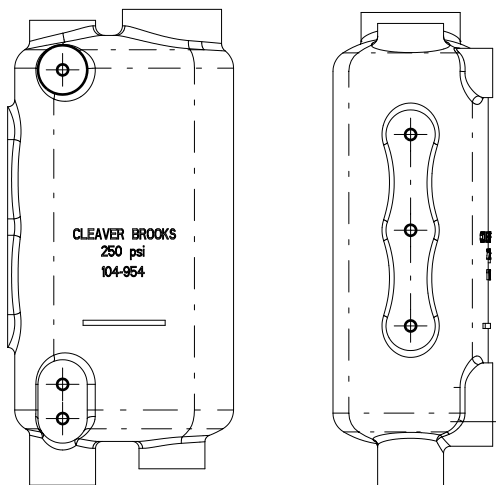


Cleaver-Brooks

CBLM

Level Master

Installation and Operation Manual





Do not operate, service, or repair this equipment unless you fully understand all applicable sections of this manual.

Do not allow others to operate, service, or repair this equipment unless they fully understand all applicable sections of this manual.

Failure to follow all applicable warnings and instructions may result in severe personal injury or death.

To: Owners, Operators and/or Maintenance Personnel

This manual presents information that will help to properly operate and care for the equipment. Study its contents carefully. The unit will provide good service and continued operation if proper operating and maintenance instructions are followed. No attempt should be made to operate the unit until the principles of operation and all of the components are thoroughly understood.

Failure to follow all applicable instructions and warnings may result in severe personal injury or death.

It is the responsibility of the owner to train and advise not only his or her personnel, but also the contractors' personnel who are servicing, repairing, or operating the equipment, in all safety aspects.

Cleaver-Brooks equipment is designed and engineered to give long life and excellent service on the job. The electrical and mechanical devices supplied as part of the unit were chosen because of their known ability to perform; however, proper operating techniques and maintenance procedures must be followed at all times. Although these components afford a high degree of protection and safety, operation of equipment is not to be considered free from all dangers and hazards inherent in the operation of a boiler system.

"Automatic" features included in the design do not relieve the operator of any responsibility. Such features merely free him of certain repetitive chores and give him more time to devote to the proper upkeep of equipment.

It is solely the operator's responsibility to properly operate and maintain the equipment. No amount of written instructions can replace intelligent thinking and reasoning, and this manual is not intended to relieve operating personnel of the responsibility for proper operation.

Operating controls will normally function for long periods of time. Do not become lax in daily or monthly testing, assuming that normal operation will continue indefinitely. Malfunctions of controls lead to uneconomical operation and damage and, in most cases; these conditions can be traced directly to carelessness and deficiencies in testing and maintenance.

Operation of the equipment by the owner and his operating personnel must comply with all requirements or regulations of his insurance company and/or other authority having jurisdiction. In the event of any conflict or inconsistency between such requirements and the warnings or instructions contained herein, please contact Cleaver-Brooks before proceeding.

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Notes

Section 1

Features and Specifications

The Cleaver-Brooks Level Master is a microprocessor based, primary safety water level control for watertube and firetube steam boilers.

Primary Safety Features: - - - - -	2
Controller Features: - - - - -	2
Level Sensor Features:- - - - -	2
Water Column Features: - - - - -	3
Specifications: - - - - -	3
Level Sensor: - - - - -	3

Note: This control is not intended for use on Hot Water boilers.

The system consists of four parts: a controller, an in-situ continuous reading water level sensor, a water column and 25 feet of sensor cable and three connectors. The Level Master is UL recognized (file # MH27829).

The controller has operator selectable level and sensitivity settings as well as routines for blowdown and auxiliary low water cutoff testing.

The sensor top mounts in a water column and can be easily removed for periodic inspection or cleaning. The water column is rated for 250 psig steam and has connections for gauge glass, level sensor, and tri-cocks.

The data link between the controller and sensor is RS-485 that is highly resistant to electrical noise and interference.



Figure 1-1: Low Water Cut Off Controller



Figure 1-2: Low Water Cut Off Sensor Circuit Board

Primary Safety Features:

- Low Water Cut-Off (LWCO).
- Independent watchdog system for shutdown in the event of microprocessor failure.
- Internal redundant LWCO relays with current monitoring.
- Contacts for external alarms for LWCO violation conditions.
- Eight user selectable pre-configured water level settings.
- Float non-movement detection and alarm.
- High water alarm function.
- Water column blowdown routine.
- Real time clock for time stamped event logging for all blowdown cycles and alarm occurrences.
- Auxiliary low water cut-off check routine.
- Display is user configurable for on-off or modulating (4-20ma) water level control.
- Non-volatile memory for all logged events.

Controller Features: (Figure 1-1)

- Bargraph style continuous display of water level.
- Two row by 16 character, backlit LCD for all controller messages.
- Dual color Power/Error indicator on the front panel.
- Reset/Menu Button for easy diagnostic retrieval.
- Expanded programming parameters via RS-232 computer connection.
- Operator configuration via external "MODE" switch.
- Nema 1 enclosure, panel mounted.
- Removable terminal strips for easy field wiring.

Level Sensor Features: (Figure 1-2)

- High speed, noise immune RS-485 link to controller.
- Nema 4x enclosure with sealed conduit connection.
- Titanium float for long life, independent of feedwater quality.
- Red brass tube and chamber connection.
- Easy installation using five conductor shielded cable.

**Water Column Features:**

- Made from cast steel.
- ASME Rating to 250 PSI Steam.
- Connections for sight glass, level sensor, and tri-cocks.
- Casting mark for low water cut-off point.

Specifications:**Controller**

120 VAC, 50/60 Hz. input power

Power consumption 20 VA

Operating temperature maximum of 122°F

Panel mounting dimensions of 5.39 ± 0.015 inches
(1/2 DIN)

Minimum panel depth of 6.0 inches

One piece front panel with integral membrane push button

10 Amp relay contacts for controls

UL recognized

Level Sensor

RS-485 link to controller

Nema 4x enclosure

Operating temperature maximum of 130°F for electronics, 400°F for sensor

Sensor stroke length of 16 inches

Resolution greater than 0.050 inches

Accuracy of 0.025 inches

Repeatability of 0.010 inches

Update rate of 10.0 milliseconds

Red brass tube and chamber connection

Titanium float

Figure 1-3: Level Master Water Column

Notes

Section 2

Installation of the Level Master water level control system is straightforward provided the installer takes care to insure all wiring and piping connections are performed correctly. The system installation is described in two parts; first, the mechanical installation of the controller, water column, level sensor, and second, the wiring of the controller and level sensor.

Part1: Mechanical Installation



Disconnect all power prior to installing the controller in a control enclosure. Failure to follow this warning could result in serious personal injury or death.



Only qualified personnel may install or service the controller, water column or sensor.



Ensure the boiler is off-line, at zero pressure, and at ambient temperature before installing the water column or level sensor.

Note: Perform a leak test on all piping connections before firing the boiler.

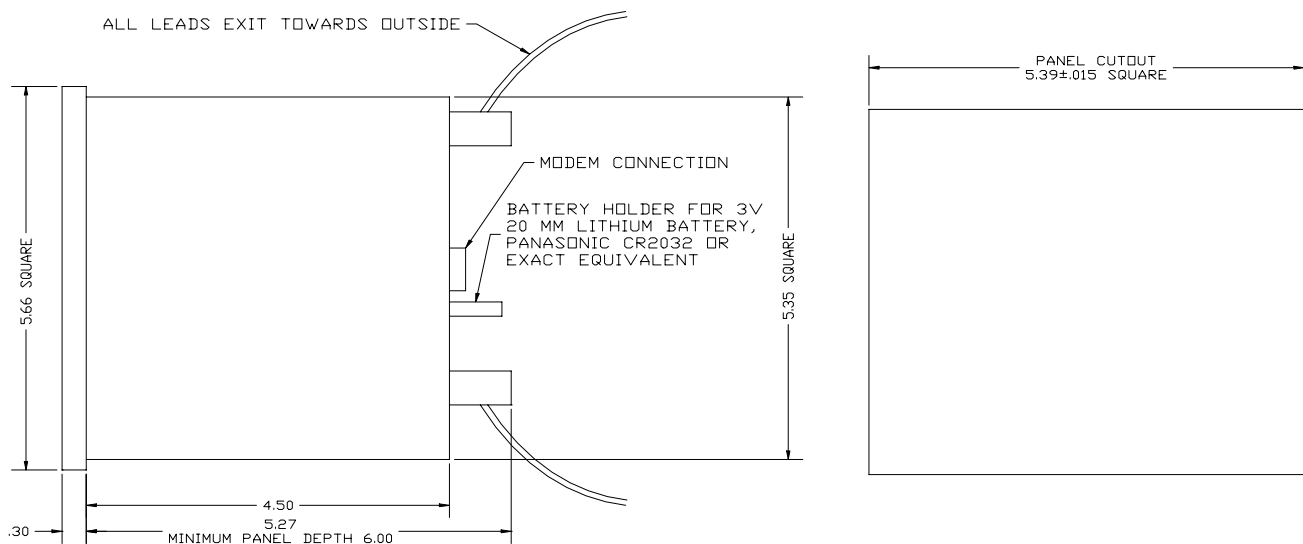


Figure 2-1: Enclosure Cut Out Dimensions

Note: The controller is designed to be flush mounted in a panel or enclosure that has a minimum depth of 6.0 inches to allow for rear wiring connections. Figure 2-1 shows the enclosure cut-out dimensions.

Install the controller in the cutout using the supplied clamps. Do not over-tighten, only moderate pressure is required to fix the controller to the enclosure door.

Humidity - Install the Level Master controller where the relative humidity never reaches the saturation point. Condensation of moisture may cause controller shutdown.

Vibration - Do not install the Level Master controller where it could be subject to excessive vibration

Weather - The Level Master controller is not designed to be weather tight. If it is installed outdoors **it must be protected.**

Mount the water column in equalizing piping so that the low water cut-off mark on the water column corresponds to the desired level. Piping must include a proper blowdown valve and sight glass connections. Ensure all connections are tight and horizontal and vertical runs are plumb.

Install the sensor in the pressure chamber orienting the enclosure front in a convenient direction for ease of wiring. Remove the plug on the bottom of the chamber to ensure that the bottom of the sensor is properly positioned in the chamber. Sensor wiring to the controller must be run in conduit.

Maximum cable distance from the sensor to the controller - 100ft.

Note: controller shall be mounted at the location where the water column can be seen.

