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GENERAL DESCRIPTION

The BFX 500 is a fully automated batch silver recovery system for Photo Processors. It is intended for use in small color labs, or other small photo labs for the electrolytic plating of silver from process solutions. The BFX 500 will plate silver from various combinations of C-41, E-6 fixer, RA-4 Bleach Fix and "Washless" stabilizers. The BFX 500 treats seven gallons per batch.

The upper tank assembly is the electrolytic cell for plating the silver in the spent process solution. The lower tank is the collection point for the next batch of to be processed. The power supply and controls are located on the side panel. The BFX 500 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 500 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 500 is shipped completely assembled and ready for installation.

The BFX 500 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 500 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 500 is activated. A manual override switch is provided.

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 recover 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 500 General Specifications

| | |
|---------------------------|---|
| Average Recovery Capacity | 1.5 Troy ounces per hour Dependent on silver content and type of solution. |
| Plating Range | 0 to 40 Amps |
| Dimensions | 15 inches wide x 22 inches deep x 42 inches high |
| Tank Capacity | 10 Gallons (38 Liters) |
| Batch Size | 7 Gallons (30.4 Liters) |
| Electrical Requirements | 115 VAC, 50/60 Hz 5 Amps |
| Net Weight | 125 Pounds |
| Shipping Weight | 160 Pounds |

INSTALLATION INSTRUCTIONS

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.

Unpacking the BFX 500 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.

Placing The Equipment

Before you install the BFX 500 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.

Final Placement

After you have determined the desired location, check the floor for level and adjust the BFX 500 unit as necessary to a level operating position.

Assembling The Equipment

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.

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.

Installation of Inlet Lines

Connect discharge lines from the processor(s) to the inlet of the BFX 500 accumulation tank. Be sure to connect tank drains as well as overflow lines to silver recovery system. The drains going to the BFX 500 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.

Connecting The Power Supply

Connect the power cord of the BFX 500 unit to a 115 VAC 50/60 Hz power source capable of delivering a minimum of 8 amperes. The BFX 500 is now ready for operation.

General Operation 40 AMP Supply with Distribution Box

Introduction

The Hallmark BFX 500 is a computer controlled silver recovery system. The computer has many user adjustable settings that are used to customize the performance of the system. The input buttons that are used to change the settings of the system and program the computer are located on the keypad on the front of the power supply of the unit.

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

Safety Precautions

A proper earth ground must be provided to assure the safety of people who can come in with contact the machinery.

Be sure to disconnect the AC power source when servicing the system.

If the restart on power failure option is enabled (as it is when the unit is shipped), be sure that operators are aware that the system will automatically restart when power is restored. This is particularly important if electrical power is lost to the entire plant. Operators must be warned to avoid touching moving parts of equipment that will be reactivated when the electricity is restored.

Operation

The unit is designed to be ON full time so that the computer in the control panel 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 should be connected to the AC power from the power line 100% of the time during normal operation.

The power supply contains an EEPROM to store all of the user inputs for its adjustable settings. The user settings for current and batch times are not lost if the system loses its source of AC power. When AC power is restored to the control system, all the user settings will be intact. In addition to the user settings, the technical settings are also saved in EEPROM

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 operator or technician to input values for the user adjustable settings and to set up the technical settings.

Modes

The power supply can run in four different modes. Each mode defines a different level of operator involvement. The modes range from fully automatic to fully manual. The default setting is the fully automatic mode. The mode is determined by the technical settings.

Switch Readings and Pump Controls

The two liquid level switches (LL1 and LL3) are normally closed if no liquid is present in the tanks. If the system is empty, the LED's on the distribution box should be lit, indicating a closed condition. The default state of the tanks is normally empty; therefore, when the tanks fill, the switches open and the LED's will go out. The connection on the liquid level switches must be opened to tell the power supply to turn on the pumps to fill the tanks. If there is a break in a wire or a bad connection, the tanks will not be overfilled.

Liquid Level Switch 1 (LL1) is only 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 power supply starts the pump and the unprocessed fixer 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 to signal that a new batch can be started.

Fault Conditions

Fault conditions that can cause the power supply to shut down or not start are listed below.

Excessive Heat. The fan must not be blocked, and the power supply must have an adequate source of fresh, unheated air. The power supply is thermally limited to prevent damage to itself from overheating. If the unit is too hot, the power supply will be unable to output the selected amperage.

Low Amps Output. If the unit is too hot, the power supply will be unable to output the selected amperage. For example, if 15 Amps output has been selected and the power supply is only outputting 9 Amps, most likely cause is a high temperature in the power supply.

Low AC Input Voltage. If AC power available has low voltage, the under-voltage lockout signal in the power supply will sense this condition. The installer must check to make sure the AC input voltage levels match the specifications shown on the back panel of the power supply.

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

Hardware Limits

The system is configured at the factory with the following hardware and software performance ranges. These defaults are fixed and are not adjustable through software.

| | |
|---------------------------------|--------------|
| Built in voltage limit | 5.1 Volts DC |
| Maximum current | 45 Amps |
| The computer settings available | 4 to 40 Amps |

Default Settings for User Adjustable Settings

The default settings for the user adjustable values are listed below.

| <u>User Adjustable Setting</u> | <u>Value</u> |
|--------------------------------|--------------|
| Current Setting (CV1) | 25 AMPS |
| Batch Time Hours (CV2) | 2 HOURS |
| Batch Time Minutes (CV3) | 1 MINUTE |
| pH Pump Time Minutes (CV5) | 0 MINUTE |
| pH Pump Time Seconds (CV6) | 0 SECONDS |

Change Value (CV) Routines for User Adjustable Settings

The system has a routine to change the numeric values of the adjustable setpoints that are available to the end user. The user may change the current, the batch time hours and minutes, and usually the pH pump time hours and minutes. To make changes to these settings, the user needs to enter 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. 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.

