



## OPERATING INSTRUCTION MANUAL

# Mark 3XE Silver Recovery Unit



Hallmark Refining Corporation  
1016 Dale Lane  
PO Box 1446  
Mount Vernon, WA 98274  
Phone 360/428-5880  
Toll Free 800/255-1895  
Fax 360/424-8118  
[www.hallmarkrefining.com](http://www.hallmarkrefining.com)  
Revised October 2001

## **Statement of Warranty and Liability**

All equipment manufactured by Hallmark Refining Corporation is guaranteed against defects in material and workmanship for a period of six months from the date of shipment from the factory. Any claimed defects must be reported, and the materials and/or equipment must be returned, freight prepaid, to HRC within the guarantee period. HRC's liability for defects in material and workmanship shall be limited to replacing or repairing (at its option) such defective materials or equipment at no cost to the original purchaser. Any damage or loss occurring during shipment is not covered by the terms of this warranty. Any shipping damage is the responsibility of the carrier(s) and should be reported to the carrier(s) immediately.

All material and/or equipment furnished by other suppliers are not warranted by HRC and are covered by the suppliers warranty only for defects in material and workmanship. Transportation, handling damage, normal wear and tear and other damage outside the control of HRC are not covered by this warranty. Under no circumstances will HRC be responsible for any of the following: damage, loss or liability of any nature arising out of the installation and/or use of the materials and/or use of equipment furnished.

There are no other warranties expressed or implied, except as stated above. This warranty becomes null and void if any devices or accessories other than those distributed or officially recommended by HRC are installed, attached or used in conjunction with this equipment.

## Table of Contents

Statement of Warranty and Liability .....	2
An Introduction to Silver Recovery .....	4
Installation of the Mark 3XE Silver Recovery Unit .....	5
Silver Testing .....	8
Silver Testing Procedure.....	8
Changing a Column on the Silver Recovery Unit .....	9
Changing a Column is as easy as 1 – 2 – 3 !.....	11
Operation of the Mark 3XE Silver Recovery System.....	12
Float Switch Assembly in the Mark 3XE Silver Recovery Unit .....	12
Calibration of the Pump .....	12
Adjusting the Stroke Rate of the Effluent Flow.....	13
Poppet Valves.....	14
Priming the Pump .....	15
Mark 3XE Silver Recovery Unit Troubleshooting Guide.....	16
Parts List for the Mark 3XE Silver Recovery Unit .....	18
Wiring Schematic for the Mark 3XE Control Box.....	19
Specifications for the Mark 3XE Silver Recovery Unit.....	20

## Illustrations

Illustration 1: Hook up Configuration of the Mark 3XE Silver Recovery Unit .....	7
Illustration 2: Changing a Mark 3X Column on the Mark 3XE SRU.....	10
Illustration 3: The Mark 3XE Float Switch Assembly .....	12
Illustration 4: Calibrating the Pump on the Mark 3XE SRU .....	13
Illustration 5: Orientation of the GRI Pump Poppet Valves and O-Rings.....	14
Illustration 6: Wiring Schematic for the Mark 3XE SRU.....	19

## An Introduction to Silver Recovery

Silver recovery has become an increasingly important concern for photo labs as the local discharge limits for silver have become stricter. Properly maintained silver recovery systems can achieve most of these strict requirements and may even be a source of income. Proper operation and maintenance are vital to achieving both environmental and economic goals.

The images created on photographic films and papers are captured by exposure to silver halide. When these films and papers pass through their respective chemical processes, most of the silver is dissolved into one or more chemical solutions. These solutions are called Fixer for film and Bleach-Fix for paper, and in some processes a Stabilizer Rinse may be used that will contain silver. As the Fixer or Bleach-Fix removes silver, active ingredients are used up. Automated processing machines replenish these chemicals automatically. Excess chemistry, containing silver, overflows into waste holding tanks, which should be transferred to the Silver Recovery Unit or they may overflow directly into the Silver Recovery Unit.

As films and papers travel through these solutions, they carry chemicals from one step to the next. This means that any chemical step downstream from the Fixer or Bleach-Fix may also contain silver in its overflow. These will need to be treated if they contain silver above the local limit.

