

# Chromalox®

## Installation, Operation and

### RENEWAL PARTS IDENTIFICATION

#### SERVICE REFERENCE

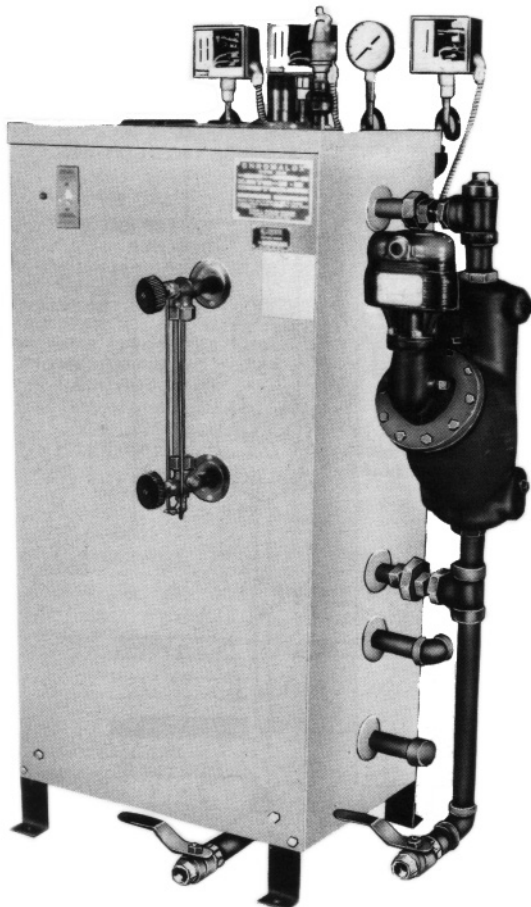
DIVISION 4	SECTION CHPES
SALES REFERENCE (Supersedes PQ436)	PQ436-1
161-562802-002	
DATE	MAY, 1999

## Type CHPES-6A through CHPES-180A High Pressure Electric Steam Boiler

Standard Trim is 250 PSI — 0-225 PSI Operating Pressure Range

Boiler Serial Number .....	Power Circuit Voltage .....
Model .....	Control Circuit Voltage .....
National Board No. ....	Amps ..... Phase ..... Cy .....

**Important** — This data file contains the National Board Registration Certificate for your boiler. It must be kept near the boiler at all times.

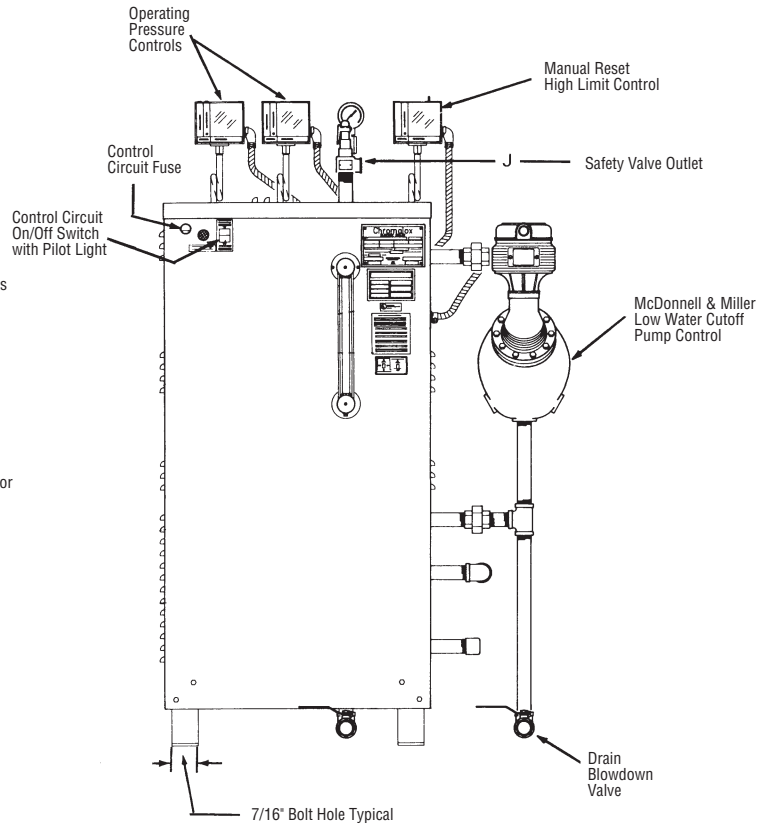
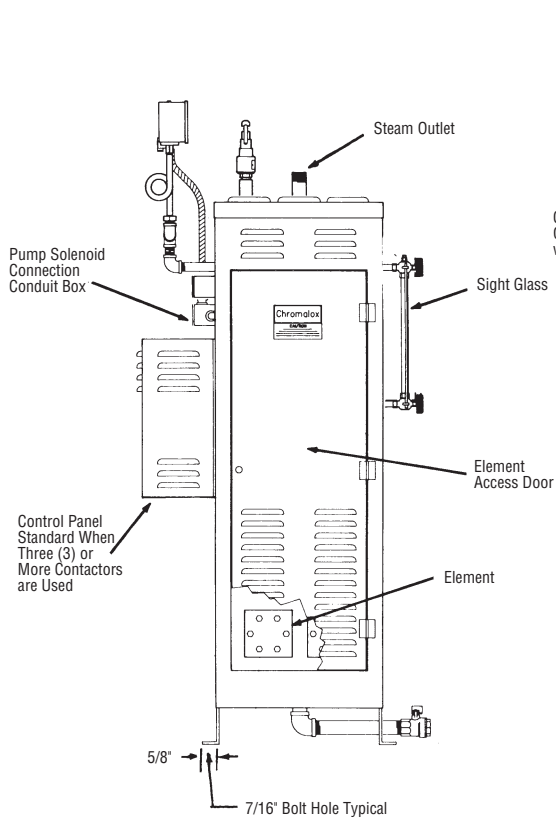
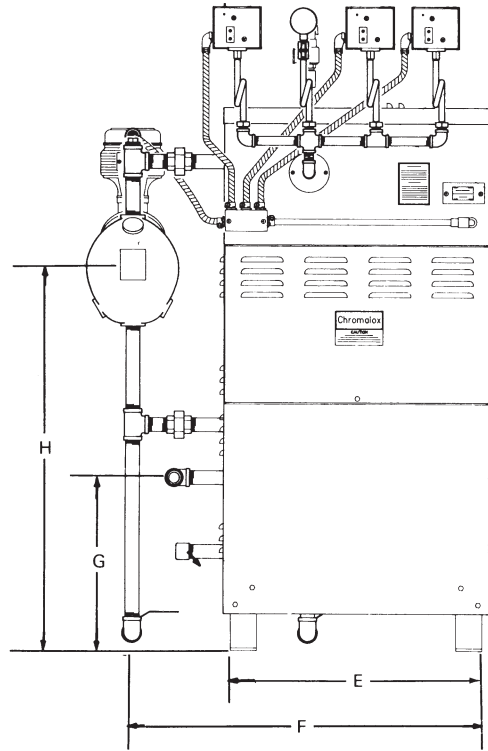
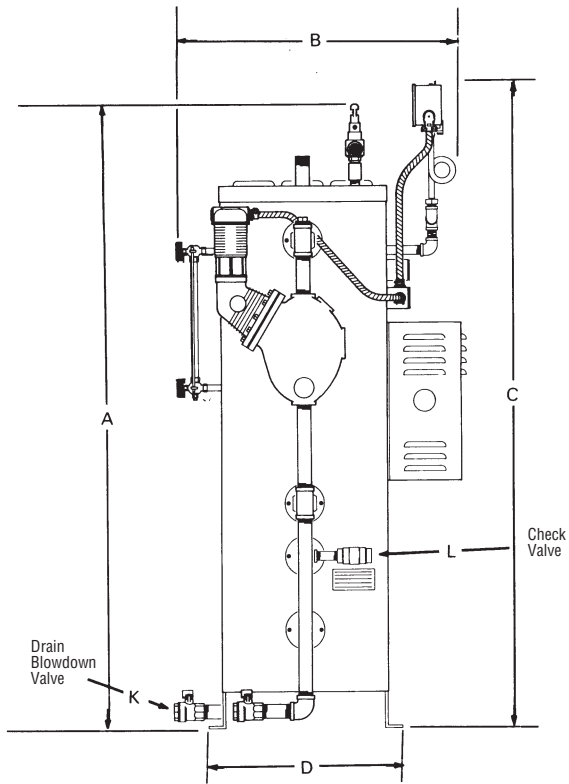


Model	Rating (BHP)	Elec Cap. (kW)	Vol. (Gals.)	Output at 212°F (Lbs./Hr.)	3 Phase Voltages*			No./kW Heating Elements
					Quantity/Rating of Contactors			
					208	240	480†	
<b>Type CHPES — 20-250 PSIG</b>								
CHPES-6A	0.6	6	6	18	30	30	30	1-6
CHPES-9A	0.9	9	6	27	30	30	30	1-9
CHPES-12A	1.22	12	6	36.2	40	30	30	1-12
CHPES-18A	1.73	17	6	51.2	50	50	30	1-17
CHPES-24A	2.45	24	14.3	72.3	2-40	2-30	2-30	2-12
CHPES-30A	2.95	29	14.3	87.4	1-40 1-50	1-40 1-30	40	1-12 1-17
CHPES-36A	3.47	34	14.3	102.5	2-50	2-50	50	2-17
CHPES-48A	4.69	46	14.3	138.7	1-40 2-50	1-30 2-50	1-40 1-30	1-12 2-17
CHPES-60A	5.91	58	14.3	174.8	2-50 2-40	2-30 2-50	2-40	2-12 2-17
CHPES-72A	6.93	68	14.3	205	4-50	4-50	2-50	4-17
CHPES-100A	10.40	102	27.8	307	6-50	6-50	3-50	6-17
CHPES-135A	13.9	136	30.5	410	—	8-50	4-50	8-17
CHPES-160A	16.1	157.5	30.5	475	—	7-60	1-30 3-60	7-22.5
CHPES-180A	18.4	180	30.5	543	—	8-60	4-60	8-22.5

\* Single phase available up to and including 24 kW capacity.  
† All boilers must have separate 120V Control Circuit or Transformer.  
Boilers under 40 Amps max are not fused.

# DIMENSIONS

## MODEL CHPES-6A through CHPES-180A



## DIMENSIONS

Model	Type CHPES — Dimensions (In.)											
	A	B*	C	D	E	F	G	H	I	J	K	L
CHPES-6A	37	22-1/2	30	15-1/4	20	30-1/2	9-1/2	16	1/2	1	1/2	1/2
CHPES-9A	37	22-1/2	30	15-1/4	20	30-1/2	9-1/2	16	1/2	1	1/2	1/2
CHPES-12A	37	22-1/2	30	15-1/4	20	30-1/2	9-1/2	16	1/2	1	1/2	1/2
CHPES-18A	37	22-1/2	30	15-1/4	20	30-1/2	9-1/2	16	1/2	1	1/2	1/2
CHPES-24A	43-1/2	26	46	17-1/2	23	34-1/2	16-1/2	24-1/2	1	1	1	3/4
CHPES-30A	43-1/2	26	46	17-1/2	23	34-1/2	16-1/2	24-1/2	1	1	1	3/4
CHPES-36A	43-1/2	26	46	17-1/2	23	34-1/2	16-1/2	24-1/2	1	1	1	3/4

\*Add two inches for transformer.