The settings CV1 through CV6 are for general operator use. There are other settings available, but they are accessible only to a factory or field technician, and will not be seen during normal operation. The expanded set of technical settings is documented in Sections II and III – Technical Settings of this manual.

CV1 Set Current

The batch timer unit allows the operator to set the number of amps that are output from each channel. Use CV1 change the amps up or down. The range available is 4 to 40 amps output per channel.

CV2 Set Batch Time in Hours

The batch timer enables the operator to control the time the unit will run. Use CV2 to set the number of hours that the unit will run. The range available is 0 to 24 hours.

CV3 Set Batch Time in Minutes

Use CV3 to set the minutes, in conjunction with the hours setting, within the range of 0 and 59 minutes.

CV4 Bypass Timer / LL Switches

During setup of the system or when doing diagnostic testing, there may be a need to override the system's normal timers and liquid level switch settings. Use CV4 to bypass a timer or LL switch. This feature forces the computer program to advance to the next step in the process. To utilize this option, scroll through the Change Values options to CV4 and press the ENTER button to bypass the step that the system is presently executing and move on to the next one. The power supply must be in a running state in order to bypass a step in the operation, if the display reads UNIT OFF this feature will not work. A detailed example of the use of this feature while setting up and checking the functions of the system is found in the Appendix at the end of this manual.

CV5 Set pH Pump Time in Minutes

(If technical setting ST 26 is set at 1 to disable the pH pump, this setting will not appear.)

This feature (if available) allows the run time for the pH pump to be set by the operator. The range available for this setting is 0 to 10 minutes.

CV6 Set pH Pump Time in Seconds

(If ST 26 is set at 1 to disable the pH pump, this setting will not appear.)

This feature (if available) allows the run time for the pH pump to be set by the operator. The range available for this setting is 0 to 59 seconds.

CV7 Exit

When the unit is in the field, this option is the last selection available to an operator in normal situations. Press the ENTER button to return to the operational display. If the CHANGE VALUE routines are left idle for more than 30 seconds, with no keypad inputs, the computer will exit the CV routines on its own.

Technical Settings 40 AMP Supply with Distribution Box

Program/Lockout Jumper

The technical settings for the BFX 500 power supply are normally altered only by factory engineers and field technicians. Under most circumstances, the end user has no need to change any of these settings. To gain access to the technical settings, the PROGRAM/LOCKOUT hardware jumper on the power supply computer board must be placed in the PROGRAM position. If the technician needs to use the computer routines to alter any of the technical Change Value settings, the jumper position of **J4** must be changed from LOCKOUT to the PROGRAM position.

If the PROGRAM/LOCKOUT jumper J4 is absent (not installed), the unit will be continually in PROGRAM mode. The unit will still be operational but the technical program settings will not be protected from accidental alteration. Once a system has been installed and is running properly, it is recommended that the jumper be set to LOCKOUT. In the LOCKOUT position the user can change the user accessible settings at any time, but is denied access to the computer routines for changing the technical settings.

WARNING

If the user or technician attempts to move the J4 jumper, the system must be well grounded to prevent an electrostatic discharge. Changing the jumper could cause static that could harm or destroy sensitive electronic components.

When the jumper is in the PROGRAM position, additional CHANGE VALUE (CV) settings CV8 through CV15 are revealed and may be changed by the technician. Also, another series of adjustable technical settings, STATE CHANGE (ST) are available. The STATE CHANGE settings can only be reached by inputting a special keystroke sequence on the keypad, further protecting them from inadvertent changes. The STATE CHANGE settings are used to customize each system and will usually be set by the factory or a Hallmark technician. Section III of this manual discusses the ST (STATE CHANGE) settings.

Additional Change Value Settings

CV8 Set Fill Times in Minutes – Technical Setting

(If this message says HOLD time, refer to ST23 setting)

Factory Default is set to 2 minutes

The range available is 0 to 30 minutes. This setting controls the amount of time the collection pump runs, to allow the rotor (cathode) tank to fill before beginning processing of the batch.

CV9 Clear Batch Count – Technical Setting

This setting will reset the batch counter to zero. During normal operations, the system counts how many batch cycles it has processed. If CV9 is reset by the technician, the batch counter tally is set to zero. There is no option to partially reset the batch count – the system can only be reset to start its counting sequence at 0.

CV11 Set Prompt/No Prompt – Technical Setting

Set at 0 for the BFX 500

0 = No Prompt 1 = Prompt

This setting determines how much input the operator will have during the running of a batch. Use *CV11* to choose between **Prompt** before the next step in the processing cycle, or **No Prompt** option. If **Prompt** is selected, the system stops and waits for operator input. If **No Prompt** is selected the system runs automatically.

CV12 Set Auto/Manual – Technical Setting

Set at 0 for the BFX 500

0 = Auto 1 = Manual

This setting determines the mode of operation for the unit. This setting works in conjunction with *CV11* to determine how much input the operator will have over the system when it is operating.

CV13 Set to Fault or Restart on Power Failure**On/Off Option – Technical Setting****0 = Restart on Power Failure****1 = Fault on Power Failure****Set at 0 for the BFX 500**

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. All Change Value (CV) and State Change (ST) settings are stored in the EEPROM. The system will restart when power is restored. CV13 is the setting that is used to determine how the restart sequence will proceed. The technician can determine if the power supply will restart upon restoration of power or will stay off. If the display reads 0, the option is set for automatic restart after a power failure and the unit will resume operation at the exact state of processing when the power interruption occurred without any operator keypad input. If this setting is set to 1, the option is off and the display screen on unit will show the message

POWER FAIL - RUN OR RESET

And the system will wait for a manual restart. Pushing RUN will restart the batch where it left off and RESET will take the system out of its routine and back at the beginning of the processing cycle.

