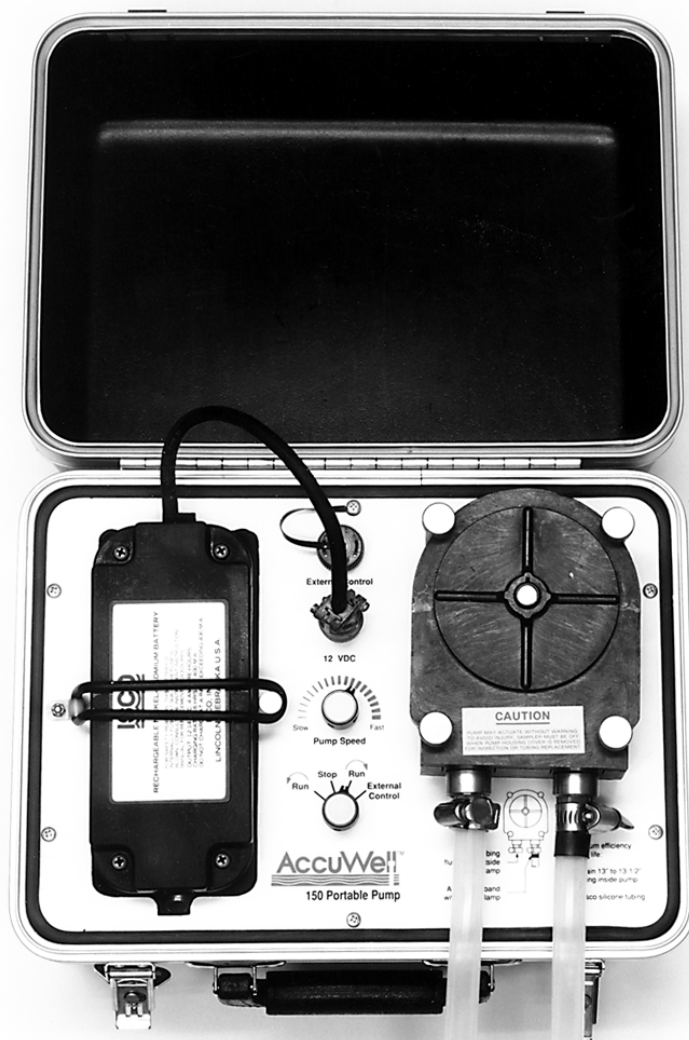


PTP-150 Portable Pump

Instruction Manual



#60-4653-010

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Revision F, January, 2003.

Isco, Inc.

Foreword

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

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

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

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

Contact Information

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

PTP-150 Portable Pump

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PTP-150 Portable Pump

Section 1 Introduction

This section of the PTP-150 Portable Pump Instruction Manual provides an introduction to the pump. It includes an outline of the organization of the manual and an overall description of the pump. It also includes a description of the controls and connectors, and a table of the technical specifications of the pump.

1.1 Organization of the Instruction Manual

The purpose of this manual is to help you understand how the pump works, how to use it, and how to take care of it. To do this, the manual is divided into three sections. The first section gives general information about the pump. The second section provides information on pump set up and collecting a sample. The third section contains routine maintenance information, battery charging, and service details.

1.2 Description of the Portable Pump

The Portable Pump is a device for collecting samples from various liquid sources. You can power this compact unit with several different batteries or power supplies. Among them are the Isco Nickel-Cadmium Battery, Isco Lead-Acid Battery Pack, Isco AC Power Pack, or an external 12-volt DC source, such as a deep-cycle RV or marine battery. Two switches control pump action. The PUMP CONTROL switch is a four-position rotary type and controls direction of pump rotation. The SPEED CONTROL switch is a potentiometer which controls pump speed. Controlling the speed of the pump allows taking very low turbulence samples.

The PTP-150 Portable Pump uses the proven Isco peristaltic pump system to transport the sample from the source to the sample bottle. The Portable Pump is particularly useful for purging and/or sampling from shallow groundwater monitoring wells (maximum depth 26 feet). The only materials in contact with the sample are the polyethylene or Teflon® intake line, the plastic CPVC or stainless steel inlet strainer (if used), the silicone rubber pump tubing, and the plastic or glass sample bottles. Cleaning the system between sampling locations is not complicated. You can find information on cleaning groundwater monitoring equipment to meet EPA standards in Section 2. You can simply replace inexpensive lengths of tubing, if that is more convenient. Ambient operating temperatures range from 32°F to 120°F (0°C to 49°C) in weather conditions including rain or dust. A water-tight plastic enclosure houses the controls and pump mechanism.

® Teflon, trademark of E. I. Du Pont de Nemours, Inc.

WARNING

The PTP-150 Portable Pump is not approved for use in “hazardous areas,” as defined by the National Electrical Code. Sparks from the motor brushes or switch contacts could ignite flammable gases present in the atmosphere, causing an explosion.

1.3 Controls and Connectors

The controls and connectors of the Portable Pump are listed in Tables 1-1 and 1-2, and their respective functions briefly described. Refer to Figure 1-1 for a pictorial view of the PTP-150 front panel.

1.4 Technical Specifications

The technical specifications of the Portable Pump are listed in Table 1-3.



Figure 1-1 Portable Pump Control Panel

Table 1-1 Controls

Control	Setting	Function
PUMP CONTROL Switch	← RUN (Counterclockwise) STOP, → RUN (Clockwise) External Control	Controls direction of pump rotation. Also provides capability of remote actuation.
PUMP SPEED	SLOW.....FAST	Controls pump speed.

Table 1-2 Connectors

Connector	Type	Function
12 VDC	2-Pin M/S Male Connector	12-volt DC power input for pump.
EXTERNAL CONTROL	4-Pin Special Connector	External Control turns pump off from a remote (normally open) contact closure.

Table 1-3 Technical Specifications for the PTP-150

Dimensions	Height: 10 ¹ / ₂ in (27 cm) Width: 13 in (22 cm) Depth: 9 ¹ / ₄ in (24 cm)
Weight	9 lbs (4 kg) With nickel-cadmium battery: 13 lbs, 3 oz (6 kg)
Enclosure	NEMA 4X
Power	12 Volts DC
Consumption	3.5 amperes (typical)
Suction Lift	maximum 26 feet (7.9 m)
Pump Rate (3 ft head, maximum speed, 22 ft tubing)	³ / ₈ -inch I.D. Suction line - 4700 mL/min (typical)
Operating Temperature	32° to 120° F (0° to 49° C)
Overcurrent Protection	8-Ampere, slow blow fuse

PTP-150 Portable Pump

Section 2 Operation

The following section provides information on using the pump. The following paragraphs describe set up of the Portable Pump. Included are connection to power, attaching the intake line, and placement of the pump.

