Hallmark Refining Corporation
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OPERATION AND INSTRUCTION MANUAL

SILVER RECOVERY SYSTEM

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Foreword

Congratulations on your purchase of a Hallmark Silver Recovery System, you are now the owner of a reliable method of silver recovery from waste photo processing chemistry. The most significant contaminant in photographic waste chemicals is silver. Hallmark Refining is a leader in the manufacture of equipment to recover silver from photographic processes. By treating your waste on site you will eliminate the need to dispose of these chemicals as hazardous waste.

Reducing waste at the source, or recycling usable material will benefit the Photo Processing industry. This in turn will reduce raw material cost, waste disposal cost and the potential liability associated with hazardous waste. Your purchase of this equipment exhibits your dedication and concern for the environment and your industry.

Hallmark Refining Corporation is dedicate to continuing to bring you products and services to minimize the impact of photographic process chemicals on the environment.

Thank you for choosing Hallmark as your silver recovery equipment supplier.

HRC Hallmark Refining Corporation®

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 equipment and furnished.

There are no other warranties expressed or implied, except at 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.

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1. THE ELECTROLYTIC SILVER PLATING PROCESS

The BFX 1000 is a fully automated batch silver recovery system for Photo Processors. It is intended for use in professional labs, in house labs or large mini-labs for the electrolytic plating of silver from process solutions. The BFX 1000 will plate silver from various combinations of C-41, E-6 fixer, RA-4 Bleach Fix and “Washless” stabilizers. The system may also be used for recovering silver from fixer in a recirculated, closed loop mode. The BFX 1000 treats twenty-five gallons per batch.

The tank assembly is the electrolytic cell for plating the silver in the spent process solution. A separate external tank is required for the collection of effluent to be processed for the next batch. The external collection must hold a minimum of 25 gallons, 50 gallons is recommended. The BFX 1000 includes two magnetic drive pumps; P-2 is dedicated to the transfer of silver bearing waste solutions into the electrolytic cell. The P-3 pump that transfers the treated solution to a secondary holding tank for final treatment in a CRC column silver trailing system. The BFX 1000 is constructed of a one half inch thick blue polypropylene tank material that is chemically inert to all photographic process chemicals. All tubing for installation is provided. The BFX 1000 is shipped completely assembled and ready for installation.

The BFX 1000 Provides is an automated system for plating silver from photographic waste and transferring the treated solution to the secondary holding tank for final treatment in the CRC column silver trailing system. The length of plating time and the plating current must be set once by the operator for the particular mix of silver bearing waste solutions involved. After the plating time is established it should remain the same for subsequent batches. The plating time and current value can be easily be adjusted at any time by the operator.

The BFX 1000 will shut off at the end of the set time cycle. The transfer pump then turns on and pumps the solution to the secondary holding tank final treatment in the CRC column silver trailing system. The unit is then ready for the next batch when the collection tank is full. Indicator lights on the control panel will verify when the BFX 1000 is activated. A manual override switch is provided.

2.

THE ELECTROLYTIC SILVER PLATING PROCESS

This silver recovery method applies a direct current across two electrodes in a silver bearing solution. Metallic silver deposits on the cathode. Sulfite and thiosulfate are oxidized on the anode.

Approximately 1 gram of sodium sulfite is oxidized for every gram of silver deposited. Considerable agitation and a large plating surface area can achieve good plating efficiency and the silver is 90-98 percent pure. The cathode is removed periodically, and the silver metal is removed. An electrolytic system should recovery about 90 percent of the recoverable silver.

Care must be taken to control the current density in the cell because high density can cause “sulfiding.” Sulfiding is the decomposition of thiosulfate into sulfite at the cathode, which contaminates the deposited silver and reduces recovery efficiency. The higher the silver concentration, the higher the current density can be without sulfiding.

The HRC ELECTRO Series of silver recovery systems are designed to utilize the maximum amount plating surface in the cell. The cathode is a stainless steel cylinder in continuous motion, during the plating process. This creates a high level of agitation and maximizes the silver yield.

GENERAL SPECIFICATIONS

BFX 1000 General Specifications

Average Recovery Capacity	2.0 Troy ounces per hour Dependent on silver content and type of solution.
Plating Range	0 to 45 Amps
Dimensions	40 inches wide x 21 inches deep x 45 inches high
Batch Size External Collection Tank Required:	25 Gallons 25-50 Gallons
Power Requirements	115 VAC, 20 Amps
Power Supply	115 VAC, 75 Amps
Net Weight	175 Pounds
Shipping Weight	222 Pounds

INSTALLATION

The unit is shipped pre-plumbed, complete with all fittings and required tubing. The electrical outlets and sockets are pre-wired at the factory, ready for fast and easy installation.

4.1 Unpacking the BFX 1000 Equipment

Remove the unit from the shipping container. Remove all packing and protective materials. Examine all the components for any obvious shipping damage and report it immediately to the carrier.

4.2 Site Planning and Preparation

Before you install the BFX 1000 recovery equipment consider the location carefully. The recovery equipment should be located so that the discharge lines from the process equipment can be connected to accumulation tank of the recovery unit as easily as possible. Consider using PVC pipe instead of tubing if the run is long. You must also consider the Mark 15 tailing system and the proximity to a drain for discharge to the sewer after the recovery process is completed. Setting the equipment on the floor to see how it will layout before final installation is a good starting place.

4.3 Final Placement

After you have determined the desired location, check the floor for level and adjust the BFX 1000 unit as necessary to a level operating position.

4.4 Assembly

Remove the top cell splash covers and check the cathode coupling bolts for secure operation. The cathode drive shaft must be installed in the drive coupling so the cathode does not rub on the cell tank or bottom.

4.4.1 Installation of discharge lines

Install the discharge tubing on the transfer pump marked “out” to the holding tank of the Mark 15 Tailing System. Install and secure hose clamps on these fittings.

4.4.2 Installation of Inlet Lines

Connect discharge lines from the processor(s) to the inlet of the BFX 1000 accumulation tank. Be sure to connect tank drains as well as overflow lines to silver recovery system. The drains going to the BFX 1000 must be ***silver bearing waste only***. (Fixers, Bleach/Fix and Stabilizers) It is the responsibility of the installer to provide any flow control or anti-siphoning devices required for the pump out of the unit.

4.4.3 Connecting The Power Supply

Check the control panel to insure that all switches are in the off position. Connect the

power cord of the BFX 1000 unit to a 115 VAC 50/60 Hz power source capable of delivering a minimum of 20 amperes. The BFX 1000 is now ready for operation.

5.

80 AMP POWER SUPPLY WITH DISTRIBUTION PANEL

5.1 Configuration and Computer Control

The 80 Amp power supply is normally connected to the distribution panel. The two units work together as an integrated system. Most of the sophisticated computer control and intelligence of the system is found in the distribution panel module.