WARNING

If the unit is in a location where human contact with moving parts is possible, then set this variable to 1 to have MANUAL restart with a prompt message.

CV14 Amps Display Method – Technical Setting**0 = Average 1 = Peak**

Set at 0 for the BFX 500

LEAVE THIS SETTING AT 0.

The peak option is not recommended on the BFX 500.

Background Information:

This option may be used by the technician to diagnose hardware problems.

If the display is set shows **Peak 0**, the unit is not using the peak display method, and will instead show the average amps from readings taken over a 4-second period.

CV14 Amps Display Method – Technical Setting

If the display is set to **Peak 1** the unit is set up to show the peak amps from readings taken over a 4-second period.

If the readings seem to jump around and not stay consistent, then the peak setting will give a more accurate reading. If it becomes necessary to use the peak reading regularly, it is an indication the brushes located in the tank are becoming worn.

CV15 Exit – Technical Setting

Press ENTER to exit the CHANGE VALUES routine and resume normal operation

Additional Technical Settings 40 AMP Supply with Distribution Box

To Change State Change Settings: ST 17 through ST 24

ST Settings Keystroke Access Code

To access the ST changes press the CV button until CV15, the EXIT option, is displayed. Press the UP ARROW button concurrently to enter the ST (State Change) routines. Use the CV Key to move through the ST options available and the UP and DOWN arrows to change the setting of a particular ST option. Pressing ENTER locks in the State Change entry.

Purpose of ST Settings

The ST values are rarely changed in the field. These settings are the ground level setup that is used to customize the power supply. One computer program is used to run all the models of power supplies available from Hallmark Refining. Some of the settings refer to options used on other Hallmark power supply models.

All of the ST settings are shown in binary logic. The display will read 0 or 1, and an explanatory word to indicate which setting is being adjusted. The table at the end of this documentation summarizes the settings in a one-page format.

ST Settings Factory Defaults

When the unit leaves the factory it is set to run as a BFX 500 40 Amp unit. The default ST settings are set as follows:

ST17 through ST 22 = 0
ST23 through ST24 = 1
ST25 through ST28 = 0

| | | | |
|------|---|--|------------------------------|
| ST17 | 0 | 40 Amp Power Supply | Must be set at 0 for BFX 500 |
| ST18 | 0 | Master/Slave Two Power Supplies | Must be set at 0 for BFX 500 |
| ST19 | 0 | One Channel Displayed | |
| ST20 | 0 | No More Active Output Displays | |
| ST21 | 0 | Not Applicable. Not Used. | |
| ST22 | 0 | LL1 Switch Present and Enabled | |
| ST23 | 1 | LL2 Switch Disabled. No LL2 Switch Present | |
| ST24 | 1 | LL4 Switch Disabled. No LL4 Switch Present | |
| ST25 | 0 | Set for Master Unit | |
| ST26 | 0 | pH Pump Enabled | |
| ST27 | 0 | Set for Batch Mode | |
| ST28 | 0 | 0 Not Applicable to 40 Amp | |

ST Settings

ST17 SET POWER SUPPLY SIZE
 0 = 40 Amp
 1 = 125 Amp

BFX 500: Set to 0

Always leave this setting at 0 for the 40/80 Amp units. Selects what kind of supply the computer is running. 0 selects a 40-amp power supply and 1 selects a 125 power amp supply.

ST18 SET SINGLE POWER SUPPLY OR DUAL (MASTER AND SLAVE CONFIGURATION)
 0 = 40 Amp Single Power Supply
 1 = 80 Amp Master/Slave 2 Power Supply Setup

BFX 500: Set to 0

This option enables the system to run two power supplies as one. By doing this, the output is doubled. For example, by combining two 40 Amp power supplies, the system runs as a single 80 Amp unit, which is the hardware setup for the BFX 500. By combining two 125 Amp power supplies, the system runs as a single 250 Amp unit. The amperage is set with the ST17 setting and is also determined by the hardware of the unit.

For these units, if the display reads 0 the unit is running as a 40 Amp unit. If the display reads 1, then two units will run together as an 80 Amp unit.

The BFX 500 units must always have this setting set at 1.

ST19 SELECTS NUMBER OF CHANNELS DISPLAYED

0 = One channel display

1 = Add more channel displays

BFX 500: Set to 0

Selects the number of channels that are displayed. The BFX 500 will have only one output display even though there are two 40 Amp supplies running. The computer program will take two channels of display data and combine them into one channel that is shown in the message window. The display will show the sum to the two outputs. If ST19 is set at 0, one channel is displayed and if it is set at 1, then the two separate channels are displayed. Other Hallmark units have more rotors and require more channels to be displayed. This computer program is equipped to run most of the units currently available from Hallmark and some of the settings that are available relate to those units.

ST20 SELECTS OUTPUT DISPLAYS

0 = Add no more output displays

1 = Add two more output displays

BFX 500: Set to 0

Selects number of active outputs displayed on the amp display. 0 adds no more outputs. 1 adds two more outputs. Combined with ST19 these can add 0-3 outputs.

ST21 NOT APPLICABLE**BFX 500: Set to 0**

This selection is a spare for future use and will not influence the operation of this unit.