Model	Type CHPES — Dimensions (In.)											
	A	B*	C	D	E	F	G	H	I	J	K	L
CHPES-48A	43-1/2	26	46	17-1/2	23	34-1/2	16-1/2	24-1/2	1	1	1	3/4
CHPES-60A	43-1/2	26	46	17-1/2	23	34-1/2	16-1/2	24-1/2	1	1	1	3/4
CHPES-72A	43-1/2	26	46	17-1/2	23	34-1/2	16-1/2	24-1/2	1	1	1	3/4
CHPES-100A	63-1/2	30	55	21	27	36	16-3/4	37-1/2	1-1/2	1-1/4	1	3/4
CHPES-135A	63-1/2	32	55	20-1/2	26	37-1/2	16	37-1/2	2	1-1/4	1	3/4
CHPES-160A	63-1/2	32	55	20-1/2	26	37-1/2	16	37-1/2	2	1-1/4	1	3/4
CHPES-180A	63-1/2	32	55	20-1/2	26	37-1/2	16	37-1/2	2	1-1/4	1	3/4

## INSTALLATION

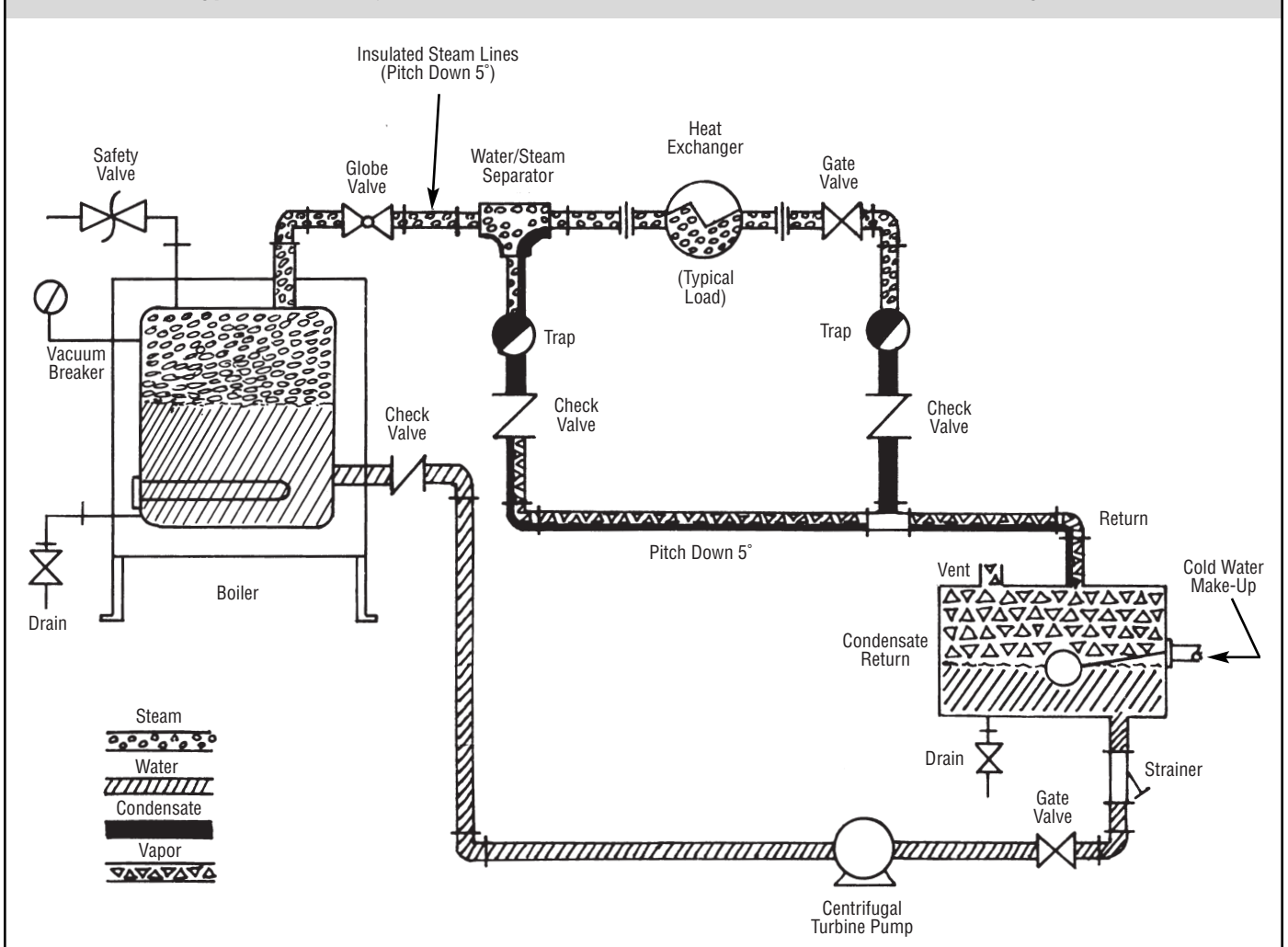
**WARNING: To avoid electrical shock hazard, boilers must be suitably grounded to earth.**

- The boiler should be mounted on a solid level foundation. **Note:** When installing boiler, allow sufficient room (21" minimum) to facilitate removal of elements if and when necessary.
- WARNING: A minimum distance of 18" between boiler and any combustible material must be maintained.**
- Complete all piping to boiler. Connect water line to tagged fitting on the motor and pump assembly, if used, or to tagged fitting on water control feeder.
- When any type of feed other than a pump feed is used — the existing water supply must be 10 pounds greater than the boiler operating pressure to assure water supply maintains proper water level in boiler. Otherwise, lack of water can cause heater failure. Keep feed

water line valves open at all times except during blowdown.

- All water feed systems are connected to water inlet check valve.
- Connect steam line (with Globe valve) to boiler steam outlet. Valve should be placed as close as possible to boiler outlet and sized per label on boiler.
- To insure maximum efficiency of supplied kW, all piping from outlet should be insulated.
- Drain and relief valve piping should be in accordance with state and local codes. Floor drain to be provided directly below unit.
- All electrical wiring should be done by licensed electrician in accordance with national and local electrical codes.
- If pump is located less than 30 feet from boiler, a second check valve is required.

### Typical Plumbing Installation of a Steam Boiler with Condensate Return System



## WIRING

**WARNING: Hazard of Shock. Disconnect all power before working on boiler. Boilers must be effectively grounded in accordance with the National Electrical Code to eliminate shock hazard.**

**WARNING: Use 90° copper conductors only.**

1. Select proper wire gauge and type for supply conductors in accordance with the National Electrical Code and local wiring codes following wiring diagram supplied (See recommendations for disconnect switches and fusing).
2. The unit is completely wired and pre-tested before shipment. No internal wiring is required. Check all electrical connections for tightness and retighten if necessary before energizing. If a separate control circuit is used, the control circuit should be connected to the control terminal block, inside access door (not required with transformer).
3. **Safety Switches — WARNING: Purchaser should use a safety switch employing circuit breakers or fuses between his main power source and the boiler.**
4. Because of their water lines, boilers are susceptible to lightning

damage. Industrial type lightning protectors should be installed per manufacturer's recommendations at your service entrance. Check your contractor or electrical dealer for recommended type for your system.

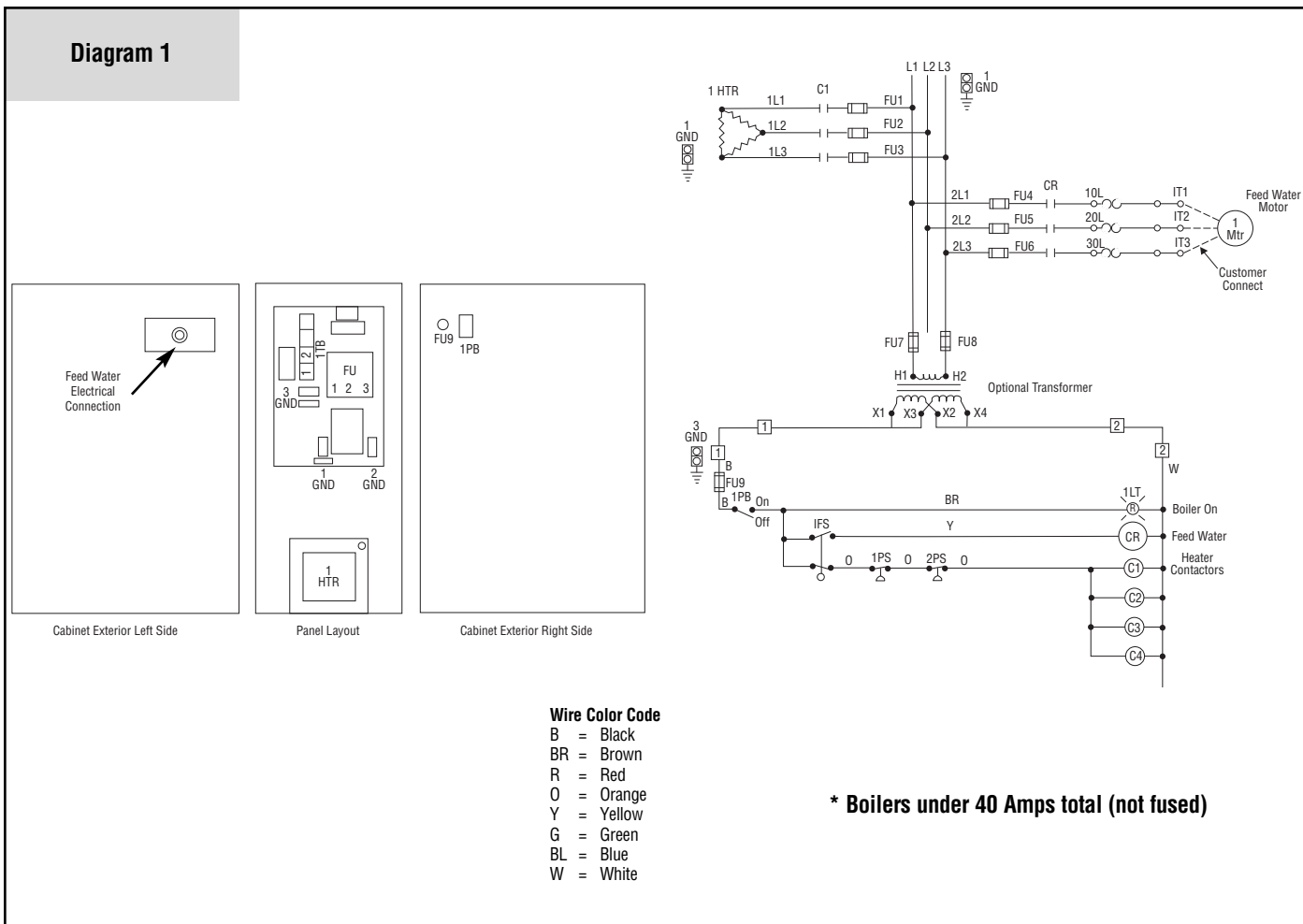
5. Be sure all electrical connections are sufficiently tightened.
6. **WARNING: Substitution of components or modification of wiring system voids the warranty and may lead to dangerous operating conditions.**
7. **SPECIAL INSTRUCTIONS FOR CUSTOMERS SUPPLYING THEIR OWN CONDENSATE OR PUMP SYSTEMS.**
  - A. Check the voltage of the motor before making the wiring connection. Some Chromalox boilers are supplied with dual voltage systems. The motor should always match the voltage of the control circuit.
  - B. The motor circuit should be wired into the pump control as shown in wiring diagram (float type pump control). If boiler is equipped with solid state pump control, refer to wiring diagram and use terminals 5 and 2.