2.1 Connection to a Power Source

The Portable Pump operates from a 12-volt DC power source. Normally, the pump runs from an Isco battery pack mounted in the pump case. You can use either an Isco Nickel-Cadmium Battery Pack or an Isco Lead-Acid Battery. For locations which have AC power available nearby, you can use the Isco High Capacity Power Pack. You can also use an external 12-volt DC source (such as an automotive or RV battery), but you will need an optional battery connect cable, available from Isco. See Section 2.1.3.

2.1.1 Selection of a Battery

If you intend to use the pump regularly and run it until the battery is discharged, use the Nickel-Cadmium Battery Pack. It offers a large number of charge cycles, and will not be damaged if not recharged right away. If you use the pump only occasionally and need a battery which will keep a charge for some time (up to a year) choose the Lead-Acid Battery Pack. Charge cycles are substantially fewer, however.

 CAUTION
--

The lead-acid battery must be recharged immediately after use, or it will be ruined.

2.1.2 Attaching the Battery Pack

Both the lead-acid and nickel-cadmium batteries are convenient power sources for the Portable Pump. Neither battery is included as a standard item with the pump, and must be ordered separately. They are the same batteries used in Isco Samplers and Flow Meters. Open the PTP-150 case. Notice the black pan-like depression in the pump's front panel. Mount the battery in this pan and secure it with the rubber retaining ring. Turn the PUMP CONTROL Switch to STOP. Attach the M/S connector on the end of the battery cable to the mating connector (called "12 VDC") on the pump front panel. Set the SPEED CONTROL to SLOW. Install the silicone pump tubing, if that has not already been done. (See Section 2.3.) Turn the PUMP CONTROL from STOP to either of the RUN modes. The Portable Pump will begin to run.

2.1.3 External 12-Volt Direct Current Source

An external 12 VDC source, such as an automotive, marine, R-V, or motorcycle battery will power the Portable Pump. The optional connect cable, Isco P/N 60-1394-023, mentioned in Section 2.1, is available for this purpose. If you want to use an external battery, plug the two-pin M/S connector on the end of the cable into the “12 VDC” connector on the front panel of the pump. Connect the positive and negative clamps on the other end of the cable to the positive and negative terminals of the external battery. The positive clamp has a + sign on it and the wire is covered with red shrink tubing. **Be sure of proper polarity when attaching the clips to the battery.**

2.1.4 External AC Power Source

You can power the pump with an Isco High Capacity Power Pack if AC power is available nearby. Attach the cable with the M/S connector to the 12 VDC connector on the front panel of the pump. Plug the line cord on the Power Pack into an appropriate AC power source. **Do not attempt to connect the pump directly to an AC source.**

 WARNING
--

HAZARD OF ELECTRIC SHOCK! The possibility of shock from accidental grounding is greater outdoors. Use only grounded cords listed for outdoor use and connected to GFCI-equipped (Ground Fault Circuit Interrupter) outlets.

2.2 Using the Portable Pump

The following paragraphs provide information on using the pump. There are paragraphs describing the pump’s controls and the process of collecting a sample. These procedures assume that you have already prepared the pump, such as connecting a power source and attaching an intake line. For tubing installation, see Section 2.3.

2.2.1 Description of Controls

The control panel of the Portable Pump is shown in Figure 1-1. The operation and use of the individual controls are described in the following paragraphs.

Pump Control Switch – This four-position rotary switch controls the operation of the pump. When the PUMP CONTROL switch is in the STOP position, the pump cannot run. For the purpose of this description, we will run the pump in the ⇒ RUN (clockwise) mode which will make the tube on the left side of the pump the intake and make the tube on the right side the discharge tube. You can run the pump the other way and change the intake and discharge tubes around, if you wish, by changing the PUMP CONTROL switch setting. The External Control is designed to run the pump in the clockwise direction.

When the PUMP CONTROL switch is in the ⇒ RUN (clockwise) position, the pump will continuously draw liquid up the intake line (the line on the left side) and eventually begin to discharge sample liquid from the pump outlet (the line on the right side). Use this position to collect a sample and for cleaning and rinsing the line.

When the PUMP CONTROL switch is in the \Leftarrow RUN (counter-clockwise) position, liquid is continuously forced down the intake line (on the left side), eventually clearing the line. This position purges the system of liquid after the sample has been collected.

When the PUMP CONTROL switch is in the EXTERNAL CONTROL position, you can turn the pump off from a remote location with a contact closure. The pump will turn in the \Rightarrow RUN (clockwise) position. The remote contact set attaches to the PTP-150 with a two-conductor cable that plugs into the EXTERNAL CONTROL connector on the PTP-150 control panel. Consult the factory for details.

Speed Control – This adjustable potentiometer controls the speed of the PTP-150. For purging, “grab” samples, and other noncritical sampling situations, select a higher setting for this control. If you want to take a low-turbulence sample from a groundwater monitoring well, select a lower setting.

2.3 Installation of the Pump Tubing

Before operating the pump, install the pump tubing inside the pump case, if this has not already been done.

 WARNING
--

Always disconnect the battery (or other power source) before opening the pump housing to service the tubing. Your hands could be seriously injured if the pump starts and the rollers catch your fingers.

Note the four large thumbscrews on the outer pump housing. Unscrew them until they are free from the inner pump housing. Do not try to pull them out of the outer housing. They are “captive” (meant to stay with the case.) Pull the outer pump housing free from the rest of the pump assembly.

Thread the pump tubing through one of the semicircular openings on the inner pump housing. Seat the stainless ferrule into one of the openings on the housing. Note the shaft with the two rollers on it. Thread the tubing between the rollers and the wall of the housing. You can rotate the shaft and rollers with your hand to maneuver the tubing into place. Route the tubing out of the inner pump housing. Use the other tubing clamp to secure the tubing in the semicircular opening where it leaves the pump housing.

The pump housing must hold the two clamps securely when reassembled. The clamps secure the tubing inside the housing. You may have to slide one of the clamps up or down the length of tubing to get it to fit into the opening of the housing. Do not make the tubing too short (tight) inside the pump housing; this will make the pump work harder. There should be 13 to 13½ inches of tubing inside the pump. Route the tubing so it follows the natural curve of the pump case. Rotating the shaft by hand,

center the tubing where the rollers pass over it. Replace the top half of the pump cover and reattach the four thumb screws. The installation is now complete.