ST22 LL1 ENABLED/DISABLED

0 = LL1 Present 1 = LL1 Not Present

BFX 500: Set to 0

Some systems don't have a Liquid Level 1 (LL1) switch. This setting tells the computer there will be no input from the LL1 switch. If there is an LL1 switch in the collection tank, this must be set to 0 indicating the switch is present. If there is not an LL1 switch installed in your system, this setting should be set at 1. If there is an LL1 switch, the unit will say, "Waiting for Batch" if the LL1 switch is not activated. The LL1 switch detects if the collection tank is full enough to run a full batch of fixer. If there is not an LL1 switch, the unit will prompt, "Push Run to Start". All units will have an LL1 switch to prevent the user starting a batch without liquid present, unless you use this setting to disable it.

NOTE - The 40 amp BFX 500 does have a LL2 switch to start the batch after collection is sufficient, so the LL1 starts the collection and a LL2 is used to start the batch. ST23 must be set to 1 for the setup to work in this manner.

ST23 LL2 ENABLED/DISABLED

0 = LL2 Enabled

1 = LL2 Disabled

BFX 500: Set to 1

Selects if there is a Liquid Level 2 (LL2) switch. Set at 0 if LL2 is present. Set at 1 if LL2 is not present. Units that have a separate rotor tank usually have an LL2 switch, and units without a separate tank usually do not. If this setting is enabled,

the unit will wait at the end of the processing time to allow the rotor tank to drain. There is a corresponding time before the processing time to allow the rotor tank to fill. This option also determines if the filling period is timed or tripped by the LL2 switch. If 1 is selected there is only a fill time. This setting should be set to 1 to disable the LL2 switch on the BFX 500 40 Amp units.

ST24 LL4 ENABLED/DISABLED

0 = LL4 Enabled

1 = LL4 Disabled

BFX 500: Set to 1

Selects if there is Liquid Level 4 (LL4) switch. Set at 0 if LL4 is present. Set at 1 LL4 is not present. If the unit does not have an LL4 switch, the setting should be set to a 1 to keep from triggering a fault in the processing state. This is set by the factory to 1 (No LL4) in the BFX 500.

ST25 MASTER/SLAVE SELECTION

0 = Master

1 = Slave

BFX 500: Set to 0

Master/Slave switch. **The BFX 500 is always a master unit**, because a single computer controls all of the steps in the process. This setting enables the communication ports to other Hallmark models. Set at 0 to select master mode. Set at 1 to select slave mode. If 1 is selected, the unit will be remote controlled by one of the older batch or C-Probe control units.

Do not change this setting in the BFX 500 units.

ST26 ACCEPT OR REMOVE pH PUMP

0 = pH Pump Enabled 1 = pH Pump Disabled

BFX 500: Set to 0

If there is a pH pump installed, select 0. If the pH pump is absent, select 1.

NOTE: This disables the pH pump fill time during filling, and removes the pH pump time options (CV5 and CV6) from the change value options.**ST27 BATCH OR C-PROBE**

0 = Batch Timer Unit 1 = C-Probe Unit

BFX 500: Set to 0

This setting is used for Hallmark units using a silver probe (C-Probe). The BFX 500 units are not equipped for this option. This manual does not cover C-probe operation.

This setting should always be set at 0 for the BFX 500.**ST28 C-PROBE OR VOLTAGE CONDUCTIVITY**

0 = Remote C-Probe 1 = Voltage Conductivity

BFX 500: Set to 0

This setting is used for Hallmark units using a silver probe (C-Probe). 0 selects C-Probe. 1 selects voltage conductivity. This is an option for C-Probe units. This setting is ignored by batch units.

This option must be set at 0 for the BFX 500 units.**ST30 EXIT**

Allows exit from the ST programming values routine. Press ENTER to return to the main program immediately. If there is no keypad activity for 30 seconds, the unit will revert back to the main program on its own.

Settings Checklist

Suggested Defaults

END USER SETTINGS

| | |
|-----|------------|
| CV1 | 25 AMPS |
| CV2 | 2 HOURS |
| CV3 | 1 MINUTE |
| CV4 | NO SETTING |
| CV5 | 0 MINUTES |
| CV6 | 0 SECONDS |
| CV7 | EXIT |

TECHNICAL SETTINGS

| | |
|------|----------------------------------|
| CV8 | 2 MINUTES FILL TIME |
| CV9 | NO SETTING |
| CV11 | 0 FOR NO PROMPT MODE |
| CV12 | 0 FOR AUTO MODE |
| CV13 | 0 FOR AUTO RESTART ON PF |
| CV14 | 0 FOR AVERAGE READINGS |
| CV15 | EXIT CV ROUTINES |
| ST17 | 0 FOR 40 AMP OUTPUT |
| ST18 | 0 FOR 40 AMP UNIT |
| ST19 | 0 FOR ONE CHANNEL DISPLAY |
| ST20 | 0 FOR NO ADDITIONAL CHANNELS |
| ST21 | 0 NOT APPLICABLE TO 40 AMP UNIT |
| ST22 | 0 FOR LL1 SWITCH ENABLED |
| ST23 | 1 FOR LL2 SWITCH NOT PRESENT |
| ST24 | 1 FOR LL4 SWITCH DISABLED |
| ST25 | 0 FOR MASTER SETTING |
| ST26 | 0 FOR pH PUMP PRESENT |
| ST27 | 0 FOR BATCH MODE |
| ST28 | 0 NOT APPLICABLE TO 40 AMP BATCH |
| ST30 | EXIT |

System Testing Procedure

Bypass the Timer and Override Liquid Level Switches

The steps outlined below can be used to test the system during installation, or for troubleshooting.