The input buttons and display screen are physically located on the remote front panel. Much of the computer occurs in the distribution panel's computer.

The Batch Recovery Diagram on the following page shows the layout of the Collection Tank, Batch Tank, and Tailing Tank in the Hallmark processing unit. The computer in the power supply distribution panel detects the condition of the system switches that are used measure the level of liquids in the tanks. It also controls the pumps that transfer liquids from tank to tank and the pH adjustment liquid pump, and it controls the cathode rotor motor.

The following paragraphs give information on utilizing the Change Value (CV) routines. The keypad on the front of the power supply has a key marked Change Values that is used to scroll through each of the settings available. Each CV setting has a specific function or value that it controls, and after the desired change to the value is made by pressing the UP and DOWN arrows on the keypad, the change is locked in (executed) by pressing the ENTER button on the keypad.

If the messages start with the letters "SA", this means that the unit is operating in stand-alone (dumb) mode. SA denotes Stand Alone mode. If the unit has reverted to stand-alone mode it cannot communicate with the distribution box and the system will not operate with all functions. Check the cable connections and AC power connection to **the distribution box.**

The system has a routine to change the numeric values of the adjustable setpoints. The following paragraphs give information on utilizing the Change Value (CV) routines. The keypad on the front of the power supply has a key marked Change Values that is used to scroll through each of the settings available. Each CV setting has a specific function or value that it controls, and after the desired change to the value is made by pressing the UP and DOWN arrows on the keypad, the change is locked in (executed) by pressing the ENTER button on the keypad.

If the messages start with the letters "SA", this means that the unit is operating in stand-alone (dumb) mode. SA denotes Stand Alone mode. If the unit has reverted to stand-alone mode it cannot communicate with the distribution box and the system will not operate with all functions. Check the cable connections and AC power connection to the distribution panel.

5.2

Startup Conditions

A proper earth ground must be provided to assure the safety of people who work near the machinery.

This unit is designed to be connected to external power at all times.

If all of these conditions are not met the unit will revert to the stand-alone (SA) mode. **This manual does not address the operation of the stand-alone mode!** Please consult the appropriate manual if it becomes necessary to use the SA mode. The program and display buttons operate differently in SA mode and all of the messages shown in the display will begin with SA.

5.3 Fault Conditions

Fault conditions that can cause the power supply to shut down or not start up

1. The overtemperature sensor has shut down the PWM switching control chip. The unit is too hot. The fan must not be blocked. It must have an adequate source of fresh, unheated air.

2. The unit also must be properly grounded for safety and to ensure the reliability of the output diodes.

5.4 General Operations

The unit is designed to be ON full time so that the CPU in the main power supply stays alive. The front panel switches that turn the unit OFF only disable the unit from outputting power. The unit is actually still ON, but in an idle state. The unit is designed to be connected to the AC power from the power line 100% of the time during normal operation.

The distribution panel computer is equipped with EEPROM to store all of the user's inputs. All rhe settings for batch times, batch counts, etc. that have been stored in the computer are not lost if the distribution panel loses its source of AC power or if it is disconnected to the main power supply. When the distribution panel is reconnected to the power supply and all startup conditions are met, it will resume operating with the stored values previously input by the user.

5.5 Operating Modes

There are four modes of operation for this power supply when the distribution panel is connected; they range from fully automatic to fully manual. The operator selects one of the modes using, Change Value 9 (CV9) and Change Value 10 (CV IO), in the Change Value Routine.

The following table gives a short description of each of the modes of operation, and explains briefly the operator input that is needed in the three modes that are less than fully automatic.

Mode	**Title**	**Description**
Fully Automatic	Auto/No Prompt	Fully Automatic. No keypad input from operator.
Automatic with Prompt	Auto/Prompt	System pauses and waits for keypad input to **rerun** (process again) the batch or **empty** the batch tank into the tailing tank.
Manual without Prompt	Manual/No Prompt	Operator input required to begin process. Through keypad input, the operator determines when the batch process begins.
Fully Manual	Manual/Prompt	Operator controls start of batch and **emptying** or **rerunning** of batch.

5.6

Switches, Pump Controls, and Corresponding LED Indicators

The 4 liquid level switches are normally closed. All 4 LED's on the distribution panel should be lit, indicating a closed condition. This presumes that the default state of the tanks holding liquids is normally empty. The connection on the liquid level switches must be opened to tell the power supply to turn on pumps to fill the tanks. If there is a break in a wire or a bad connection, the system will not overfill the tanks.

Liquid Level Switch 1 (LL1) is enabled during the fully automatic mode. This switch will trip when the collection tank is full enough for a batch. When this switch is triggered the unprocessed liquid will automatically be pumped into the batch tank and the batch processing protocol will be started.

Liquid Level Switch 3 (LL3) trips when the batch tank begins to fill. This switch also indicates when the tank is empty at the end of a batch signaling that a new batch can be started.

Liquid Level 4 (LL4) is also called the pump saver switch. This switch trips when the batch tank is half full but its primary function is to alert the operator if the level in the tank drops below half full while the batch is being processed.

Liquid Level 2 (LL2) trips when the batch tank is full. When this switch is triggered the circulating pump starts and begins filling the rotor tank.

5.7 Keypad Controls and Message Display

The power supply has a 6 button keypad and a 2 line message display. The top line of the display always shows the operating state (mode) of the unit, or the significant action that is occurring in the processing system.

The keypad enables the technician to input values as described below and to instruct the power supply to take appropriate actions as described in the mode operation sections of this manual.

5.7.1 Change Value (CV) Settings

The system has a routine to change the numeric values of the adjustable setpoints. This routine is called the Change Value (CV) routine. The following paragraphs give information for the technician to utilize the Change Value (CV) routine. The keypad on the front of the power supply has a key marked Change Values that is used to scroll through each of the settings available to the technician. Each CV setting has a specific function or value that it controls, and after the desired change to the value is made by pressing the UP and DOW'N arrows on the keypad, the change is locked in (executed) by pressing the ENTER button on the keypad.

Change Value 1 (CV1) Set Current in Amps

The batch timer unit allows the operator to set the number of Amps that are output from each channel. Use *CV1* change this setting up or down. The range available is 2 to 40 amps output per channel.

Change Value 2, and 3 (CV2, CV3) Setting Hours and Minutes for Run Time

The batch timer's main feature is that the operator controls the time that the unit will run.

Use *CV2* to set the number hours that the unit will run. The range available is 0 to 99. Use *CV3* to set the minutes within the range of 0 and 59.

Change Value 4 (CV4) Setting Hold Time

The hold time setting allows for the rotor tank to drain before the main tank is pumped out at the end of a batch. The hold time is set to the length of time the rotor tank takes to drain. This setting also determines how long the rotor tank is allowed to fill before the power supply begins operating. Use *CV4* to adjust this setting within the range of 0 to 59 minutes.