## TYPICAL WIRING DIAGRAMS

Use Applicable wiring diagrams based on model number and power voltage.

Boiler	3 Phase Voltage			Boiler	3 Phase Voltage			Boiler	3 Phase Voltage		
	208	240	480		208	240	480		208	240	480
CHPES-6A	1	1	1	CHPES-30A	2	2	3	CHPES-100A	8	8	9
CHPES-9A	1	1	1	CHPES-36A	2	2	3	CHPES-135A		10	11
CHPES-12A	1	1	1	CHPES-48A	4	4	5	CHPES-160A		12	12
CHPES-18A	1	1	1	CHPES-60A	6	6	7	CHPES-180A		10	10
CHPES-24A	2	2	3	CHPES-72A	6	6	7	Export	14		

**Diagram 1**



# TYPICAL WIRING DIAGRAMS

Diagram 2

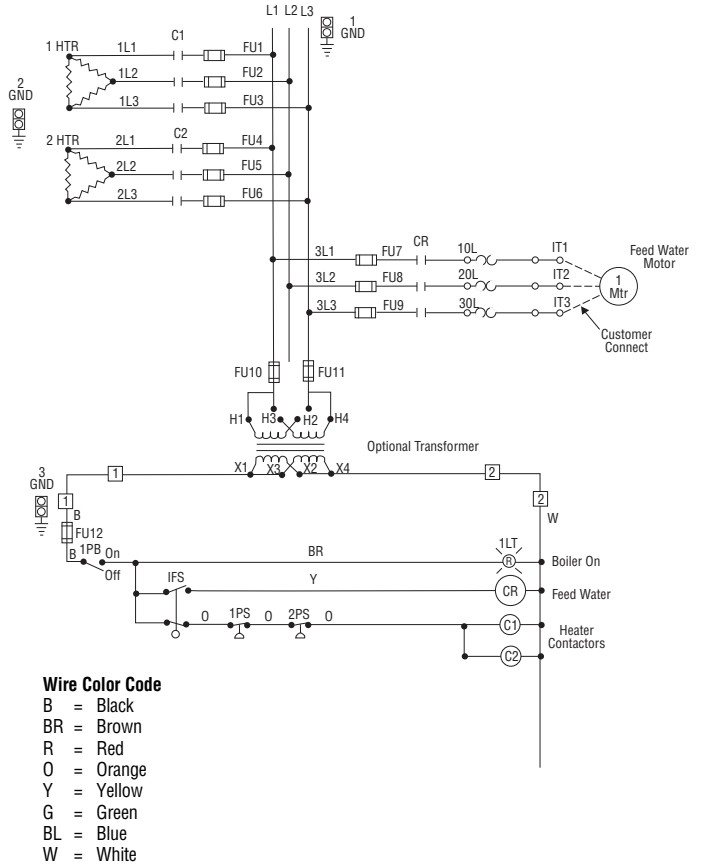
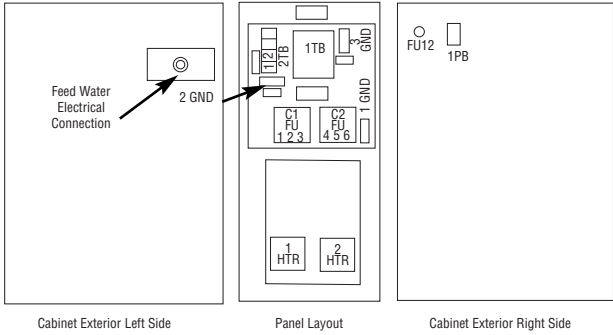
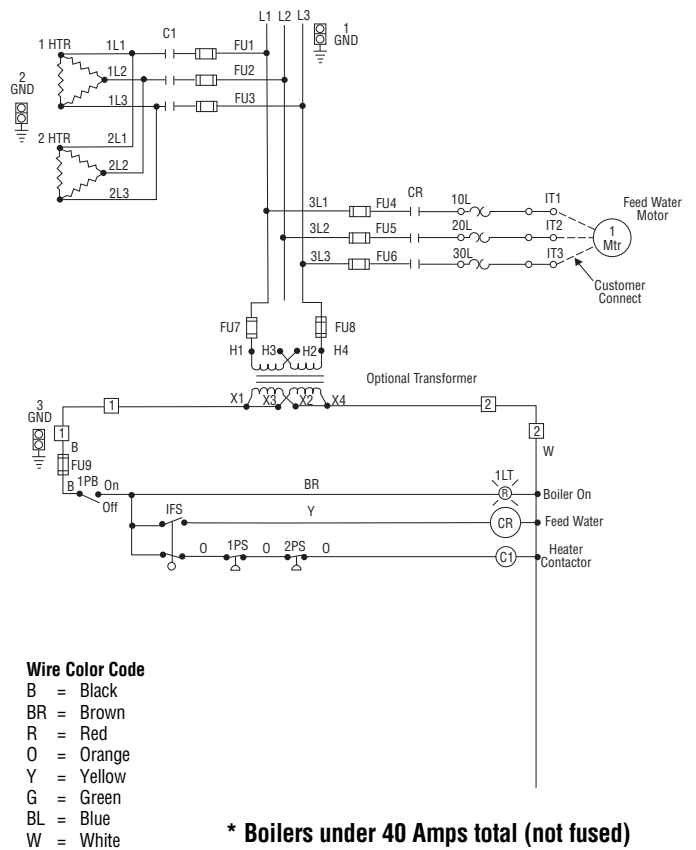
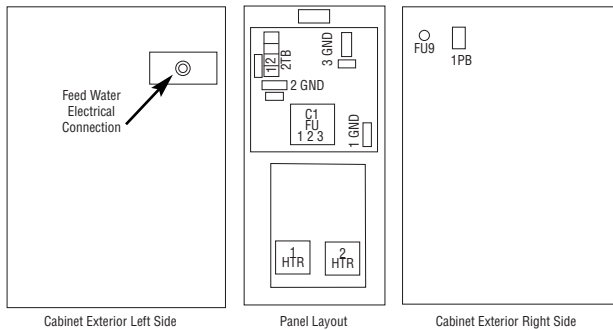
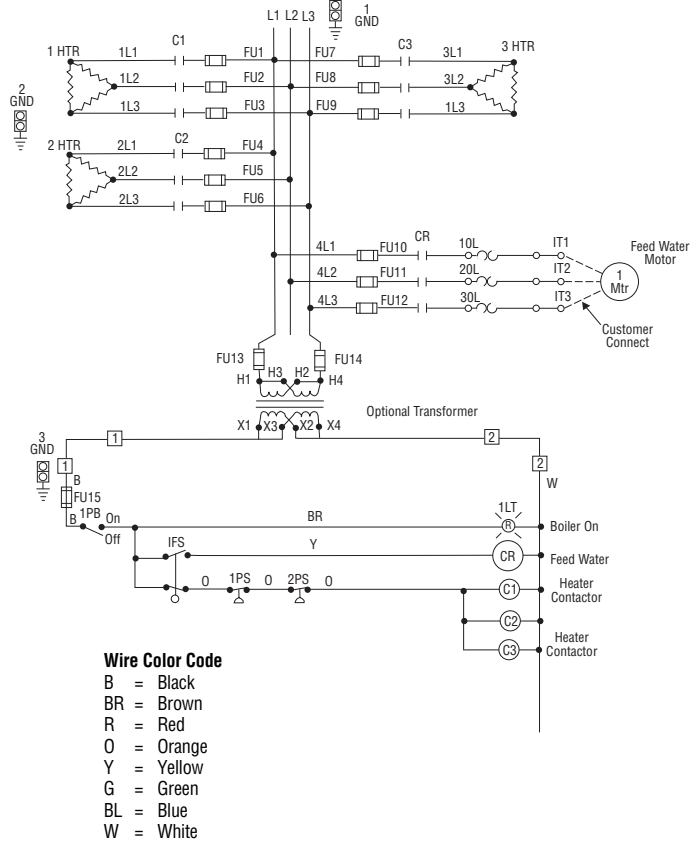
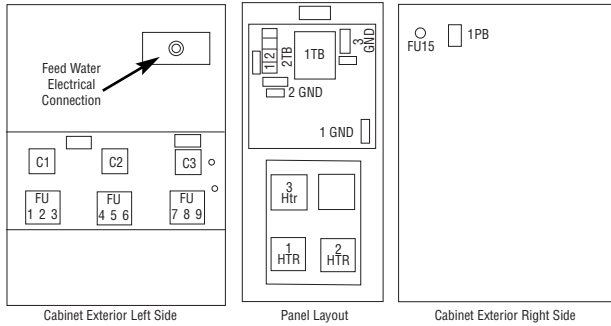