Setup

Check that the power supply is connected to AC power and that the display will light up by pushing the RUN button on the keypad. The display should say:
HALLMARK REFINING CORPORATION

The display will quickly change to another message. The second message displayed will vary depending on the way the system has been configured at the factory. For most operations the automatic mode has been selected and the display will read:

WAITING FOR BATCH

Quick Testing

The computer has a special routine that allows the user to quickly move through the steps that occur during the processing of a batch and make the computer perform the next part of the processing sequence. This procedure forces the computer to bypass the step it has paused on and move on to the next step, or it forces the computer move forward, ignoring the Liquid Level switch that has caused it to pause.

Example: Overriding the Liquid Level 1 Switch

The LL1 switch is located in the collection tank. This switch flips open when there is enough fixer collected in the tank. When the LL1 switch opens, the computer program detects that the rotor tank is ready to begin filling. During installation and testing of the system, if the user does not want to wait until the LL1 switch opens, it can be bypassed by using the CV4 option in the CHANGE VALUE routines. Using the CHANGE VALUE button located on the front keypad, cycle through the options until CV4 appears. Push the ENTER button to force the computer to ignore the LL1 switch. The remainder of the automatic cycle will proceed normally. If there are additional waiting periods in a normal cycle that the user wants to bypass, CV4 can be used repeatedly to move the system through a cycle.

If the system is running, CV4 is used to bypass any step of the batch processing or to override any liquid level LL switch the computer monitors.

The computer has several situations when it waits for liquid level switches to trip. It also has timed waiting periods in a normal automatic processing cycle.

Waiting for Batch

During this step the computer is waiting for input from the LL1 switch.

Filling

This is the step to fill the batch tank.

Processing

This is a timed step to remove the silver from the fixer solution.

Emptying

During this step, the rotor tank is drained by the tailing pump. When the tank is empty the LL3 switch will close, telling the computer that the tank is ready to start a new batch.

Holding

This is a 5-minute waiting period to allow the liquids to drain from the pipes and tanks of the system.

To use CV4 to bypass a step, follow the steps below. If the system is not running, CV4 has no effect.

While the system is running, push the CHANGE VALUE key until the CV4 Bypass Timer/LL option is displayed.

When this option is found, push the ENTER button. With each press of the ENTER key, the system advances to the next step in the processing cycle. When CV4 and the ENTER key are used, the normal waiting periods are bypassed and all conditions of Liquid Level switches are ignored.

SILVER CONCENTRATION TEST PROCEDURE

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

Procedure:

- a) Immerse 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.

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 500 is 7.8 to 8.4.

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

3.6 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.

ROUTINE EQUIPMENT INSPECTIONS

Do a routine daily visual inspection of the following:

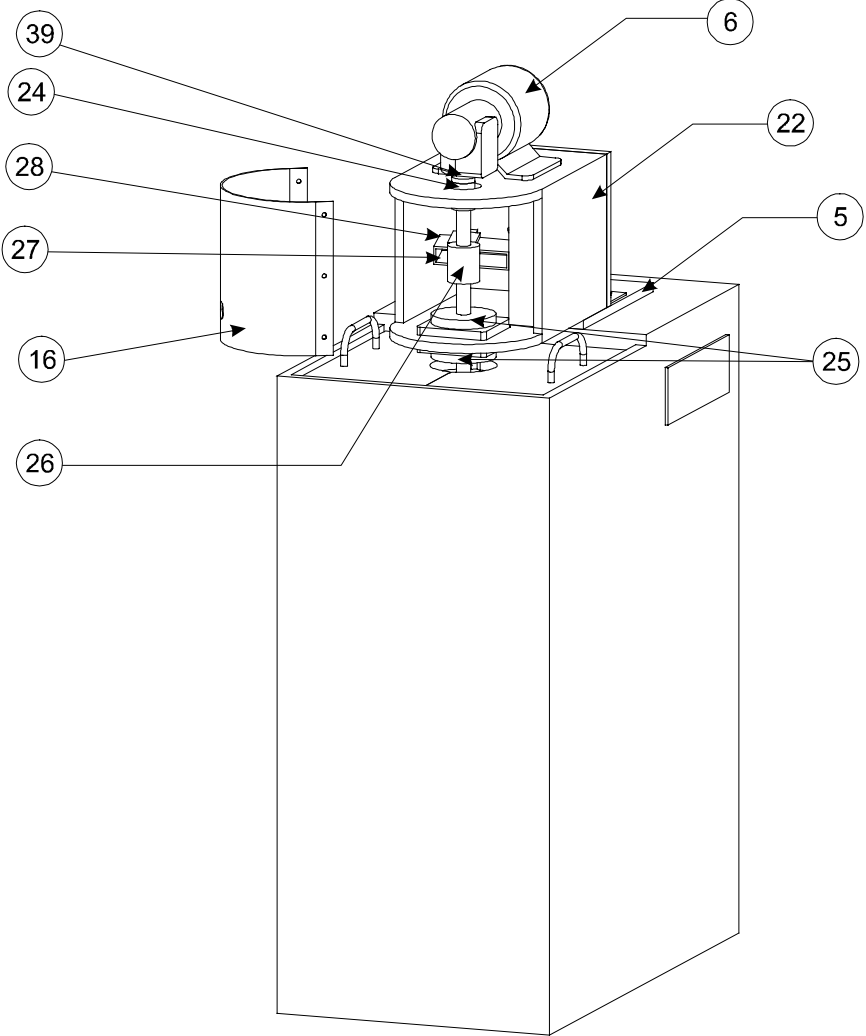
- a) Periodically inspect tubing and tighten clamps connection to avoid leaks.
- b) Inspect the drum for proper plating and take corrective action if necessary.
- c) Keep your equipment clean and the work area around it free of clutter, to avoid accidents when working on or around the recovery unit.
- d) Grease the bearings after harvesting the and cleaning the cathode.

