occurred where it is unlikely that there was any measurable reduction in the oxygen concentration. Wastewater containing 2 mg/l of dissolved sulfide, and at a pH of 7.0, can produce in a chamber with high turbulence, a concentration of 300 ppm H_2S , in the air. This is considered to be a lethal concentration. Many people have died from H_2S , not only in sewers and industries, but also from swamps and from hot springs. In one resort area, at least five persons died from H_2S poisoning before the people were ready to admit that H_2S is not a therapeutic agent. Hardly a year passes in the U.S. without a

sewer fatality from H_2S as well as deaths elsewhere in the world.

“The presence of H_2S in a sewer atmosphere is easily determined. A bellows-and-ampoule type of tester is very satisfactory for the purpose, even though it is only crudely quantitative. When using a tester of this type, do not bring the air to the ampoule by way of a tube, as this may change the H_2S concentration. Hang the ampoule in the air to be tested, with a suction tube to the bulb or bellows.

“Lead acetate paper is very useful as a qualitative indicator. It cannot be used to estimate the amount of sulfide, but it will quickly turn black in an atmosphere containing only a tenth of a lethal concentration.

“Electrodes or other similar electrical indicating devices for H_2S in the air have been marketed. Some of them are known to be unreliable, and we know of none that have proved dependable. Do not use one unless you check it at frequent intervals against air containing known H_2S concentrations. A supposed safety device that is unreliable is worse than none at all.

“Remember that the nose fails, too, when it comes to sensing dangerous concentrations of H_2S .

“Various other toxic gases have been mentioned in some publications. It is unlikely that any person has been asphyxiated in a sewer by any of those other gases, except possibly chlorine.

“The vapor of gasoline and other hydrocarbons is sometimes present in amounts that could cause discomfort and illness, but under that condition, the explosion hazard would be far more serious. The explosimeter tests, as well as the sense of smell, would warn of the danger. Pipelines in chemical plants might contain any number of harmful vapors. They, too, are sensed by smell and explosimeter tests if they get into the public sewer. Such occurrences are rare.

“The attempt to instill a sense of urgency about real hazards is diluted if a man is told to give attention to a long list of things that in fact are irrelevant.

“Be very careful to avoid high H_2S concentrations, flammable atmospheres, and hazards of physical injuries. Remember that much H_2S may be released by the stirring up of sludge in the bottom of a structure. Obey your senses in respect to irritating gases, such as chlorine (unconsciousness comes suddenly from breathing too much.) Be cautious about strange odors. Do not determine percent oxygen in the air. There is a danger that the result will influence a man's thinking about the seriousness of the real hazards. Most important, use ample ventilation, and do not enter a potentially hazardous structure except in a good safety harness with two men at the top who can lift you out.”

Chapter 7. Isco Software Updates Flash Memory and the UPDATE Disk

Many Isco instruments use a new type of memory called a Flash EPROM. Unlike earlier EPROMs that require UV erasure and were not easily field-replaced, the Flash EPROM lets you upgrade the software in the instrument without opening the unit or returning it to the factory. You can now update the software with a disk from Isco, an IBM® compatible personal computer and a connect cable.

The disk contains UPDATE, a program specifically for Flash memories, and a set of software files to update the Flash EPROM.

The disk is labeled with:

- The instrument series number
- The software revision number for each instrument in the series
- The part number of the disk

This instruction sheet assumes that:

- You know how to run the computer and are familiar with Microsoft® Windows®. UPDATE uses standard windows mouse and keyboard commands. If you are not familiar with Windows, please consult the Windows user manuals.
- You have a cable to connect the computer to the instrument. If you do not, you can order one from your Isco sales representative, or from the factory. The part number is on the back of this page.

Before attempting to update a system please read the following:

CAUTION

Updating the instrument will erase the data stored in memory. This includes both programming selections and measurements recorded by FLOWLINK®, Isco's data storage and acquisition software. The program will revert to the default (factory) settings, and other stored data will be lost altogether.

Before you run UPDATE, record your program selections. Then you can reprogram the machine easily after you have installed the update. If the instrument uses FLOWLINK, collect the stored data first.

Running UPDATE

1. Plug the computer connect cable into the serial port on your computer and the Interrogator connector on the instrument. (The interrogator connector label shows the drawing of a lap-top computer.)

2. Insert the UPDATE disk in the computer's floppy disk drive, and change the DOS prompt to the floppy drive's prefix, for example: C:\> B:
3. At the DOS prompt, type: UPDATE. The windows in UPDATE contain the instructions for updating the instrument.

These instructions for running UPDATE assume you are running UPDATE from the UPDATE disk. If you copy the disk's contents to your hard drive, first create a directory for the files. The UPDATE program and the instrument software files must be in the same directory. Furthermore, the directory containing UPDATE and the update files must be the current directory when you run UPDATE.

If you receive several update disks over time, always copy the update files and the UPDATE program to the directory you have created for this on your computer. That will ensure you always have the current version of the UPDATE program as well as the new instrument software files.

Isco ships UPDATE and the update software on 3½-inch, high density disks. The Isco Customer Service Department will also supply 5¼-inch double-density disks free of charge. To obtain the disks or other assistance, contact the Customer Service Department.

Isco Inc.

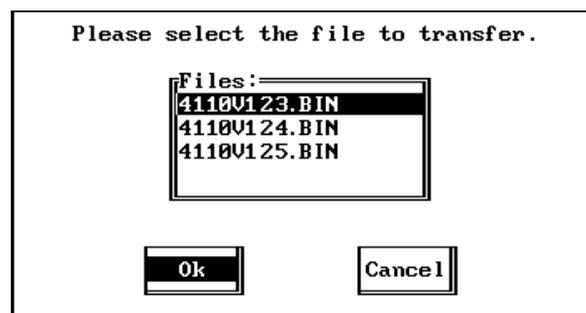
P. O. Box 82531

Lincoln, NE 68501

Telephone: (800) 228-4373

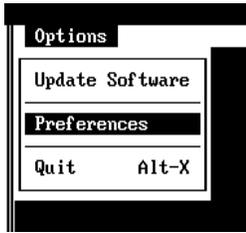
Outside U.S.A.: (402) 464-0231

FAX: (402) 465-3022



This window appears only when the directory or disk contains more than one version of the update files and the Preferences option for Show Update File is "All Update Files". It lists the update files in

the directory. The first four numbers in the file name are the instrument's model number. The numbers following the "v" are the software version. If several versions appear in the window, select the file with the highest version number.