With today's heightened environmental concerns, most sewage agencies regard silver as a hazardous material. Silver bearing chemicals must be treated to remove the silver before the chemicals may be disposed. There are several ways to treat waste chemicals. The Mark 3XE Silver Recovery System is designed to de-silver silver bearing waste solutions on site. The level of silver that can remain in the disposed chemicals varies from location to location, but generally must fall below 5 parts per million (5 ppm). Many agencies however, require an even lower level of silver in a waste destined for sewer disposal.

The Mark 3XE Silver Recovery System will reduce the level of silver consistently to below 5 ppm when maintained and operated properly.

**Hallmark Refining recommends that all photofinishing labs comply with the laws governing the disposal of hazardous materials for their operation.**

## Installation of the Mark 3XE Silver Recovery Unit

- Pump Station
- Operation Manual
- Containment Cart
- Plumbing Kit containing:
  - (1) Sample Valve Assembly
  - (4) 5/8" Poly Elbows
  - (8) Large Stainless Steel Clamps
  - (4) Casters
  - 10' 5/8" Clear Tubing
  - 2' 3/8" Clear Tubing with Adapter
- Two Mark 3X Silver Recovery Columns with Shipping Information

### Tools Required:

- 1 Slotted Screwdriver
  - 1 Phillips Screwdriver
  - Channel Locks or Pliers
- 1) Remove the pump station from its box. Open the small box containing the plumbing kit and locate the casters and self-tapping screws. Install the casters on the bottom of the containment tray. Place the pump station inside the tray, on the left.
  - 2) Remove the columns from their boxes and the plugs from the top of the columns. Some air may escape when the plugs are removed. This is normal. Replace the plugs with the teflon tape wrapped 5/8" poly elbows from the plumbing kit. These inserts must be screwed in snugly to prevent leaking. One rotation with the channel locks or pliers after finger tightening should be adequate. Place the columns inside the containment tray, on the right. Be careful not to bump the side of the holding tank with the columns.
  - 3) Connect the pump station to the "in" of the first column using the pre-assembled section of tubing provided and a large hose clamp. Tighten the hose clamp over, not behind, the barbs of the 5/8" poly elbow.

- 4) Connect the two columns together using the pre-assembled sample valve assembly and large hose clamps. The “out” of the first column should lead into the “in” of the second column.
- 5) Attach a length of 5/8” tubing from the outlet elbow of the secondary column to the outflow and secure it with the remaining hose clamp. This tubing needs to be long enough to reach the drain with a loop in it between the drain and the second column. (See Illustration 1)
- 6) From inside the tank, remove the rubberbands used to immobilize the float switches during shipping.  
**If the system is plugged in, the alarm will beep continuously until the top float switch rubberband is removed!**  
**When the system is turned on, the system will run continuously until the bottom float switch rubberband is removed! This will significantly reduce the life span of the pump.**
- 7) Check to be sure that all hose fittings and elbows have been securely tightened, but not over tightened. Plug the system into an uninterrupted source of power, preferably with a GFI Outlet.
- 8) Fill the holding tank of the pump station with water to test the system for leaks. **For optimal silver recovery, both columns must be filled with water prior to the introduction of silver bearing waste. Water can be pumped through the columns from the holding tank or be manually poured into the inlet of the column.**
- 9) The system is now ready for pour-in operation. If the system is to be direct plumbed from the processor, remove one of the plugs from the rear of the system tank and install a 5/8” polyethylene elbow. The most common connection would be to 5/8” tubing and would utilize a large barbed elbow (part number 510-065), and a large stainless steel hose clamp.



**The Hallmark Mark 3XE Silver Recovery Unit should be located near an outlet and be easily accessible. The use of extension cords is not recommended.**



**Illustration 1: Hook up Configuration of the Mark 3XE Silver Recovery Unit**

## Silver Testing

Environmental issues are important in the everyday operations of one hour photo labs. The Environmental Protection Agency classifies the photographic waste above 5 ppm of silver as hazardous. Many states have strict guidelines for dumping chemical waste down the drain. The Mark 3XE Silver Recovery Unit has been installed to meet these guidelines. Recovering the silver is safe, profitable and simple if the instructions for using the Mark 3XE Silver Recovery Unit are followed.

### Silver Testing Procedure

#### Materials:

Silver test paper (Part Number 112-001) is available through Hallmark Refining. Please call 800/255-1895 to order.