2.4 Identifying the Pump Intake and Discharge Lines

The identification of the intake and discharge tubes depends on the position of the PUMP CONTROL switch. With this switch in the \Rightarrow RUN position (clockwise) the tube on the right side of the pump (as you face it) is the discharge line and the tube on the left side of the pump is the intake line. With the PUMP CONTROL switch in the \Leftarrow RUN (counterclockwise) position, the tube on the right side becomes the intake line and the tube on the left side of the pump becomes the discharge line.

2.5 Attaching the Intake Line

There are several intake lines available for use with the Portable Pump. The standard line is $\frac{3}{8}$ -inch (0.94 cm) ID polyethylene. It is available in 25- (7.5 m) and 50-foot (15 m) lengths. Also available is a 25-foot, $\frac{3}{8}$ -inch (0.64 cm) ID "Teflon" line. Finally, for non-critical general and wastewater sampling, there is vinyl tubing. It is available with $\frac{3}{8}$ -inch (0.94 cm) ID in 25 feet (7.5 m) length (and also bulk lengths).

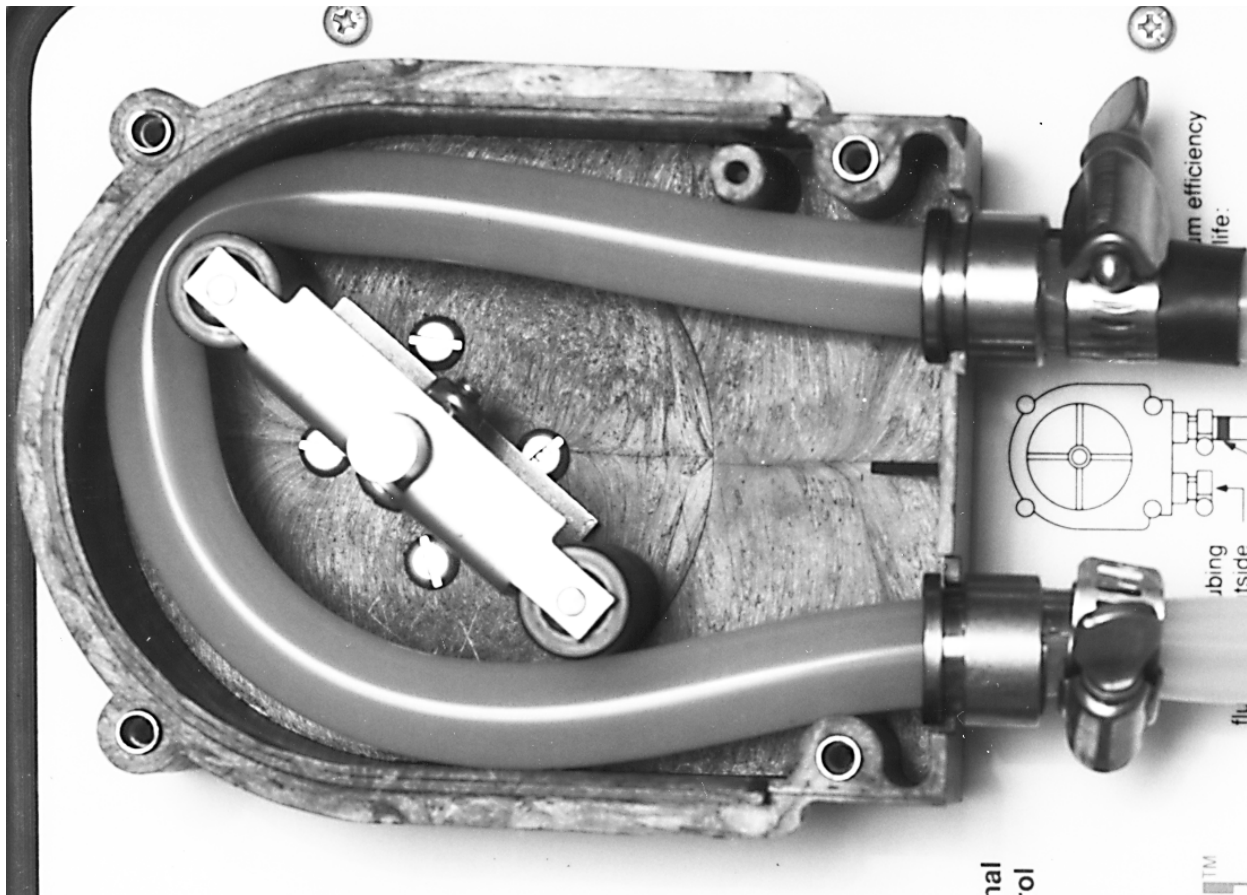


Figure 2-1 Installing the Pump Tube

 **Note**

The vinyl lines are not suitable for groundwater sampling applications, particularly those searching for VOCs (volatile organic compounds). The plasticizer used in the vinyl will migrate into the sample, contaminating it.

The “Teflon” lines are actually polyethylene tubing with a Teflon liner. The polyethylene cover over the 0.03 inch (0.076 cm) wall Teflon tubing prevents the Teflon liner from kinking or collapsing in service and protects it from abrasion and damage. Note that the minimum bend radius of the Teflon intake line is four inches. These lines are available in a $\frac{3}{8}$ -inch ID with a length of 25 feet.

Isco ships the $\frac{3}{8}$ -inch ID vinyl intake lines from the factory with an inlet strainer installed on the end of the intake line. The purpose of the strainer is to prevent solid particles from entering and clogging the intake line. Isco carries all-stainless steel strainers and an all-plastic CPVC strainer. Teflon tubing is not compatible with CPVC strainers. The strainer supplied with the vinyl $\frac{3}{8}$ -inch ID intake line has $\frac{23}{64}$ -inch (0.91 cm) diameter holes in it, preventing larger particles from entering the strainer. Isco recommends use of the strainer for bottom sampling or sampling from streams where large solid particles are present. The vinyl intake line is also available in the standard lengths without the inlet strainers. There are slightly different procedures for attaching the intake lines.