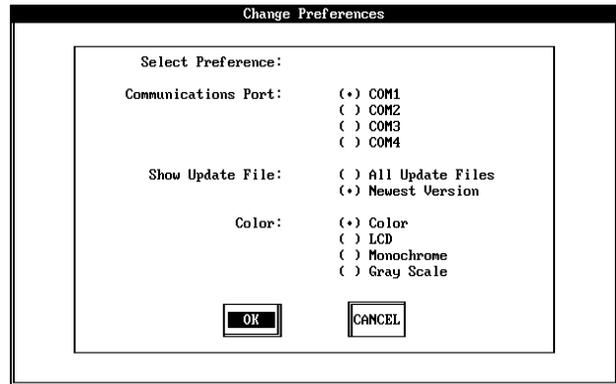


Options Menu
Setting Preferences

Update has preference-settings that appear in the window below. To change them:

1. Click CANCEL in the Introduction window.
2. Select Preferences from the OPTIONS menu. The notes below explain the selections in the window. Select OK when done.

3. Select the UPDATE SOFTWARE from the OPTIONS menu, and follow the instructions in each window.



Note

Select the COM PORT you are using for the Computer Connector Cable.

Select NEWEST VERSION to see only the most recent update files in a directory: Select ALL UPDATE FILES to see all update files.

Select the color scheme that best matches your monitor.

Table 2 Minimum DOS and Computer Hardware Requirements

DOS	DOS 3.3 or later versions	DOS 5.0 or later versions recommended. Microsoft Windows not required.
CPU	80286, 80386, 80486	IBM PC or compatible. 80386 or 80486 recommended. (Must operate at 19,200 baud when communicating through the serial port.)
	640 kilobytes RAM (Random Access Memory), minimum	
	Serial port	For connecting the computer to Isco flow meters, flow loggers, or samplers.
Keyboard	Any compatible keyboard	
Hard disk	Not applicable	Not required.
Floppy disk	3½-inch floppy drive (1.44 megabytes)	At least one floppy disk drive.
Monitor	LCD, Gray Scale, Color, or Monochrome	IBM CGA, EGA, or VGA compatible.
Mouse	Microsoft®-compatible mouse	Optional. Mouse recommended.
Cabling	Isco Computer Connect Cable (9-pin: part #60-2544-044) (25-pin: part #60-2544-040)	For connecting the computer to flow meters, flow loggers, or samplers.