Change Value 5 and 6 (CV5 and CV6) Setting the Minutes and Seconds for Run Time for the pH Pump

These settings determine the run time for the pH pump. The pH pump starts when the batch begins filling. The batch will not start until the pH pump has finished its run time. The technician can use *CV5* to set the minutes within the range of 0 to 5 minutes and *CV6* to set the seconds within the range of 0 and 59. A setting of 00:00 disables the pH pump.

Change Value 7 (CV7) Restart on Power Failure/ Fault on Power Failure

The power supply needs electrical power at all times. However, if the AC power from the electrical service fails, the power supply has a memory backup that saves operation information, and the system will restart when power is restored. CV7 enables this feature. The operator can determine if the power supply will restart upon restoration of power or will stay off.

Change Value 8 (CV8) Clear Batch Count

The unit contains a counter that keeps track of the number batches that; have been processed. This feature can be used to keep track of the age of rotors, pumps or even the power supply itself. The technician can use *CV8* to clear the counter and start over with the count.

Change Value 9 (CV9) Set Operation Mode

This Value setting determines the mode of operation for the unit. Two choices **are** available and the operator can choose the option desired using *CV9.* The technician chooses between **Auto** and **Manual.**

Change Value 10 (CV10) Set Prompt/No Prompt Option

This setting determines how much input the end user operator will have during the running of a batch. The technician can use *CVIO* to choose between **Prompt** and **No Prompt** options.

Please Note: There are four combinations in which the unit can be operated. An example of standard run options for each of these is listed later in this manual.

Change Value 11 (CV11) Bypass Timer/LL

This feature allows the technician to bypass all system controls. If the operator chooses this option, the two LL switches can be bypassed while filling, or all timed functions can be bypassed and the power supply will simply move on to the next step in the process. To bypass to the next step in the process scroll through the CV choices to *CV11* and press the Enter key.

Change Value 12 (CV12) Display Average or Peak

CV12 is a toggle that moves between average and peak display. The average setting shows the average amps from readings taken over a four second period. If the readings seem to jump around and not stay consistent, then the peak setting will give a more accurate reading. The peak setting shows the peak amps from readings taken over a four second period. If it becomes necessary to use the peak reading regularly, it is an indication that the brushes located in the tank are becoming worn.

Change Value 13 (CV13) Disable or Enable LL4

This feature is also referred to as the "pump saver" feature. Liquid level 4 settings detect if the batch is full or not. When enabled, this feature will detect falling liquid levels during the processing of a batch and will not shut down the unit. If the liquid levels are low, an alarm will sound to notify the operator of the problem. The most common cause of this occurrence is a leak in the tank.

If this setting is enabled and the batch tank is **not** full, then the unit will not run. If the operator desires to run a partial batch, the liquid level 4 switch should be bypassed (ignored). If a partial batch needs to be run, use *CV14* to override the system's response to the liquid level 4 switch by toggling this setting on and off.

Please note that if this feature is disabled there is no protection to prevent damage to the pumps if the liquid level drops below the level that is safe for the pumps.

5.8

AUTOMATIC, NO PROMPT MODE

CV9 Set to **Auto**
CV1O Set to **No Prompt**

In this mode the power supply has complete control. The unit will need no input from the operator after the initial settings have been made. The initial values that the technician will set include the current setting in amps, run time for the batch and for the pH pump and whether the unit will restart upon power failure. Once these are set the unit will take over operations and the operator will no longer be concerned with the settings in the Change Value routine.

There are many safety features built into the computer program that will stop operation of the power supply if any fault condition should occur.

Many steps exist in the processing of a batch of solution, the following description will show an example of how the unit runs in this mode and what the display will show.

Before a batch is begun all the LL switch LED indicators must be lit, showing that the switches are closed and indicating an empty condition. This assumes that the default condition for all the tanks is empty. **The automatic sequence will not begin if there is liquid in the batch** tank **if both** LL **switches are functioning properly.**

Switch Conditions that Must Exist before an Automatic/No Prompt Batch Can Begin

SWITCH	**SWITCH LOCATION**	SWITCH POSITION	LED	NOTES	POWER SUPPLY DISPLAY LINE 2
Liquid Level 1 (LL1)	Top of the Collection Tank	Closed	LED is ON	Collection tank is not full yet.	L1=1
Liquid Level 2 (LL2)	Top of Batch Tank	**Closed**	LED is ON	Batch tank is not full	L2=1
Liquid Level 3 (LL3)	Bottom of Batch Tank	Closed	LED is ON	Batch tank is empty	L3=1
Liquid Level 4 (LL4)	Middle of Batch tank.	**Closed**	LED is ON	Batch tank is less than half full.	L4=1

If all LEDs are lit, the collection tank has not finished filling. While the collection tank is filling the top line of the display says *Waiting for Batch.* The second line is an alternating (rolling) display: the messages will say *Batch Count (indicates the number of batches that have been run); CV9 Auto (indicates Automatic mode); L1=1 L2=1 L3=1 L4=1 (indicates the LL switches are in a closed state).*

The Liquid Level 1 switch is located at the top of the collection tank and must trip to begin a batch. When this switch opens, the corresponding LED will go out and the batch transfer fill pump will begin to operate, moving the contents of the collection tank to the batch tank. The pH pump will also begin operating and must finish its timed run before the batch process can continue. As soon as the liquid level begins to drop the LL1 switch may close again and the LED will come back on to indicate that the collection tank is no longer full enough for another

batch.

While the batch tank is filling the top line of the display reads *Filling,* and the second line rolls reading alternately: *Batch Count NNNN, CV9 Auto; Volts 0.00 Time Left NN:NN:NN (indicates the time left for the pH pump to finish); L1=0, L2=1, L3=1, L4=1*.

The batch transfer fill pump will continue to run until the LL2 switch located at the fill line in the batch tank trips open, at which time the corresponding LED will go out. At this time the pH pump may continue to run until its time has elapsed.

After the pH pump times out, the Batch Circulating pump starts to fill the rotor tank and the rotors begin to operate, however the power supply will not start until the holding time elapses. During this time the first line of the display reads *Holding* and the second line rolls through the following display: *Batch Count NNNN; Time Left 00:00; CV9 Auto.* After the holding time elapses the display will read *Restarting 000,* this indicates that the power supply is ramping up it output.

When the power supply has reached full output, the top line of the display will read *Processing* and the second line will roll through the following: *Batch Count NAWN, Time Left 00:00:00; CV9 Auto; Volts 0.00; Amps NN.*

When the time expires and the batch processing is finished there is another hold time to allow the rotor tank to empty into the batch tank before the batch drain pump is started. The display show *Holding* on the top line and rolls through *Batch Count NNNN; Time Left 00:00; CV9 Auto.*

While the batch drain pump is running the display will read *Emptying* on the top line and will roll between *Batch Count NNNN, CV9* Auto; and *L1=1 L2=0 L3=0 L4=0*. As the LL switches close the corresponding display will change to indicate a closed position and the LED will light up again. When all LL switches have closed one of the messages on the second line of the display will read *L1=1 L2=1 L3=1 L4=1,* **and there is an 8 second wait time before the batch pump shuts down to prevent a false switch sensor message**.