**2.5.1 $\frac{3}{8}$ -inch ID
Polyethylene Intake
Line**

To install the $\frac{3}{8}$ -inch ID polyethylene intake line, first remove the pump cover. Loosen the four thumb screws and pull the outer pump housing away from the rest of the pump. Loosen the lower clamp and slide the pump tubing guide and clamp assembly up the pump tube. Insert the end of the intake tube with the stainless steel ferrule into the end of the pump tube approximately $\frac{1}{2}$ -inch (1.3 cm). Slide the pump tubing guide and clamp assembly down over this junction and tighten the clamp on the stainless steel ferrule. Put the pump tubing guide and clamp assembly back in the inner pump housing with its groove mated to the semicircular opening in the pump case. Slip the pump tube under the rollers to keep it from interfering with the outer pump case. Replace the outer pump housing with the grooves of the tubing guide and clamp assembly fitted properly in both halves of the pump. Reinstall the four thumb screws. To remove the intake line and replace the suction tubing, refer to Section 3.3.2.

**2.5.2 $\frac{3}{8}$ -inch ID “Teflon”
Intake Lines**

The installation procedure for the $\frac{3}{8}$ -inch ID Teflon intake lines (actually polyethylene with a Teflon liner) is similar to that for the $\frac{3}{8}$ -inch ID polyethylene line. Just slip the Teflon intake line inside the silicone rubber pump tube. Wetting the end of intake line may aid the insertion. For removal of the intake line and replacement of the suction tubing, refer to Section 3.3.2.

2.5.3 $\frac{3}{8}$ -inch Vinyl Intake Line

Installing the $\frac{3}{8}$ -inch ID vinyl intake line is similar to the other lines, except this line does not fit directly into the pump tube. Instead, a $\frac{3}{8}$ -inch ID stainless steel ferrule connects both the intake line and the pump tube. To install, follow the same procedure as the other lines, except insert half of the ferrule in the intake line and the other half into the pump tube until the ends of the two tubes are touching. Tighten the pump tubing guide and clamp assembly to secure the pump tube to the stainless steel ferrule. The remainder of the installation is the same. An additional clamp is provided to secure the intake line to the ferrule. For removal of the intake line and replacement of the suction tubing, refer to Section 3.3.1.

2.6 Placing the Pump

The pump case is water-resistant, making it useable in most normal field situations without any special precautions. However, protect the pump from direct exposure to liquid as much as possible. Avoid submerging the pump. Moisture can damage the electronics and wiring, and is not good for the motor and gears. The Portable Pump has a handle to make it easier to carry. Place the liquid sample collected by the Portable Pump in a suitable sample container. Have the required type and number of sample containers available when taking the pump into the field. The various glass and plastic sample containers available from Isco are listed in Appendix A Replacement Parts List.

When using the pump to collect a sample, place the pump intake line in the liquid source and the discharge line in the sample container. Note that in operation the pump outlet line tends to “jump” due to the peristaltic action of the pump. Therefore, hold the pump outlet in place over the sample container while collecting the sample. Note also that you can use a longer piece of pump tubing to lengthen the pump outlet line. This is available in 15-foot (4.6 m) bulk lengths. You can also lengthen it by using a length of suction tubing inserted into the end of the pump outlet tubing.

2.7 Collecting a Sample

The procedure for collecting a sample using the PTP-150 Portable Pump is quite simple. First, make sure the PUMP CONTROL Switch is in the STOP position and the SPEED CONTROL is in the SLOW position. Place the intake line in the liquid source and hold the pump outlet tube over the sample container. Place the PUMP CONTROL Switch in the \Rightarrow (clockwise) position and pump the liquid sample into the sample container. Adjust the SPEED CONTROL pot to a level appropriate for the type and volume of sample you are taking. After you have pumped the desired sample volume, purge the the tubing by switching the PUMP CONTROL switch to the opposite \Leftarrow (counter- clockwise) direction.

PTP-150 Portable Pump

Section 3 Routine Maintenance and Servicing

This section of the manual provides routine maintenance instructions necessary to keep the pump in good working condition. Included in the servicing information are paragraphs on cleaning the pump and components, replacing the pump and suction tubing, charging the optional batteries, lubricating the pump, servicing the nickel-cadmium battery, and replacing the fuse. The pump's electronic circuitry is briefly described.

3.1 Cleaning

Following are instructions for cleaning the pump case and tubing. You may clean the case by scrubbing it with a brush and soapy water. When you clean the case, make sure the lid is closed and the latches are engaged. You can clean the intake line and pump tubing by placing the end of the intake line in a cleaning solution and pumping this solution through the tubing system.

3.1.1 Cleaning Protocols for Priority Pollutants

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

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

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

Isco Glass Sample Bottles

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

Sample Tubing (³/₈-Inch ID Vinyl, Polyethylene or Teflon-Lined Polyethylene)

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

Isco Pump Tube

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

Teflon Tubing

1. Rinse twice with spectro-grade acetone.
2. Rinse thoroughly with hot tap water using a brush if possible to remove particulate matter and surface film.
3. Rinse thoroughly three times with tap water.
4. Acid wash with at least 20 percent hydrochloric acid.
5. Rinse thoroughly three times with tap water.
6. Rinse thoroughly three times with distilled water.
7. Rinse thoroughly with petroleum ether and dry by drawing room air through tubing.
8. Dry overnight in warm oven (less than 150°F) if possible.
9. Cap ends with aluminum foil.

3.1.2 Using the PTP-150 to Clean Groundwater Pumps and Tubing

You can use the PTP-150 to clean ACCUWELL purge pumps, sample pumps, and tubing assemblies. You can use the PTP-150 in either the suction or pressure mode to force cleaning solutions through the well pumps and tubing.

Do so as follows:

Suction (Draws cleaning solution through well pump or tubing)

1. Attach the Portable Pump intake tube to the discharge tubing of the well pump.
2. Place the well pump intake port into a container holding the cleaning or rinsing solution.
3. Turn on the Portable Pump. The Portable Pump will draw the cleaning solution through the pump and tubing.
4. Direct the discharge from the portable pump to a waste container or to the original container for recirculation.

Pressurization (Forces cleaning solution through well pump or tubing) Note that this will not work on the ACT-420 Pump.

1. Insert a hose barb fitting into the pump intake on the bottom of the well pump.
2. Attach the Portable Pump discharge tube to the fitting installed in the intake port at the bottom of the well pump.
3. Place the intake tube in the container of cleaning or rinsing solution.
4. Turn the Portable Pump on. The pump discharge will force the cleaning solution through the well pump and tubing assembly.
5. You can direct the discharge of the well pump to a waste container, or back into the original container for recirculation.