PARTS LISTS AND WIRING DIAGRAMS

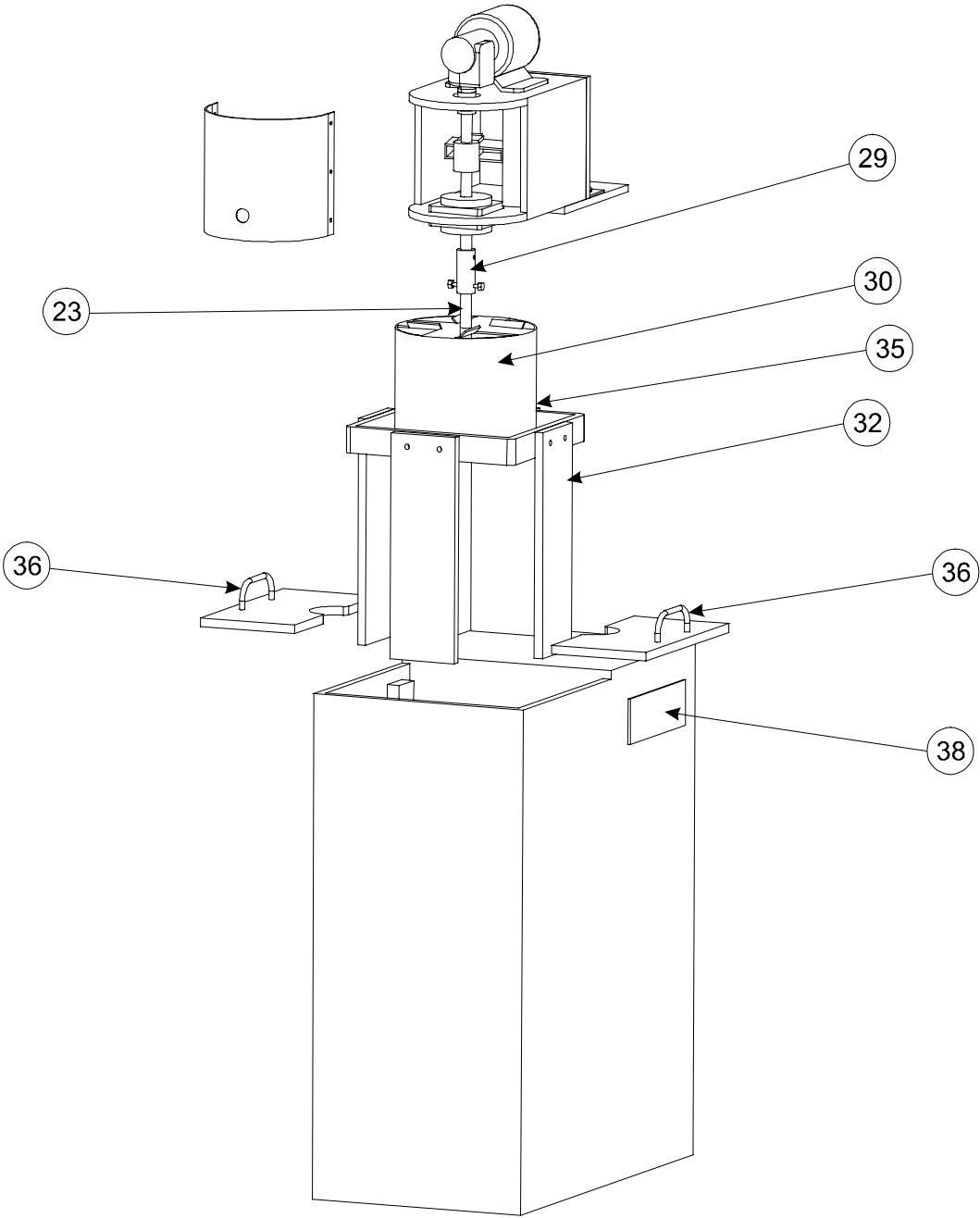
PL BFX-500 - Silver Recovery System

| Ref # | Part Number | Part Description | # of Parts |
|-------|-------------|--|------------|
| 1 | 742-001 | Flex Conduit Ploytuff B2075 HU | 1 |
| 2 | 251-002 | Equipment Feet 15/16 2097 | 2 |
| 3 | 742-001 | Conn Liquid Tite PO75N-BK HUBBE | 1 |
| 4 | 742-003 | Elbow Liquid-Tite PO759N-BK HUB | 1 |
| 5 | 250-001 | Hinge SS 6" X 3" x 1/8" | 1 |
| 6 | 703-150 | Motor, Drive Bodine 1/50 HP | 1 |
| 7 | 601-005 | Cord, Grip 1/2" SHC1022CR HUBBE | 1 |
| 8 | 728-016 | PWR Cord 3/Cond 1W614 | 1 |
| 9 | 313-007 | Elbow 90 INSXMP | 2 |
| 10 | 307-005 | Elbow 90 INSXMP | 2 |
| 11 | MD-15TB | MD-15RLT 115V Iwaki Pump | 2 |
| 12 | 336-005 | Male Adapter INSXMP | 1 |
| 13 | 335-005 | Fem Adapter INSXFP | 2 |
| 14 | 524-782 | Switch, Liquid Level 10-782-RP | 1 |
| 15 | 524-650 | Switch, Liquid 15-650-RP | 2 |
| 16 | 903-503 | Drive Cover Clear | 1 |
| 17 | 313-010 | Elbow, 90 INSXMP | 1 |
| 18 | 5C115 | Fan, Muffin 3 1/8 Square 5C115 | 1 |
| 19 | 249-001 | Fan, Guard 3 1/8 4C740 | 2 |
| 20 | 850-020 | Plug, MPT SCH 80 | 1 |
| 21 | 903-519 | Heat Sink, Aluminum | 1 |
| 22 | 903-502 | Drive Housing, Poly Pro | 1 |
| 23 | 903-511 | Shaft, Cathode 1/2" | 1 |
| 24 | 903-516 | Motor, Coupling Rubber 21SR | 1 |
| 25 | 903-512 | Flange, Bearing SKY-FY 1/2" | 2 |
| 26 | 903-513 | Shaft, Commutator Assy. 1/2" | 1 |
| 27 | 903-514 | Brush, SCC22015 Arrowhead | 1 |
| 28 | 903-517 | Brush, Holder 36A161973AAG01 | 1 |
| 29 | 903-518 | Cathode, Coupling 1/2" | 1 |
| 30 | 903-531 | Cathode, 8" X 6" | 1 |
| 31 | 903-515 | Fuse, Fusetron Buss FNMI | 1 |
| 32 | 903-506 | Anodes, Carbon 14x4 | 4 |
| 33 | 903-509 | Overflow Assy. | 1 |
| 34 | 903-510 | Fill Pipe Assy. | 1 |
| 35 | 903-005 | Anode, Ring 10 3/4" x 10 3/4" | 1 |
| 36 | 18645A23 | Lid Handles 316 SS | 2 |
| 37 | SV040 | 40 Amp Power Supply w/Distribution Box | 1 |
| 38 | | Front Control Panel | 1 |
| 39 | 903-429 | Endcaps | 2 |