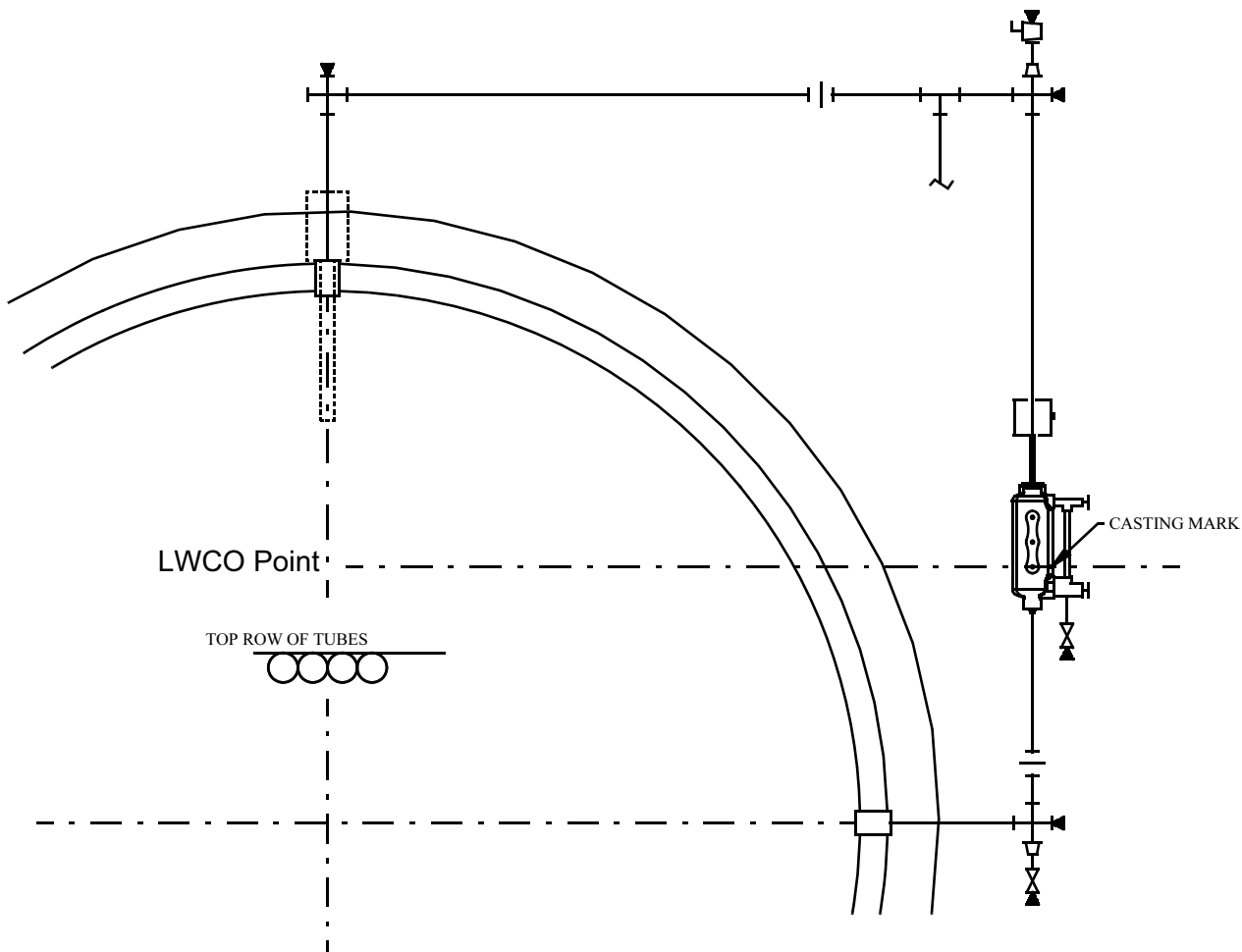


Figure 2-2: Piping Layout

Installation and Initial Testing

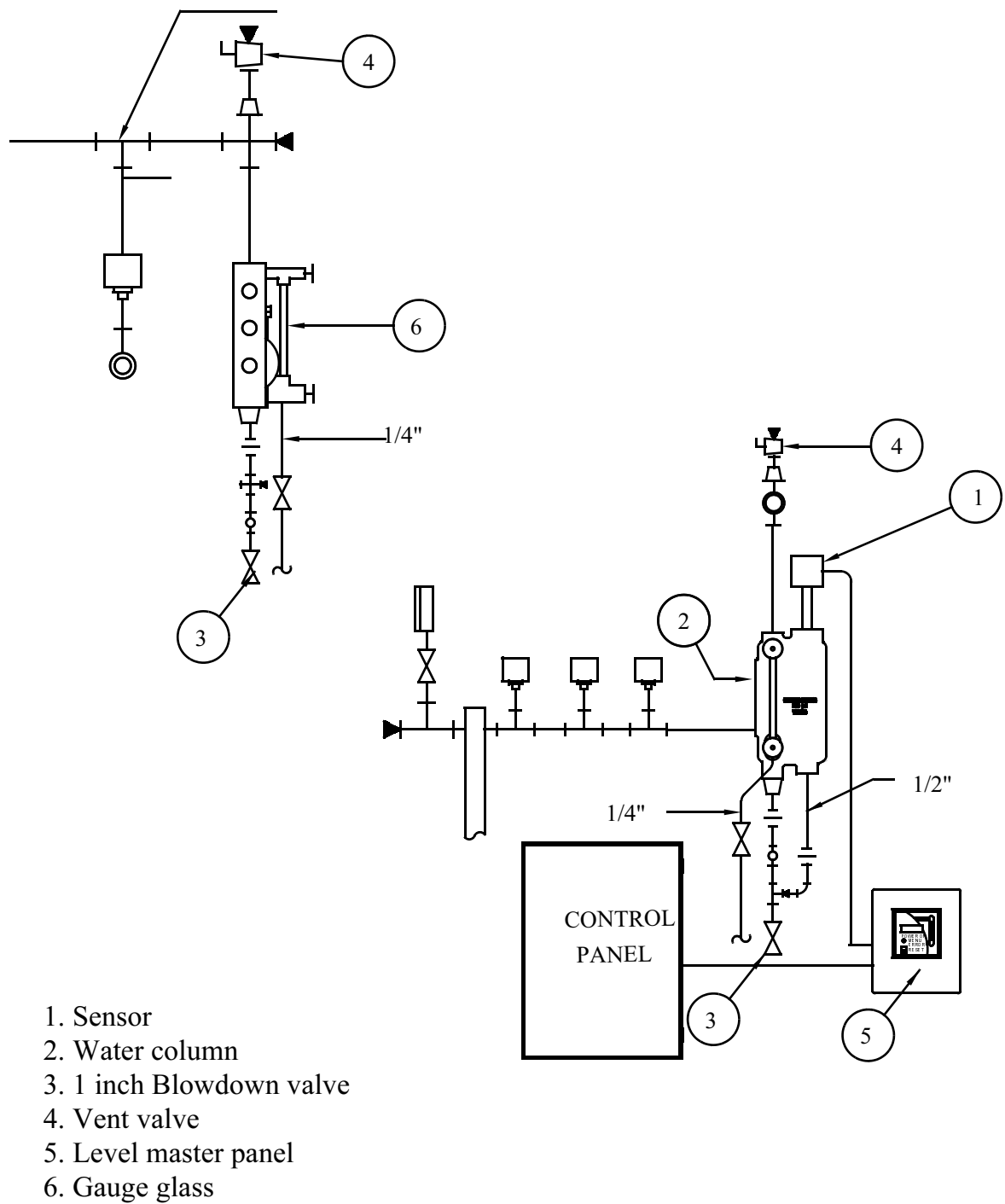


Figure 2-3: Typical Level Master Installation

Part 2: Wiring of the Controller and Level Sensor



⚠ WARNING

Disconnect and lock out all power prior to wiring the controller or level sensor. Failure to follow this warning could result in severe personal injury or death.

Note: The low water cut-off contact must be wired in series with all other boiler limits to effect a boiler shutdown on low water condition.

The wiring connections for the sensor are shown below in Figure 2-4.

Four #18 AWG conductor shielded cable is required C/B Part # 826-104 (General Cable #C02543 or equal) from the level sensor to the controller.

⚠ CAUTION

It is recommended to use a grounding wrist strap when wiring the system.

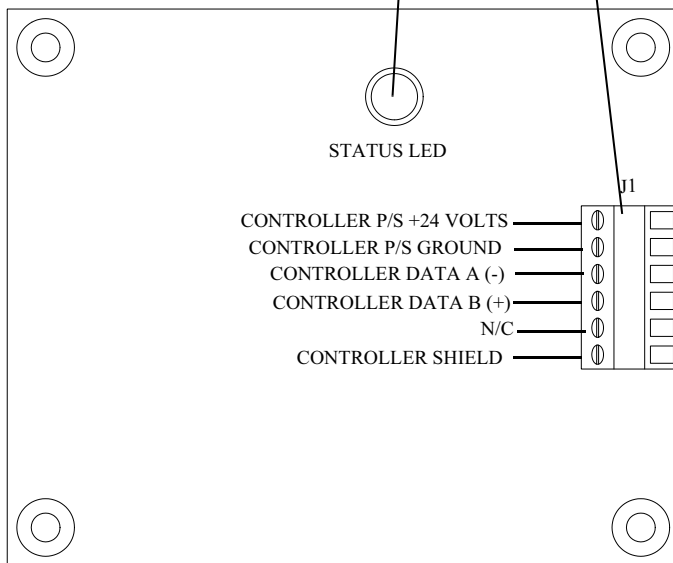


Figure 2-4: Wiring connections for the sensor

Note: The cable **MUST** be run in separate conduit, away from the ignition wires.

Wiring connections for the controller are shown in Figure 2-5.

Depending on configuration settings and job site requirements not all terminals are used.

Figure 2-6 is an interconnection diagram showing sample wiring without the 4-20ma level output option.