Diagram 3

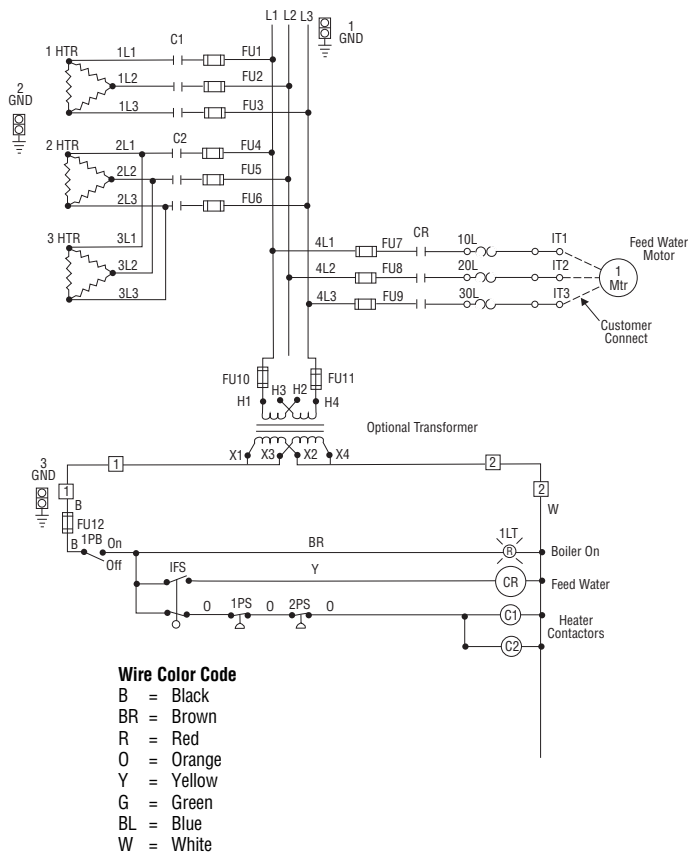
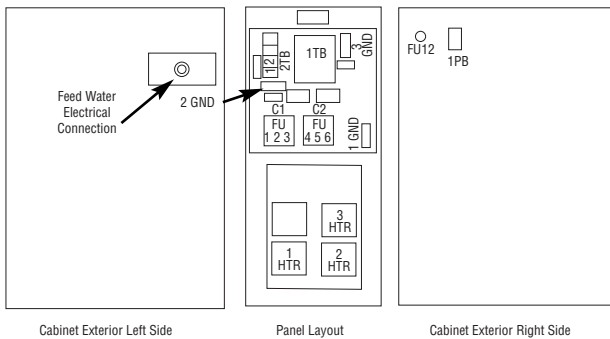


# TYPICAL WIRING DIAGRAMS

## Diagram 4

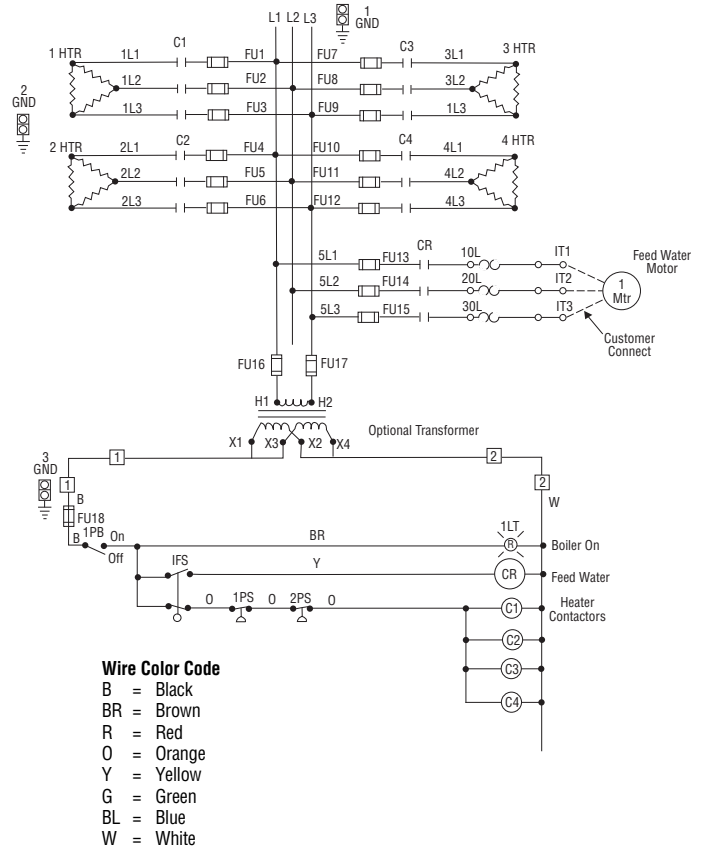
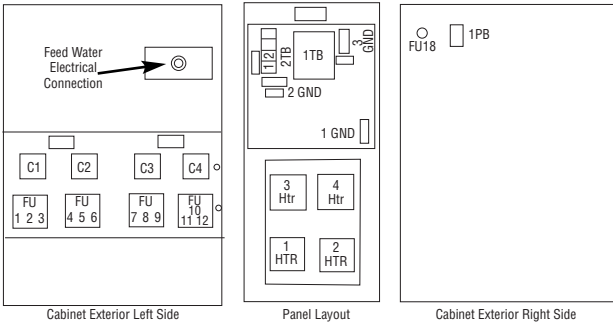


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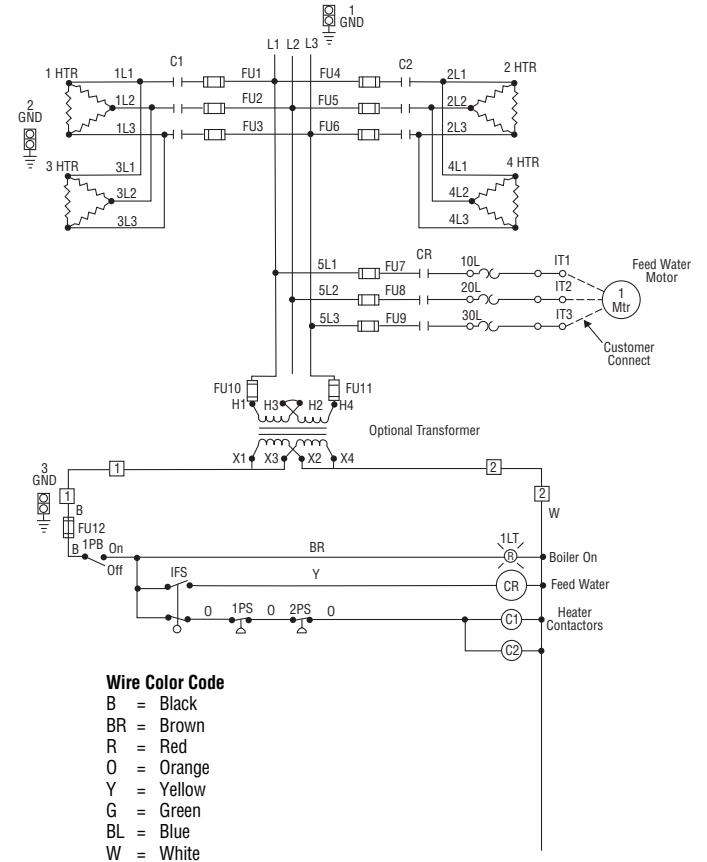
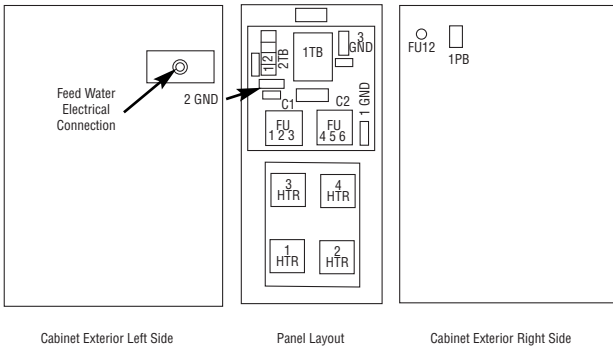


# TYPICAL WIRING DIAGRAMS

## Diagram 6

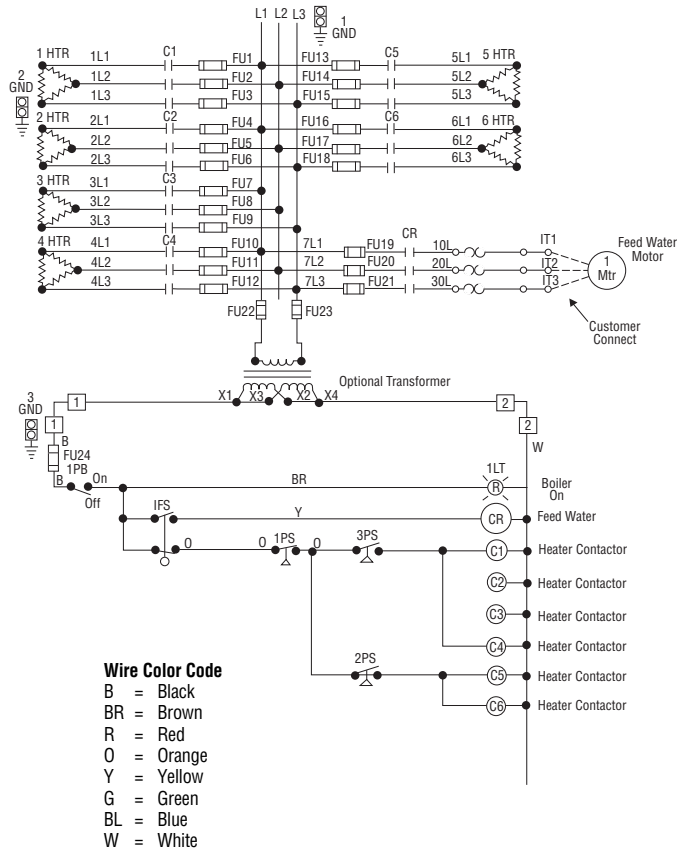
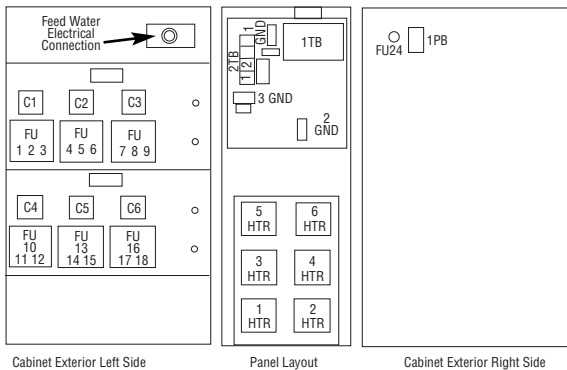