The system has come full circle and is again waiting for the collection tank to fill so a new batch can begin.

5.9

AUTOMATIC, *PROMPT*

CV9 Set to **Auto**
CV1O Set to **Prompt**

This mode is almost fully automatic, the LL1 switch will still determine when the batch transfer fill pump begins operating and the sequence will run uninterrupted until the batch processing time has been completed. However before the batch will empty, the operator must decide whether to reprocess the batch for a longer period of time or if the batch is finished and should be dumped.

There are many safety features built into the computer program that will stop operation of the power supply if any fault condition should occur.

Many steps exist in the processing of a batch of solution, the following description will show an example of how the unit runs in this mode and what the display will show.

Before a batch is begun all the LL switch LED indicators must be lit showing that the switches are closed indicating an empty condition. This assumes that the default condition for all the tanks is empty. **The automatic sequence will not begin if there is liquid in the batch tank if both LL switches are functioning properly.**

Switch Conditions that Must Exist before an Automatic Batch Can Begin

SWITCH	**SWITCH LOCATION**	SWITCH POSITION	LED	NOTES	POWER SUPPLY DISPLAY LINE 2
Liquid Level 1 (LL1)	Top of the Collection Tank	Closed	LED is ON	Collection tank is not full yet.	L1=1
Liquid Level 2 (LL2)	Top of Batch Tank	Closed	LED is ON	Batch tank is not full	L2=1
Liquid Level 3 (LL3)	Bottom of Batch Tank	Closed	LED is ON	Batch tank is empty	L3=1
Liquid Level 4 (LL4)	Middle of Batch tank.	Closed	LED is ON	Batch tank is less than half full.	L4=1

If all LEDs are lit the collection tank has not finished filling. While the collection tank is filling the top line of the display says *Waiting for Batch.* The second line is an altemating (rolling) display: the messages will say *Batch Count NNNN (indicates the number of batches that have been run); CV9 Auto (indicates Automatic mode); LI =1 L2 =1 L3=1 L4=1 (indicates the LL switches are in a closed state).*

The Liquid Level 1 switch is located at the top of the collection tank and must trip to begin a batch. When this switch opens, the corresponding LED will go out and the batch transfer fill pump will begin to operate, moving the contents of the collection tank to the batch tank. The pH pump will also begin operating and must finish its timed run before the batch process can continue. As soon as the liquid level begins to drop the LL1 switch may close again and the LED will come back on to indicate that the collection tank is no longer full enough for another batch.

While the batch tank is filling the top line of the display reads *Filling,* and the second line rolls

reading alternately: *Batch Count NNNN, CV9 Auto; Volts 0.00 Time Left NN:NN:NN (indicates the time left for the pH pump to finish); L1=0, L2=1, L3=1, L4=1*.

The batch transfer fill pump will continue to run until the LL2 switch located at the fill line in the batch tank trips open, at which time the corresponding LED will go out. At this time the pH pump may continue to run until its time has elapsed.

After the pH pump times out, the Batch Circulating pump starts to fill the rotor tank and the rotors begin to operate, however the power supply will not start until the holding time elapses. During this time the first line of the display reads *Holding* and the second line rolls through the following display: *Batch Count NNNN; Time Left 00:00; CV9 Auto.* After the holding time elapses the display will read *Restarting 000,* this indicates that the power supply is ramping up it output.

When the power supply has reached full output, the top line of the display will read *Processing* and the second line will roll through the following: *Batch Count NAWN, Time Left 00:00:00; CV9 Auto; Volts 0.00; Amps NN.*

When the time expires and the batch processing is finished the display will read *Push Run to Empty or Push Reset to process.*

If the operator chooses to continue processing and the run time was more than one (1) hour the reprocessing time will default to one (1) hour. The operator can reprocess the batch as many times as needed. To reprocess a batch, push the Stop/Reset button on the keypad. The display will be the same as in the original run.

When the operator chooses to empty, then the Run button should be pushed. The display *shows Emptying* on the top line and rolls through *Batch Count NNNN, CV9 Auto; L1=0 L2=0 L3=0 L4=0.* The final display at the end of emptying will be *L1=1 L2=1 L3=1 L4=1,* exactly as it looked at the beginning of the batch process.

PLEASE NOTE: There is no holding time for the rotor tank to drain in this mode, and the operator has to determine if the rotor tank will empty when the LL3 switch triggers the batch drain pump to shut down. If the LL3 switch closes before the rotor tank has finished draining there will still be liquid left in the tank and that may cause the LL3 switch to open, indicating that fluid is still in the tank but the computer will not restart the drain pump. The operator will then have to determine the best way to remove the liquid. There is no holding time because this is no longer a fully automatic system and the operator has control over the final outcome.

The system has come full circle and is again waiting for the collection tank to fill so a new batch can begin.

MANUAL, *NO PROMPT* MODE

CV9 Set to **Manual**
CV1O Set to **No Prompt**

In this mode, the operator manually controls when the batch transfer fill pump starts operating. The LL1 switch is disabled and is not used by the system. To start a batch, the operator will push the RUN button. This is the only input required from the operator and the system is automatic once the batch has started.

There are many safety features built into the computer program that will stop operation of the power supply if any fault condition should occur.

Many steps exist in the processing of a batch of solution, the following description will show an example of how the unit runs in this mode and what the display will show.

Before a batch is begun all the LL switch LED indicators must be lit showing that the switches are closed indicating an empty condition. This assumes that the default condition for all the tanks is empty. **The automatic sequence** will not **begin if there is liquid in the batch tank if all LL switches are functioning properly.**

Switch Conditions that Must Exist before a Manual, No Prompt Batch Can Begin

SWITCH	**SWITCH LOCATION**	SWITCH POSITION	LED	NOTES	POWER SUPPLY DISPLAY LINE 2
Liquid Level 1 (LL1) Disabled in this mode	Top of the Collection Tank	**Disabled**	LED is ON	Collection tank is not full yet.	L1=1
Liquid Level 2 (LL2)	Top of Batch tank	Closed	LED is ON	Batch tank is not full	L2=1
Liquid Level 3 (LL3)	Bottom of Batch Tank	Closed	LED is ON	Batch tank is empty	L3=1
Liquid Level 4 (LL4)	Middle of Batch Tank	Closed	LED is ON	Batch Tank is less than half full.	L4=1

If all LEDs are lit, the collection tank has not finished filling. Because the LL1 switch is disabled in this mode the operator is in control of when the batch will start, to indicate this the top line of the display says *Push Run to Start.* The second line is an alternating (rolling) display: the messages will say *Batch Count NNNN (indicates the number of batches that have been run); CV9 Manual (indicates Manual mode); LI =1 L2 =1 L3=1 L4=1 (indicates the LL switches are in a closed state).*

When the operator is ready to begin filling the batch tank the Run button is pushed to start the batch transfer fill pump. While the batch tank is filling the top line of the display reads *Filling,* and the second line rolls reading alternately: *Batch Count NNNN, CV9 Manual; Time Left NN:NN:NN (indicates the time left for the pH pump to finish); L1=1, L2=1, L3=1, L4=1*.