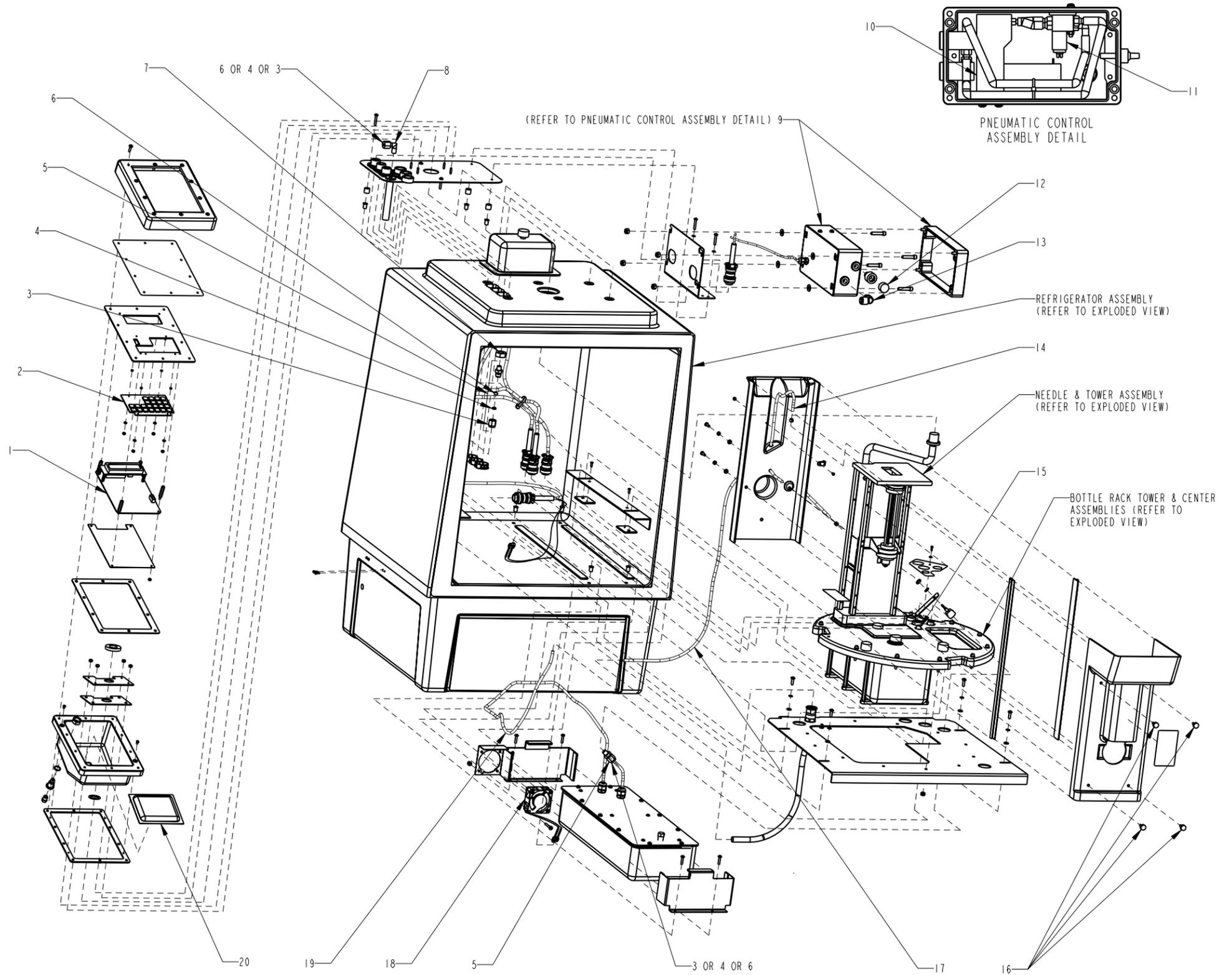
Replacement Parts List for the 6100FR

MODEL 6100FR
REFRIGERATED VOC SAMPLER
W/ BLADDER PUMP

606102010.DRW

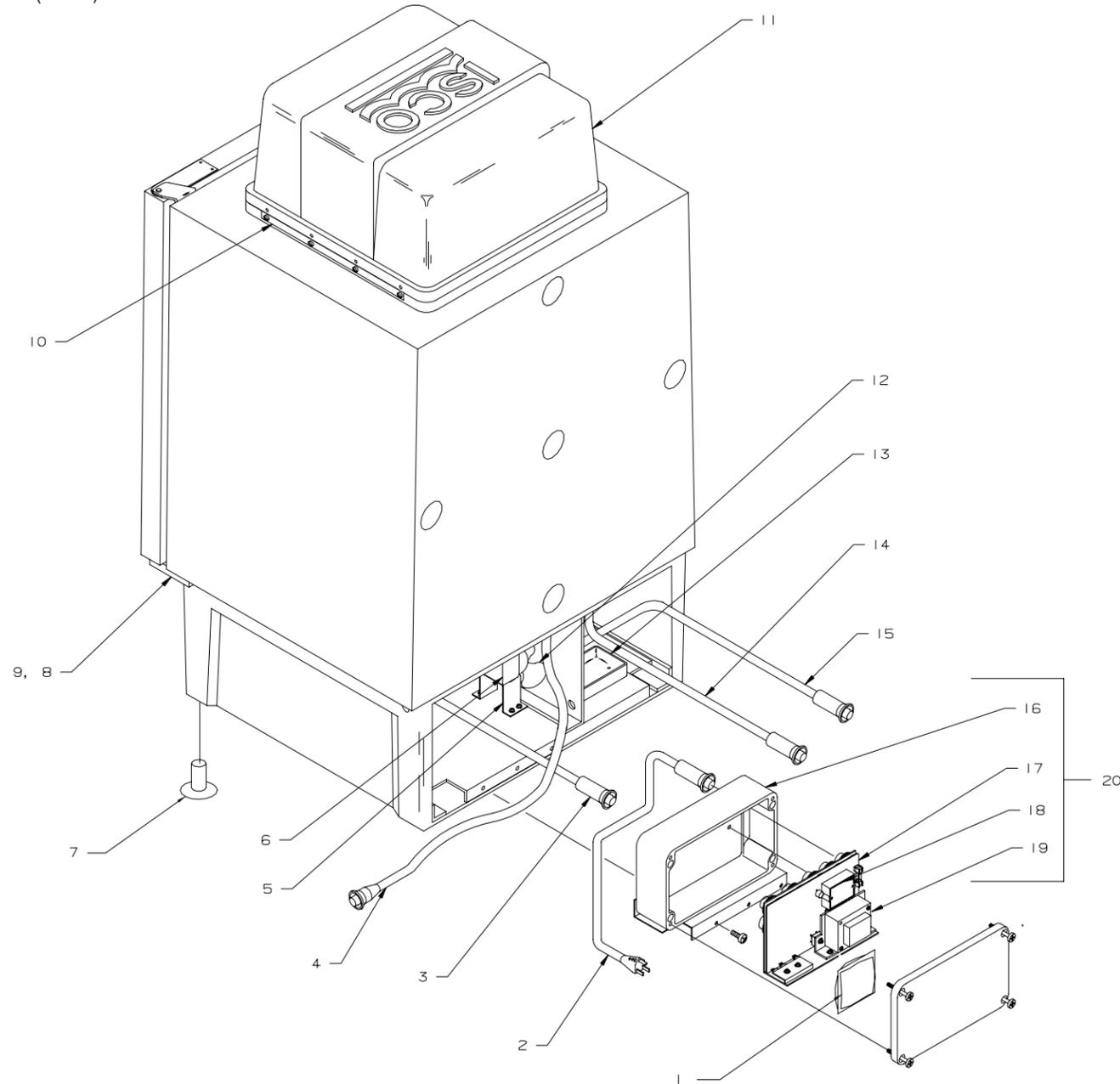
ITEM	PART NO.	DESCRIPTION
1	60-6004-015	CPU PCB ASSEMBLY
2	60-6004-013	KEYBOARD PCB ASSEMBLY
3	209-0163-62	TUBING FITTING NUT, 1/4 TUBING
4	209-0163-63	BACK FERRULE, 1/4 TUBING
5	209-0162-36	TUBE FITTING, 1/8 NPT, 1/4 TUBING (INCLUDES ITEMS 3, 4 & 6)
6	209-0163-64	FRONT FERRULE, 1/4 TUBING
7	232-1197-02	JAM NUT, 5/8-18
8	209-0167-66	ELBOW TUBE FITTING, 1/8 NPT, 1/4 TUBING (INCLUDES ITEMS 3, 4 & 6)
9	60-6104-022	PNEUMATIC CONTROL ASSEMBLY (INCLUDES ITEMS 10 & 11)
10	60-6003-089	COMPRESSOR/VACUUM PUMP
11	209-0095-09	SOLENOID VALVE
12	69-9003-520	AIR FILTER DESICCATOR
13	209-0167-33	ELBOW TUBE FITTING, 1/4 NPT, 3/8 TUBING
14	60-6103-015	SAMPLE TUBE, .125 ID X .25 OD - 21 INCHES LONG
15	411-0311-72	FUSE, 5A, 250V, SLO-BLO
16	60-2724-021	THUMBSCREW ASSEMBLY
17	60-6103-038	VINYL TUBING, .125 ID X .25 OD - 20 FEET LONG
18	60-6104-012	FAN ASSEMBLY
19	60-6104-021	BALLAST BOX TUBING W/ INSTALLATION GUIDE
20	009-0002-08	DESICCANT, 4 OZ
*21	66-6000-007	DELIVERY TUBE - 25 FEET LONG
*22	66-6104-025	DELIVERY TUBE - 75 FEET LONG W/ INSTALLATION DIAGRAM

NOTE: * ITEM IS NOT SHOWN IN ILLUSTRATION.