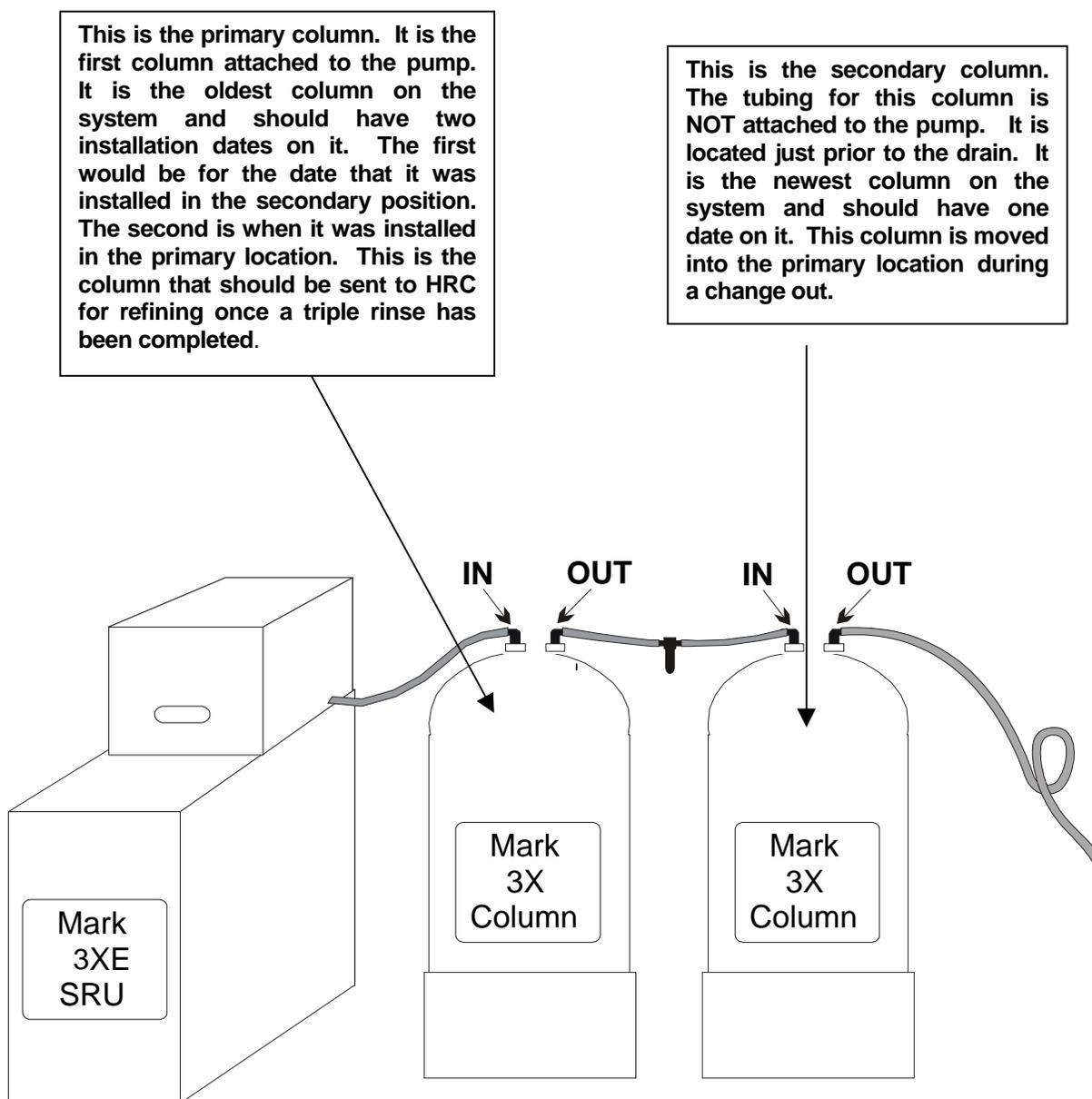
#### Procedure:

Test the silver recovery unit during weekly maintenance. When ANY color change is detected, remove the first column, replace it with the second column and place the new column in the secondary position, closest to the drain.