Installation and Initial Testing

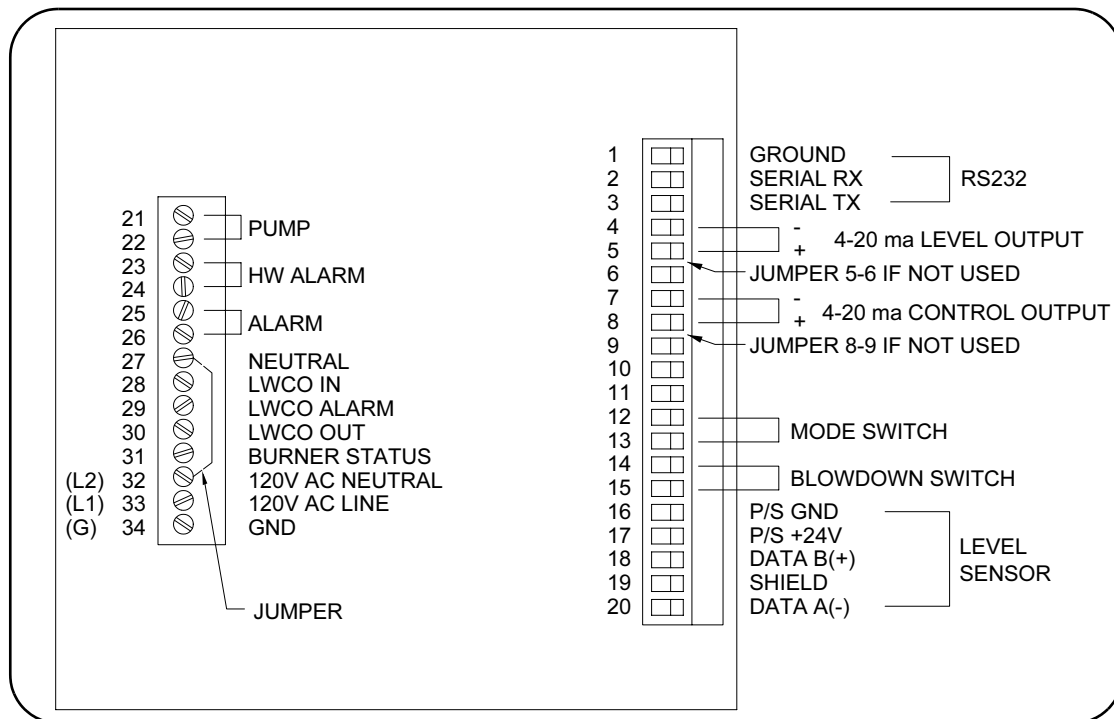
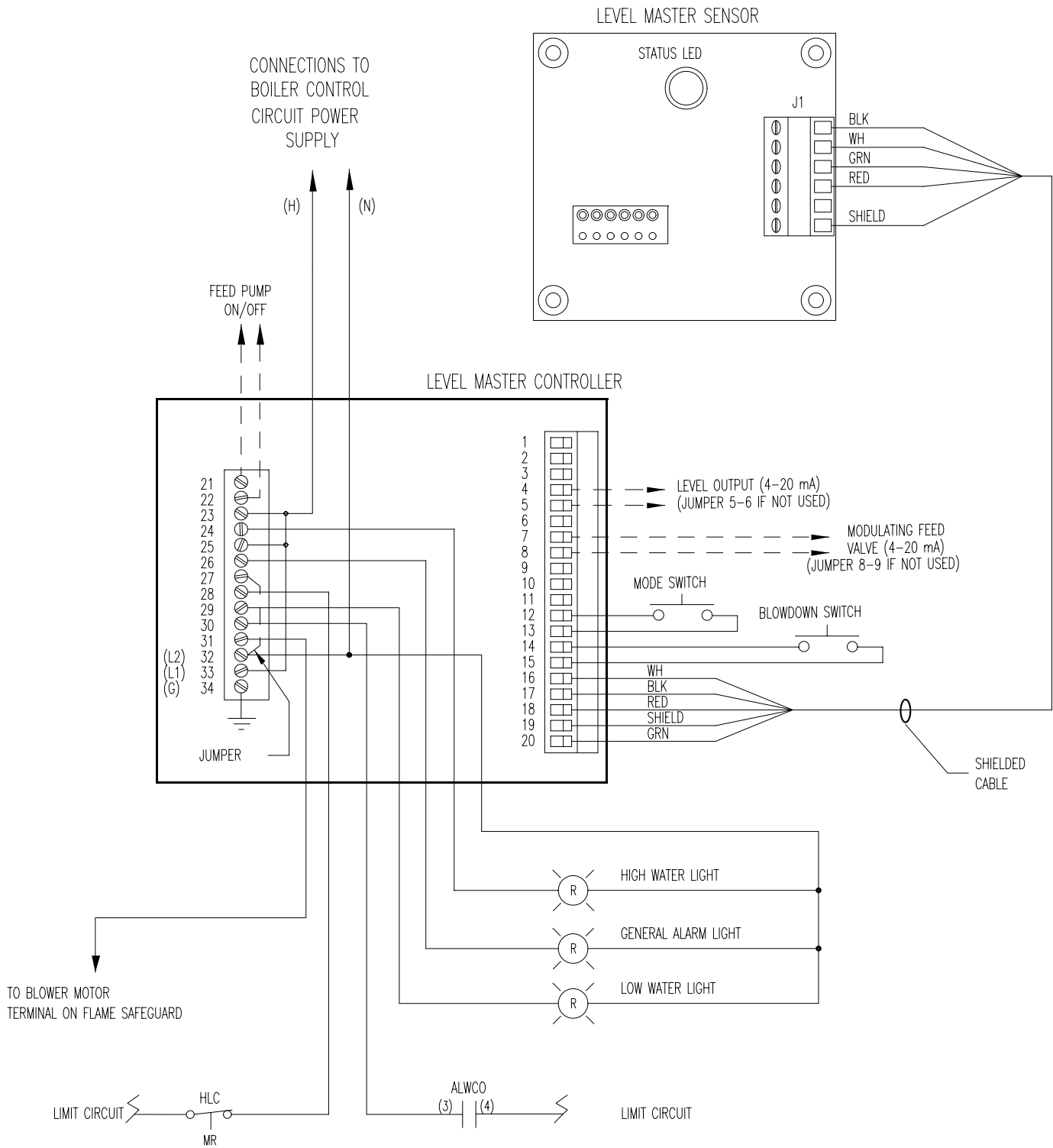


Figure 2-5: Wiring connections for the controller

Terminal	Function
1,2,3	RS 232 Interface, for communication to the controller from a computer.
4,5,6	Water level re-transmit signal (4-20 ma). (default 4ma @ LWCO 20MA @ HWA)
7,8,9	Modulating control output for feed water valve (4-20 ma).
10,11	For low fire input for float check
12,13	Mode switch, used to access user configuration parameters.
14,15	Blow down switch, allows blowdown without boiler shutdown.
16,17,18,19,20	Connections to level probe.
21,22	On-off control for feed water valve or pump contactor/starter.
23,24	Normally open high water alarm contact.
25,26	Normally open general alarm contact.
27	Jumper to 120VAC neutral
28	Supply LWCO
29	LWCO Alarm
30	Return LWCO, wired in burner safety shutdown circuit.
31	Burner status, wired to flame safeguard blower terminal.
32,33,34	AC line in connections. (See note below)

Note: 120 volt power supply to terminals 32 (L2) and 33 (L1) shall be from the boiler/burner control panel.



Note: Do not use this product to switch currents over 10 amp at 115 VAC resistive load.

Note: Do not power feed pump motor directly from the controller. Always use pilot relay or starter.

Figure 2-6: Sample Wiring Diagram

Initial Testing	
Display	Description
	Prior to re-applying power please check all wiring. Check that the on-off switch for the boiler/burner is off. Turn power on to boiler/burner.
	On initial power-up the Level Master will run its self-start routine. During this process the controller will cycle the level indication LED's to verify their operation. The green power on LED will be on, and the on board alarm will beep. The LCD will display the following:
Note: The low water cut-off contact remains de-energized during this period	
Cleaver-Brooks Copyright @YYYY	
Waiting On Sensor	
	Providing that the water level is within the normal water level limits the display will indicate how far above low water cut-off the sensor is at. Depending on the actual level a corresponding number of green level indicating LED's on the face of the controller will be lit.
X.XX" >LWCO Boiler Off	
	If the water level is below low water warning point the controller will enter the low water alarm countdown period and after expired will enter a low level warning alarm condition. The lower orange level indicating LED will be lit and the general alarm relay will be energized.
	The LCD will display the following.
Low Lvl Wrn Timer X Sec	
X.XX" >LWCO Low Lvl Wrn	
	If the water level is below low water cut-off point the controller will enter the low water cut-off countdown period and after it expires will enter a shutdown condition. The lower red level indicating LED will be lit. The red LED above the Reset/Menu button will be on. This LED will flash red/green for the newest version of software.
	The LCD will display the following.
LW Shutdown Timer X Sec	
LW Shutdown Date Time	
	The low water cut-off relay and the alarm output relay will be in the alarm state until the water level is restored to normal operating levels.
Note: On manual reset models the controller low water cut-off limit contact will remain open until the reset button is pressed.	

Initial Testing	
Display	Description
	If the water level is above high water warning point the controller will enter the high water warning countdown period and after it expires it will enter an alarm condition. The upper orange level indicating LED will be lit and the general alarm relay will be energized. The LCD will display the following.
High Lvl Wrn Timer X Sec	
X.XX" >LWCO High Lvl Wrn	
	If the water level is above high water alarm point the controller will enter the high water warning countdown period and after expired will enter an alarm condition. The upper red level indicating LED will be lit. The high water alarm relay and the general alarm relay will be energized. The red LED above the Reset/Menu button will be lit or flashing.
	The LCD will display the following.
High Water Alarm Timer X Sec	
High Water Alarm Date Time	
Note: The alarm conditions will remain on the LCD until the Reset/Menu button is depressed. The warning conditions will clear on the LCD when the water returns to normal level. All warning and alarm conditions are logged into the controller history.	
	If the sensor is not wired properly or if it is defective the controller will display the following.
Waiting On Sensor	
	Followed by -
Sensor Not Found Date Time	
	The alarm relay will be energized and the low water cut-off relay will be de-energized and the red LED above the Reset/Menu button will be lit. The sensor has a LED on the left side of the control board. The LED will be green for normal operation or red indicating an on board failure.

Configuration													
	The Level Master has configuration parameters that should be set at installation. Below are the parameters.												
	<table> <tr> <th><u>Name</u></th><th><u>Default</u></th></tr> <tr> <td>Sensitivity Table</td><td>1</td></tr> <tr> <td>Alarm/Warning Timer</td><td>5</td></tr> <tr> <td>Set Date/Time</td><td>XX/XX/XX XX:XX</td></tr> <tr> <td>Display Format</td><td>On/Off</td></tr> <tr> <td>Exit To Previous Menu</td><td></td></tr> </table>	<u>Name</u>	<u>Default</u>	Sensitivity Table	1	Alarm/Warning Timer	5	Set Date/Time	XX/XX/XX XX:XX	Display Format	On/Off	Exit To Previous Menu	
<u>Name</u>	<u>Default</u>												
Sensitivity Table	1												
Alarm/Warning Timer	5												
Set Date/Time	XX/XX/XX XX:XX												
Display Format	On/Off												
Exit To Previous Menu													
	To enter the configuration mode on the Level Master, press and release the menu switch. This places the controller in configuration mode. The display will scroll through the available options.												
Note: Configuration mode can only be entered when the water level is within normal operating range. (no low or high alarm message is displayed).													
Sensitivity Table 1													
Alarm/Warning Timer 5													
Set Date/Time MM/DD/YY HH:MM													
Display Format On/Off													
Exit to previous Menu													
	When the desired parameter appears, press the Reset/Menu button on the front of the controller. The controller will then start to display the available options under that menu item. The controller will cycle twice through menu options, if no items are selected the controller automatically exits configuration mode.												

