Statement of Warranty and Liability

All equipment manufactured by Hallmark Refining Corporation is guaranteed against defects in materials and workmanship for a period of six months from the date of shipment from our factory. Any claimed defects must be reported within 30 days, and the materials and/or equipment must be returned freight prepaid, to our plant within the guarantee period. Our liability for defects in material and/or workmanship shall be limited to the replacing or repairing, at our option, such defective materials and/or equipment at no cost to the purchaser. Any damages or loss occurring during shipment are not covered by this warranty but are the responsibility of the carrier(s). Please report all shipping damage to the carrier(s) immediately.

All materials and/or equipment furnished by other suppliers carry no warranty except said supplier's warranty as to materials and workmanship. Transportation, handling damage, wear and tear, and other causes of damage outside the control of the manufacturer are not covered by this warranty. Under no circumstances will Hallmark Refining Corporation be responsible for any 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, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, EXCEPT AS STATED ABOVE. The warranty becomes null and void if any devices or accessories other than those distributed or officially recommended by Hallmark Refining Corporation, are installed, or attached to this equipment.

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Introduction

The Hallmark Silver Controller is an upgrade for the Great Lakes Silver Controller. It performs all functions of the original Great Lakes silver probe controller box, as well as several additional functions. This upgrade applies to Hallmark 3000 and 6000 series Electrolytic Silver Recovery Systems.

The Hallmark Silver Controller is a computer controlled silver concentration measurement device. The silver probe keeps constant track of the amount of silver in the fixer. The silver controller has three primary control outputs. Two of those outputs are relay outputs, and one output is an analog signal that is typically fed into a connected power supply for analog control of that power supply. There is also an alarm relay output and an open collector transistor output for ON/OFF control of certain remote power supplies. The transistor is in the conduction state when OFF is selected.

The silver probe computer program evaluates the input from its sensing apparatus and outputs the appropriate number of volts to control its two relays and the analog output of its control amplifier. The resulting control signal is also displayed on a large LED display as Grams/Liter concentration. The silver probe computer has many user adjustable settings that are used to customize the performance of the controller. Besides the start and stop setpoints of the two relays, the computer can also control the span of the output by changing the gain of the signal. The input buttons that are used to change the settings of the controller are located on the keypad on the front of the unit. **The silver controller has its own computer. Do not confuse the silver probe computer with the Hallmark power supply computer.**

The routine to change the numeric values of the adjustable setpoints used by the silver controller computer program is called the **Change Values** routine (CV). These setpoints allow the operator to change the relay start and stop levels as well as other performance characteristics of the silver controller.

Silver Controller Operation

The Silver Controller Connected to a Power Supply

The silver controller is almost always connected to a power supply. The connection to the power supply may be through a relay output of the silver controller, or it may be connected directly to the analog output of the silver controller. If the power supply is a Hallmark power supply, the power supply has its own computer intelligence, and the two components work closely together. **This manual discusses the computer program in the Silver Controller.** The silver controller keypad input buttons and the display screen are physically located on the front hinged lid of the unit. The keypad is used to start and stop the unit and to change values (setpoint parameters) for the silver controller.

Silver Probe Components

Overview

The system uses a Great Lakes Preamp Model 713A4L1000B to process the signal from the probe that is immersed in the silver fixer solution. The output from the preamp is next fed into an isolation amplifier that is the analog input of the Hallmark Silver Controller computer. The computer has setpoints, scaling, delays and other functions that process the raw signal. The computer then outputs to its two output relays and to the analog output. This analog output ranges from 0 to 4.5 volts.

Probe Head

The probe head sensor contains two “batteries” whose voltages are compared and the difference is measured. One battery is formed by the solution sensing electrode and the other battery is formed in the reference cell. The probe uses an electrical circuit to buffer this differential voltage signal and send it to the analyzer circuits in the controller.

Amplifier and Analyzer

The Great Lakes amplifier box assembly is connected to the Great Lakes analyzer with a shielded cable. The shielded cable is essential to protect against noise disturbance that could cause feedback to the amplifier box. Noise feedback will cause the box to cycle on and off repeatedly, and the entire system will not function correctly.

Computer

The computer in the front panel contains the program that operates the systems well as the EEPROM memory that holds the adjustable system settings. The computer program uses routines to change setpoints that are used to customize the system for each installation. The setpoints for the computer are set through the keypad located on the front panel.