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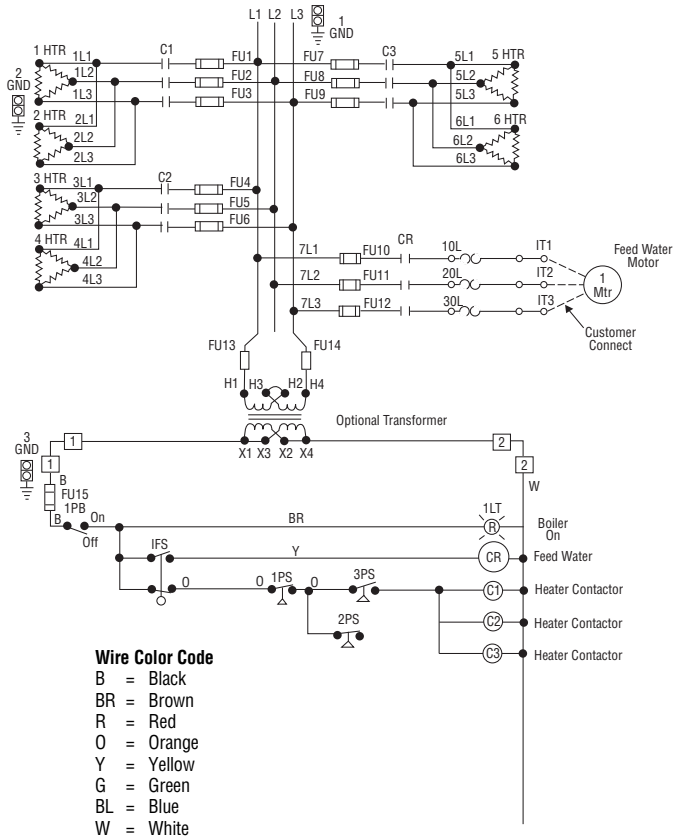
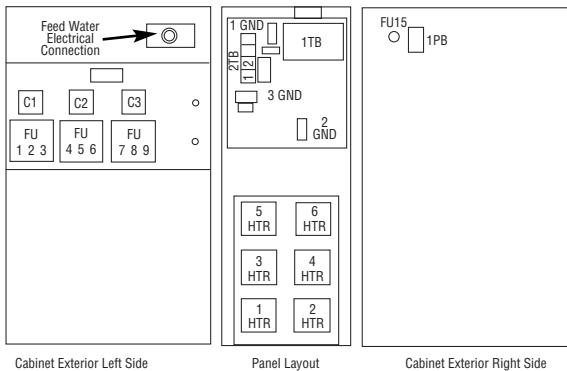


# TYPICAL WIRING DIAGRAMS

## Diagram 8



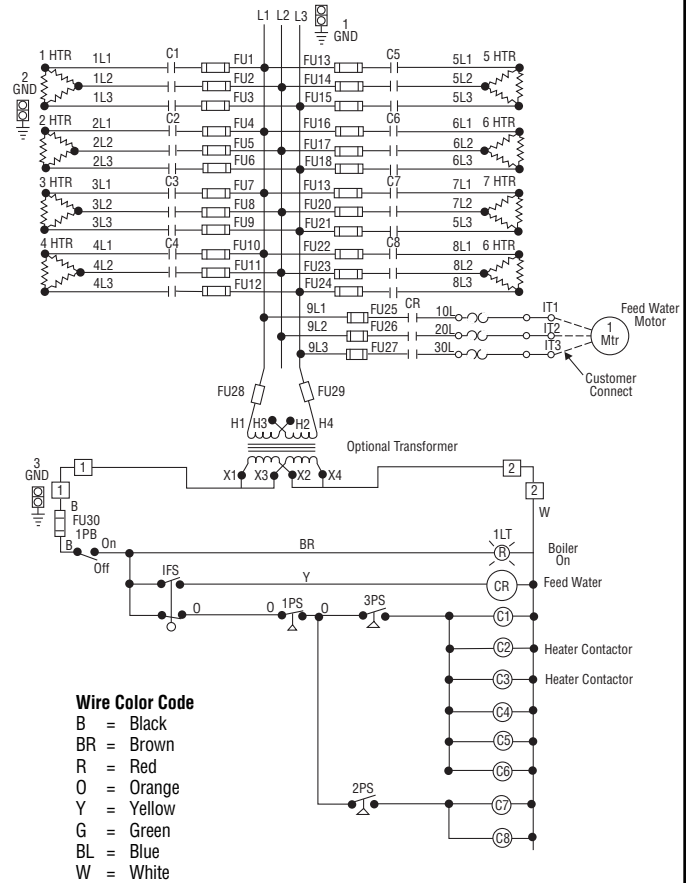
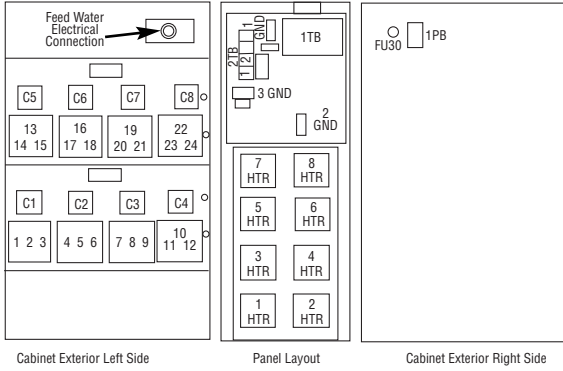
## Diagram 9



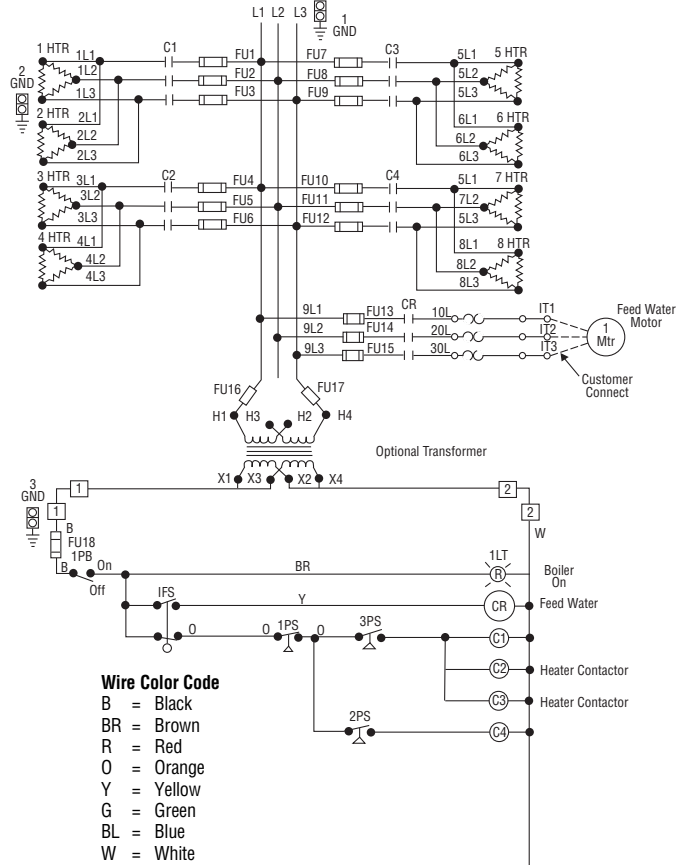
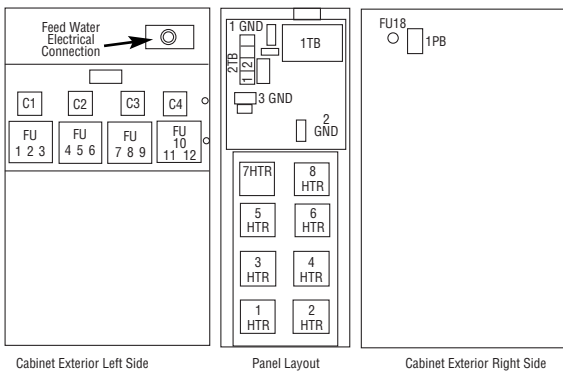


# TYPICAL WIRING DIAGRAMS

**Diagram 10**

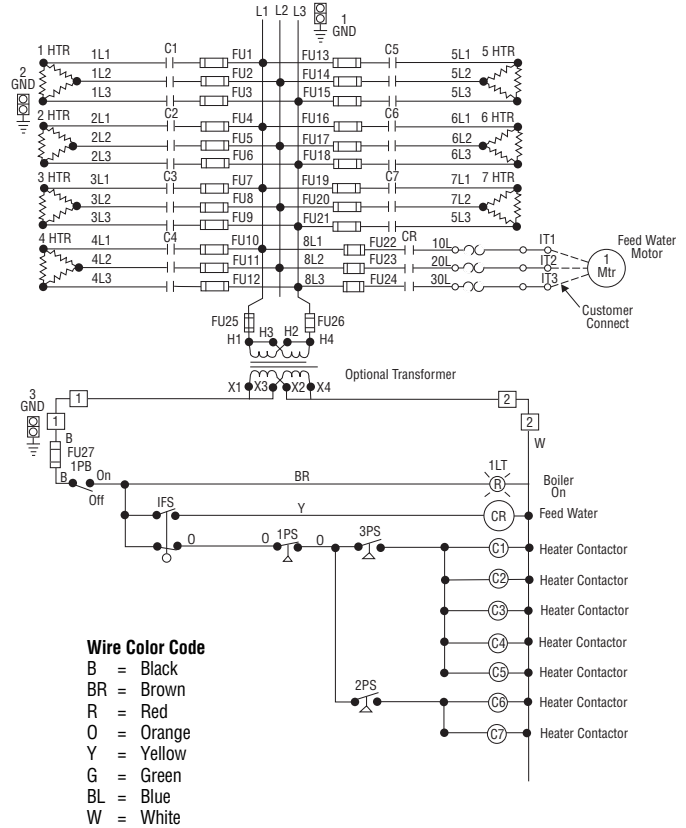
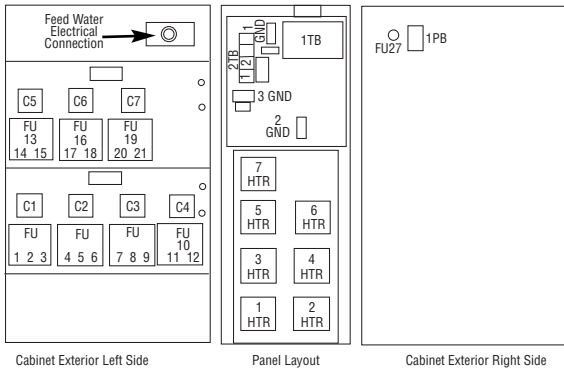


**Diagram 11**

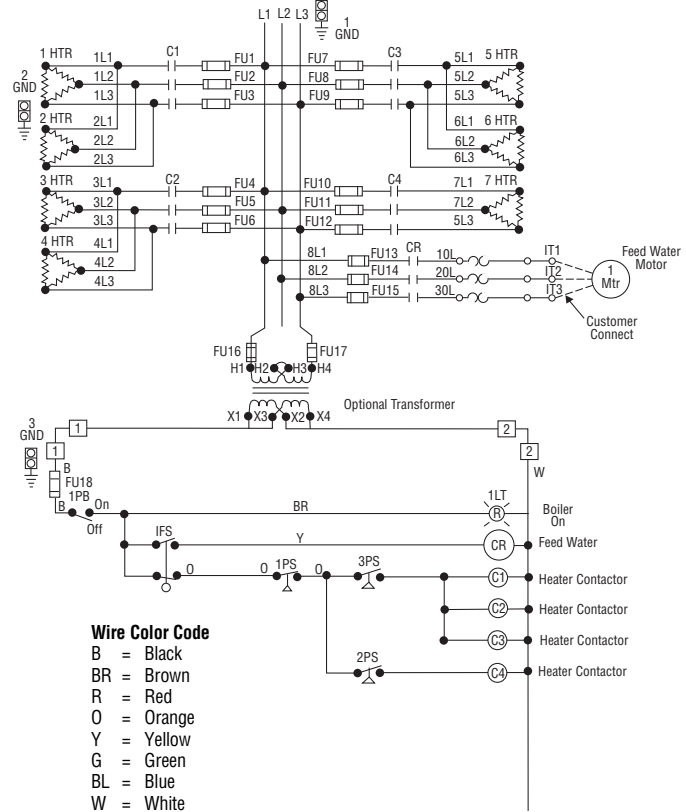
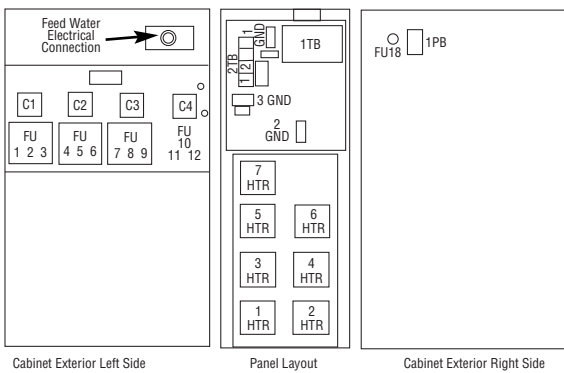