Notes

SECTION 3

Sensitivity Tables

The sensitivity table refers to the preset levels that the sensor and the controller are set to. The type, size, and design pressure of the boiler determine what the sensitivity setting should be. Below are the recommended settings.

When in commissioning mode and the sensitivity table is selected the controller starts scrolling 1 through 9. When the desired value appears, press the Reset/Menu button. When the desired parameter is selected the controller will go to the next menu item. If you do not wish to make any

changes to the parameter in that menu, don't press the Reset/Menu button. The controller will cycle through the available parameters twice and then move to the next menu item.

The recommended sensitivity level selections for various type and sizes of Cleaver-Brooks boilers are shown in Table 3.1

Table: 3-1 Firetube Boilers			
Recommended Sensitivity Selection			
CB,CBLE			
Diameter	15# Steam	150# Steam	151-250# Steam
36	2	1	2
48	2	1	2
60	2	1	2
78	2	2	2
96	2	2	2
CBE			
Diameter	15# Steam	150# Steam	151-250# Steam
48	1	1	2
60	1	1	2
78	2	1	2
CBW,CEW			
Diameter	15# Steam	150# Steam	151-250# Steam
60	1	1	2
78	2	1	2
96	2	1	2

Table: 3-1 Watertube Boilers					
Recommended Sensitivity Selection					
FLX		M4/M5		M5LWV	
15# Steam	150# Steam	15# Steam	150# Steam	15# Steam	150# Steam
3	6	3	4	3	2

Table: 3-2 Sensitivity									
Sensitivity	1	2	3	4	5	6	7	8	9
High Water Alarm	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
High Water Warning	4.5	4.65	4.81	4.62	4.87	4.81	5.0	4.87	4.5
Pump Off	1.5	2.12	2.75	2.0	3.0	2.75	3.5	3.0	1.5
Pump On	0.75	1.12	2.0	0.75	0.75	1.5	2.0	1.75	0.75
Low Water Warning	0.3	0.45	0.8	0.3	0.3	0.6	0.8	0.7	0.3
Low Water Cut-Off	0	0	0	0	0	0	0	0	0

All values given in the table above are in inches and are with respect to the casting mark on the Level Master chamber.

Chapter 4

Commissioning and Operation

Mode selection	4-2
Set Date/Time	4-5
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Blowdown	4-12
ALWCO Check	4-14

Programming

Programming of the Level Master is defined by two distinct areas, Commissioning and Operation.

Commissioning

Commissioning is designed to enable the installer or owner/operator to setup the system in accordance to the plant requirements and local codes. The Mode switch is used to toggle through the various commissioning modes required by the controller. The commissioning modes are **Sensitivity**, **Alarm/Warning**, **Set Date/Time and Display** format.

To make a mode selection press the Mode switch once, see Figure 4-1. This will initiate the Mode change menu. The display will return to normal after cycling through the menu choices two times.

When commissioning the boiler and controller first set the Alarm/Warning Timer and the Date/Time in the controller.



Figure 4-1. Mode Button

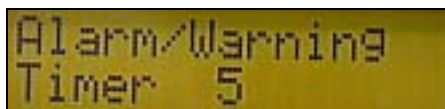


Figure 4-2.

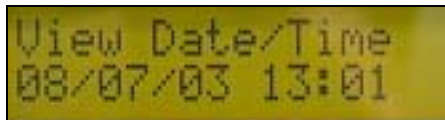


Figure 4-3.

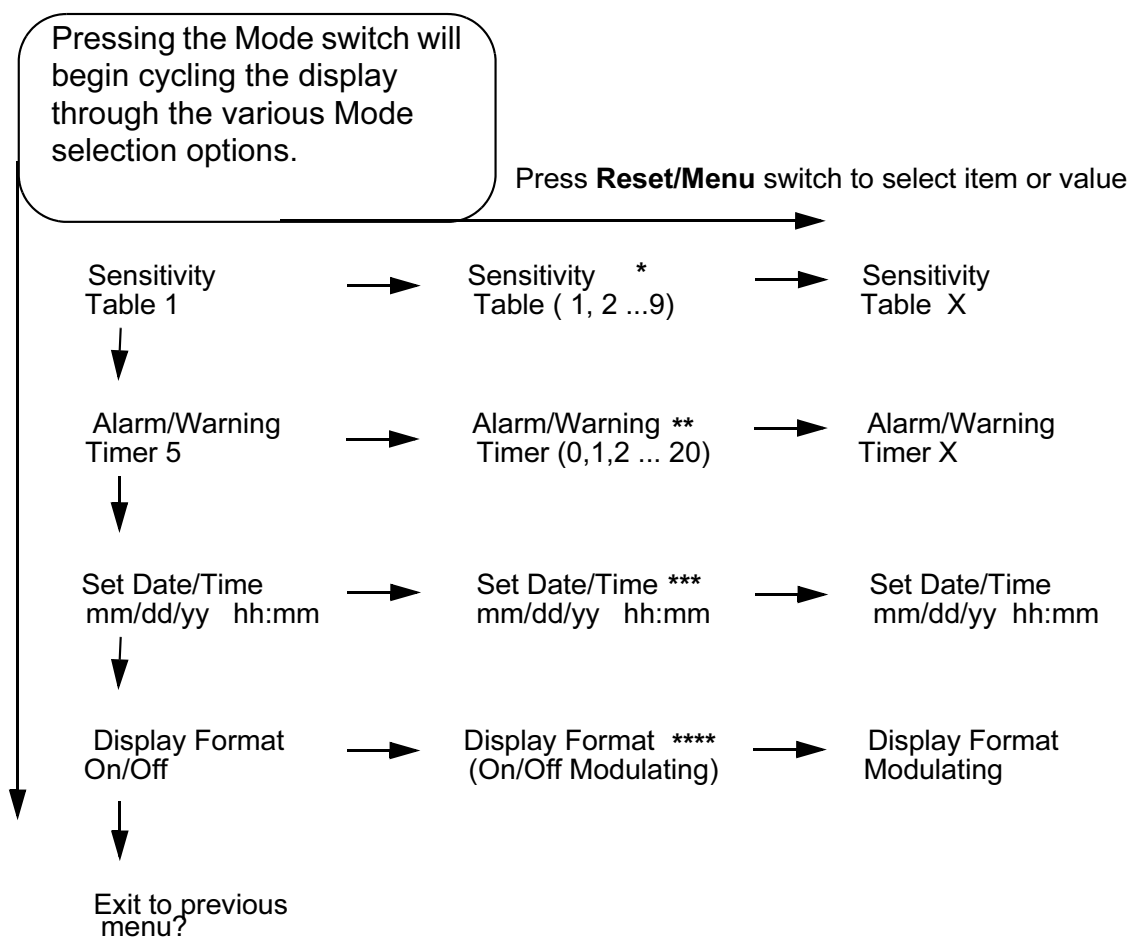
1. Alarm/Warning Timer

This is a timer that delays the actuation of the alarms or warnings from the controller, see Figure 4-2. This timer also delays activation of the Low Water Cutoff relay. The timer helps prevent nuisance alarms caused by bouncing water level in the boiler. The minimum time is zero seconds and the maximum time is 20 seconds. The factory default = 5 seconds. Press the reset/menu button when the alarm/warning item appears. The controller starts to scroll through the available values. When the desired value is displayed press the Reset/Menu and the controller will go to the next menu item. If you do not wish to make any changes to the parameter in that menu, don't press the Reset/Menu button. The controller will cycle through the available parameters twice and then move to the next menu item.

2. Set Date/Time

This menu item allows setting of the date and time, see Figure 4-3. The controller uses this time to time stamp blowdown cycles and alarms. To change the date and time, press the Reset/Menu button when Set Date/Time appears. The display cursor will move to the first character in the date field. To change the value press the Reset/Menu button until the desired value appears. The controller will move the cursor to the next value. If no change is required do not press the Reset/Menu button and the controller will move to the next field.

Commissioning Flow Chart.

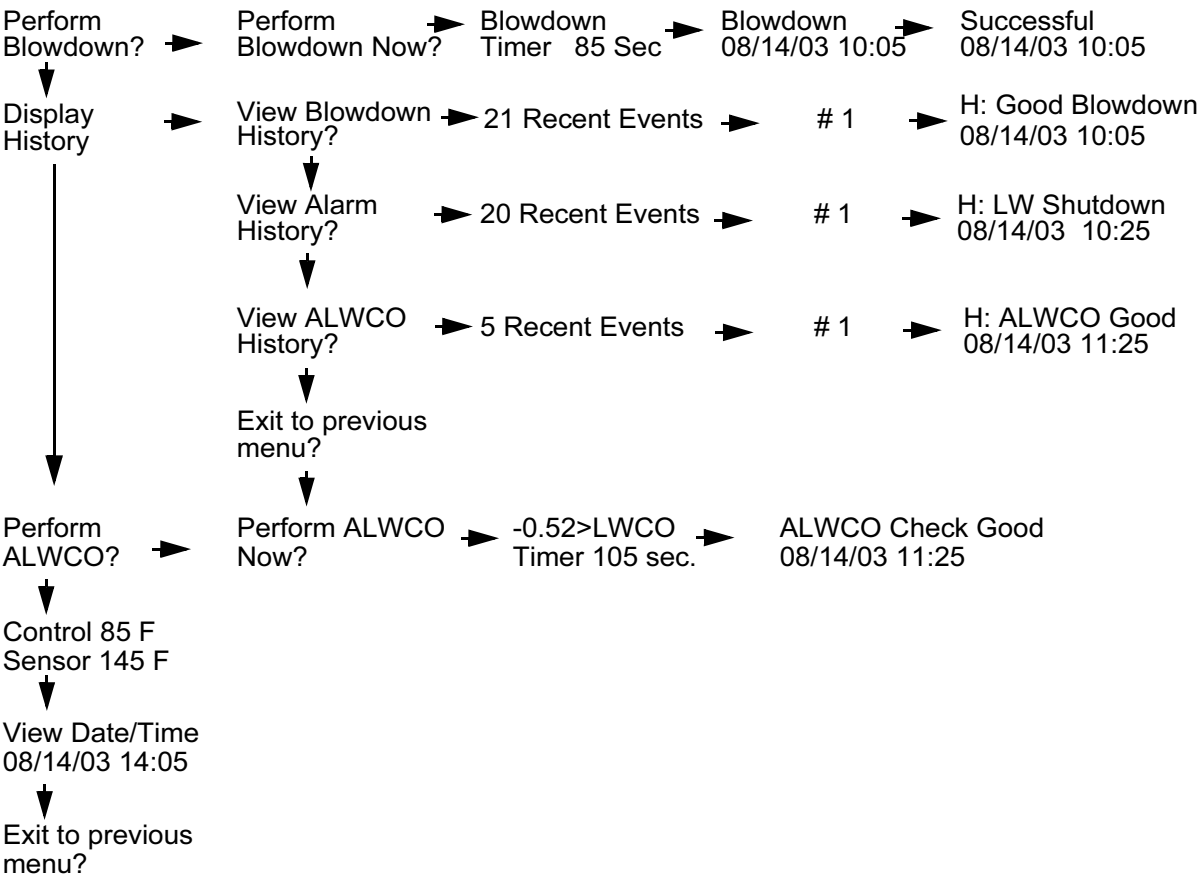


- * Sensitivity table values will scroll from 1 to 9. Once the desired number appears, press Reset/Menu to select.
- ** Alarm/Warning delay timer values will scroll from 0 to 20 (seconds). Once the desired number appears, press Reset/Menu to select
- *** Cursor will advance through one field at the time. Once the cursor is on the field to be changed, press Reset/Menu to advance one digit at a time.
- **** Display format will alternate between On/Off and Modulating. To select display format press Reset/Menu once the desired selection appears.