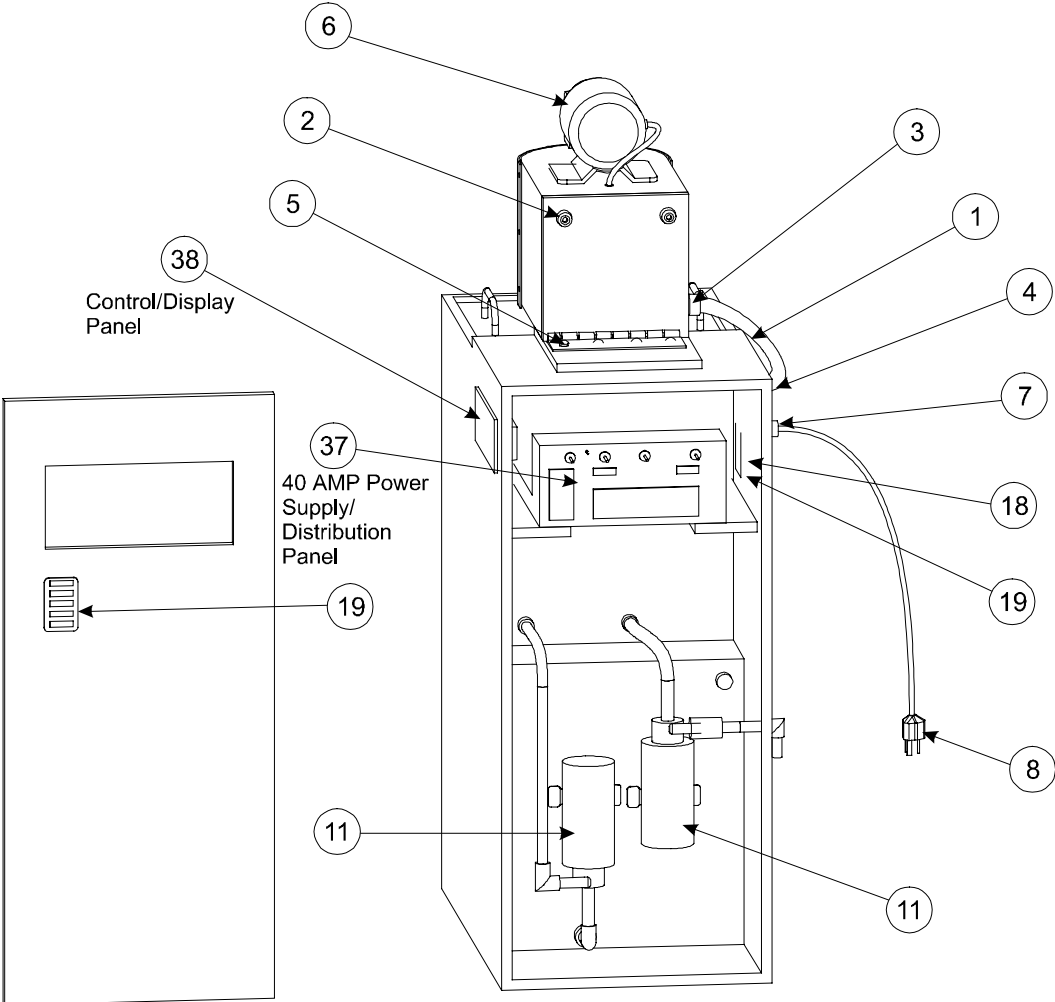
BFX 500 DRAWINGS



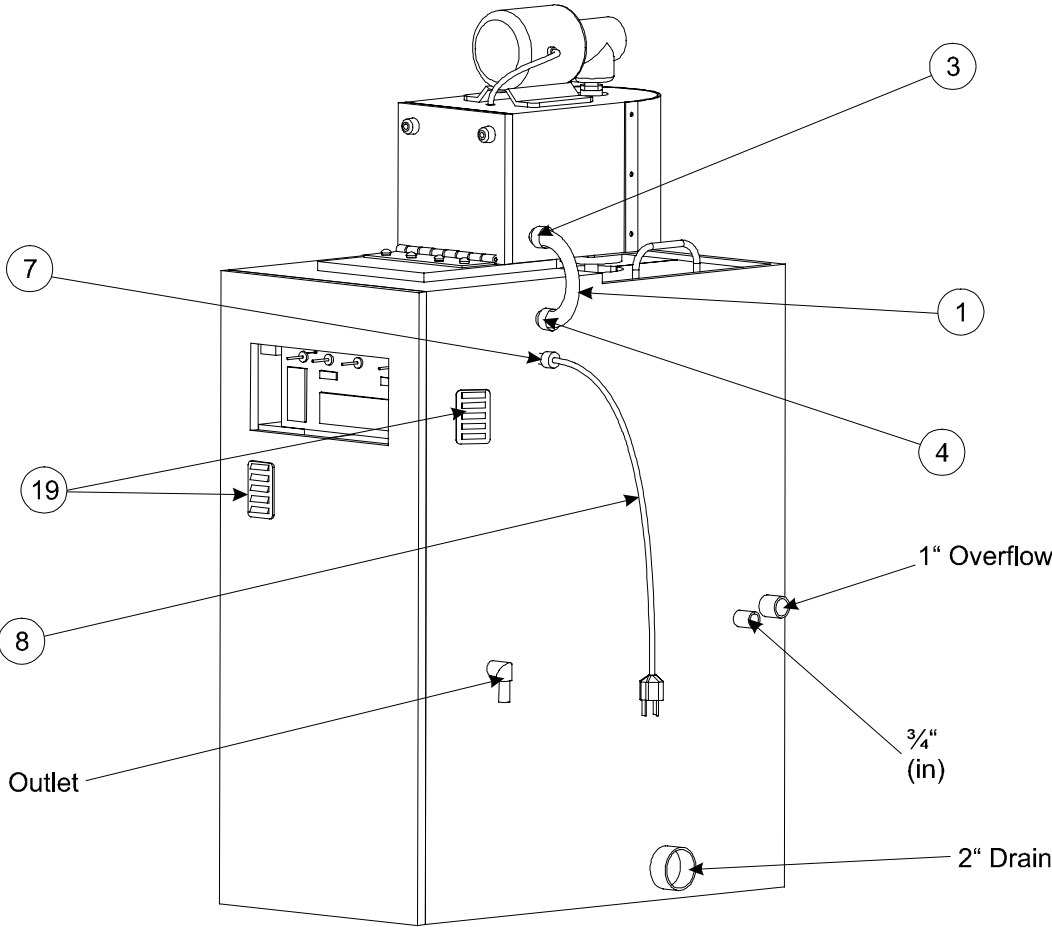
BFX500 Silver Recovery System