Both these methods offer an effective way to clean well pumps. They will clean the pumps and tubing thoroughly without your having to disassemble the pump.

3.1.3 Cleaning Procedure for Groundwater Monitoring Equipment

The EPA RCRA *Groundwater Monitoring Enforcement Guidance Document*, published in September 1986, recommends the following cleaning procedures for groundwater monitoring equipment. Use these procedures for all groundwater monitoring programs.

Cleaning procedure for the collection of both inorganic and organic constituents:

1. Clean with a nonphosphate detergent.
2. Rinse with dilute hydrochloric acid.
3. Rinse with tap water.
4. Rinse with Type II reagent grade distilled water.
5. Rinse with acetone.
6. Rinse with pesticide quality hexane.

Cleaning procedure for the collection of organic constituents:

1. Clean with nonphosphate detergent.
2. Rinse with tap water.
3. Rinse with Type II reagent-grade distilled water.
4. Rinse with acetone.
5. Rinse with pesticide-quality hexane.

Cleaning procedure for the collection of inorganic constituents:

1. Clean with a nonphosphate detergent.
2. Rinse with a dilute solution of hydrochloric acid (0.1N).
3. Rinse with tap water.
4. Rinse with Type II reagent-grade distilled water.

 **Note**

Make sure all sampling equipment is completely rinsed and dry before use so that no residue from the cleaning agents can carry over to the samples.

3.2 Pump Tubing Maintenance and Replacement

The pump tube serves two functions in the Portable Pump: it serves as a pump tube in the peristaltic pump, and also as a distribution tube, routing the sample liquid from the pump outlet to the sample bottle.

3.2.1 Sample Contamination

The pump tube consists of a single 33-inch (84 cm) long piece of Dow Corning “medical-grade” Silastic® brand silicone rubber tubing. Isco uses this particular tubing because of its superior mechanical properties and because **it does not contain any organic materials**. This is extremely important if you must collect samples containing organic compounds. Non - “medical grade” silicone rubber tubing manufactured by Dow Corning or other manufacturers may contain organic materials used as vulcanizing agents. During the vulcanizing process, these compounds change into other compounds which may leach into the sample. Therefore, if you use a non - “medical grade” type of silicone tubing in the pump, compounds leached from the pump tubing may contaminate the sample. The Dow Corning “medical grade” Silastic brand silicone rubber tubing Isco supplies for the Portable Pump will **not** contribute any organic material to the sample.

3.2.2 Inspect Pump Tubing Regularly

The silicone rubber pump tubing is reliable and long-lived. However, because of the constant mechanical strain placed on the tubing by the peristaltic action of the pump, it will eventually fatigue and fail. Remove the outer pump housing from time to time and inspect the tubing for wear. Replace it with the spare pump tube or with a new pump tube when necessary. Additional pump tubing sections are available from Isco. Note that since the amount of tubing (13½ inches) actually used in the pump is less than half the total length of the pump tube (33 inches), sometimes you can use the tube twice in the pump by just turning it around. This is possible, of course, only if the used portion of the tube has not split or otherwise deteriorated to the point of leaking.

 **WARNING**

Always disconnect the battery (or other power source) before opening the pump housing to service the tubing. Your hands could be seriously injured if the pump starts and the rollers catch your fingers.

3.2.3 Removal of Pump Tubing

To remove the pump tube, remove the outer pump housing by loosening the four thumb screws. This will expose the pump tubing, which is squeezed between the pump rollers and the curved surface of the inner pump housing. Extract the tubing and the pump tubing guide and clamp assemblies from the inner housing. Loosen and remove both pump tubing guide and clamp assemblies from the pump and distribution tube. Remove the intake line, if attached. This completes the removal of the old pump tube.

3.2.4 Tubing Reinstallation

To install the new pump tube, first reinstall the intake line. Replace and tighten the pump tubing guide and clamp assemblies. Be sure the pump tubing guide and clamp assembly at the outlet end of the pump tubing are positioned at the edge of the black band on the pump tube. The edge of the black band is located 13½ inches (34.3 cm) from the inlet end of the pump tube and is used for placement of the outlet pump tubing guide and clamp assembly. This placement is critical for prolonging the life of the pump tube and to assure efficient operation.

Install the pump tubing as described in Section 2.3.

3.2.5 Seating the New Pump Tubing

To maximize tubing life and pumping efficiency, it is important to maintain 13 to 13½ inches of tubing inside the pump. This is normally done by carefully following the above instructions and correctly positioning the black band on the pump tube. However, as a final check, do the following: After installing the new pump tube, loosen the clamp on the left side (outlet) of the pump. Replace the outer pump housing. Place the PUMP CONTROL switch in the ⇒ RUN (clockwise) position, and let the pump run briefly, allowing the tubing to “seek” correct positioning. While the pump is still running, retighten the top clamp. The pump tube placement should now be correct.

3.3 Replacement of the Intake Tubing

You will eventually have to replace the intake tubing for several reasons. The intake tubing will wear out, crack, or become contaminated. In cases of critical sampling, you may have to replace the intake line between sampling programs to avoid cross-contamination. It may be necessary to replace the intake line with a different line, when changing sampling sites.

In either case, inspect the intake line periodically for damage. Clean the intake line and the remainder of the pump tubing system as EPA regulations require, according to the type of sampling.

The 3/8-inch ID polyethylene tubing is available from Isco in lengths of 10 and 25 feet. If a stainless steel strainer was ordered with the polyethylene intake line, it will be attached to the line at the factory.

The 3/8-inch ID Teflon-lined polyethylene tubing is available from Isco in lengths of 10 and 25 feet. If a stainless steel strainer was ordered with the “Teflon” intake line, it will be attached to the line at the factory.

Replacement vinyl intake lines are available from Isco in two forms. First, a complete intake line, with weighted strainer, is available in 10 foot and 25 foot lengths for $\frac{3}{8}$ -inch ID vinyl suction tubes. Second, bulk suction tube in $\frac{3}{8}$ -inch ID vinyl tube is available in 100, 500, and 1000 foot rolls.

The following paragraphs describe replacement of the complete intake line-strainer assemblies, sizing of the intake line, and the use of the bulk tubing.

3.3.1 $\frac{3}{8}$ -inch ID Vinyl Intake Line

Loosen the guide and clamp assembly, and slip it up the pump tube to expose the connection between the intake line and pump tube. Finally, pull the intake line out of the pump tube.