Operational Flow Chart.

The Reset/Menu button is used to select the operational display and change operational settings. Pressing the Reset/Menu button once starts the controller scrolling through the operational settings; Perform Blowdown, Display History, Perform ALWCO, etc. When the required operational parameter appears on the display, push the Reset/Menu button to gain access to that particular operational parameter.

Press Reset/Menu switch to select the display



3. Display Format

The controller can show either pump on/off or percent output of the level control signal on the second line of the display while the boiler is running. When the boiler is off the display will indicate Boiler Off, see Figure 4-4.



Figure 4-4.

When the display is set to on/off the second line of the display will indicate either pump on or pump off this is based on the water level while the boiler is running, see Figure 4-5.

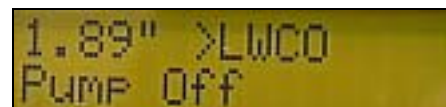


Figure 4-5.

When the display is set to modulating, the second line of the display will indicate the percent of control output to the modulating feedwater control valve while the boiler is running, see Figure 4-6. To change the display format, press the Reset/Menu button when Display Format appears. The display will toggle On/Off or Modulating. To change the value press the Reset/Menu button when the desired value appears. If no change is required do not press the Reset/Menu button.

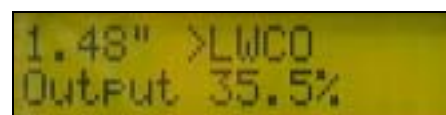


Figure 4-6.

Stuck Float Detection

The Level Master has built in stuck float detection. The controller will watch for float movement when the boiler/burner is running (terminal 31 energized). If the float does not move after the pre-determined time limits the controller will indicate *Slow Float*, Figure 4-7.

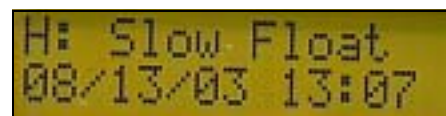


Figure 4-7.

If the warning time has expired and the float has not moved the controller will open the LWCO contact output and annunciate *Float Check Fail*, see Figure 4-8.

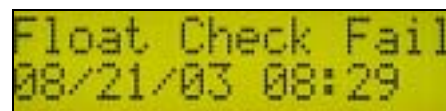


Figure 4-8.

The display will toggle with the message *Requires Column Blowdown* after a float check fail, see Figure 4-9.

Refer to the Perform Blowdown section of this chapter for instructions on performing water column blowdown.

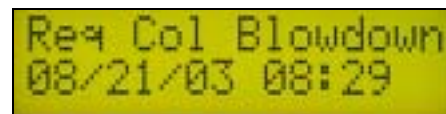


Figure 4-9.

Note: Boiler cannot be restarted until a proper blowdown is performed and Successful Blowdown is displayed.

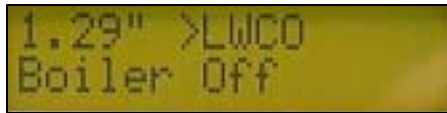


Figure 4-10.

Operation

Check-Out

With the boiler off and the water level in the boiler within normal limits the controller should display as Figure 4-10.

Start the boiler. The second line of the display should change to either Pump On/Off or percent output. If the second line of the display does not change, check that the burner status terminal (31) is wired correctly, see Figure 2-6.

Note: Shut the boiler off immediately and correct wiring. Verify before proceeding.

To verify low water cut-off wiring, during the pre-purge cycle of the boiler, open the blowdown valve on the water column. The boiler should shutdown on low water and a low water message with the time stamp should appear.

If shutdown does not occur, open the burner switch, verify wiring and re-check. The operation/wiring of the feed water system can also be checked with this process.

Note: Do not attempt to fire the boiler unless low water shutdown has been proven to operate properly.

Normal Operation

Under normal operation the Level Master controller will indicate on the display, actual water level above low water cut-off. The green LED's on the controller indicate a relative water level in the water column depending on the sensitivity table setting, see Figure 4-11.



Figure 4-11. Normal Operation Display

Operational Menu

Pressing the Reset/Menu button during normal operation, cycles the controller through the following menu items.

Perform Blowdown, Display History, Perform ALWCO, View Date/Time, Exit to previous menu, see Operational Flow chart on Page 4-4.

The last three items are display only. Pressing the Reset/Menu button while these are displayed takes the controller back to normal display. Perform blowdown and perform ALWCO are described in the maintenance section of this manual. The controller will cycle through the above choices a couple of times and then return to normal display if no selection is made.

4. Display History

Pressing the Reset/Menu button while the display history selection is displayed will offer the following three choices.

View Blowdown History? Figure 4-12.

View Alarm History? Figure 4-13.

View Alwco History? Figure 4-14.

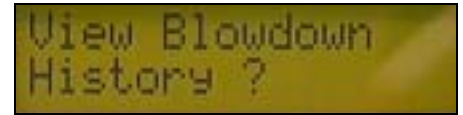


Figure 4-12.

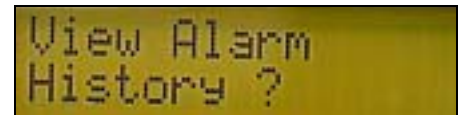


Figure 4-13.

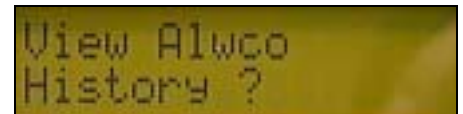


Figure 4-14.

5. View Blowdown History

View Blowdown History will display the twenty one (21) most recent events, see Figure 4-15.

First the event number is displayed followed by the event. Each event is date and time stamped with the most recent event displayed first. Figures 4-16 through 4-19 are examples of the blowdown history display.

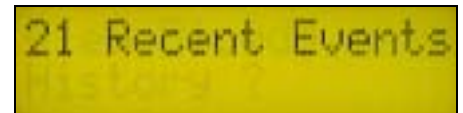


Figure 4-15.



Figure 4-16.

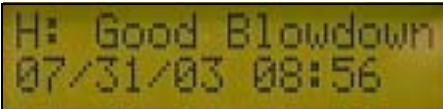


Figure 4-17.



Figure 4-18.

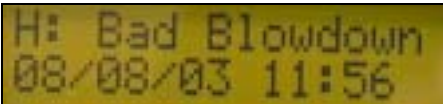


Figure 4-19.

The controller will cycle through the events 6 times or until the Reset/Menu button is pressed, which will then display the previous menu.

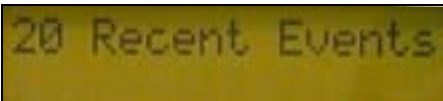


Figure 4-20.

6. View Alarm History

View Alarm History will display the twenty (20) most recent events. First the event number is displayed followed by the event. Each event is date and time stamped with the most recent event displayed first. Figure 4-20 through 4-24 are examples of a the Alarm history.

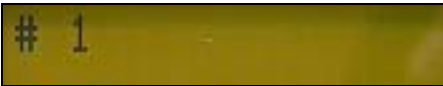


Figure 4-21.

#1 is displayed followed by the event description and time/date stamp

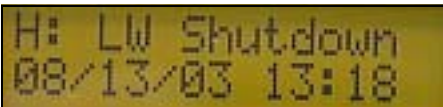


Figure 4-22.

#2 is displayed with the description and time/date stamp.



Figure 4-23.

The controller will cycle through the events 6 times or until the Reset/Menu button is pressed, which will then display the previous menu.

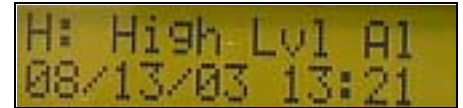


Figure 4-24.

7. Warning and Alarm Messages

Below is a listing of the alarm messages the controller can indicate.

Warnings:

- Low Lvl Wrn (Low Level Warning)
- High Lvl Wrn (High Level Warning)
- Warning Slow Float Movement

Alarms:

- LW Shutdown (Low Water Shutdown)
- High Water Alarm
- Float Check Fail
- LWCO Relay Fail
- LWCO Relay Short
- Sensor Not Found

8. View ALWCO History

View Alwco History will display the five most recent events. First the event number is displayed followed by the event. Each event is date and time stamped with the most recent event displayed first.

Figures 4-25 through 4-29 are examples Alwco histories.

The display indicates (event #1, #2...etc) followed by the description with date and time stamp.

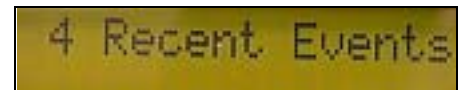


Figure 4-25.

Note: See the Troubleshooting section for more detail on each of the Warnings and Alarms



Figure 4-26.

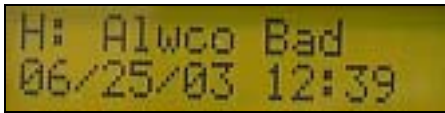


Figure 4-27.



Figure 4-28.



Figure 4-29.

The controller will cycle through the events 6 times or until the Reset/Menu button is pressed, which will then display the previous menu.

Perform Blowdown

The Level Master will provide years of safe operation providing that the control is periodically checked and operation is verified. It is this reliability which may lead to laxity in this very important preventive maintenance check.

It is recommended that the water column be blown down daily (or more often, depending on the water quality). The Level Master controller helps simplify this process by providing a reminder routine that will notify the operator at least once every 24 hours that the water column requires blowdown or if a successful blowdown has not been performed during that period. The period for notification can be changed anywhere from 4 to 24 hours via software configuration (refer to appendix A for software configuration parameters).

Note: The controller has connections for a by-pass switch to allow blowdown while the boiler is running (refer to Figure 2-6).

Figure 4-30 is an example of the message to inform the operator to perform a blowdown (Requires Column Blowdown).

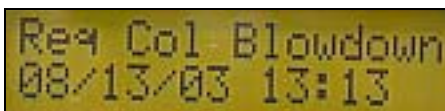


Figure 4-30.

To clear the display, press the Reset/Menu button.