# TYPICAL WIRING DIAGRAMS

## Diagram 12

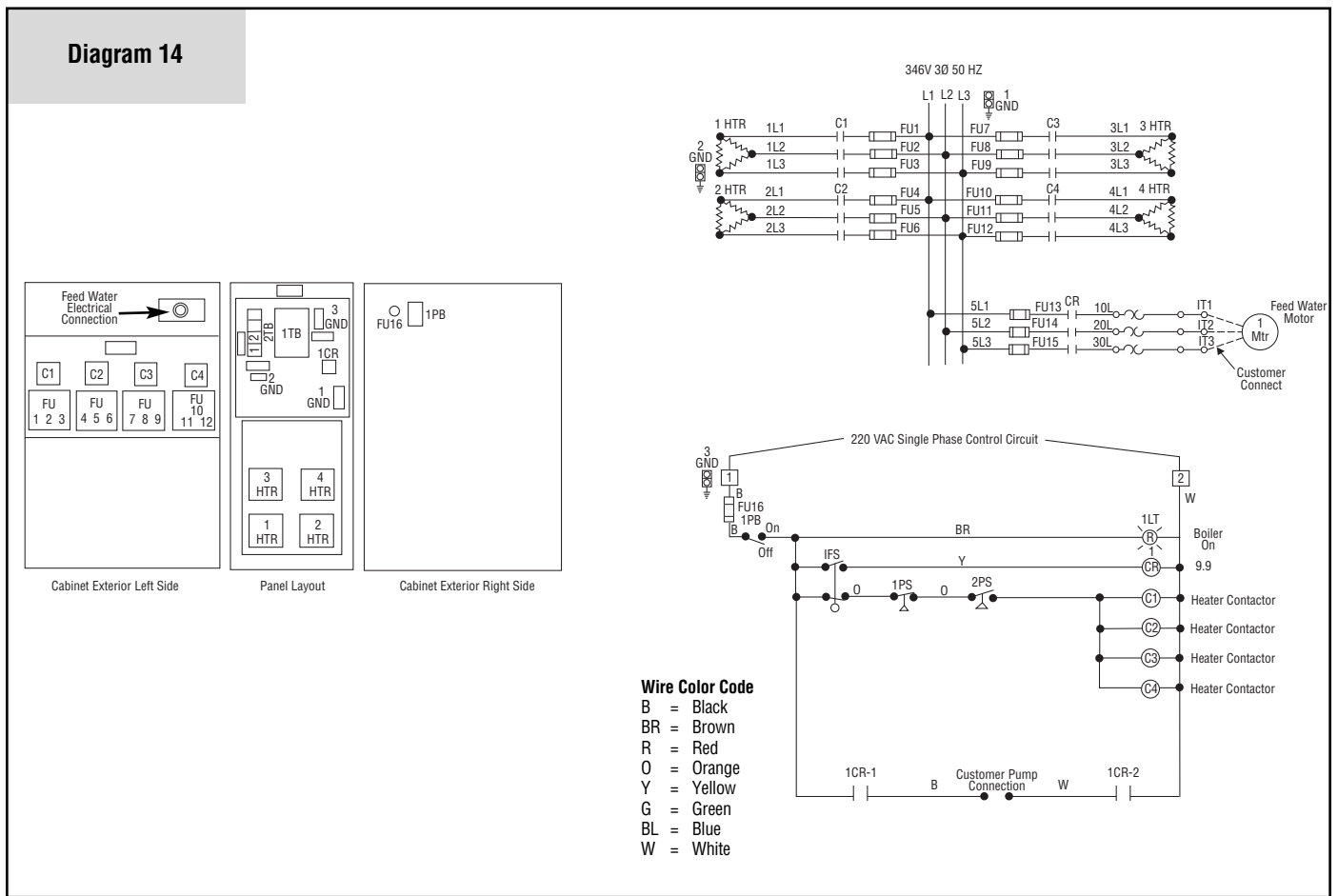


## Diagram 13



## TYPICAL WIRING DIAGRAMS

**Diagram 14**



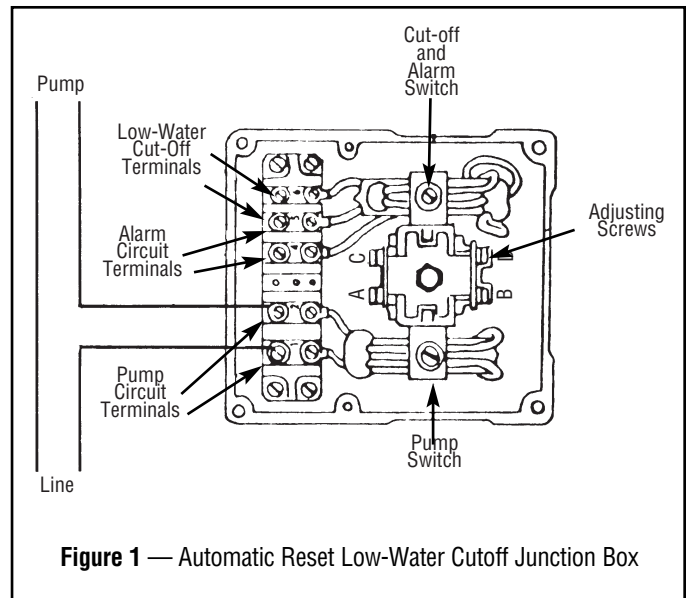
## PRE-OPERATION CHECK

After proper wiring and piping of boiler system is complete, testing of controls can start. **Before testing controls, it is recommended that all contactor fusing be removed.** This is to prevent possible element failure under test conditions.

### A. OPERATING AND TESTING THE McDONNELL & MILLER LOW WATER CUTOFF CONTROL.

1. Be sure all valves from incoming water supply are fully open. **Turn boiler switch to "ON" position,** pump or solenoid valve will energize, allowing boiler to fill with water. Proper water level is automatically reached with level control supplied. Pump or solenoid feed will shut off at proper water level. Contactor(s) will energize, supplying power voltage to elements.
2. **Checking operation of pump switch.** (Figure 1) With water level visible in sight glass, partially open drain valve at bottom of boiler. If automatic blowdown supplied, push manual blowdown switch until valve open light is on, hold for few seconds. Water level will fall, allowing float to trip pump switch to "ON" position. Close drain valve or release manual blowdown switch. Pump motor or solenoid valve will energize and water level will resume to normal level in sight glass.
3. **Checking low water cutout switch operation,** open drain valve completely. If automatic blowdown supplied, push in and hold manual blowdown switch until water level falls enough to trip cutout switch. Close drain valve or release manual blowdown switch. If low water cutout is automatic reset, pump or solenoid will return water level to normal. If low water cutout is manual reset, then manual reset button on McDonnell & Miller low water cutoff control must be pushed to complete circuit. **Turn off boiler. Reinstall contactor fuses.**

**WARNING: Be sure all electrical connections are tight before energizing boiler. Reset all manual reset controls by pushing reset buttons on: (1) high limit control located on top of boiler and (2) McDonnell & Miller located on the side of boiler.**



**Figure 1** — Automatic Reset Low-Water Cutoff Junction Box

## OPERATION

### B. ADJUSTING OPERATING PRESSURE CONTROLS

1. Chromalox boilers are supplied with operating and high limit pressure controls. One is used for controlling the operating pressure of the boiler while the other is used as a high limit control. To determine the difference in the controls, the high limit has a manual reset lever on top of the case. Also, there is no differential scale present.
2. On all controls, the pressure adjusting screw on the top of the case sets the desired pressure. Turning the screw counterclockwise reduces the pressure setting (**CUT OUT**) (See Figure 2). High limit control should be set at 10 psig above the operating pressure of the boiler.
3. The differential adjusting screw on the operating control is set in the same manner as the pressure adjusting screw. The **CUT OUT** setting minus the differential setting, equals **CUT IN** pressure of the operating control.

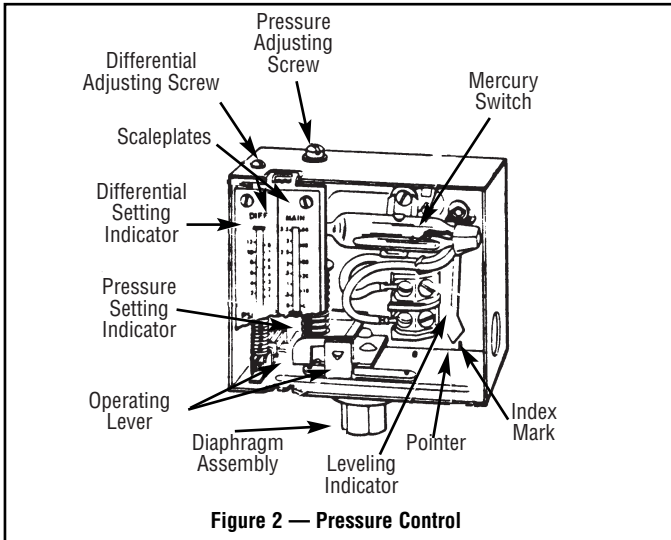


Figure 2 — Pressure Control

To check operation of the controls, close steam outlet valve and adjust operating pressure control to a low pressure setting. Also, set high limit control at 10 psig above operating pressure control. Turn on boiler, and

allow pressure to build up. When pressure gauge reading approaches set point of pressure control, the switch will trip and shut off boiler. Turn off boiler.

To reset pressure control, bleed off enough pressure in the boiler by opening steam outlet drain, or blowdown valve to allow the operating control to reset.

### 4. HIGH LIMIT PRESSURE CONTROL OPERATION

The high limit is tested in the same manner but with the operating control set above the pressure setting of the high limit. (Figure 3)

#### CAUTION: THIS IS FOR TEST PURPOSES ONLY!

When the high limit trips, turn off boiler and reset high limit to proper setting. The manual reset level must be pushed to resume operation upon startup.