Replacement Parts List for the 6100FR (continued)

MODEL 6100FR
REFRIGERATOR ASSEMBLY
(BACK)



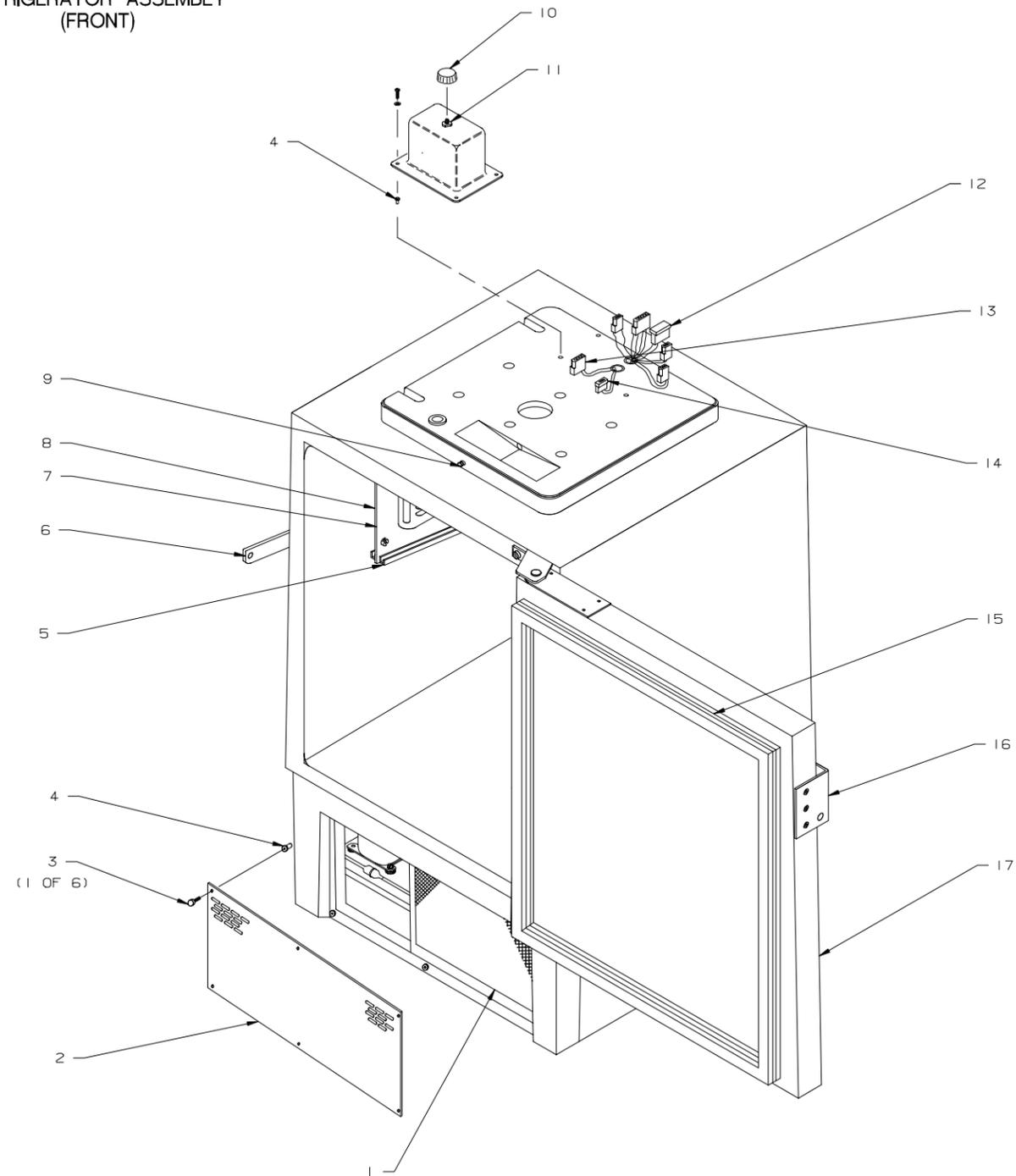
ITEM	INVENTORY NO.	DESCRIPTION
1	099-0002-00	DESICCANT BAG 8 OZ
2	60-9004-242	LINE CORD ASSEMBLY
3	60-9004-241	AMBIENT AIR TEMPERATURE SENSOR ASSEMBLY
4	60-9004-224	SAMPLER POWER WIRING ASSEMBLY
5	60-2723-133	FAN MOUNT
6	304-2300-09	FAN MOTOR
7	231-5159-64	ADJUSTING SCREW
8	60-2723-007	HINGE BUSHING
9	60-2724-066	DOOR HINGE ASSEMBLY, BOTTOM
10	60-2723-085	COVER HINGE
11	60-9004-100	TOP COVER (INCLUDES ITEMS 10 & 21)
12	209-0195-03	FAN BLADE
13	60-2723-068	DRIP PAN
14	60-9004-260	EVAPORATOR HEATER ASSEMBLY (INCLUDES ITEM 22)
15	60-9004-256	CRANKCASE HEATER ASSEMBLY (INCLUDES ITEM 22)
16	60-9003-479	TEMPERATURE CONTROL BOX
17	60-9004-257	PCB ASSEMBLY
18	366-0001-00	SOLID STATE RELAY
19	442-4899-03	TRANSFORMER
20	60-9004-208	TEMPERATURE CONTROL BOX ASSEMBLY
*21	109-0800-00	OVER CENTER DRAW LATCH
*22	432-0000-00	CRANKCASE HEATER

NOTE: * ITEM IS NOT SHOWN IN ILLUSTRATION

(DWG 60-6102-014)

Replacement Parts List for the 6100FR (continued)

MODEL 6100FR
REFRIGERATOR ASSEMBLY
(FRONT)



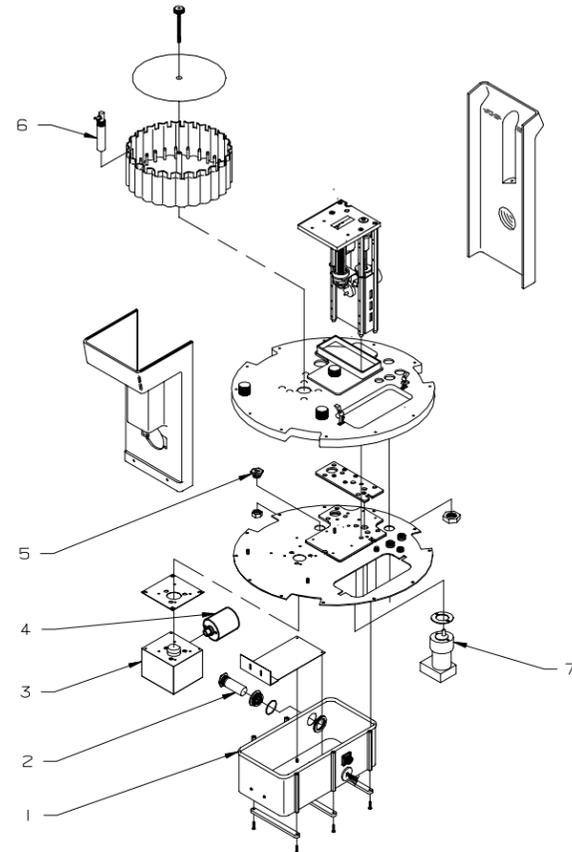
(DWG 60-6102-015)