To perform a blowdown, press the Reset/Menu button, the controller will respond with the display in Figure 4-31.
Press Reset/Menu again and the controller will respond with the display in Figure 4-32.

Press Reset/Menu again and the controller will respond with the display shown in Figure 4-33.

The water column timer display toggles with Figure 4-34.

The controller will begin a countdown period of 90 seconds. During this period of time, open the Blowdown Valve and wait until the RED low water light (LED) on the right side of the controller is illuminated. Then close the blowdown valve.
Connections for a blowdown by-pass switch are provided to allow the boiler to continue running during a blowdown. The blowdown switch should be located close to the blowdown valve so that the operator can operate the valve and the switch simultaneously.
Upon completion of a successful blowdown the controller will respond with the message in Figure 4-35 & 4-36.

The message has the time and date of the blowdown and the event is logged in the blowdown history.
If the blowdown was not successful the message displayed in Figure 4-37 & 4-38 will be displayed.

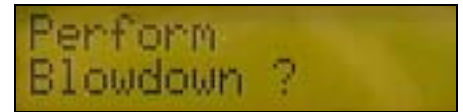


Figure 4-31.

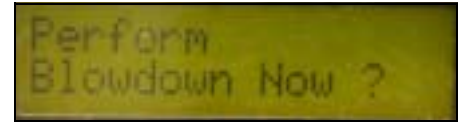


Figure 4-32.

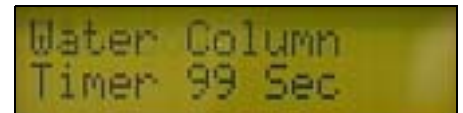


Figure 4-33.



Figure 4-34.

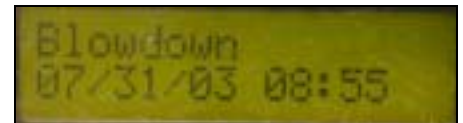


Figure 4-35.



Figure 4-36.

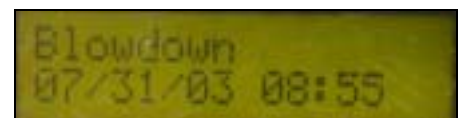


Figure 4-37.

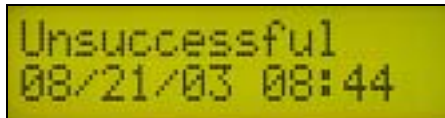


Figure 4-38.

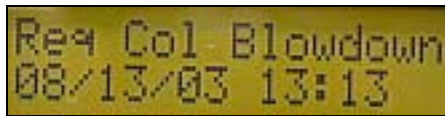


Figure 4-39.

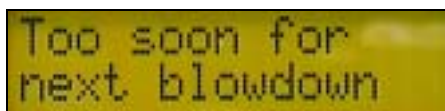


Figure 4-40.

This message in Figure 4-38 will appear for 5 minutes and the display will then toggle with the display in Figure 4-39.

Note: Time between blowdowns cannot be less than 1 minute. If the water level remains below the low water cutoff point for more than 30 seconds the Level Master will open the low water cutoff contacts and shutdown the boiler (even with the Blowdown Bypass switch pressed).

The message has the time and date of the unsuccessful blowdown and the event is logged in the blowdown history. The alarm relay on the controller will be energized until a successful blowdown has been completed.

If a another blowdown cycle is attempted before the 1 minute period has expired the controller will respond with the display in Figure 4-40.

After which the controller will cycle through the available menu options.

In addition to performing a water column blowdown at least daily it is recommended that a slow drain test be performed at least semi-annually. To perform this test, either stop the flow of feed water to the boiler or drain the boiler manually while running at low fire. Observe the water level in the sight glass and check for proper burner cut-off. If unsuccessful, repair or replace the control at once.

9. ALWCO Check

The Level Master controller has provisions to test the **A**uxiliary **L**ow **W**ater **C**ut-**O**ff device on the boiler. This check allows the water level in the boiler to drop below the setting of the low water cut-off without shutting the boiler down. The controller does safeguard in case the ALWCO fails. If the water level drops below the recommended ALWCO point and the boiler has not shut-off the Level Master will shut down the boiler. The ALWCO check must be run with the boiler/burner running.

To perform a ALWCO check, press the Reset/Menu button, the controller will cycle through the menus, when the display in Figure 4-41 appears, press Reset/Menu again.

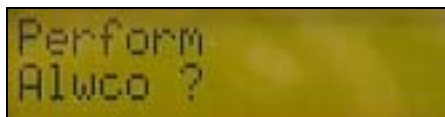


Figure 4-41.

Press Reset/Menu again and the controller will respond with the display in Figure 4-42.

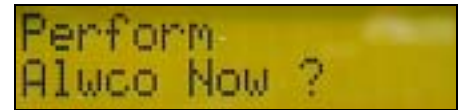


Figure 4-42.

If the boiler is not running or the Level Master is not wired properly, when the ALWCO check is initiated, the controller will respond with the message in Figure 4-44. Correct the wiring or turn the boiler on and re-initiate ALWCO.

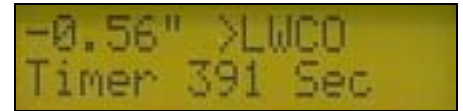


Figure 4-43.



Figure 4-44.

Once initiated the ALWCO check cycle will be complete when the boiler/burner shuts down. The controller will indicate a successful ALWCO check and immediately go into LW Shutdown. Once water level is restored the Reset/Menu button must be pressed to reset the controller.

If the ALWCO check is not performed within the allotted time or the level drops below the point at which the ALWCO should have shut the boiler down the controller will respond with the display in Figure 4-45.

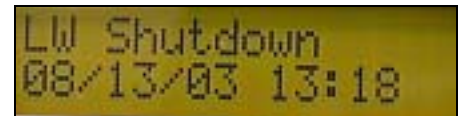


Figure 4-45.

The Low Water Shutdown screen toggles with the display in Figure 4-46.

The controller must be reset at this point and the event is logged into the ALWCO history file.

Note: Auxiliary low water cutoff check must be performed with operator present at all times.

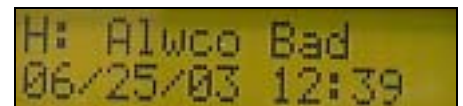


Figure 4-46.

Notes

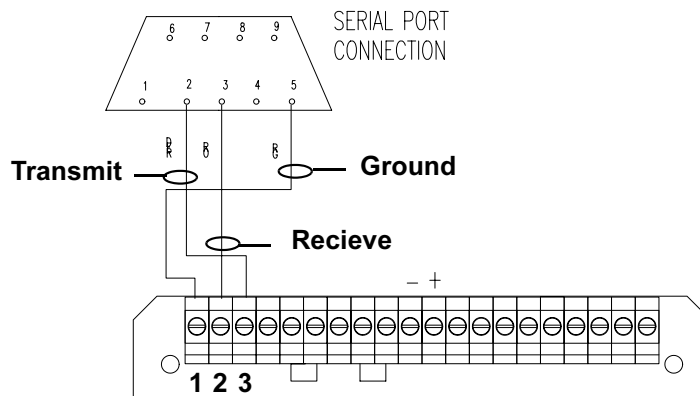
Section 5

Software Configuration

The Level Master controller has additional parameters that can be configured via computer. The controller communicates through the use of an RS232 serial connection. The computer needs terminal emulation software such as Windows Hyperterminal to communicate. Below is how to wire the RS232 connection.

The following procedure describes communication with Cleaver-Brooks level master controller using Hyper Terminal communication software.

1. Start hyperterminal.
2. Enter a name and select icon.
3. Connect using Com 1.



Is used

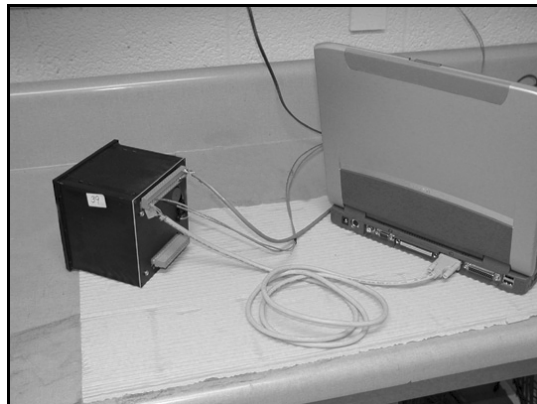


Figure 5-1: RS 232 connector

4. Set port settings to 19200, 8, N, 1, None.

Press the Esc key twice. The computer screen will display a message similar to <Cleaver-Brooks Copyright @YYYY>

The following parameters require a password in order to be changed. Only authorized personal familiar with boiler burner operation should change parameters

At this point communication with the controller is established.

The serial port task provides a number of commands that can set and/or read system parameters that control basic operation and enable or disable features.

The following commands can be used without a password:

A	date	set/read system date
B	time	set/read system time
C	ver	read system name, copyright and software version
D	temp	read controller and sensor temperature
E	stat	read system statistics
F	dispalarms	display history alarm/warning/information data on PC connection
G	Dispalarms, x	display history alarm/warning/information for x number of previous events

All other commands require a valid password prior to use the password is "Fielduser". The remaining commands are listed on the following pages.

Resetting the controller removes any previous password authorization, and will require a password again.

Format of serial port commands:

- 1) Enter the command name followed by a 'enter' to view the current value.
- 2) Enter the command name followed by a comma and parameters to set a new value.

Status Command

Command	Format	Description	Default value
pass	pass,password		
	On a new unit (version 0.40), if you type 420 you should see: 420 = 49,87,51, 66		
alarm	alarm alarm,x	View current value Alarm/warning countdown time, in seconds	5 seconds
alwcobelow	alwcobelow alwcobelow,x	View current value Maximum time water level can remain below LWCO during ALWCO test, in seconds	120 seconds can be 0 to 255 seconds
alwcototal	alwcototal alwcototal,x	View current value Maximum time for ALWCO test, in seconds	200 seconds can be 0 to 600 seconds
badmin	badmin badmin,x	View current value Minimum time water level must remain below LWCO during test, in seconds	0 seconds
bdnotify	bdnotify bdnotify,x	View current value Time after previous blowdown before operator is notified a new blowdown is required, in hours (4-24 hours)	24 hours
bdtotal	bdtotal bdtotal,x	View current value Maximum time for blowdown test, in seconds	90 seconds
bdwait	bdwait bdwait,x	View current value Minimum time required between successive blowdowns, in minutes (Range)	1 minute
date	date,mm/dd/yy	Set or view date	
display	display display,x	View current value Set on/off (0) or modulating (1) control	1 (modulating)
lvlzero	lvlzero lvlzero, 1234 sets the 4ma point at 1.234"	Water level 4mA point, in inches (i.e., water level above LWCO for 4mA point)	0 (not used)
lvlspan	lvlspan lvlspan, 2345 sets the 20mA point at 2.345"	Water level 20mA point, in inches (i.e., water level above LWCO for 20mA point)	0 (not used)
setpass	setpass,xxx,1 xxx = password	Set operator password, 10 characters maximum.	