Message Display

The front panel has a 2-line message display. The display shows the conditions of the system.

Keypad Buttons

The 6-button keypad enables the operator or technician to input values for the user adjustable settings.

Computer Board

The computer board in the front panel contains the full computer program that controls the system. It has an EEPROM chip that saves the adjustable settings that have been input. The EEPROM information is non-volatile and will not be lost if electrical power is disconnected. This computer program uses setup routines to enable the operator to set up the system for each unique installation.

7 Segment Red LED Display

The output display is a digital display with 3 large red 7 segment LED's that show the number of Grams/Liter being output from the probe transmitter.

Green LED – System Power Available

The Green LED indicates if the unit is plugged in and is powered up. This green LED is located above the Change Values Button.

Yellow LEDs – Relays Activated

The two yellow LEDs indicate if the two relays are activated. When the LED's are lit they show activation of the relay coils. There is a normally closed / normally open relay contact available.

Red LED – Alarm Relay

The red LED is located just above the right UP arrow. If this LED is lit, the alarm relay has been activated. The alarm relay is a normally closed / normally open relay contact.

Connecting the Silver Controller to AC Power

The unit must be supplied with AC power full time so that the computer in the control panel stays alive. The unit does not have an ON / OFF power switch.

The unit is connected to AC power by way of two terminal strip connections. These two connections are labeled AC 1 and AC 2. These connections are in series with a 1 Amp Slo Blow Fuse for unit protection. This fuse is not used to provide AC power to the control relays for external control. AC power for user devices controlled by the silver control relays must be supplied externally and fused accordingly.

The CPU Control panel contains an EEPROM to store all of the user inputs for its adjustable settings. The user settings 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.

Safety Warnings and Fault Conditions

Low AC Input Voltage

The installer must check to make sure the AC input voltage levels match the specifications. The controller must have at least 105 and up to 130 VAC provided to it in order to run properly.

Improper Grounding

The unit also must be properly grounded for safety. The silver controller box is totally insulated and isolated from true earth potential because the control voltage is reference to the cathodes of the external electrolytic unit. The earth connection on the terminal strip is for the convenience for the installer only, as there is no

actual earth connection used in the controller box. The earth connection is always referenced to the anode of the silver electrolytic system and all connections must have continuity to this reference. The amplifier box for the probe has an earth connection that must connect to the anodes.

Restarting After an Electrical Power Outage

<<<WARNING>>> The controller will automatically restart itself if there has been a failure in electrical power supplied to the system. Be sure that the unit is disconnected from the utility before working on pumps and rotors. The system will not lose any information during a power failure. All programmable setpoint information is stored in an EEPROM, which is not affected by power disruptions.

Change Value (CV) Routines for User Adjustable Settings - Grouped by Function

Using the Keypad to Enter New Values

Using the Change Value routine, the values of the adjustable setpoints can be changed. To make changes to these settings, the user must enter the Change Value (CV) routine. The keypad on the front of the unit 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. To make a change, press the UP and DOWN arrows on the keypad, the change is locked in (executed) by pressing the ENTER button on the keypad. When a change is made, part of the CV message displayed will blink to show the operator there has been a change. **Pressing the ENTER button locks in the new information.**

There are software setpoints for the Silver Controller.

Shutoff Point in Grams Per Liter - CV 3 and CV 5

The shutoff point has two elements: Low Relay and High Relay Grams Per Liter at Shutoff. These two software settings are input through the controller keypad.

The lowest shutoff point that can be set is .020 grams per liter, and the highest shutoff point is 4.78 grams per liter. The software of the computer forces the shutoff point to be at least .20 grams per liter below the restart point (set through CV3). The highest restart point that can be set is 4.78 grams per liter.

The maximum G/L (grams/liter) to be output by the controller is a software setpoint. The built in limits are 0.0 G/L to 4.0 G/L. If the over range limits are sensed, the unit will shut down and set the alarm relay, and also the control panel red LED above the up arrow will be turned on.