- 1) While the unit is pumping, place a container under the sample valve and obtain a small sample. Do this three times, pouring the chemistry back into the holding tank each time until the third sample. The first two will not give an accurate reading, so it is necessary to use the third sample.
- 2) Tear off approximately two inches of the silver test paper and dip it halfway into the sample solution for 5 seconds.
- 3) Rinse the strip under slowly running water for 30 seconds. The silver will not rinse off. The color of the silver bearing waste must be removed to get an accurate reading.
- 4) Blot the strip dry with a paper towel.
- 5) If the strip is **not** yellow, it is time to change the column. ANY brown color is an indicator that it is time to change the silver recovery column. To order a new Mark 3X Column, call Hallmark Refining at 800/255-1895.

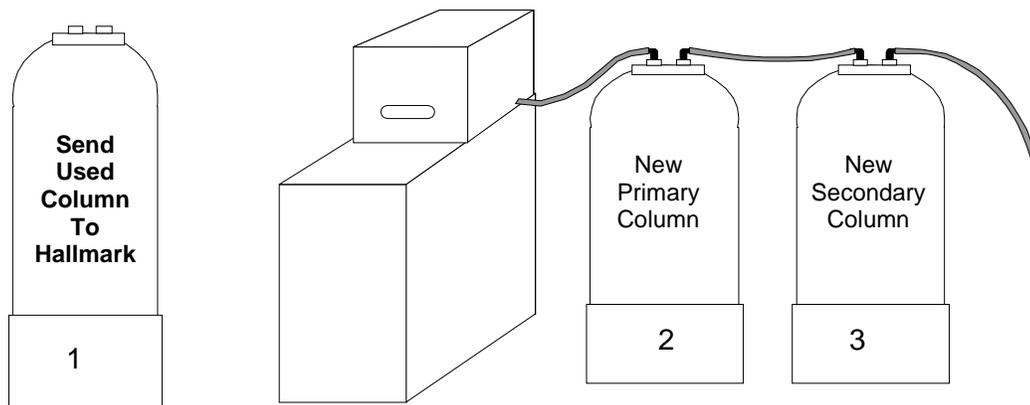
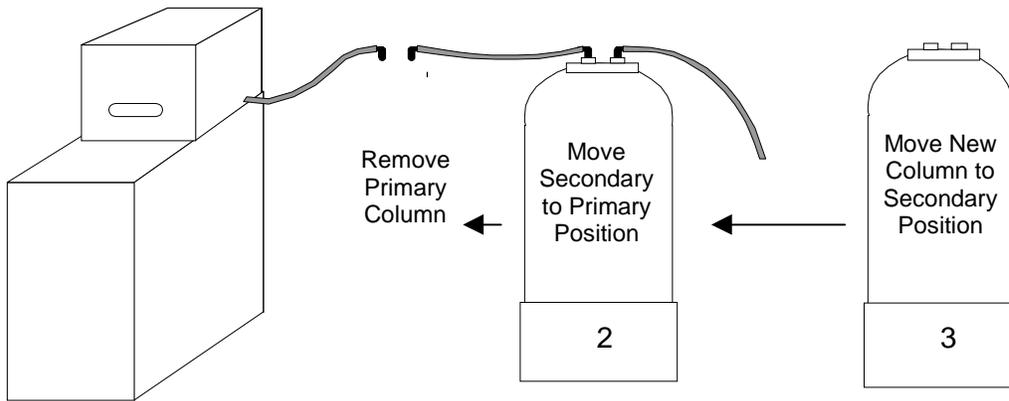
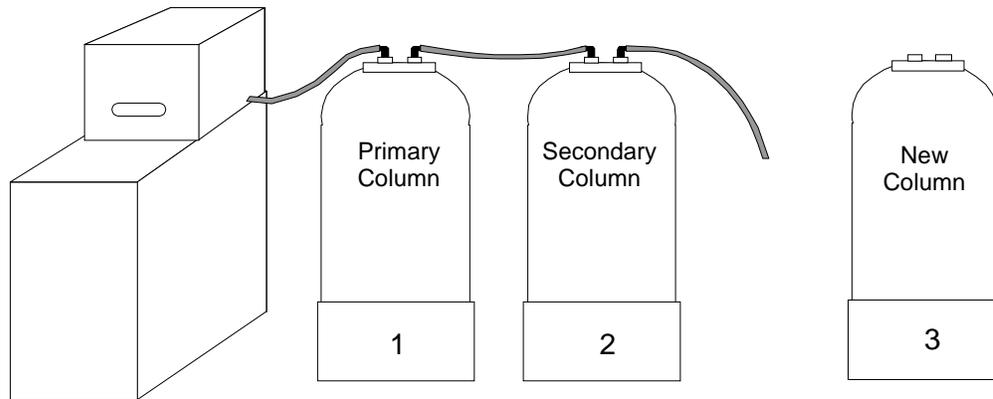
## Changing a Column on the Silver Recovery Unit