Command	Format	Description	Default value
time	time time,HH:MM	Set or view time	
usetable	usetable usetable,x	View current table used and change to a new table. Select water sensitivity table 1 to 9	This perform the same operation as changing the water table number in the front panel menu.
valvelimit	valvelimit valvelimit, 10	View or change the valve velocity limiter from 0 to 30 seconds. 0 is disabled.	0
valvepoint	valvepoint valvepoint,x,# Where x = point # From 1 to 11 and # = the number from 0 to 100 valvepoint,1,100 sets the 1st point in the table to 100.	Lists the 11 point valve point table Sets any of the 11 points in the valve point table	100, 90, 80, 70, 60, 50, 40, 30, 20, 10, 0 this is a linear table that corresponds to the 20mA at valve open (pump on) and 4mA at valve closed (pump off)

The 'stat' command returns the Level Master controller status. Alarms, warnings, relay conditions, water level and feedwater valve position are returned.

The controller responds with:

```
stat = HAHWLALWSABFAFLFLSHRLRGRFR xx.x yyy.y'[cr])
```

- Current water level in inches
- Current valve position% output
- FR = feedwater pump relay on
- GR = general purpose relay on
- LR = LWCO relay energized
- HR = high water alarm relay on
- LS = LWCO relay short error
- LF = LWCO relay fail error
- AF = ALWCO test fail
- BF = blowdown test fail
- SA = sensor alarm (sensor not found)
- LW = low water warning
- LA = low water alarm
- HW = high water warning
- HA = high water alarm

SECTION 6

Troubleshooting and Parts

Note: All McDonnell & Miller models 193 and 194 are longer than model 157 and modifications to the piping will be necessary in order to install the Level Master Water Column. Models 193 are 17 1/2" in length a models 194 are 17 1/4" in length. Also the gauge glass for model 194 are 1/8" longer than corresponding replacement.

To mount the panel use bracket part number 8-3267. Use additional union per Figure 6-1.

When installing the level master system or when problems occur during the initial installation, please adhere to the following guidelines:

The installation must conform to the local electrical codes. Code compliance is the responsibility of the customer or his contractor.

Disconnect power to the boiler prior to installation.

WARNING

Make sure that all screw terminal connectors are tightened to the proper torque, and all electrical connectors are made. Loose or stripped screw terminals will increase the resistivity of the related circuit and will generate high temperature in the controller; this could cause serious damage to the product, or lead to personal injury or death.

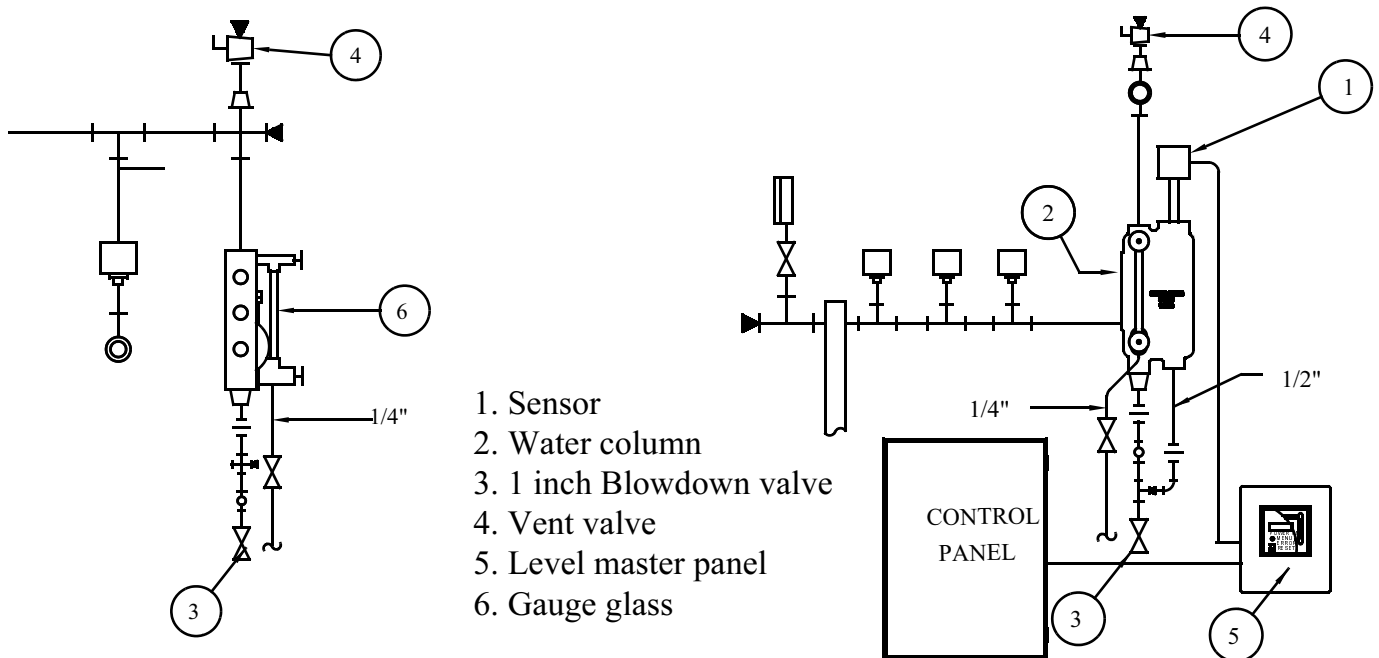


Figure 6-1: Water Column Piping

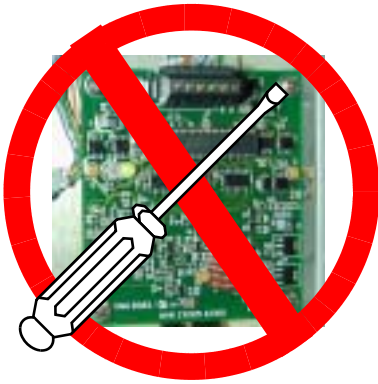


Figure 6-2: Do not use sharp tools on circuit board



Figure 6-3: Battery location



Figure 6-4: Level Master Float and Shaft

⚠ WARNING

If a system malfunction is detected, make sure to check all electrical wiring and connections. Confirm that all connections are wired pin-to-pin in accordance with the Level Master manual. Incorrect wiring can cause a short, which can damage the product, produce a system malfunction or result in severe personal injury or death.

⚠ CAUTION

Do not insert a screwdriver or sharp object into the circuit boards in the system. This can cause electrical component failures and system malfunctions.

⚠ CAUTION

It is recommended to use a wrist strap that is connected to ground when wiring the system.

If the battery is removed from the controller while power is disconnected, the time and date will have to be reset. See Section 4, Commissioning and Operation in this Level Master manual for instructions.

Do not use magnetized tools during installation.

⚠ WARNING

Do not remove the water column when boiler is pressurized or hot. This can cause damage to the product, produce a system malfunction or result in severe injuries or death.

Note: When Level Master components are newly installed check for proper system operation and make sure the installation and wiring complies with the Cleaver-Brooks Level Master and boiler Installation and Operation manuals.

Table 6-1: Troubleshooting

Problem	Display Message	Possible Cause	Corrective Measures
Water level is not maintained. Frequent shut-downs and warnings	Low Lvl Wrn LW Shutdown High Lvl Wrn High Water Alarm	Improper sizing of feedwater pump, control valve or piping. Sensitivity table selection is wrong No power to the pump starter No control output to the valve	Check sizing and piping configuration. Select different table. Make sure that power is present at the terminals 21 and 22 when display shows "Pump On" Using a multimeter, check the current ma output on the terminals 7 and 8. Output shall vary from 4 to 20 ma (4 ma at the "Pump On" point and 20 ma at "Pump Off" point).
Unsuccessful auxiliary low water cut off test	Alwco Check Bad	ALWCO shuts down the burner before level master. Level master shuts down the burner before ALWCO does.	Adjust position of ALWCO to be located below level master cut off point. Timing allocated for ALWCO test is too short. Adjust time using serial port connection and PC. ALWCO position is too low. Level master allows for water level to drop below low water cutoff point by no more than 1.8".
Water column cannot blowdown properly.	Blowdown Unsuccessful	Improper Piping Water level does not drop below low water cutoff point Blowdown procedure takes too long.	Follow piping recommendations in this manual. Allow water level to drop below low water cutoff point by fully opening column blowdown valve and allowing sufficient time. Level master allows a total of 90 seconds for blowdown from the time it was initiated via front display. Water level cannot be below low water cutoff for more than 30 seconds.

Problem	Display Message	Possible Cause	Corrective Measures
Boiler shuts down on the float check failure.	Float Check Fail (Also Wrn Slow Float Movement)	Impulse lines to the water column are plugged. Sensor well has sludge build up and prevents float movement. Boiler operates at low fire for a long period of time.	With no steam pressure, remove piping and clean. Remove probe assembly and clean sensor well. Contact Cleaver-Brooks Incorporate low fire relay circuit.
Controller display indicates low water cutoff relay failure.	LWCO Relay Fail	Improper wiring	Make sure that terminal 28 is wired before terminal 30 in the burner limit circuit. Make sure that voltage is not present at terminal 30 when power is removed from the terminal 28.
Display indicates that low water cutoff relay is shorted.	LWCO Relay Short	Jumper between terminal 28 and 30.	With water level below low water cut off, check the voltage at terminals 28 and 30. If voltage is present at both terminals, shut off the burner immediately and look for short circuits.
Communications between the sensor and the controller cannot be established	Sensor not found	Improper wiring	Make sure that the wiring between the sensor and the controller is done in accordance with this manual. Make sure that no loose wires are present. Check all of the connections and wire connections are tight and secure

Table 2: Parts List

Description	Part No.	Comments
Controller	623-00035	Auto Reset
Controller	623-00102	Manual Reset
Sensor	623-00036	Replacement Only
Battery	CR 2032 3.0V	Panasonic
Sensor Flange	623-00118	

SECTION 7

Displayed Message Details

January 12, 2003

Table 7-1 - Front Panel Alarm, Error, Informational, and Warning Messages Level Master Controller, Version 0.59f and later

Displayed Message Details	Type	Where Displayed	Meaning
Alwco Check Bad	Informational	Front Panel	Alwco test performed, was unsuccessful at indicated date and time.
Alwco Check Good	Informational	Front Panel	Alwco test performed, was successful at indicated date and time.
Blowdown Now ?	Informational	Front Panel	Displayed after a float failure has occurred when the operator confirms the previous float fail message.
Blowdown Successful	Informational	Front Panel	Blowdown test performed, was successful at indicated date and time.
Blowdown Unsuccessful	Informational	Front Panel	Blowdown test performed, was unsuccessful at indicated date and time. This is part of the blowdown message sequence shown at the end of this table. Also see "Requires Column Blowdown".
Boiler Off	Informational	Front Panel	Displayed on 2nd line of Front Panel if boiler burner input is NOT powered. 1st line of display contains "xx.x " > LWCO" See related messages "Pump On", "Pump Off" and "Output x.xx %".
Call CB Service	Error	Front Panel	This is alternately displayed with the following messages: a) LWCO Relay Fail b) Clock Failed c) Clock Failed 2
Change Battery	Informational	Front Panel	Displayed when the system battery needs to be changed. This message will be displayed once each day after 8am until the battery has been changed. This is a low priority message, other alarm and warning messages will be displayed first.
Cleaver Brooks Copyright @2003	Informational	Front Panel	Displayed at system power-up.