CV 3 - Low Relay OFF

Setting Range from 0.02 Grams/Liter to 4.78 Grams/Liter

CV 5 - High Relay OFF

Setting Range from 0.02 Grams/Liter to 4.78 Grams/Liter

Relay Turn-On Points - CV2 and CV4

CV 2 - Low Relay ON

Setting Range from .04 Grams/Liter to 4.8 Grams/Liter

CV 4 - High Relay ON

Setting Range from .04 Grams/Liter to 4.8 Grams/Liter

Response Delay

CV 6

Setting Range from 001 to 255 (10ths of seconds)

The speed at which the controller increases or decreases the volts (Grams/Liter) output in response to increasing silver concentrations is software settable by changing CV 6. This is the delay time before the probe voltage responds to a change in the input from the Great Lakes transmitter. If the setting time is too short, making the response time very rapid, the power supply will cycle on and off unnecessarily. A response delay of 1 second is the typical setting needed. The response delay input is in $1/10^{th}$ second increments. A setting of 10 equals 1 second. A setting of 15 equals 1.5 seconds. Note that the LCD display always responds instantly, but the LED display and the analog output will follow the response delay settings.

Gain (Also known as SPAN)

CV 1

Setting Range from .5 to 1.5

This setting adjusts the SPAN of the output voltage control through software. The SPAN is the calibration range of the low grams per liter setting to the high grams per liter setting. A typical span would be .7 grams/liter low setting and 1.2 grams/liter high setting. **The low setting of the calibration range is established first by adjusting the system using the CALIBRATE dial until the reading matches the reference solution for the low setting**. The next step is to measure the high reference solution. If the high reference solution reading is not correct, the span setting adjustment must be changed until the high grams/liter reading matches the reference solution. This adjustment is made by changing the gain of the output signal from the probe.

If the span adjustment cannot set properly with this software routine, then the hardware will need to be adjusted with the potentiometer in the system. The pot labeled Set Gain VR 4 on the amplifier board controls the large scale adjustment of the gain. If the hardware pot is going to be changed, the software setpoint for

CV 1 must be set to 1.0 (no adjustment through software). The procedure for setting the hardware pot VR4 is covered in separate documentation.

CV 1 - NO SPAN ADJUSTMENT IS NEEDED
If the measurement of the high grams/liter calibrated reference solution is correct, the gain setting should be set to 1. This sets the system with no change (gain) from input to output. This is the same as multiplying the gain reading by 1 (no change).

CV 1 - SPAN READING IS TOO LOW
If the reading of the high grams/liter is below the desired reading, the gain must be set higher to increase the output signal. This is done by setting the gain factor to a number higher than 1 The gain increase settings range from 1 to 1.5.

CV 1 - SPAN READING IS TOO HIGH
If the reading of the high grams/liter is above the desired reading, the gain must be set lower to decrease the output signal. This is done by setting the gain factor to a number lower than 1 The gain decrease settings range from 0.5 to 1.

CV 1 – SPAN ADJUSTMENT SETTINGS CHART

Grams/Liter Low Setting Adjusted with Calibration Dial	**Instrument Reading** Grams/Liter High Setting Reading From Probe	**Target Reading** Grams/Liter High Setting Desired From Reference Solution	**Notes**	**Gain Adjustment Factor Required**	
.7 g/l	1.2 g/l	1.2 g/l	Reading is correct. No adjustment needed	1	
.7 g/l	1.0 g/l	1.2 g/l	Reading is too low.	1.4	
.7 g/l	1.3 g/l	1.2 g/l	Reading is too high.	.9	

After the span has been adjusted through the gain change setting, the low setting in grams/liter may need to be re-adjusted with the calibration knob. A second test of the software adjustable gain factor may also be needed.

Normal or Timed Mode

CV7

Settings: Normal Mode = 0
Timed Mode = 1

Operation as a Batch Timer – No Silver Probe

If there is a failure in the silver probe unit, The Hallmark system has backup control routines that allow the unit to operate as a batch timer system. If the system must be operated without the silver probe, it does not have variable voltage output. Under these conditions, the system is run at a fixed rate. The fixed voltage setting is not software selectable, and the time (hours and minutes) for the processing of batches is software selectable.

The silver controller runs the system in NORMAL mode. If there is a failure in the silver probe or some other unusual situation, the system can be run in TIMED mode. If the system is run in a timed mode, all input from the silver probe is completely bypassed. This is an emergency setup allowing the user to run the system for a fixed time period. The time period is set through CV 8 and CV 9. After CV 8 and CV 9 have been set to the correct time period, and CV 7 has been changed from Normal Mode to Timed Mode, **the system must be stopped and restarted for the mode change to take effect. The Stop key must be pressed and then the Reset key pressed.**

Batch Timer Mode – Setting the Hours and Minutes for a Batch Run

These settings only apply if the unit is being run in a batch mode, with CV 7 set to TIMED. CV 8 sets the number of hours for each batch run, and CV 9 sets the minutes for each batch run.