The batch transfer fill pump will continue to run until the LL2 switch located at the fill line in the batch tank trips open, at which time the corresponding LED will go out and one of the messages on the second line of the display will read *L1=1 L2=0 L3=0 L4=0*. At this time the

pH pump may continue to run until its time has elapsed.

After the pH pump times out, the Batch Circulating pump starts to fill the rotor tank and the rotors begin to operate, however the power supply will not start until the holding time elapses. During this time the first line of the display reads *Holding* and the second line rolls through the following display: *Batch Count NNNN; Time Left 00:00; CV9 Manual.* After the holding time elapses the display will read *Restarting 000,* this indicates that the power supply is ramping up it output.

When the power supply has reached full output, the top line of the display will read *Processing* and the second line will roll through the following: *Batch Count NAWN, Time Left 00:00:00; CV9 Manual; Volts 0.00; Amps NN.*

After the processing of the batch is finished the display will show *Emptying* on the top line and rolls through *Batch Count NNNN; CV9 Manual; L1=1 L2=1 L3=1 L4=1,* exactly like it looked at the beginning of the process.

When the power supply has reached full output the top line of the display will read *Processing* and the second line will roll through the following: *Batch Count* NNNN: *Time Left 00: 00: 00; CV9 Manual, Volts 0.00; Amps NN.*

The system has come full circle and is again waiting for the instruction from the operator to begin a new batch. To start another batch the operator needs to press the Run button.

5.11

MANUAL, *PROMPT*

CV9 Set to **Manual**
CV1O Set to **Prompt**

In this mode, the operator manually controls when the batch transfer fill pump begins operating. The LL1 switch is disabled and is not used by the system. The system will pause for operator input after the batch time, that was set using *CV2 and CV3,* **has** elapsed. The operator has the option of emptying the batch tank after the initial batch time has expired or reprocessing the batch.

There are many safety features built into the computer program that will stop operation of the power supply if any fault condition should occur.

Many steps exist in the processing of a batch of solution, the following description will show an example of how the unit runs in this mode and what the display will show.

Before a batch is begun all the LL switch LED indicators must be lit showing that the switches are closed indicating an empty condition. This assumes that the default condition for all the tanks is empty. **The automatic sequence will not begin if there is liquid in the batch tank if all LL switches are functioning properly,**

Switch Conditions that Must Exist before a Manual, No Prompt Batch Can Begin

SWITCH	**SWITCH LOCATION**	SWITCH POSITION	LED	NOTES	POWER SUPPLY DISPLAY LINE 2
Liquid Level 1 (LL1) Disabled in this mode	Top of the Collection Tank	**Disabled**	LED is ON	Collection tank is not full yet.	L1=1
Liquid Level 2 (LL2)	Top of the Batch tank	Closed	LED is ON	Batch tank is not full	L2=1
Liquid Level 3 (LL3)	Bottom of Batch Tank	Closed	LED is ON	Batch tank is empty	L3=1
Liquid Level 4 (LL4)	Middle of Batch tank	Closed	LED is ON	Batch tank is less than half full	L4=1

The LL1 switch is disabled in this mode and the operator determines when the batch transfer fill pump will begin to transfer the contents from the collection tank to the batch tank and all LEDs will be lit until the batch tank is full. While the system is waiting for operator input the top line of the display says *Push Run to Start.* The second line is an alternating (rolling) display: the messages will say *Batch Count NNNN (indicates the number of batches that have been run); CV9 Manual (indicates Manual mode); LI =1 L2 =1 L3=1 L4=1 (indicates the LL switches are in a closed state).*

When the operator is ready to begin filling the batch tank the Run button is pushed to start the batch transfer fill pump. While the batch tank is filling the top line of the display reads *Filling,* and the second line rolls reading alternately: *Batch Count NNNN, CV9 Manual; Time Left NN:NN:NN (indicates the time left for the pH pump to finish); L1=1, L2=1, L3=1, L4=1*.

The batch transfer fill pump will continue to run until the LL2 switch located at the fill line in the batch tank trips open, at which time the corresponding LED will go out and one of the messages on the second line of the display will read *L1=1 L2=0 L3=0 L4=0*. At this time the pH pump may continue to run until its time has elapsed.

After the pH pump times out, the Batch Circulating pump starts to fill the rotor tank and the rotors begin to operate, however the power supply will not start until the holding time elapses. During this time the first line of the display reads *Holding* and the second line rolls through the following display: *Batch Count NNNN; Time Left 00:00; CV9 Manual.* After the holding time elapses the display will read *Restarting 000,* this indicates that the power supply is ramping up it output.

When the power supply has reached full output, the top line of the display will read *Processing* and the second line will roll through the following: *Batch Count NAWN, Time Left 00:00:00; CV9 Manual; Volts 0.00; Amps NN.*

When the time expires and the batch processing is finished the display will read *Push Run to Empty or Push Reset to process.*

If the operator chooses to continue processing and the run time was more than one (1) hour the reprocessing time will default to one (1) hour. The operator can reprocess the batch as many times as needed. To reprocess a batch, push the Stop/Reset button on the keypad. The display will be the same as in the original run.

When the operator chooses to empty, then the Run button should be pushed. The display *shows Emptying* on the top line and rolls through *Batch Count NNNN, CV9 Manual; L1=0 L2=0 L3=0 L4=0.* The final display at the end of emptying will be *L1=1 L2=1 L3=1 L4=1*, exactly as it looked at the beginning of the batch process.

PLEASE NOTE: There is no holding time for the rotor tank to drain in this mode, and the operator has to determine if the rotor tank will empty when the LL3 switch triggers the batch drain pump to shut down. If the LL3 switch closes before the rotor tank has finished draining there will still be liquid left in the tank and that may cause the LL3 switch to open, indicating that fluid is still in the tank but the computer will not restart the drain pump. The operator will then have to determine the best way to remove the liquid. There is no holding time because this is no longer a fully automatic system and the operator has control over the final outcome.

The system has come full circle and is again waiting for the collection tank to fill so a new batch can begin.