1. When it is time to change a column on the silver recovery unit, the column being removed will need to be rinsed with clean water before removal to comply with EPA (Environmental Protection Agency) and DOT (Department of Transportation) laws. Failure to rinse the column prior to removal could result in a fine for the improper shipment of “hazardous waste”.
2. Fill the holding tank of the Mark 3XE Silver Recovery Unit with cold tap water and allow it to be pumped through the system. This must be done at a slow rate (approximately 63 mL/min. or the equivalent of 1 gal/hr) to prevent flushing the silver out of the column. The goal is to “rinse” the contents of the column, but not to flush the contents out of the column. This step should be repeated three times. Washing can stop when no color change is detected in silver estimating paper used to sample the effluent from the column. To be certain that no soluble silver is present, allow the cartridge to stand overnight and then test a sample of the solution. If silver is present, repeat the washing step until no visible silver is present when tested.
3. After completing the rinse step, remove the primary column and slide the secondary column into the primary position. Install a new column in the secondary position (closest to the drain) and reinstall the elbows, tubing and hose clamps. Be certain the elbows have sufficient teflon tape.
4. The rinsed column can now be capped with the plugs from the replacement column and packaged for shipment.
5. Fill the holding tank with water and allow the water to pump through the system before filling the tank with additional silver bearing waste. Alternatively, the new column being installed into the secondary position may be manually filled with 3 gallons (11 Liters) of water. The columns work most effectively when they are filled with water before processing silver.



**Illustration 2: Changing a Mark 3X Column on the Mark 3XE SRU**

**Changing a Column is as easy as 1 – 2 – 3 !**



## Operation of the Mark 3XE Silver Recovery System

### Float Switch Assembly in the Mark 3XE Silver Recovery Unit

Both the “Alarm” and “On-Off” float switches operate in a “normally open” mode. That is, in the absence of liquid to raise the float, the circuit is “open”. Once the switch “closes”, the circuit is closed, and causes either the pump to turn on or the alarm to sound, depending on which switch is activated by a rising level of solution.



Illustration 3: The Mark 3XE Float Switch Assembly

### Calibration of the Pump

The pump is factory calibrated to pump 100mL/min. This is the optimal speed of the pump for efficient silver recovery. Quicker speed will not allow the proper reaction and dwell time required to remove the silver from solution.

The calibration of the pump can be determined by doing a pump output test.

1. Turn the system off.
2. Disconnect the tube from the “in” elbow of the primary column. Place the tube in a graduated cylinder (beaker).
3. Turn the system on. When the first drop of liquid enters the cylinder, start timing the output for one minute and immediately turn the system off.
4. The output should be 63 milliliters/minute for a Mark 3X Column. If it is not within 20% of this recommended flow rate, call Hallmark Refining at 1-800-255-1895 and ask for a technician to assist you or refer to the troubleshooting guide for additional information.

## Adjusting the Stroke Rate of the Effluent Flow

If the flow rate of the effluent is too high or low, it can be adjusted by following the procedure outlined below:



**Before adjusting the bellows stroke length, always disconnect the electrical power from the Silver Recovery Unit. Toggle the power switch on the front panel of the unit to turn the system OFF.**

1. Turn the unit off and disconnect the electrical power.
2. With a screwdriver, turn the bellows stroke adjustment screw clockwise to increase the flow rate and counter-clockwise to decrease the flow rate to the proper output. Do this in small increments and repeat the calibration procedure above.
3. Depending on the position of the adjustment screw on the crankshaft, the pump motor may need to be “bumped” to rotate the screw to a more accessible position. Manually rotate the crankshaft to a more accessible position so the stroke rate can be adjusted.
4. Reconnect the electrical power. Measure the new flow rate using the procedure outlined in the calibration procedure. When calibrating the effluent rate, several adjustments may need to be made to fine-tune the flow rate.



**Illustration 4: Calibrating the Pump on the Mark 3XE SRU**

## Poppet Valves

Poppet valves open and close to allow liquid to flow one way in the hoses. For this reason, the point of the poppet valve **must** point toward the source of the liquid.