Using Bulk Tubing – If you wish to use bulk suction tubing, it is necessary to disassemble the old intake line. Remove the small stainless steel ferrule from the end of the intake line by slitting the tubing with a knife. This ferrule prevents the collapse of the pump and suction tubing when you tighten the pump tubing guide and clamp assembly. Remove the strainer (if present) and hose clamp from the other end of the intake line. Cut the new suction tube to the desired length, and force the stainless steel ferrule into the end of the suction tube until the ends are flush.

Install the strainer on the opposite end of the suction tube and tighten the hose clamp.

Shortening a Line – If you want to shorten an existing intake line, first remove the strainer (if used) by unscrewing the threads. Shorten the intake line to a length of 10 feet by cutting it with a sharp knife. Reinstall the strainer by heating the end of the suction line and screwing the threaded connector into it. You can install the shortened intake line in the pump as previously-described.

3.3.2 $\frac{3}{8}$ -inch ID Teflon and Polyethylene Intake Line

Loosen the pump inlet tubing guide and clamp assembly, and slip it up the pump tube to expose the junction between the intake line and pump tube. Finally, pull the intake line out of the pump tube.

If you want to shorten an existing intake line, follow the instructions for shortening a line as described above in Section 3.3.1.

3.4 Nickel-Cadmium Battery Pack

A standard Isco Nickel-Cadmium Battery Pack is the typical power source for the Portable Pump. A nickel-cadmium battery offers advantages over other batteries, particularly lead-acid batteries. The number of charge/discharge cycles is high: as many as 1,000. These batteries can remain discharged indefinitely, even at very low temperatures, without damage. With properly regulated charging current, you can charge them for extended periods without damage. The battery has an internal fuse rated at approximately 50 amperes, which prevents the possibility of fire or burns in case of a short circuit.

 **CAUTION**

Do not test these batteries for charge by “sparking the output,” and be extremely careful putting voltmeter probes into the output connector. Any accidents which result in a shorted output will damage the battery in less than three seconds.

If the internal fuse link opens, you will have to disassemble the battery to repair the fuse. Refer to Section 3.5.2 for details.

3.4.1 Charging

Recharge the nickel-cadmium battery with an Isco Power Pack, or an Isco Battery Charger. Either of these provides the proper charging current to the battery. Isco does not recommend the use of chargers designed for lead-acid batteries, such as automotive battery chargers. The open-circuit voltage of lead-acid battery chargers is generally not high enough to fully charge a nickel-cadmium battery. To charge the battery, connect the plug on the battery cable to the mating receptacle on the power pack or to the connector on the battery charger.

Five Station Charger – If you need to maintain a number of nickel-cadmium batteries, Isco offers the Five-Station Battery Charger. You can charge as many as five nickel-cadmium battery packs simultaneously. The Five-Station Battery Charger operates from the 120 VAC line and delivers five separate 400 mA current-limited outputs for charging.

Determining Charge – Because the battery will show an almost constant output voltage regardless of state-of-charge, voltage measurements are of no value. Isco recommends charging the nickel-cadmium battery for 15 to 18 hours. You can achieve the 15-hour interval by putting the battery on charge before leaving work in the evening. It should be nearly charged by 8:00 AM the next morning. (5:00 PM to 8:00 AM is 15 hours.) While charging, the battery will stay cool to the touch. When fully charged, the battery will feel warm as the charging current will dissipate as heat. Discontinue charging when the battery feels warm.

Self-Discharge Characteristic – After charging, return the battery to service within a reasonable period of time (one to two weeks) to ensure availability of most of the battery’s capacity. Nickel-cadmium batteries have a higher rate of self-discharge than most other batteries. Unlike some nonrechargeable “primary” batteries (such as alkalines), which can be stored for several years without losing charge, nickel-cadmium batteries will self-discharge completely in a matter of months, depending on storage temperature and other factors, such as age. A figure of as much as 1% per day (loss of remaining charge) has been reported.

This characteristic does not affect the life or useability of nickel-cadmium batteries, and it does not mean the batteries are bad. However, understand that the batteries will not last as long if charged but not used promptly. This self-discharge characteristic is worsened if you store the batteries in a hot place, such as

a room with a furnace, boiler, or water heater. The self-discharge characteristic also seems to worsen as the batteries age, due to the growth of crystalline filaments between the plates. If you have recharged a battery but are in doubt about how long it has been stored after charging, simply recharge it for a few hours before use.

3.4.2 Effects of Overcharging

Overcharging the battery causes it to overheat, gradually breaking down the separator material between the plates inside the cells. Repeated overcharging will reduce the useable life of the battery.

3.4.3 Non-Isco Battery Chargers

Isco does **not** recommend using other types of nickel-cadmium battery chargers. You could damage both battery and charger with incompatible equipment.

Chargers exist for “fast charge” nickel-cadmium batteries which deliver very high currents, charging the batteries in as little as one hour. However, these chargers are only useable with batteries specifically designed to take a fast charge. The cells used in Isco nickel-cadmium batteries are “standard” cells intended for charging at 400 mA for 15 to 18 hours. Chargers providing more current than this may cause overheating and venting of water. This water cannot be replaced, causing premature failure. Chargers that deliver too little current to the battery may never charge it completely, and could possibly sustain damage themselves.

Do not attempt use of any other equipment for the nickel-cadmium battery without an accurate digital multimeter to monitor the charging current. If the charger delivers more than 600 mA, Isco recommends you do not use it. The cells may vent. Overcharging shortens the life of the battery by deteriorating of the separator material used between the plates. If the charger provides less than 100 mA, the charging period becomes impractically long. Even then, the battery may never recharge completely. Be sure of proper polarity before connecting any other charging apparatus. If you use an Isco Power Pack, you can overcharge the battery occasionally with little loss of capacity. Avoid repeated overcharging. Again, use the battery pack promptly after recharging.

3.4.4 “Memory” Effects

It has long been believed that nickel-cadmium batteries exhibited “memory” effects, and that a complete charge/discharge cycle (exercising the battery) was necessary to maintain battery capacity. It is now known that the “memory” effect is not a problem under normal operating conditions. If it occurs, it is temporary and you can reverse it by a deep discharge and charge. If you discharge the battery to random depths, charge for random amounts of time, and subject the battery to various duty cycles, the “memory” effects will not be present.

3.5 Servicing the Nickel-Cadmium Battery Pack

The following sections explain how to replace the fuse and cables on the optional Nickel-Cadmium Battery Pack. Both these procedures can be done in the field.