6. SILVER CONCENTRATION TEST PROCEDURE

Required Material: Silver Test Paper (“Ag-Fix” Gallard- Schlesinger, #MD-9000)

Procedure:

a) Immures a strip of the Ag-Fix paper for (5) five seconds in a sample of the solution to be tested.

b) Immerse the strip in a beaker of fresh water for one minute ***without agitation.***

c)Allow the strip to dry for two to three minutes.

d) Compare the strip of paper with the dispenser (estimating in-between colors) and read the concentration in gram/ liter from the color that matches the best.

A goal of 200-500 PPM in silver concentration should be achieved in a ELECTRO-plating process. The final treatment is then completed in the Mark 15 Silver Recovery Tailing System.

7.

PH TEST PROCEDURE

Required Material: Fil-Chem pH paper #6074 is recommended; #6680 is an alternative. Both products are available from Fil-Chem, Inc., Paul Frank Division, 29 east 22nd Street New York, N. Y. 10010

Procedure:
a) Immerse the a pH test strip into a sample for (5) five seconds.

b) Remove and shake off the excess liquid and ***read immediately*** (holding the strip up to the light or placing it on a white background is sometimes helpful)

c) Using the indicator bar (the largest bar located in the middle of the scale) determine which smaller pH bar matches it in color. Estimate in-between values, if the colors are not perfectly matched.

d) Read the pH value of the bar from the scale provided on the box.
The idle pH operating range for plating silver in the BFX 1000 is 7.8 to 8.4.

The alternative use of a pH meter is preferable, if one is available.

IRON TESTING PROCEDURE.

Materials Required:
Quantofix Iron 1000 Test Kit (available from HRC Corporation)

Kit includes: One (1) Aluminum container with 100 test sticks
One (1) Bottle Iron-1
One (1) Measuring tube with 5 ml mark
One (1) Small measuring spoon

Procedure:

a) Rinse measuring tube with sample (pH 1-7) and fill to the mark.

b) Add one spoon of Iron- 1 and shake carefully.

c) Remove only as many as test sticks as are required, and reseal the container immediately after use. *Do not touch the test paper zone*.

d) Dip the test stick briefly into the prepared test solution and after 20 seconds compare the paper zone with t he color scale. In the presence of iron the test paper turns red.

For determination of iron (II) beside iron (III) dip sticks directly into the acidic sample solution (without adding Iron-1)

SULFITE CONCENTRATION TEST PROCEDURE

Materials: Sulfite test paper (Gallard-Schlesinger, Quantofix Sulfite Test Paper available from HRC Corporation)

One 100 ml graduated cylinder.

One 5 ml plastic syringe.

a) Using the syringe draw 1 ml of bleach-fix solution into the graduated cylinder and fill to the 100 ml mark with water (1-99) dilution) Stopper and shake to mix.

b) Immerse a strip of sulfite test paper in this solution for 5 seconds, remove and off excess liquid.

c) Compare the test strip color to the colors on the reference chart on the side of the test strip container.

d) Use the corresponding number of the color that best matches the test strip color to obtain the grams per liter of sulfite, bisulfite or sodium sulfite using the table that follows. Estimate values for the colors in-between those given.

Reference Chart Number	Grams/Liter of Sodium Bisulfite (NaHS03)	Grams/Liter of Sodium Sulfite (Na2S03)	Grams/Liter of Sulfite (S03)
0	0	0	0
10	1	1.5	1
25	3.2	3.9	2.5
50	6.5	7.8	5
100	13	15.8	10
250	32.5	39.4	25
500	65	80	50
1000	130	158	100

e) Regenerated bleach-fix (new replenisher) should be read at approximately 12.5 grams per/liter of sulfite.

10. HARVESTING THE SILVER.

a) After 10 to 15 batches have been processed the cathode drum should be removed from the recovery unit by loosening the bolt securing it to the drive head. Rinse excess chemical with fresh water.

b) The silver can than be removed from the drum using a putty knife or other scraping tool that will minimize the scratching of the drum.

c) The plated silver should scraped from the drum and allowed to dry.

d) Wash the drum with plain soap and water before returning the it to the recovery unit.

e) Place the drum back in the drive and tighten bolt securing it to the drive head.

f) The dry silver can than be packaged and shipped to Hallmark for refining.
Note: Silver can be shipped as a non-hazardous material in all states except California. Silver is a hazardous material in California and it must be labeled and manifested for shipment.

11.

ROUTINE EQUIPMENT INSPECTIONS.

Do a routine daily visual inspection of the following:

a) Periodically inspect tubing and tighten clamps connection to avoid leaks.

b) Inspect the drum for proper plating and take corrective action if necessary.

c) Keep your equipment clean and the work area around it free of clutter, to avoid accidents when working on or around the recovery unit.

d) Grease the bearings after harvesting the and cleaning the cathode.

12.

TROUBLE SHOOTING GUIDE

Problem	Probable Solution
Cathode will not plate.	1.) pH may be to low, adjust to 8.0 or above. 2.) Power supply malfunction, check circuit breaker. Replace power supply if necessary.
Plating on cathode is soft.	To much power is being applied, reduce the time an/or the amperage
Plating on cathode not smooth (nodules on plating surface)	Not enough power is being applied, increase amperage and/or time.
Timer does not start or stop or stop properly.	Replace Timer.
Solution empties from the tank during the plating time.	Solution is siphoning out through the pump out tube. The tube should be raised to level higher than the plating tank.
Drive motor not turning.	Check fuse in drive head. A voltage spike may have blown the fuse.
Pump not transferring solution.	Verify that the timer is receiving voltage. Check the timer to make sure it is programmed properly.

13.

PARTS LISTS AND WIRING DIAGRAMS

BFX-1000 - Silver Recovery System Parts LIst

Ref #	Part Number	Part Description	# of Parts
1	703-001	Bison Gear motor 1/20 HP	1
2	903-402	Housing Drive Assy	1
3	903-530	End Piece 30-EZ-1/2	1
4	903-430	End Piece 5/8	1
5	903-516	Motor Coupling Rubber	1
6	903-413	Drive Shaft w/Commutator 5/8”	1
7	903-412	Flange Bearing 5/8”	2
8	903-414	Brush	1
9	903-417	Brush Holder	1
10	903-411	FX & BX Plexiglass Drive Cover	1
11	903-518	Cathode Coupling ½”	1
12	900-011	Cathode 9”x7”	1
13	903-404	Drive Rear Cover	1
14	251-002	Equipment Feet (370069)	2
15	250-006	Hinge SS 6”x3”x1/8”	1
16	903-422	Drive Support	2
17	900-006	Anode Clip -1000	1
18	900-010	Anode Ring	1
19	903-405	FX Carbon Anode ½”x4”x18”	8
20	903-410	Overflow Assy (Standpipe)	1
21	903-409	Spray Bar Assy	1
22	728-018	Power Cord 18/3 x 8 ft (1W364)	1
23	107-007	Tubing Reinforced ¾” 9200-2605	5
24	MD-20TB	MD-20RLT 115V Mag Drive Pump (MD-20RT-115NL)	3
25	507-007	Valve Plastomatic (CKM075V-PVPM)	1
26	524-650	Liquid Level Switch/Compac	3
27	903-201	Liquid Level Assy BFX 1000	1
28	18645A23	Lid Handle	3
29	5C115	Fan	1
30	249-001	Fan Guard	1
31	SV040	40 Amp Power Supply W/ Dist. Box	1
32	SV040S	40 Amp Supply Supplement	1