**If the gaskets of the poppet valves are not properly seated or the cone is twisted and not able to open and close freely, slow pumping or no liquid movement will be experienced. If this is a continuous problem, check the rest of the system for blockage.**

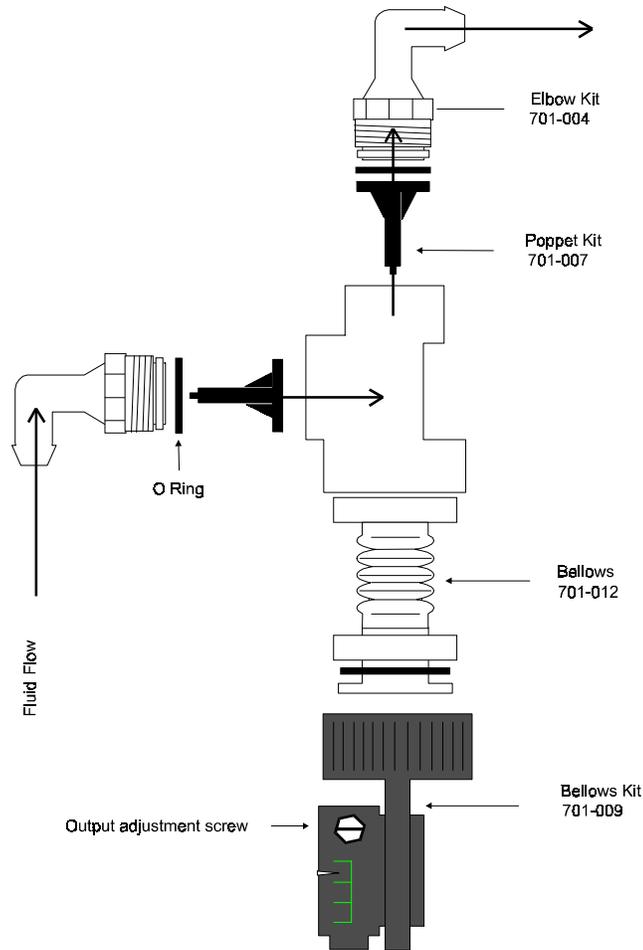


Illustration 5: Orientation of the GRI Pump Poppet Valves and O-Rings

## Priming the Pump

1. Turn off the power to the Mark 3XE Silver Recovery Unit.
2. Disconnect the hose clamp and hose attached to the “in” on the primary column.
3. Remove the clear elbow on the top of the pump so that the top poppet valve is accessible.
4. Remove the O-Ring and the poppet valve.
5. Fill the reservoir (bellows) with water until it slightly spills over. Inspect the poppet and O-Ring to ensure they are in good working order.
6. Re-install the poppet (point down) and then the O-Ring. Screw the elbow back on hand tight. Refer to Illustration 4 for the orientation of the poppet valves.
7. Be certain there are enough chemicals in the holding tank to cover the bottom float switch.
8. Have a container ready to catch the liquid that will come out of the pump and tubing still detached from the column.
9. Turn on the power to the Mark 3XE Silver Recovery Unit.
10. After 20-30 seconds, liquid should begin to flow through the pump.
11. Give the pump a few minutes to regain its prime before reconnecting it to the column.