ITEM	INVENTORY NO.	DESCRIPTION
1	60-9003-182	FILTER FOR REFRIGERATOR
2	60-2723-032	GRILLE FOR REFRIGERATOR
3	60-2724-021	THUMBSCREW ASSEMBLY
4	239-0908-32	WELL NUT FASTENER 8-32
5	60-9003-487	DRIP RAIL (LEFT)
6	60-2723-043	DOOR LATCH, POWDER COATED
7	60-2723-035	EVAPORATOR PLATE MODIFICATION
8	60-9004-259	EVAPORATOR PLATE, TUBING AND HEATER ASSEMBLY (INCLUDES ITEMS 7 & 18)
9	60-2723-054	TOP COVER LATCH KEEPER
10	180-0012-01	KNOB PACKAGE
11	380-9510-70	POT 10K 2W 3/4 TURN
12	60-9004-224	SAMPLER POWER WIRING ASSEMBLY
13	60-9004-226	AIR TEMPERATURE SENSOR WIRING ASSEMBLY
14	60-9004-240	EVAPORATOR TEMPERATURE SENSOR ASSEMBLY
15	60-2723-005	REFRIGERATOR DOOR GASKET
16	61-2723-042	DOOR HANDLE, POWDER COATED
17	60-2724-062	REFRIGERATOR DOOR (INCLUDES ITEMS 29, 15 & 16)
*18	206-0010-00	CAPILLARY TUBING, 10 FT. LONG
*19	60-9003-489	DRIP RAIL (RIGHT)
*20	60-2723-034	DRIP TRAY
*21	432-0000-00	CRANKCASE HEATER
*22	60-9003-498	REFRIGERATOR BACK COVER
*23	239-0906-32	WELL NUT FASTENER FOR AIR TEMPERATURE SENSOR
*24	60-2723-134	FAN SHROUD MOUNT
*25	210-0003-01	COMPRESSOR, 600 BTU/HR
*26	210-0003-02	OVERLOAD FOR COMPRESSOR
*27	210-0003-03	RELAY FOR COMPRESSOR
*28	60-2724-058	CONDENSING COIL
*29	60-2723-007	HINGE BUSHING

NOTE: * ITEM IS NOT SHOWN IN ILLUSTRATION

Replacement Parts List for the 6100FR (continued)

MODEL 6100FR
BOTTLE RACK
TOWER & CENTER
ASSEMBLIES

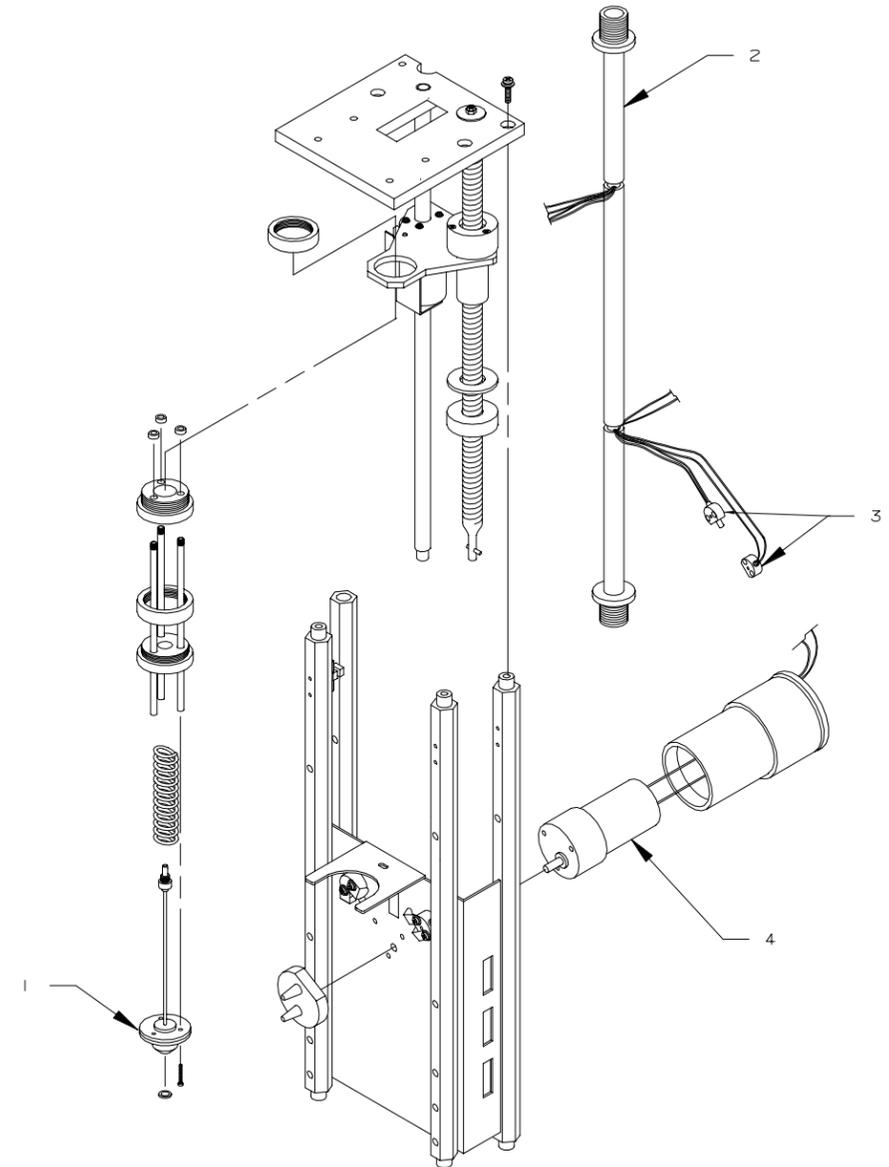


ITEM	INVENTORY NO.	DESCRIPTION
1	800-2303-01	LUBT V FS-34 (USE ON BOX GASKET WHEN EVER BOX IS REMOVED)
2	490-0010-01	DESICCATOR 3" WITH DESICCANT
3	60-6004-045	BOTTLE RACK DRIVE ASSEMBLY (INCLUDES ITEM 4)
4	60-2704-003	DISTRIBUTOR MOTOR ASSEMBLY
5	490-0006-56	HUMIDITY IND. PLUG PLASTIC
6	68-6000-003	REPLACEMENT SAMPLE VIAL W/VALVE
7	60-6004-021	TOWER DRIVE MOTOR ASSEMBLY
*8	099-0011-03	DESICCANT, 1.5 LB CAN (USED IN ITEM 2)