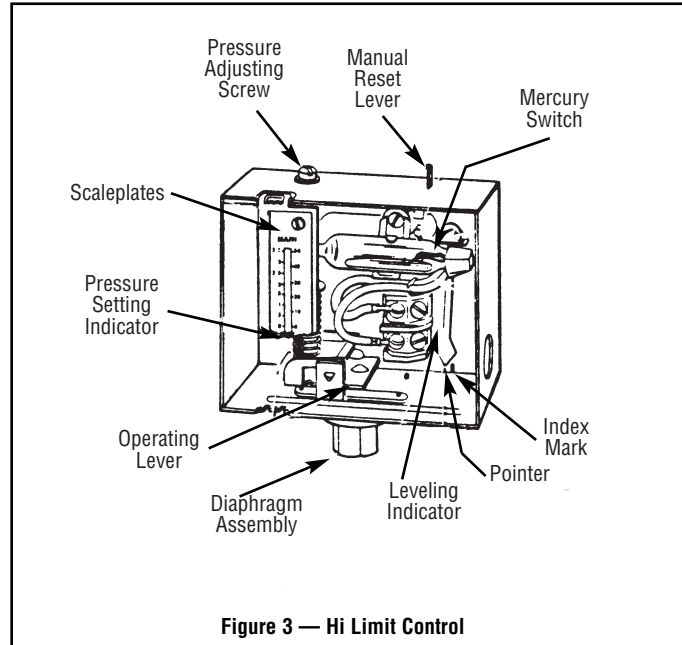


Figure 3 — Hi Limit Control

## OPERATION

### RECOMMENDED START-UP PROCEDURES

1. Close globe valve on steam outlet side of boiler. (Customer Supplied)
2. Turn on boiler and allow pressure to build up to operating pressure.
3. Only open globe valve at quarter turns at first, introducing smaller amounts of steam into process. Avoid opening globe valve all at once. This will eliminate the possibility of evacuating the boiler of water caused by the suddenly increased boiling of the water in the vessel as the pressure is reduced. On boilers where constant pressure is not maintained, globe valve should be kept partially closed. This will maintain a constant head on the boiler and stabilize any fluctuation in boiler water level.

**Note:** For best boiler performance, a 1/4" less steam valve than size of safety valve should be plumbed as close as practicable to steam outlet. Where 1/2" safety valve is used on boiler, a 1/4" steam valve is recommended.

### MANUAL BLOWDOWN INSTRUCTIONS

Blowdown is an essential part of boiler operation. It is the best preventative maintenance you can give your boiler and will add years of life to the unit. Make sure a blowdown schedule is established and followed regularly.

In extremely hard water areas, blowdown is necessary once a day. In soft water areas, once each week. If there is a particular problem which applies to your own local water condition other

than mineral content, take this into consideration in determining which schedule is to be followed.

1. At end of the working day, while boiler is still operating, turn switch to the OFF position and close water supply valve. De-energize wall mounted safety switch.
2. If blowing-down into a receptacle, allow pressure to decrease to 15-20 psi before opening blowdown valve.
3. It is preferable to connect the blowdown valve directly into a drainage system. If this is done, the boiler can be discharged at operating pressure.
4. When discharge is complete and boiler is drained — (a) close the blowdown valve; (b) open water supply valve; (c) put boiler switch in the ON position; and, (d) close wall mounted safety switch.
5. When refilling is complete, turn off the boiler switch unless further operation is desirable.
6. If you have been supplied with a Manual Reset Low Water control as required in some states, the reset button on the control must be pushed before boiler will begin developing pressure. (Do not push reset until boiler has filled with water.)

The use of chemical boiler cleaning compounds in these boilers voids all warranties unless approved by manufacturer. Some compounds will damage copper sheathed heating elements to shorten useful life.

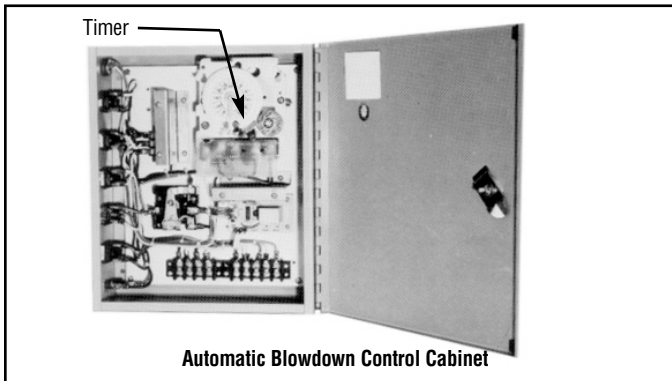
## OPERATION

### AUTOMATIC BLOWDOWN INSTRUCTIONS (IF FURNISHED)

The Automatic Blowdown is a device which automatically starts up your boiler in the morning; shuts it down at night and blows down (partially drains) the main boiler drain and the low water cut-off column for a predetermined time interval each working day.

The heart of the unit is an electrically operated straight through type ball valve. It is specially designed to handle dirty, corrosive fluids and particles without requiring cleaning or the use of a strainer.

Both the valve and the boiler are controlled by an electric control unit which indicates with pilot lights when the drain valve is in the opened or closed position and when the boiler is ON or OFF. In addition to the automatic control function, the unit has a push button which momentarily de-energizes the boiler and opens the drain valve regardless of the time of day.



The unit may also be used to blow down boilers which run continuously, day and night.

**INITIAL TESTING** — Set the switch marked “Programmed duty/24 Hour duty” located on the panel box to the “ON” position.

On the large timer set the “ON” tab at about 8 AM and the “OFF” tab at about 8 PM. Set the blowdown cycle dial at “0”.

Turn the large timer by hand until the “ON” tab passes the “TIME NOW” indicator so the “TIME NOW” arrow indicates 10 AM.

Energize the main feed to the “LINE TERMINALS” of the unit. The “BOILER ON” pilot light as well as the “VALVE CLOSED” light should glow.

Hold down the “DRAIN” button for about six seconds. The “BOILER ON” light should go out immediately as well as the “VALVE CLOSED” light. It takes about 4 seconds for the drain valve to open fully at which time the “DRAIN VALVE OPEN” light should light. As soon as the “DRAIN” button is released the valve begins to close. When it reaches the closed position, the “VALVE CLOSED” and the “BOILER ON” should light up again.

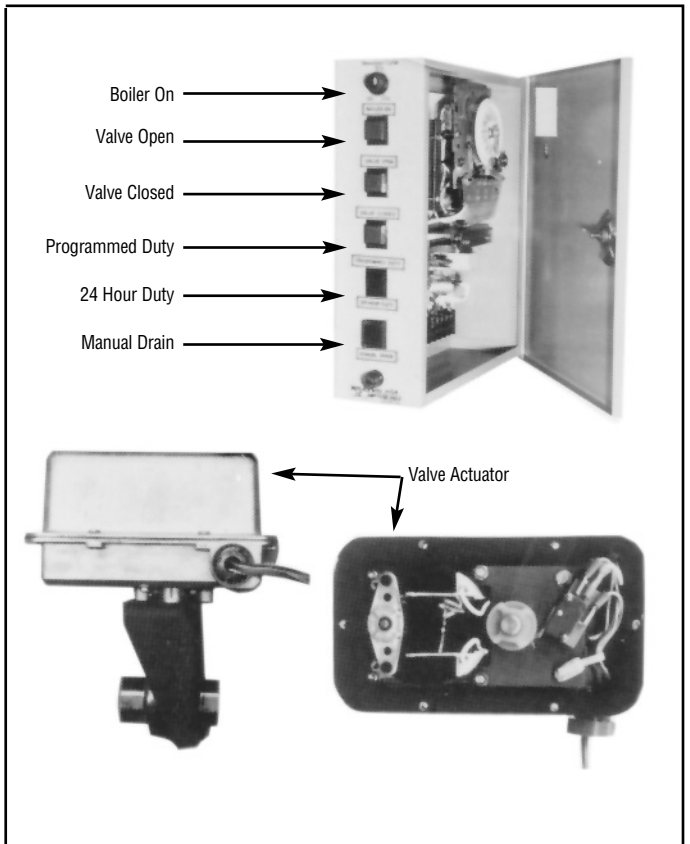
Now turn the wheel on the large timer until the “OFF” tab passes the “TIME NOW” arrow. The “BOILER ON” light should go out and the valve should begin to open. Once the “VALVE OPEN” light goes on, the valve should remain open for a few seconds and then automatically close. The “VALVE CLOSED” light should light and the “BOILER ON” light should remain off.

**OPERATION**— Set the “BOILER PROGRAMMED DUTY” switch to “BOILER ON” if the boiler is to be shut down each night. Set it to “24-HOUR DUTY” if the boiler is to remain on continuously 24-hours per day (except during blowdown).

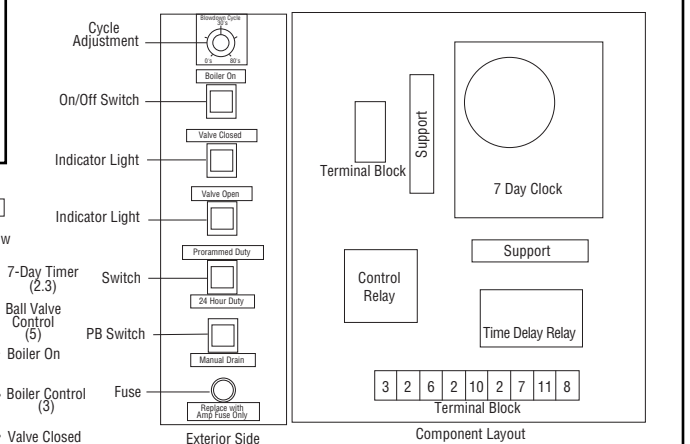
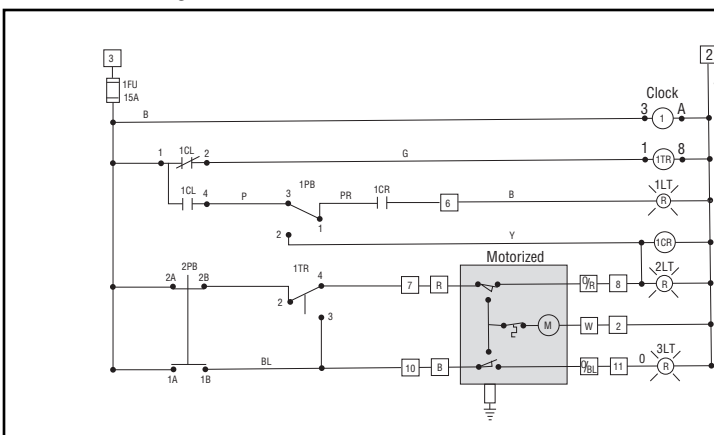
Set the tabs on the large timer for the ON and OFF times desired for the boiler, screw in the small black day-skip tabs if it is to remain off during the weekend, etc.

If the boiler is on 24-hour duty, set the OFF tab for the time that is desired for blowdown. The ON tab can be ignored, but must remain on timer.