BFX 1000 DRAWINGS

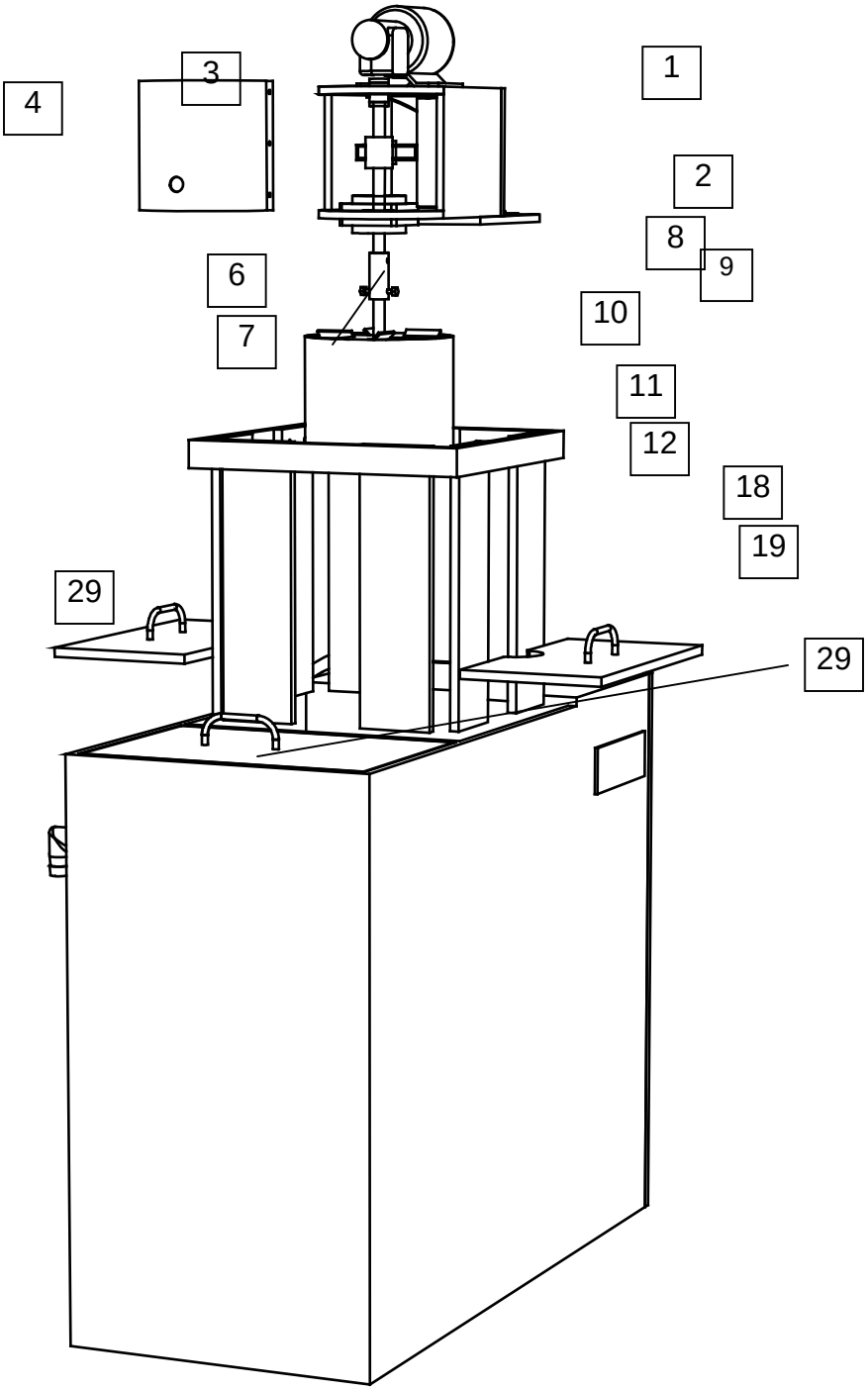

Figure 14.1 Exploded Cell View

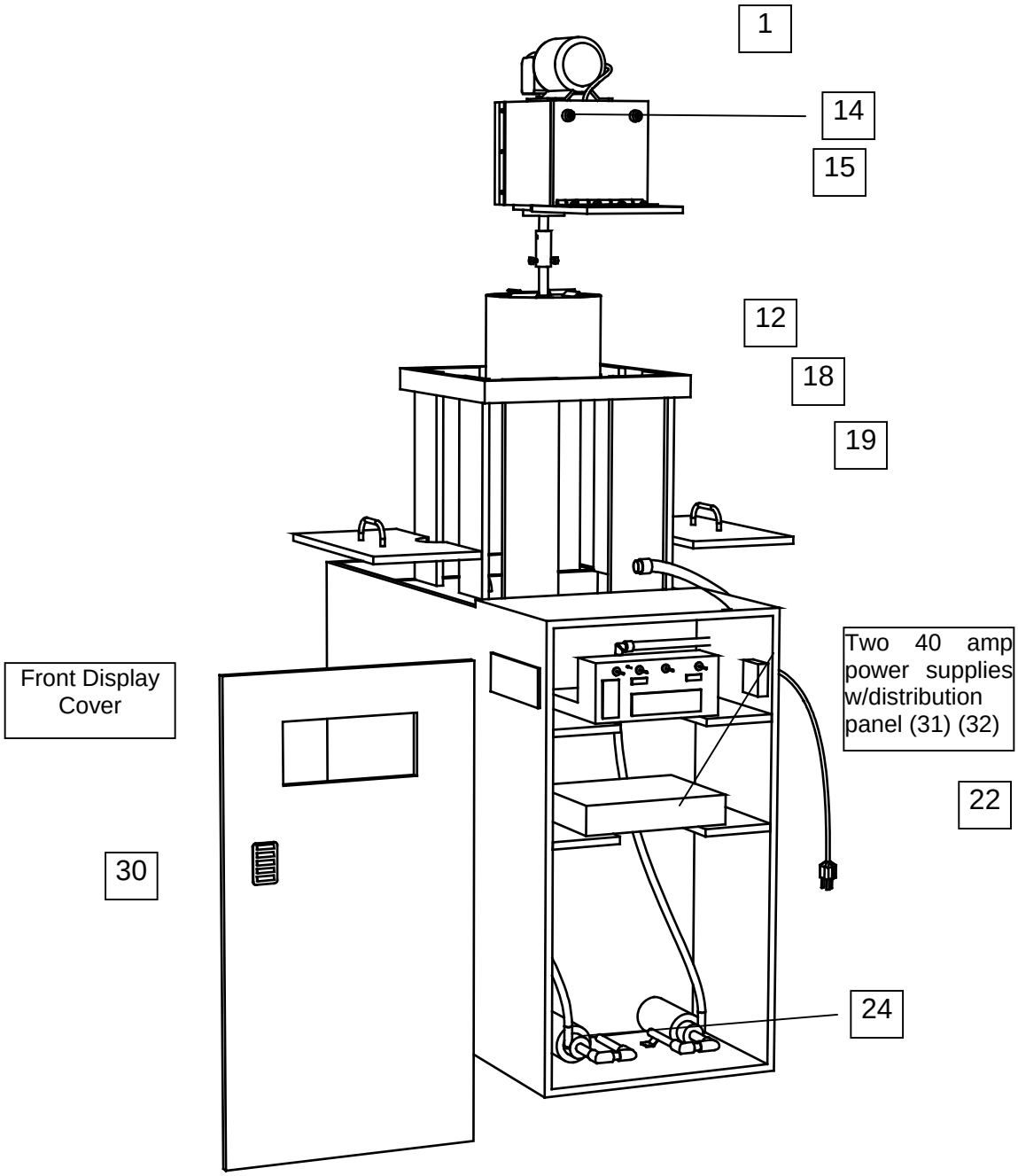

Figure 14.2 Front View