Section 7

Displayed Message Details	Type	Where Displayed	Meaning
Clock Failed 1	Warning	Front Panel	Displayed if the clock has failed in the unit. The 2nd line displayed is: Call CB Service.
Clock Failed 2	Warning	Front Panel	Displayed if the clock has failed in the unit. The 2nd line displayed is: Call CB Service.
Clock Not Set	Warning	Front Panel	Clock not set detected at indicated date and time, this is tested each hour.
Err:	Informational	Front Panel	Displayed when in debug mode while viewing the sensor errors. This indicates that the displayed sensor error has occurred but that the system is still operational.
Float Check Fail	Error	Front Panel	Float check test detected no float movement for full test time, error message, at indicated date and time (see Wrn Slow Float).
High Lvl Wrn	Warning	Front Panel	High water level warning occurred at indicated date and time.
High Water Alarm	Alarm	Front Panel	High water level alarm occurred at indicated date and time.
Low Lvl Warning	Warning	Front Panel	Low water warning occurred at indicated date and time.
LW Shutdown	Error, Alarm	Front Panel	LW Shutdown occurred at indicated date and time.
LWCO Relay Fail	Error	Front Panel	LWCO relay fail occurred at indicated date and time.
LWCO Relay Short	Error	Front Panel	LWCO relay short occurred at indicated date and time.
Output x.xx %	Informational	Front Panel	Displayed on 2nd line of Front Panel if boiler burner input is powered and modulating control is selected. 1st line of display contains "xx.x " > LWCO" See related messages "Boiler Off", "Pump On" and "Pump Off".
Pump Off	Informational	Front Panel	Displayed on 2nd line of Front Panel if boiler burner input is powered and pump is OFF during pump on/off control. 1st line of display contains "xx.x " > LWCO" See related messages "Boiler Off", "Pump On" and "Output x.xx %".
Pump On	Informational	Front Panel	Displayed on 2nd line of Front Panel if boiler burner input is powered and pump is ON during pump on/off control. 1st line of display contains "xx.x " > LWCO" See related messages "Boiler Off", "Pump Off" and "Output x.xx %".
Req Col Blowdown	Informational	Front Panel	Displayed as part of the "Float Check Fail" message.

Displayed Message Details	Type	Where Displayed	Meaning
Requires Column Blowdown	Informational	Front Panel	Blowdown test performed, was unsuccessful at indicated date and time. This is part of the blowdown message sequence shown at the end of this table. Also see "Blowdown Unsuccessful".
Sensor Not Found	Error	Front Panel	ensor communications are not detected for 12 seconds, system is shutdown. The sensor errors could be any of the following: a) below null, b) above maximum, c) checksum error, d) data failure (noise), e) AGC too high, f) No data g) No sensor connected
Shut:	Informational	Front Panel	Displayed when in debug mode while viewing the sensor errors. This indicates that the displayed sensor error has shut down the system.
Too soon for next ALWCO	Informational	Front Panel	Displayed when the operator tries to initiate the Alwco test too soon after a previous test
Too soon for next blowdown	Informational	Front Panel	Displayed when the operator tries to initiate the Blowdown test too soon after a previous test.
Turn Boiler Off	Informational	Front Panel	Displayed and alternates with the message "LWCO Relay Short".
Waiting On Sensor	Informational	Front Panel	Seen only at power-up when waiting on initial sensor connection. If no connection is found after 12 seconds, a "Sensor Not Found" message will be displayed.
Wrn Check Burner Status Input	Warning	Front Panel	Boiler is off and float movement detected, check burner input power, warning message at indicated date and time. (Note: This message is removed on software Version 060 and later).
Wrn Slow Float Movement	Warning	Front Panel	Float check test detected no float movement for 1/2 of test time, warning message, at indicated date and time (see Float Check Fail).
xx.x " > LWCO	Informational	Front Panel	Displayed on 1st line of Front Panel during normal boiler operation (no alarm, error or informational messages). Displays current water level. 2nd line of Front Panel is "Pump ON", "Pump OFF", or modulating percentage "Output x.xx %".

Section 7

Displayed Message Details	Type	Where Displayed	Meaning
Blowdown Unsuccessful then Requires Column Blow-down alternates with Blowdown Unsuccessful indefinitely until confirmed by keypress	Informational	Front Panel	Displayed for 1 minute then Displayed for 3 seconds alternates with Blowdown Unsuccessful indefinitely.

Table 7-2: Front Panel Menu Messages

Displayed Message	Type	Where Displayed	Meaning
Adj Battery Date	Menu	Front Panel	Displayed at the beginning of the battery date adjustment menu.
Alarm / Warning	Menu	Front Panel	Beginning of the alarm / warning time menu.
ALWCO Ignored	Menu	Front Panel	Displayed if operator initiates the ALWCO test sequence when the water level is already below the LWCO (can't perform the test).
Bat Date Changed	Menu	Front Panel	Displayed when the operator updated the battery date using the front panel keys (in response to the system indicating that the clock battery needs to be changed). This message indicates that the entered date was accepted.
Bat Date NOT Chg	Menu	Front Panel	Displayed when the operator updated the battery date using the front panel keys (in response to the system indicating that the clock battery needs to be changed). This message indicates that the entered date was NOT accepted because the date was already set.
Blowdown Ignored	Menu	Front Panel	Displayed if operator initiates the Blowdown test sequence when the water level is already below the LWCO (can't perform the test).
Chk LWCO pwr/lvl	Menu	Front Panel	Displayed if operator initiates the ALWCO test sequence when the burner input is not powered (can't perform the test).
Control xx.x °C or Control xx.x °F	Menu	Front Panel	The displayed controller temperature in °C or °F. The units depend on the metricdata command setting. The display units default to °F.
Display Format	Menu	Front Panel	The beginning of the display format menu.
Display History ?	Menu	Front Panel	The beginning of the display history (display alarm, display alwco, display blowdown) menus.

Table 7-2: Front Panel Menu Messages

Displayed Message	Type	Where Displayed	Meaning
Exit to previous menu	Menu	Front Panel	Displayed at the end of each menu list to allow the operator to return to the previous menu.
Modulating On / Off	Menu	Front Panel	Displayed to indicate whether modulating control is on or off.
No more history	Menu	Front Panel	Displayed when viewing the alarm, alwco or blowdown history file when no more items remain.
Perform ALWCO ?	Menu	Front Panel	1st prompt before performing the ALWCO test.
Perform ALWCO Now ?	Menu	Front Panel	2nd prompt before performing the ALWCO test.
Perform Blowdown ?	Menu	Front Panel	1st prompt before performing the Blowdown test.
Perform Blowdown Now ?	Menu	Front Panel	2nd prompt before performing the Blowdown test.
xx Recent Events	Menu	Front Panel	Displays the number of alarms, alwco, and blowdown messages in the history file.
Sensitivity	Menu	Front Panel	Displayed to indicate which water table is currently being used. See "Table x" message for additional details.
Set Date / Time	Menu	Front Panel	The beginning of the set date and time menu.
Sensor xx.x °C or Sensor xx.x °F	Menu	Front Panel	The displayed sensor temperature in °C or °F. The units depend on the metricdata command setting. The display units default to °F.
Table x	Menu	Front Panel	Displays the current water table number (from 1 to 9).
Timer x	Menu	Front Panel	Displays the current alarm / warning time in seconds (from 1 to 20).
Timer xx Sec	Menu	Front Panel	Displays the current remaining time in seconds.
View Alarm History ?	Menu	Front Panel	Beginning of the view alarm history menu.
View Alwco History ?	Menu	Front Panel	Beginning of the view alwco history menu.
View Blowdown History ?	Menu	Front Panel	Beginning of the view blowdown history menu.
View Date / Time	Menu	Front Panel	Beginning of the view date / time menu.
Water Below LWCO	Menu	Front Panel	Displayed if operator initiates the Blowdown test sequence when the water level is already below the LWCO (can't perform the test).

Table 7-3: History Messages

Displayed History Message	Type	Where Displayed	Meaning
Alwco Bad	History	Front Panel or Serial Port	Alwco test performed, was unsuccessful at indicated date and time.
Alwco Good	History	Front Panel or Serial Port	Alwco test performed, was successful at indicated date and time.
Bad Blowdown	History	Front Panel or Serial Port	Blowdown test performed, was unsuccessful at indicated date and time.
Batt Replaced	History	Front Panel or Serial Port	Battery was replaced at indicated date and time.
BD Notify	History	Front Panel or Serial Port	Blowdown notification was displayed at indicated date and time.
Clock Failed	History	Front Panel or Serial Port	Time of Day Clock failure detected at indicated date and time.
Clock Not Set	History	Front Panel or Serial Port	Clock not set detected at indicated date and time, this is tested each hour.
Clock Stopped	History	Front Panel or Serial Port	Time of Day Clock stop detected at indicated date and time.
Float Fail	History	Front Panel or Serial Port	Float check test detected no float movement for full test time, error message, at indicated date and time (see Slow Float).
Good Blowdown	History	Front Panel or Serial Port	Blowdown test performed, was successful at indicated date and time.
High Lvl Al	History	Front Panel or Serial Port	High water level alarm occurred at indicated date and time.
High Lvl Wrn	History	Front Panel or Serial Port	High water level warning occurred at indicated date and time.
Low Water Wrn	History	Front Panel or Serial Port	Low water warning occurred at indicated date and time.
LW Shutdown	History	Front Panel or Serial Port	LW Shutdown occurred at indicated date and time.
LWCO Rel Fail	History	Front Panel or Serial Port	LWCO relay fail occurred at indicated date and time.
LWCO Rel Shrt	History	Front Panel or Serial Port	LWCO relay short occurred at indicated date and time.
Sensor Error	History	Front Panel or Serial Port	Sensor Error occurred at indicated date and time.
Slow Float	History	Front Panel or Serial Port	Float check test detected no float movement for 1/2 of test time, warning message, at indicated date and time (see Float Fail).
Watchdog Pwr	History	Front Panel or Serial Port	System was reset due to watchdog timeout at indicated date and time.

NOTES



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