CV 8 TIMED HOURS

Settable from 0 hours to 60 hours

CV 9 TIMED MINUTES

Settable to 0 minutes to 59 minutes

MEM Mode or Real Time Mode

CV 10

Mem Mode = 1
Real Time Mode = 0

To change this mode, the system must be stopped and restarted for the mode change to take effect. The Stop key must be pressed and then the Reset key pressed to restart the system in the new mode.

Real Time is the normal operating mode. In Real Time mode the relays are instantly controlled by the system in response to probe voltage changes. The only delay is the delay that has been set in CV6 – Response Delay.

Mem Mode is used in situations where noise from an outside source, usually the power supply, is disturbing the probe voltage and the probe is giving false readings. In Mem Mode, the system takes a probe reading only while the power supply relays and output are shut down. During the shutdown period the CPU

sets the relays and output voltage based on the stored values, and the system ignores the probe input voltage while the relays are on. This means that every 5 minutes, the control outputs are shut down while the probe readings are taken. This mode results in constant On/OFF cycling of the power supply.

HIGH VOLTAGE ALARM SETTING

CV 11

This setpoint determines when the alarm will sound for a high voltage overload. The range for this alarm setting is from .5 g/l to 5.1 g/l.

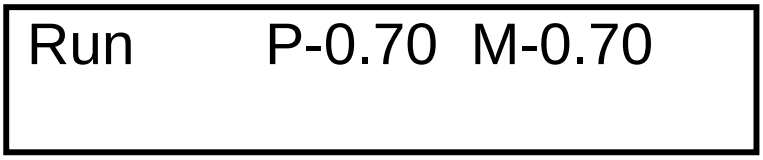
EXIT
CV 12

Pressing the ENTER key while CV 12 is displayed causes the software routine to exit from Change Values.

LCD Screen Display Messages

The computer constantly displays the status of the system. Typical display messages are shown in the pages that follow. In most cases the display will alternate several messages, showing the first message for about one second, then the next for a second, and so on.

Normal Running Conditions



System Condition: Normal Running Conditions – System is Not in Change Values Routine

C Probe Mode (Not Batch/Timed Mode) The silver probe is controlling the system.

First Line of Message Display:

Run indicates that the system is turned on.

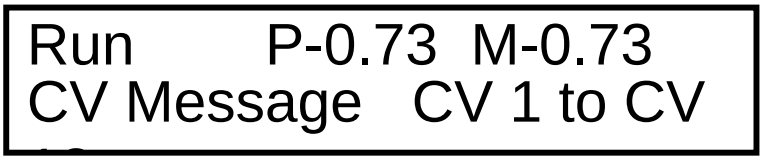
P shows the number of Grams Per Liter the probe is sensing.

M shows the number of Grams Per Liter that was stored in memory during shutdown.

Second Line of Message Display:

The second line of the message display should be blank. If a CV message appears, the system is in the Change Values mode.

Normal Running Conditions – System in Change Values Routine



System Condition: Normal Running Conditions – In Change Values Routine
C Probe Mode (Not Batch/Timed Mode) The silver probe is controlling the system. The user has entered the Change Values routine by pressing the Change Values key.

First Line of Message Display:

Run indicates that the system is turned on.

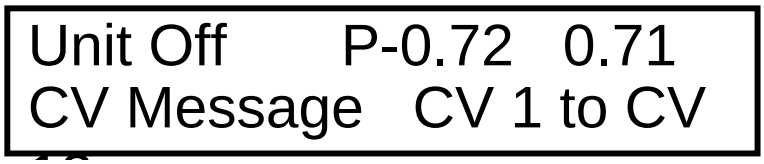
P shows the number of Grams Per Liter the probe is sensing.

M shows the number of Grams Per Liter that was stored in memory during shutdown.

Second Line of Message Display:

The second line of the message displays any of the 12 possible CV messages, from CV 1 to CV 12.

Unit Off – System Idle



First Line of Message Display:

Unit Off indicates that the system is turned off.
The OFF button has been pressed by the operator. The system is putting out no voltage. The red LED displays will show no grams per liter output. The LCD (2 line liquid crystal display) will show the silver probe reading. The LCD shows the input to the system and the red LED's show what the system is outputting.