NOTE: * ITEM IS NOT SHOWN IN ILLUSTRATION

(DWG 60-6102-012)

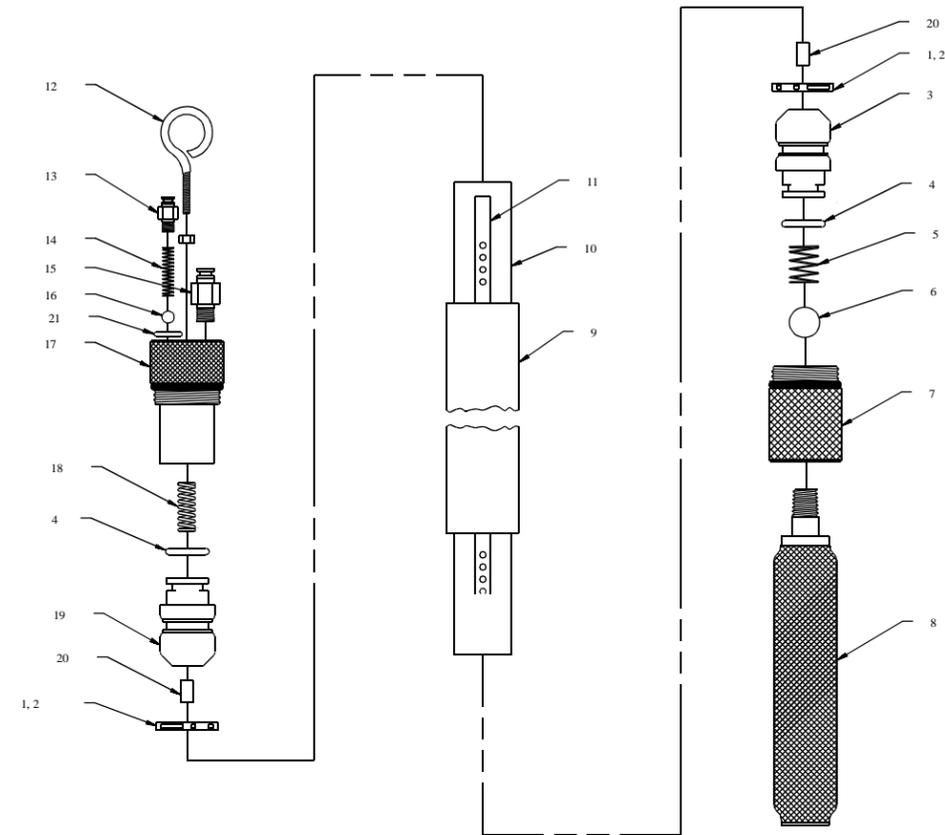
MODEL 6100FR
NEEDLE & TOWER
ASSEMBLY



ITEM	INVENTORY NO.	DESCRIPTION
1	60-6104-018	NEEDLE SUB ASSEMBLY
2	60-6104-001	WIRING ASSEMBLY - PANEL (INCLUDES ITEM 3)
3	60-6104-020	PROXIMITY SENSOR ASSEMBLY
4	60-6003-217	MOTOR GEAR MOD

(DWG 60-6102-013)

Replacement Parts List for the 6100FR (continued)

MODEL 6100
BLADDER PUMP

ITEM	INVENTORY NO.	DESCRIPTION
1	202300211	O-RING #211 - VITON
2	489001602	SST EAR CLAMP 28.4MM X 5MM WIDE
3	616003239	CENTER TUBE END LOWER PSVTD
4	202100208	O-RING VITON #208 5/8" ID X 1/8" ID
5	606003097	SPRING - LOWER CHECK BALL
6	004950075	SST BALL 3/4" DIA. T316
7	616003056	PUMP INLET - PASSIVATED
8	606004051	SCREEN ASSY 60 MESH PLEATED
9	616003055	PUMP BODY - PASSIVATED
10	606003059	BLADDER 1-1/8" ID X .020 WALL FEP
11	616003058	CENTER TUBE
12	235919932	SST EYE BOLT 1/4-20 X 2-1/2"
13	209016803	CONN M SST 1/8" MPT X 1/4" OD TUBE
14	606003098	SPRING - UPPER CHECK BALL
15	209016802	CONN M BRS 1/4" MPT X 3/8" TUBE
16	004950025	SST BALL 1/4" DIA. T316 GR 100
17	616003244	PUMP HEAD - PASSIVATED
18	203012401	SPRING COMP SST .360 X .059
19	616003230	CENTER TUBE END UPPER PASS
20	606003238	BUSHING CTR TUBE LARGE
21	202307208	O-RING VITON #009

6100FR SAMPLERS

Material Safety Data Sheet

Natrasorb M (Clay-Paper Pouch)

Identity (Trade Name as Used on Label)

Manufacturer: MULTISORB TECHNOLOGIES, INC. (formerly Multiform Desiccants, Inc.)	MSDS Number* :
Address: 325 Harlem Road Buffalo, NY 14224	CAS Number* :
Phone Number (For Information): 716/824-8900	Date Prepared: April 19, 1996
Emergency Phone Number: 716/824-8900	Prepared By* : G.E. McKedy

Section 1 - Material Identification and Information

Components - Chemical Name & Common Names (Hazardous Components 1% or greater; Carcinogens 0.1% or greater)	%*	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Montmorillonite Clay	86-93	N/A	N/A	
Crystalline silica quartz	2-4	2mg/m ³ (respirable dust)	0.1 mg/m ³ (respirable dust)	
Non-Hazardous Ingredients Paper	5-10			
TOTAL	100			

Section 2 - Physical/Chemical Characteristics

Boiling Point	N/A	Specific Gravity (H₂O = 1)	2.0 (Montmorillonite Clay)
Vapor Pressure (mm Hg and Temperature)	N/A	Melting Point	N/A
Vapor Density (Air =1)	N/A	Evaporation Rate (=1)	N/A
Solubility in Water	Not soluble, but will adsorb moisture.	Water Reactive	Not reactive, but will adsorb moisture.
Appearance and Odor	Paper pouch containing tan powder.		