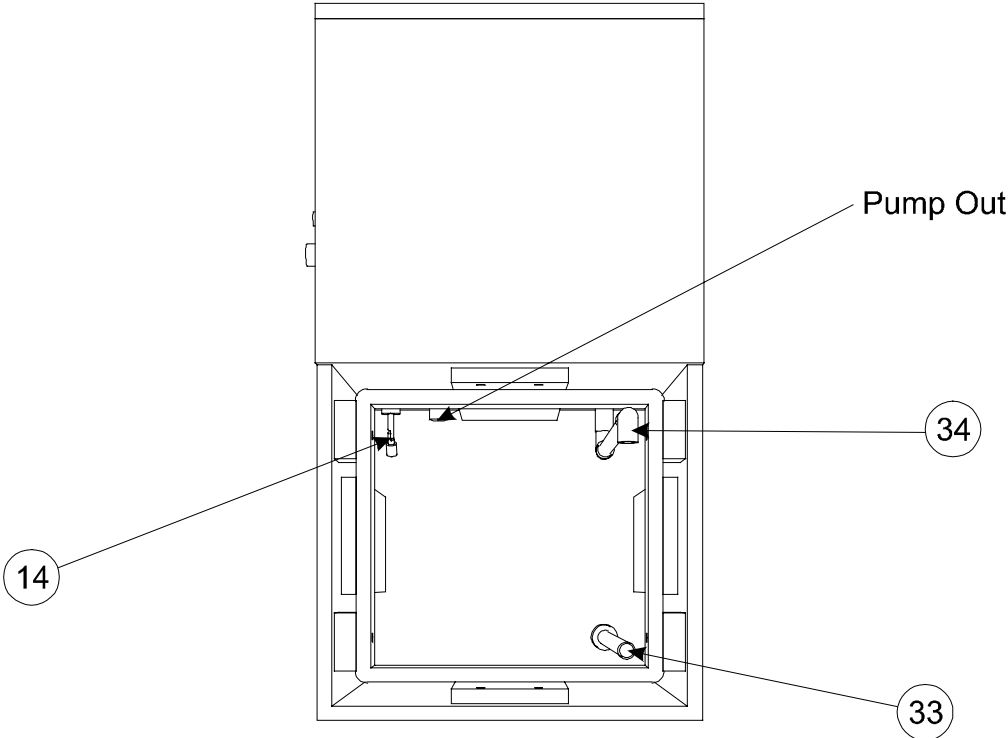
BFX 500 Cell - Exploded View



BFX 500 End View



BFX 500 - Side View



BFX 500 - Top Cell View