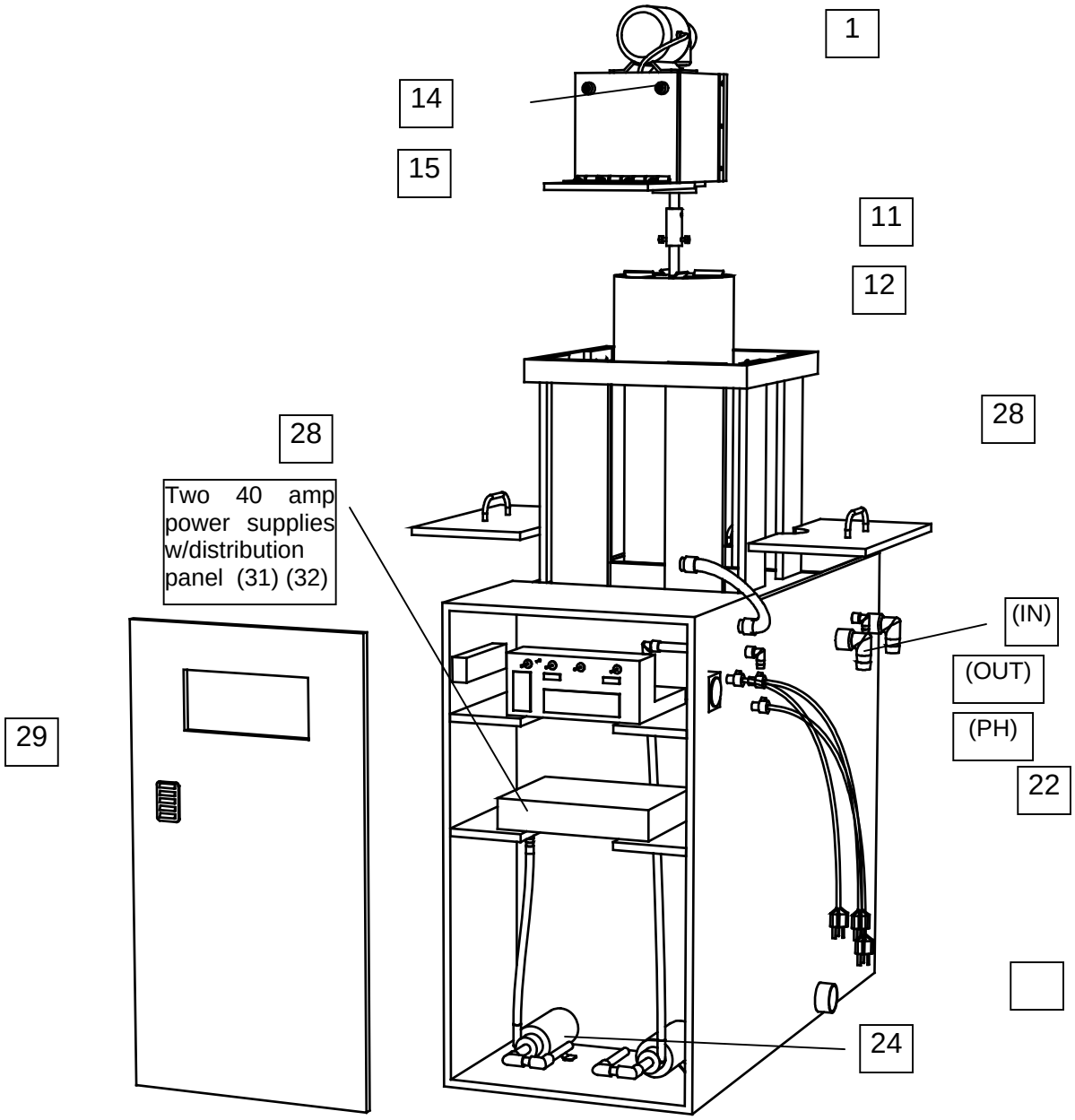

Figure 14.3 Front with Side View

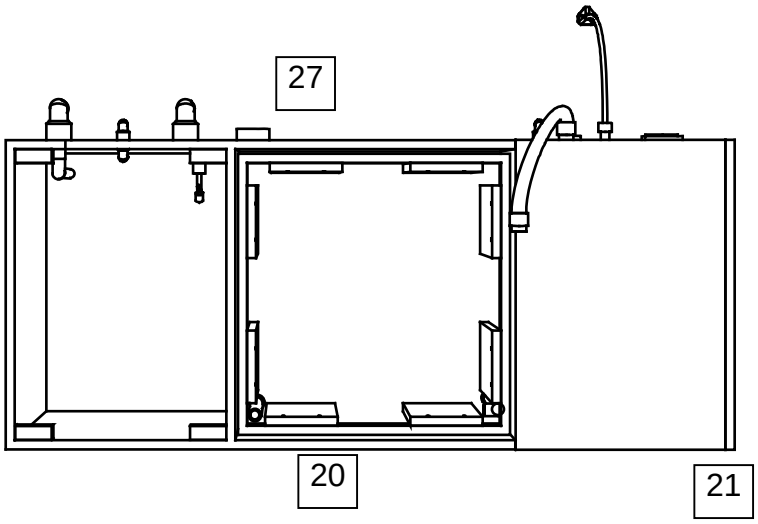

Figure 14.4

Figure 14.3 Front