Section 3 - Fire and Explosion Hazard Data

Flash Point and Methods Used	N/A	Auto-Ignition Temperature	N/A	Flammability Limits in Air % by Volume	N/A	LEL	UEL
Extinguisher Media	Water is best extinguishing medium, but dry chemical, carbon dioxide and foam can be used.						
Special Fire Fighting Procedures	None. The paper pouch will burn, but the clay will not.						
Unusual Fire and Explosion Hazards	None.						

Section 4 - Reactivity Hazard Data

STABILITY <input checked="" type="checkbox"/> Stable <input type="checkbox"/> Unstable	Conditions To Avoid	Moisture, clay will adsorb moisture.
Incompatibility (Materials to Avoid)	None.	
Hazardous Decomposition Products	Carbon dioxide, carbon monoxide, water	
HAZARDOUS POLYMERIZATION <input type="checkbox"/> May Occur <input checked="" type="checkbox"/> Will Not Occur	Conditions To Avoid	None

6100FR SAMPLERS

Section 5 - Health Hazard Data

PRIMARY ROUTES OF ENTRY	<input checked="" type="checkbox"/> Inhalation	<input checked="" type="checkbox"/> Ingestion	CARCINOGEN LISTED IN	<input type="checkbox"/> NTP	<input type="checkbox"/> OSHA
	<input checked="" type="checkbox"/> Skin Absorption	<input type="checkbox"/> Not Hazardous		<input type="checkbox"/> IARC Monograph	<input checked="" type="checkbox"/> Not Listed
HEALTH HAZARDS	Acute	May cause eye, skin and mucous membrane irritation.			
	Chronic	Prolonged inhalation may cause lung damage.			
Signs and Symptoms of Exposure	Drying and irritation.				
Medical Conditions Generally Aggravated by Exposure	Asthma				
EMERGENCY FIRST AID PROCEDURES - Seek medical assistance for further treatment, observation and support if necessary.					
Eye Contact	Flush with water for at least 15 minutes.				
Skin Contact	Wash affected area with soap and water.				
Inhalation	Remove affected person to fresh air.				
Ingestion	No adverse effects expected.				

Section 6 - Control and Protective Measures

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

Section 7 - Precautions for Safe Handling and Use/Leak Procedures

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

NTP CHEMICAL REPOSITORY
1,2-PROPANEDIOL

-IDENTIFIERS
=====

*CATALOG ID NUMBER: 000047
*CAS NUMBER: 57-55-6
*BASE CHEMICAL NAME: PROPANEDIOL,1,2-
*PRIMARY NAME: 1,2-PROPANEDIOL
*CHEMICAL FORMULA: C3H8O2
*STRUCTURAL FORMULA: CH3CH(OH)CH2OH
*WLN: QY1&1Q

*SYNONYMS:
1,2-DIHYDROXYPROPANE
METHYLETHYLENE GLYCOL
METHYL GLYCOL
MONOPROPYLENE GLYCOL
PROPANE-1,2-DIOL
PROPYLENE GLYCOL
ALPHA-PROPYLENEGLYCOL
1,2-PROPYLENE GLYCOL
TRIMETHYL GLYCOL
DOWFROST
PG 12
PROPYLENE GLYCOL USP
SIRLENE
SOLAR WINTER BAN

-PHYSICAL CHEMICAL DATA
=====

*PHYSICAL DESCRIPTION: LITERATURE: Clear, colorless, viscous liquid
REPOSITORY: Clear, colorless, viscous liquid
*MOLECULAR WEIGHT: 76.10
*SPECIFIC GRAVITY: 1.0361 @ 20/4 C [017,047]
*DENSITY: 1.04 g/mL @ 20 C [371]
*MP (DEG C): -60 C [205,269,274]
*BP (DEG C): 188.2 C [042,055,058]
*SOLUBILITIES:
WATER : >=100 mg/mL @ 21 C (RAD)
DMSO : >=100 mg/mL @ 21 C (RAD)
95% ETHANOL : >=100 mg/mL @ 21 C (RAD)
METHANOL : Not available

ACETONE : >=100 mg/mL @ 21 C (RAD)

TOLUENE : Not available

OTHER SOLVENTS:

Benzene: Soluble [017,047]
 Ether: Soluble [017,047,052,058,205]
 Chloroform: Miscible [058,205]
 Fixed oils: Insoluble [052]
 Alcohols: Miscible [062]
 Many organic solvents: Miscible [062]

*VOLATILITY:

Vapor pressure: 0.08 mm Hg @ 20 C [042,058]; 0.13 mm Hg @ 25 C [430]
 Vapor density : 2.62

*FLAMMABILITY (FLASH POINT):

This chemical has a flash point of 99 C (210 F) [042,052,058,062,371]. It is combustible. Fires involving this material can be controlled with a dry chemical, carbon dioxide or Halon extinguisher. A water spray may also be used [058,371]. The autoignition temperature is 415 C (779 F) [058,062].

*UEL: 12.6% [042,058]

LEL: 2.6% [042,058,371]

*REACTIVITY:

This compound can react with oxidizing materials [042,058,269]. It is incompatible with acid chlorides, acid anhydrides, chloroformates, and reducing agents [269]. It dissolves many essential oils [052,406]. A mixture of this compound with hydrofluoric acid and silver nitrate was put in a glass bottle which burst 30 minutes later [066].

*STABILITY:

This compound is hygroscopic [042,062]. It is sensitive to excessive heat (tends to oxidize at high temperatures) [052,058]. It is stable when stored protected from light for 2 weeks at temperatures up to 60 C [052].