## Mark 3XE Silver Recovery Unit Troubleshooting Guide

<p>The pump has no power.</p>	<ul style="list-style-type: none"> <li>• Check the power source. Is it plugged in? If not, plug it in or turn the rocker switch to the on position.</li> <li>• Is the fuse blown? Check the fuse. Replace it if necessary.</li> <li>• Check the float switch in the holding tank. Does the bottom float switch turn the pump on when it is lifted? If not, a new float switch may be needed.</li> <li>• Was it whining or humming when it stopped? If so, the motor is burned out.</li> </ul>
<p>The pump is running, but the solution is moving very slowly.</p>	<ul style="list-style-type: none"> <li>• Is the filter clean? See instructions below.</li> <li>• Has a pump output test been done? Disconnect the tube from the in valve of the first column. Place the tube in a graduated cylinder. When the first drop of liquid enters the cylinder, start timing the output for 1 minute. Turn off the system after 1 minute. The output should be 100 mL/min for a Mark 3X Column. If it is less than recommended, then do the following: Check and clean the pick-up screen in the holding tank. Inspect the poppet valves. Make certain they are properly seated in their gaskets and the O-Rings are present and correctly placed. Inspect the bellows (accordion part). Is it stretched? Is it pumping straight up and down? Is the O-Ring at the top present?</li> </ul>
<p>The pump is running, but the chemistry level in the holding tank is not dropping.</p>	<ul style="list-style-type: none"> <li>• Is the filter in the holding tank clogged? Reach in the tank and slowly pull up the hose. The filter is attached to the end of the hose. Clean the filter with a toothbrush, soap and water. Make sure there is no debris in the tank.</li> <li>• Has the pump been primed? Disconnect the hose from the first column and insert a turkey baster into the hose. Turn the system on and hand pump the baster until the liquid level rises into the first tube from the holding tank. Allow the solution to pass into the pump and out of the hose for two minutes. Perform a pump output test to check the pump performance. See instructions above.</li> <li>• Are the poppet valves in the right direction? See Illustration 4. Are the O-Rings in properly?</li> <li>• Is the bellows (plastic accordion part) warped or leaking? It may need to be replaced. The bellows tends to warp when pumping against a blockage. Make sure the blockage is removed before the new bellows is installed.</li> </ul>

<p>The system is leaking.</p>	<ul style="list-style-type: none"><li>• Are the elbows on top of the columns wrapped with Teflon tape?</li><li>• Is there a hole in the bellows? (plastic accordion part)</li><li>• Are all the O-Rings on the pump present?</li><li>• Are the elbows on the top of the columns cracked?</li><li>• Are the columns expired?</li><li>• Is the 5/8" tube leading to the drain blocked or clogged?</li></ul>
<p>The system won't stop beeping.</p>	<ul style="list-style-type: none"><li>• Was the holding tank over filled? Look inside of the holding tank and see if the liquid is above the top float switch. If it is, the tank is too full. The alarm can be turned off at the control box, but it must be turned back on as soon as the liquid level drops below the top float switch.</li></ul>
<p>The system runs 24 hours and never turns off.</p>	<ul style="list-style-type: none"><li>• There may be something under or around the bottom float switch that will not allow the system to shut off.</li><li>• Check the float switch for a sediment build up.</li><li>• Has the rubberband been removed from the bottom float switch?</li><li>• Has the float switch been installed upside down?</li></ul>

## Parts List for the Mark 3XE Silver Recovery Unit

<b>Part Number</b>	<b>Part Description</b>
732-002	On/Off Switch
722-364	Fuseholder/1.5 Amp Fuse
723-002	Fuse MDA – 1 ½ Slo Blo
915-019	Float Switch Assembly
524-001	Liquid Level Switch/Float Switch
520-002	Poly Pro Pick-Up Screen
601-003	3/8" Cord Grip
728-018	Power Cord
712-140	Digital Timer
704-001	Transformer
706-006	Relay
732-002	Tank Alarm On-Off Switch
730-001	Tank Alarm Buzzer
915-002	Sample Valve
241-001	Swivel Casters
510-065	5/8" Poly MPT Elbow
106-002	¼" Clear Tubing
106-006	5/8" Clear Tubing
106-003	3/8" Clear Tubing
522-005	Large Stainless Steel Hose Clamp
522-004	Small Stainless Steel Hose Clamp
514-035	3/8" x 5/8" Hose Adapter
701-002	GRI Bellows Metering Pump
701-007	GRI Poppets for 1" Bellows (2)
701-012	GRI 1" Bellows
701-009	GRI 1" Bellows Kit
701-004	GRI 3/8" Elbow Connectors (2)
700-191	GRI 1/2" Pump Head
700-193	GRI 1/2" Elbow Fitting
700-195	GRI 1/2" Connector for Elbow Fitting
906-218	Plastic Beaker, 250 mLs
512-065	1/2" NPT Male Fitting