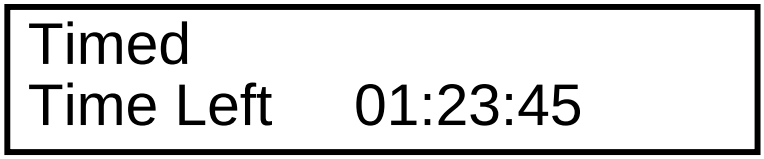
P shows the number of Grams Per Liter the probe is sensing.

The second number on the first line shows the number of Grams Per Liter that was stored in memory during shutdown.

Second Line of Message Display:

The second line of the message displays any of the 12 possible CV messages, from CV 1 to CV 12.

Unit in Timed Mode



System Condition: Timed Run – Silver Probe is NOT Running the System
System is running in batch mode.

First Line of Message Display:

Timed indicates that the system is running in timed mode.

Second Line of Message Display:

Time Left shows the hours, minutes and seconds remaining before the Low Relay shuts off at the end of the timed run.

Unit in Timed Mode – Time Expired on Batch Run

System Condition: Timed Run – Silver Probe is NOT Running the System
System is running in batch mode.

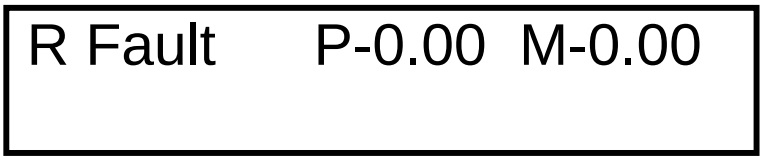
First Line of Message Display:

Timed Out indicates that the system is running in timed mode, and the batch time allocated has expired. The unit has shut itself off.

S indicates the unit is in Standby mode.

To reset the timer, push OFF/RESET and then push ON to start a new Timed Cycle. In the Unit Off mode, the Probe Grams/Liter are still indicating but not controlling the Low Relay output.

Unit Shut Off – Range Fault



System Condition: Unit is Shut Down Due to a Range Fault. The alarm relay has been tripped. The red LED above the UP arrow is lit. The range fault occurred because the system exceeded the trip point setting of g/l set with CV 11. If the system reaches zero g/l, it will also trigger the range fault. The lower limit of the range fault is hardware set to 00.00 g/l. The upper limit of the range fault is the CV 11 setting.

First Line of Message Display:

R Fault indicates that the system is shut down.

P shows the number of Grams Per Liter the probe is sensing.

M shows the number of Grams Per Liter that was stored in memory during shutdown.

Change Values - CV Settings in Numerical Order

See the main manual for detailed discussion of CV Settings grouped by function.

CV Setting	Adjustment	Setting Range	Default	Notes
CV 1	Span Adjustment	.5 to 1.5	1.0	Changes the gain factor
CV 2	Low Relay Turn-On Point	.04 g/l to 4.8 g/l	.7 g/l	
CV 3	Low Relay Turn-Off Point	.02 g/l to 4.78 g/l	.5 g/l	
CV 4	High Relay Turn-On Point	.04 g/l to 4.8 g/l	1.1 g/l	
CV 5	High Relay Turn-Off Point	.02 g/l to 4.78 g/l	.7 g/l	
CV 6	Response Delay Time	001 to 255	15	Sets Delay time in 1/10th seconds. A setting of 20 equals 2 seconds.
CV 7	Normal or Timed Mode	0 = Normal 1 = Timed	Normal	
CV 8	Timed Mode Hours	0 Hours to 60 Hours	1 Hour	Sets number of hours the unit will run if it is in Timed Mode. **This setting is used only if the unit is running in batch (timed) mode. It is ignored if the unit is running in normal mode (CV 7 set to 1.)**
CV 9	Timed Mode Minutes	0 Minutes to 50 Minutes	1 Minute	
CV 10	Mem Mode or Real Time Mode	0 = Real Time 1 = Mem Mode	0 = Real Time	
CV 11	High Voltage Alarm Setpoint	.5 g/l to 5.1 g/l	4.5 g/l	The alarm sounds if the voltage exceeds this setting.
CV 12	Exit			Pressing the ENTER key while CV 12 is displayed causes the system to exit the Change Values routine.

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