*OTHER PHYSICAL DATA:

Specific gravity: 1.0381 @ 20/20 C [062]; 1.033 @ 25/4 C [430]
 Specific gravity: 1.0362 @ 25/25 C [042]; 1.0331 @ 22/22 C [052]
 Boiling point: 186.1 C @ 740.9 mm Hg [052]; 96-98 C @ 21 mm Hg [017,047]
 Refractive index: 1.4320 @ 20 C
 Practically odorless
 Slightly acrid taste
 Viscosity: 0.581 poise @ 20 C
 Heat of combustion: -5728 cal/g
 Latent heat of vaporization: 170 cal/g
 Surface tension: 40.1 dynes/cm @ 25 C
 log P octanol: -1.41/-0.30 (calculated)
 Specific heat: 0.590 cal/g @ 20 C
 Burning rate: 1.5 mm/minute
 Evaporation rate: 0.005

-TOXICITY

=====

*NIOSH REGISTRY NUMBER: TY2000000

*TOXICITY: ([abbreviations](#))

typ. dose	mode	specie	amount	units	other
LD50	ims	rat	14	gm/kg	
LDLo	ims	rbt	6300	mg/kg	
LD50	ipr	mus	9718	mg/kg	

LD50	ipr	rat	6660	mg/kg
LDLo	ivn	ckn	27	gm/kg
LD50	ivn	dog	26	gm/kg
LD50	ivn	mus	6630	mg/kg
LD50	ivn	rat	6423	mg/kg
LDLo	ivn	rbt	4200	mg/kg
TDLo	orl	chd	79	gm/kg/56W-I
LD50	orl	dog	22	gm/kg
LD50	orl	gpg	19	gm/kg
LD50	orl	mus	24	gm/kg
LD50	orl	rat	20	gm/kg
LDLo	orl	rbt	14300	mg/kg
LDLo	scu	gpg	15500	mg/kg
LD50	scu	mus	17370	mg/kg
LD50	scu	rat	22500	mg/kg
LD50	skn	rbt	20800	mg/kg

*AQTX/TLM96: over 1000 ppm

*SAX TOXICITY EVALUATION:

THR: A skin and eye irritant. It affects the central nervous system in humans. LOW via oral, intraperitoneal, subcutaneous, intramuscular and skin routes. It is a substance which migrates to food from packaging materials.

*CARCINOGENICITY: Not available

*MUTATION DATA:

test	lowest dose	test	lowest dose
cyt-ham:fbr	32 gm/L	cyt-mus-scu	8000 mg/kg
dni-mus-scu	8000 mg/kg		

*TERATOGENICITY:

Reproductive Effects Data:

TDLo: ipr-mus 100 mg/kg (11D preg)

TDLo: ipr-mus 100 mg/kg (15D preg)

*STANDARDS, REGULATIONS & RECOMMENDATIONS:

OSHA: None

ACGIH: None

NIOSH Criteria Document: None

NFPA Hazard Rating: Health (H): None

Flammability (F): None

Reactivity (R): None

*OTHER TOXICITY DATA:

Skin and Eye Irritation Data:

skn-hmn 500 mg/7D MLD

skn-hmn 104 mg/3D-I MOD

skn-man 10%/2D

eye-rbt 100 mg MLD

eye-rbt 500 mg/24H MLD

Review: Toxicology Review

Status: EPA Genetox Program 1986, Negative: SHE-clonal assay

EPA TSCA Chemical Inventory, 1986

EPA TSCA Section 8(e) Status Report 8EHQ-0178-0041

EPA TSCA Test Submission (TSCATS) Data Base, December 1986

Meets criteria for proposed OSHA Medical Records Rule

-OTHER DATA (Regulatory)

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*OTHER: Not available

*STORAGE PRECAUTIONS:

You should protect this material from exposure to light and moisture. Keep it away from oxidizing materials and store it under refrigerated temperatures.

*SPILLS AND LEAKAGE:

If you should spill this chemical, use absorbent paper to pick up all liquid spill material. Seal the absorbent paper, as well as any of your clothing which may be contaminated, in a vapor-tight plastic bag for eventual disposal. Wash any surfaces you may have contaminated with a soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned.

*DISPOSAL AND WASTE TREATMENT: Not available

-EMERGENCY PROCEDURES

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*SKIN CONTACT:

IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water.

If symptoms such as redness or irritation develop, IMMEDIATELY call a physician and be prepared to transport the victim to a hospital for treatment.

*INHALATION:

IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital.

Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Respirator Recommendation.

*EYE CONTACT:

First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center.

Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician.

IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

*INGESTION:

DO NOT INDUCE VOMITING. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician.

If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. IMMEDIATELY transport the victim to a hospital.

*SYMPTOMS:

Symptoms of exposure to this compound may include central nervous system depression [058,151,406,430]. Other symptoms may include convulsions [301]. It may cause irritation of the skin and eyes [042,058,269]. It may cause primary skin irritation in some people, possibly due to dehydration [430].

Prolonged contact may result in defatting of the skin [058]. It can cause skin sensitization [151,159]. Ingestion of large amounts can cause gastrointestinal upset and diarrhea [058]. A single drop in human eyes has caused immediate stinging, blepharospasm, and lacrimation followed by mild transient conjunctival hyperemia [099,430]. Severe inhalation of the mist may cause mild irritation of the upper respiratory tract [058]. In children, exposure can cause stupor, tachypnea, tachycardia, diaphoresis and seizures [151]. It can also cause hypoglycemia in children [430]. Very high doses in experimental animals have produced central nervous system depression, hemolysis, and minimal kidney changes [151].

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One Year Limited Warranty *

Factory Service

Isco instruments covered by this warranty have a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period, due to faulty parts or workmanship, will be repaired at the factory at no charge to the customer. Isco's exclusive liability is limited to repair or replacement of defective instruments. Isco is not liable for consequential damages.

Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Isco, and Isco will pay surface transportation to return the repaired instrument to the customer. Isco will not pay air freight or customer's packing and crating charges.

The warranty for any instrument is the one in effect on date of shipment. Warranty period

begins on the shipping date, unless Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as charts, ribbon, tubing, and glassware; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover Isco on-line Process Analyzers and certain Isco SFE instruments, which are covered under different warranty terms, nor does it cover products not sold under the Isco trademark or for which any other warranty is specifically stated in sales literature.

This warranty is expressly in lieu of all other warranties and obligations and Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose. Any changes in this warranty must be in writing and signed by a corporate officer.

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

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

Before returning any instrument for repair, please call, fax, or e-mail the Isco service department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, preferably in the original carton, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE DEFECT.**

Return instruments to: Isco, Inc. - Attention Repair Service
4700 Superior Street
Lincoln NE 68504 USA

Mailing address: Isco, Inc.
PO Box 82531
Lincoln NE 68501 USA

Phone: Repair service: (800)775-2965 (lab instruments)
(800)228-4373 (samplers & flow meters)
Sales & General Information (800)228-4373 (USA & Canada)

Fax: (402) 465-3001

Email: service@isco.com