## Wiring Schematic for the Mark 3XE Control Box

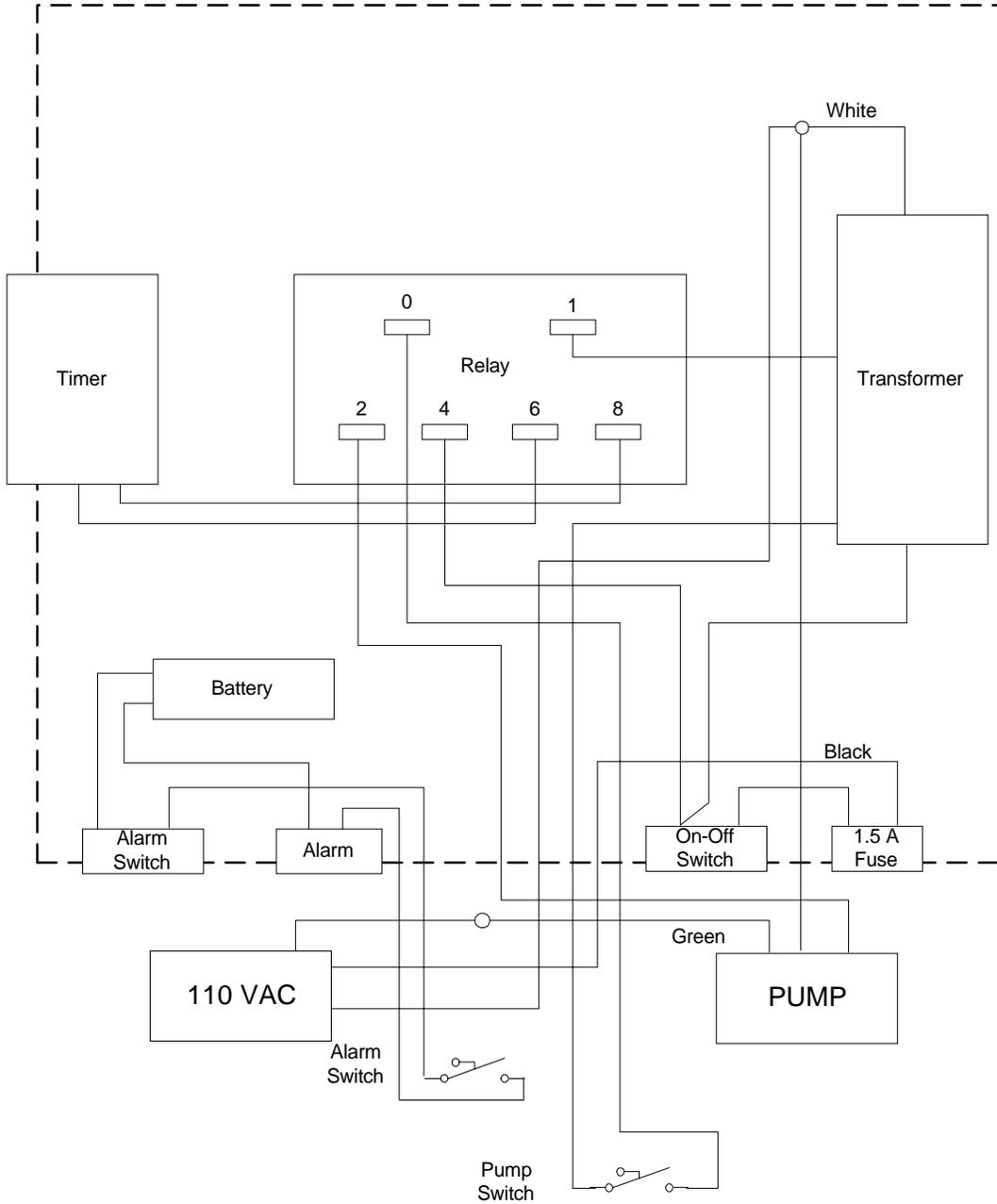


Illustration 6: Wiring Schematic for the Mark 3XE SRU

## Specifications for the Mark 3XE Silver Recovery Unit

Pump Station Size.....	18”L x 18”W x 26”H
Rollaround Containment.....	18”L x 18”W x 7”H
Column Weight (Dry).....	35 lbs.
Column Weight (Wet).....	65 lbs.
Power Requirements.....	115 VAC, 150 Watts
Collection Tank Capacity.....	9 Gallons/34 Liters
Processing Speed.....	1 gal/hr.
Pump Flow Rate.....	63 mL/min.
Column Potential (Primary).....	250 Gallons
Column Potential (Tailing).....	500 Gallons
Column Efficiency.....	1.0 ppm or less
Silver Return in Primary Application.....	Up to 50 Troy Ounces
Shipping Weight	60 lbs.