However, some familiarity with electrical/electronic repair procedures is necessary. You must know how to solder, make proper splices, and insulate them safely. It is necessary to follow the color codes to make sure proper polarity is maintained on the battery after the repair. If you do not know how to do these things, or are not comfortable with doing them, return the battery to Isco for repair. If the fuse is all right and only the cable needs repair, Isco suggests making the repair when the battery is discharged. Accidentally shorting a charged battery while changing the cable could ruin the battery, cause burns or a fire, and could also result in serious personal injury.

3.5.1 Replacing the Battery Fuse

As mentioned, the battery has internal fusing to prevent damage to the cells if the output shorts. If the internal fuse link opens, it is field-replaceable. Remove the screws holding the battery cover. Lift the battery cover off the battery case to show the splices and the fuse link. The fuse is a two-inch length of 22 A.W.G. tinned copper wire; this wire is available from Isco, or you may purchase it locally. To replace the fuse, cut away the two splices and the spent fuse wire. Do not attempt reuse of whatever is left of the old fuse wire. Solder in a new link of 22-gauge wire approximately two to three inches long. Carefully insulate the exposed wire with electrical tape, shrink tubing, or similar material. Finally, replace the cover, taking care to locate the ferrule on the output cable between the bushing on the top of the battery case and the rib in the underside of the battery cover, and reinstall the four screws.

3.5.2 Replacing the Battery Cable

If the cable on the Nickel-Cadmium Battery Pack is damaged, you can replace it as follows. Remove the screws holding the battery cover. Lift the cover off the case to reveal the cable connections. To make replacement easier, the cable connections to the internal cells are made outside the case. To replace the cable, cut away the old cable and splices, **one wire at a time**, and solder in a replacement.

Carefully insulate the exposed wires with electrical tape or other shrink tubing. Replace the cover, taking care to locate the ferrule on the cable between the bushing on the top of the case and the rib in the underside of the cover, and reinstall the screws.

CAUTION

When replacing a battery cable, be careful not to short the two leads from the battery together, or you may irreparably damage the battery and put yourself at risk of personal injury. Insulate splices carefully. Replace only one wire at a time.



Figure 3-1 Nickel-Cadmium Battery Pack Fuse Replacement

3.6 Lead-Acid Battery Pack

While the nickel-cadmium battery is generally used to power the PTP-150, the gelled-electrolyte Lead-Acid Battery Pack is also available. These batteries have different charging and operating characteristics from nickel-cadmium batteries. Please note the following:

- Do not run the pump until it discharges the battery completely; total discharge of gelled-electrolyte batteries may cause cell reversal, ruining the battery. One manufacturer has recommended 10.5 VDC (under load) as complete discharge of a 12-volt battery.
- Although it appears there is still much power left when the battery voltage drops to 10.5 VDC, there is, in fact, very little. Trying to use all remaining power from a battery will cause cell reversal. Reversal comes from minor manufacturing differences between the cells of a battery, which cause the cells to have unequal capacity. The first cell depleted will be reversed by the rest of the battery.
- Recharge the battery as soon as possible. Unlike nickel-cadmium batteries, lead-acid batteries left discharged for any period of time will not recharge to full capacity, and eventually will not accept or retain a charge at all.

- **Avoid use in subfreezing environments. A discharged battery can freeze in a cold environment, which will ruin it. The case may crack when frozen, releasing toxic materials.**
- Gelled-electrolyte batteries are easily damaged by overcharging; A six-ampere-hour battery should be charged by equipment that provides a constant voltage output of no more than **15 VDC** and a maximum initial charge current of **2 amperes** or less.
- The maximum number of charge-discharge cycles (moderate to deep discharge) is considerably lower than for a nickel-cadmium battery, typically fewer than 300. This compares with 500 to 1,000 for a nickel-cadmium battery.
- Charge retention is better for lead-acid batteries than for nickel-cadmium types. The battery will self-discharge to 50% of capacity in nine months to a year, when stored at room temperature (70°F [23°C]). At 100°F (38°C), this drops to three or four months. At 40°F (5°C), this period is well over a year. However, if a lead-acid battery does self-discharge completely, it will usually be ruined, due to sulfation of the plates.
- The voltage available from a lead-acid battery declines as the battery discharges, due to an increase in electrolyte resistance. Available voltage will decline gradually from approximately 12.5 at full charge to 10.5 at total discharge (under load). Nickel-cadmium batteries show essentially constant voltage across the entire range.

3.6.1 Use Proper Charging Equipment

The use of other types of battery chargers - even those intended for “wet cell” lead-acid batteries - may seriously overcharge these batteries, ruining them. Proper charging is done with a constant voltage – tapered current technique, rather than by the constant current method used by nickel-cadmium chargers. If you use an Isco Power Pack, monitor the charging voltage with a reliable digital voltmeter and discontinue charging when the meter reads **14.5 to 15 VDC**. Do not allow these batteries to charge unsupervised or for an extended time period. You can use the table printed on the battery case for a rough guide.

Charging time estimates are not reliable for these batteries. Charging the battery until it “feels warm” is not a reliable indicator with lead-acid batteries, as you may already have seriously overcharged them. Overcharging forces the battery to vent water, which is not replaceable.

Attaching the Battery – If you wish to use batteries that cannot be put inside the case, use the optional battery cable. Plug the M/S connector on one end of the cable into the 12 VDC connector on the side of the flow meter. Connect the positive and negative clips on the other end of the cable to the positive and negative terminals of the battery. The positive lead of the cable is painted red.

Use of corrosion-inhibiting felt washers on the battery terminals will reduce the effects of battery acid migration on the connections and the cable. (These are available from any auto parts supply house.)

Hazard of Short-Circuits – As advised previously for the nickel-cadmium battery, do not check the charge condition of lead-acid or gelled-electrolyte batteries by “sparking” the output cables (momentarily shorting the wires together). These batteries, when fully charged, can deliver enormous amounts of current into a short-circuit fault, particularly if the short is close to the battery. It is possible for cables shorted momentarily to “weld.” This will immediately cause the melting and burning of the wire insulation, if it is made of thermoplastic. **Fire, severe burns to the hands, and the release of toxic fumes are all possible from such a mishap.**

 **CAUTION**

If any power source other than an Isco battery or power pack is used, **be sure of proper voltage and polarity** before connecting to the Portable Pump.

Never attach the Portable Pump to a power source of unknown polarity or voltage. **Never** attach the Portable Pump directly to an AC power source under any circumstances, regardless of voltage.

If in doubt, check with a reliable DC voltmeter. Failure to observe this warning could damage the Portable Pump and possibly create a fire or shock hazard.

3.7 Portable Pump Circuit Description

The purpose of the electronics is to control the speed and direction of the pump motor. Quad op amp U1 provides several control functions for the rest of the circuit. The op amp connected to R12 and C4 is a triangle wave generator which provides a ramp for the comparator formed by the op amp connected to R9. The setting of the Pump Speed potentiometer determines the point at which this comparator switches. The switch point determines the width of the pulse applied to the gates of the drive transistors Q1 through Q3. The width of the pulse determines the speed of the motor.

Transistors Q1 through Q3, power MOSFETS, provide the current pulses to drive the motor. They are connected in parallel to increase their power handling capability. Relays K1 and K2 reverse the polarity of the motor, which makes it reverse direction. The two remaining op amps provide compensation for declining battery voltage to keep the pump speed constant for a given setting. They also provide a “low limit” to the speed control switch to prevent the pump motor from stalling at very low speeds. Note, however, that if the battery voltage drops low enough, the pump will stall regardless of compensation. When the Function switch is in the External Control position, the pump will run in the ⇒ RUN (clockwise) mode. A remote contact closure stops the pump.

3.7.1 Replacement of the Fuse

There is an 8-ampere slow-blow fuse in an in-line fuse holder located inside the case. If the fuse blows, replace it by first removing the six screws holding the PTP-150 front panel. Lift out the front panel and locate the fuse holder. Open the fuse holder by separating the two sections with a twisting motion.

Remove the blown fuse and insert a new 8-ampere slow-blow fuse in the holder. Reassemble the PTP-150. If the fuse blows again, there may be a serious problem. Check to make sure the pump mechanism is not jammed or stalled. Check the motor and the electronics. If you still can't find the problem, contact the factory.

A list of common replacement parts for the Portable Pump is located in Table A-1. When ordering a replacement part, be sure to include the Isco assembly or part number, a complete description, and the serial number of the unit on which the part is to be used. The serial number can be found on the tag fastened to the side of the pump case.

PTP-150 Portable Pump

Appendix A Replacement Parts List

Table A-1 contains a listing of replacement parts for the PTP-150 Portable Pump.

Table A-1 Replacement Parts List		
Complete Assembly	Individual Parts	Description
60-3004-067		Accessory Pkg - Portable Pump
60-3004-122		Gear Assembly - Portable Pump
	60-1684-067	Pittman Motor and Gear Assembly SS
	60-1684-068	Gear Shaft Assy - SS
	60-3004-125	P.P. Motor Mtg. Plate Assy.
	60-3004-126	P. P. Back Gear Plate Assembly
	60-2103-011	Motor Mounting Spacer
	60-1683-085	Pump Assy Standoff
	60-2703-058	Pump Shaft Spacer
	60-3004-127	Pump Shaft Assy - Portable Pump
	60-2703-037	Pump Shaft Spacer Plate
	60-3703-012	Pump Housing Bushing (Used in 2 Places)
	60-2703-044	Pump Housing Thumbscrew
	231-9145-12	Self-Sealing Screw 8-32 x 3/4" - SST
	60-2704-019	Pump Rotor Assy
	60-4654-006	Pump Housing Assembly - Inside
	60-4654-007	Pump Housing Assembly - Outside
	232-9161-01	SST Elastic Stop Nut 10 - 32
	231-0147-12	SST MS10-32 x 3/4" - PH
	202-1003-34	O-ring #334 - Buna - N
	60-2744-011	Pump Tubing Assy - 44"
	60-2704-011	Tubing Clamp Assy
60-4654-009		Wiring Harness - Connectors
	140-1002-01	Bendix Panel Mt. #MS3102R-10SL-4P
	141-1004-00	AMP Panel Mount Receptacle 4-Cont.
	149-1000-01	Dust Cover AMP #11 Shell #206903-1
	60-1393-082	Seal Gasket for AMP 2-Pin

Table A-1 Replacement Parts List (Continued)		
Complete Assembly	Individual Parts	Description
	60-4653-005	Seal Gasket for AMP 4-Pin
60-4654-011		Wiring Harness - Controls
	60-4653-012	Pot 20K 2W
	410-2810-00	Rotary Switch 3-Pole 4-Pos.
	202-1000-36	O-ring .364 x .035 - Buna - N 70 Duro.
	180-0232-00	Knob with Pointer
	090-1004-03	
	489-0001-00	Nylon Cable Clamp 3/16"
	231-0194-10	SST MS 6-32 x 5/8" PH Self Seal
	60-4654-008	PCB Assy - Portable Pump
	232-9297-00	Rotary Shaft Seal 3/8 THD 1/4 SHT
	60-3003-348	
	60-3003-349	
	60-2703-119	3/8" ID Suction Tube - Vinyl - 10 feet
	60-2703-113	3/8" ID Suction Tube - Vinyl - 25 feet
	60-1683-146	3/8" ID x 10' Teflon Suction Tube
	60-2703-114	3/8" ID x 25' Teflon Suction Tube
	60-1684-110	Weighted Strainer-SST - 3/8"
	60-1394-070	Weighted Strainer 1/4"
	60-1394-071	Weighted Strainer 3/8"
	230-1999-01	Clamp Ideal 1/8" x 1/4"
	60-1393-128	1/4" Suction Line Ferrule
	60-1393-105	3/8" Suction Line Ferrule
	68-1680-058	100' 3/8" Bulk Suction Tube - Vinyl
	68-1680-059	500' 3/8" Bulk Suction Tube - Vinyl

Isco One Year Limited Factory Service Warranty *

Isco warrants covered products against failure due to faulty parts or workmanship for a period of one year (365 days) from their shipping date, or from the date of installation by an authorized Isco Service Engineer, as may be appropriate.

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

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

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

This warranty applies only to products sold under the Isco trademark and is made in lieu of any other warranty, written or expressed.

No items may be returned for warranty service without a return authorization number issued from Isco.

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

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

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

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

Return Authorization

A return authorization number must be issued prior to shipping. Following authorization, Isco will pay for surface transportation (excluding packing/crating) both ways for 30 days from the beginning of the warranty period. After 30 days, expense for warranty shipments will be the responsibility of the customer.

Shipping Address: Isco, Inc. - Attention Repair Service
4700 Superior Street
Lincoln NE 68504 USA

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

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

Fax: (402) 465-3001

Email: service@isco.com