The small time delay relay controls the time that the drain valve remains open. The time is controlled by adjusting knob marked Blowdown cycle. Counterclockwise decreases, clockwise increases blowdown time. Time must be adjusted by trial.



**Display View of Automatic Blowdown Control Cabinet**



**Wiring Diagram for Automatic Blowdown**

## OPTIONAL EQUIPMENT FOR STEAM BOILERS

### AUXILIARY LOW WATER CUTOFF

#### Operation

Operation of this control is accomplished by sensing a minute AC current flowing between submerged contact probe in the boiler shell.

When this minute AC current is conducted through an external circuit resistance up to 40,000 ohms or less, a signal of sufficient magnitude is present to trigger the SCR and, in turn energize the control relay.

As the water level in the boiler drops below the level of the probe, the AC current is broken and the control relay is de-energized. The control will not energize until sufficient water is present in the boiler.

#### Specifications

Input Supply — 120 vac/50-60 hz

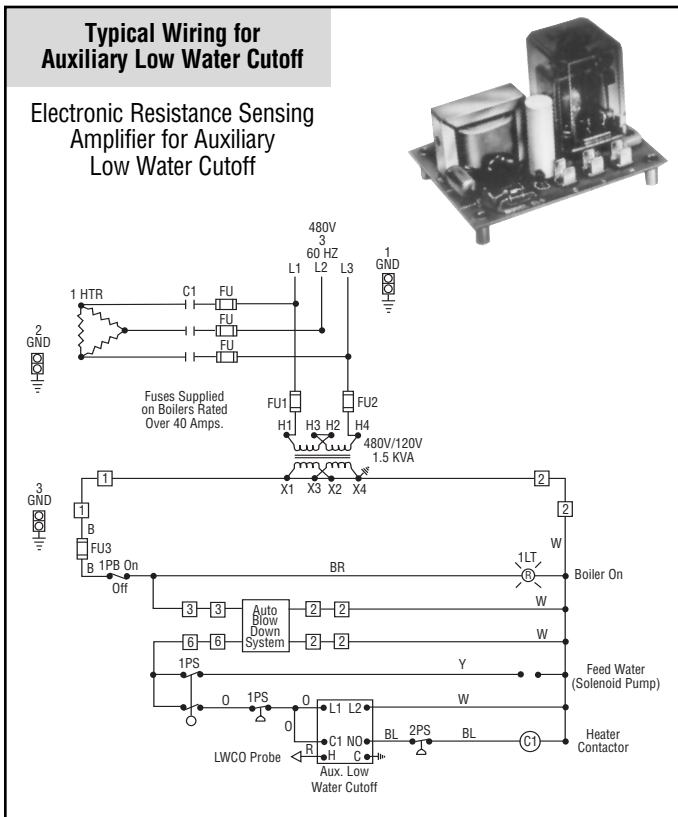
Detectable Range — 100,000 ohms

Probe Voltage — 24 Vac

Probe Current — 10 milliamps

Control Relay — Single pole double throw

**WARNING: Control will not work with de-ionized or demineralized water.**



### PROPORTIONING PRESSURE CONTROL FOR SEQUENCER AND SCR CONTROLS

#### Typical Operation

Pressure variations cause the bellows to expand or contract. Linkage between the bellows and the potentiometer wiper causes the wiper to move across the windings on the potentiometer. This varies the resistance between R and B, and between R and W, causing an unbalance in the circuit connected to the controller.

A proportioning pressure control is used to regulate a motor driven or solid state sequencer. The controller potentiometer, the feedback potentiometer in the motor and a balancing relay in the motor form an electric bridge circuit. As long as the pressure of the controlled medium remains at the set point of the controller, the circuit is balanced; i.e., equal currents flow through both sides of the balancing relay and the relay contacts are open. When the circuit is balanced, the motor does not run.

If the pressure of the controlled medium rises, the wiper in the controller moves toward W. This unbalances the circuit so a larger current flows through one side of the balancing relay. The "close" contacts in the relay make, causing the motor to drive toward its closed position. As

the motor runs, the wiper on the feedback potentiometer moves in a direction to balance the circuit. When the circuit is again in balance, the balancing relay contacts open and the motor stops.

Similarly if the pressure of the controlled medium falls, the wiper on the controller potentiometer moves toward B, and the "open" contacts in the balancing relay make. The motor drives towards its open position until circuit balance is achieved.

The slightest change in the pressure of the controlled medium will cause a change in the number of elements energized to compensate for it, thus keeping the pressure constant. This process is called modulation.

#### PROPORTIONAL PRESSURE CONTROL ONLY SUPPLIED WITH SEQUENCER

**Main Setting** — Turn the adjustment screw until the indicator is opposite the low point of the desired throttling range. That is, if the pressure is to be held at a minimum of 50 psi, set the indicator at 50 psi. The pressure will then be maintained between 50 psi and a higher pressure equal to the 50 psi plus the throttling range.

#### THROTTLING RANGE SETTING L91B

After setting the indicator for the minimum pressure, turn the throttling range adjustment screw until the throttling range indicator points to the desired throttling range on the scale. This scale is graduated from "min" to "F". The value of each division varies with the scale range of the instrument.

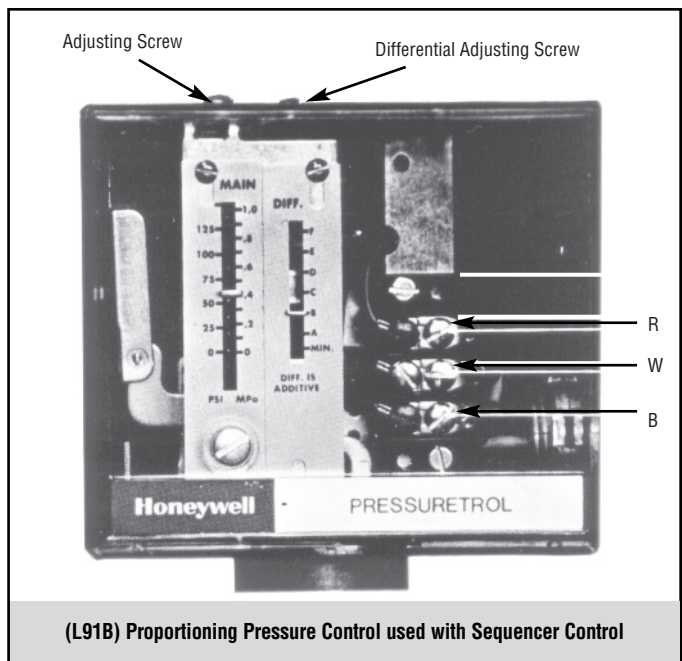
PRESSURE SCALE RATING	VALUE EACH DIVISION ON SCALE
0-15 psi	2.2 psi
20-300 psi	16.4 psi

Pressure scale rating will vary depending on pressure control supplied.

#### CHECKOUT

After the controller has been installed, wired, and set, it should be tested with the system in operation. First allow the system to stabilize. Then observe the operation of the controller while raising and lowering its set point. Pressure should increase when the set point is raised and decrease when the set point is lowered. Use accurate pressure testing equipment when checking out the controller. Do not rely on inexpensive gauges. The controllers are carefully calibrated at the factory.

If the motor or actuator runs the proper direction when the set point is adjusted, it can be assumed that the controller is operating properly. If it runs in the wrong direction, reverse the B and W wires. Observe the action of the motor to see if it stabilizes. If the motor is moving constantly, widen the proportioning range a little at a time, until the system is stable.



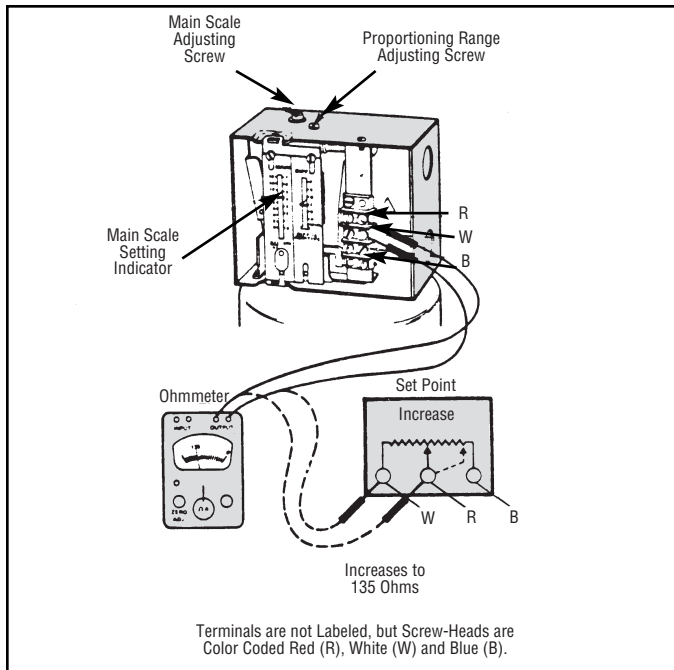
(L91B) Proportioning Pressure Control used with Sequencer Control

## OPTIONAL EQUIPMENT FOR STEAM BOILERS

### IF A CONTROLLER SEEMS TO OPERATE IMPROPERLY

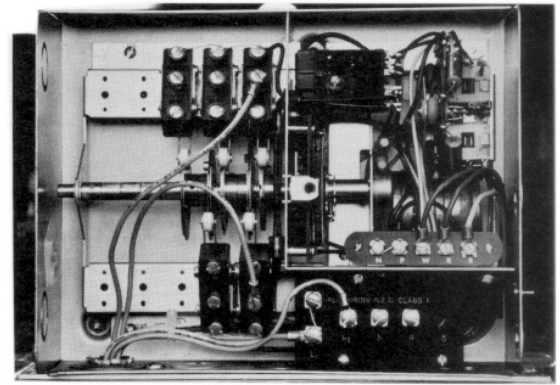
If the controller is suspected of operating improperly, it may be further checked as follows:

1. Leave the controller installed where it is, but disconnect all power to the boiler.
2. Loosen the cover screw below the main scaleplate and remove the cover.
3. Disconnect the wires from the controller.
4. Connect an ohmmeter between controller terminals B and W to measure the resistance of the potentiometer in the controller. The ohmmeter should read about 135 ohms on an L91B.
5. Connect the ohmmeter between controller terminals W and R and raise the set point of the controller above the actual pressure being measured. The ohmmeter should read the full value of the potentiometer measured in step 4 (135 ohms for an L91B).
6. Slowly lower the set point of the controller while observing the ohmmeter reading. The resistance should drop to zero at some set point below the actual pressure.
7. An approximation of the proportioning range can be made by observing the change in set point required for a resistance change from zero to full value.
8. When the controller is operating properly, reconnect the wires, replace the cover, tighten the cover screw, and reset the controller to the desired value.
9. Reconnect power to the controlled motor.



### BOILER SEQUENCER (5 STEP) MOTOR DRIVEN RECYCLE FEATURE

The step control is designed to drop out all contactors when control circuit is interrupted. On resumption of power, the camshaft rotates to the counterclockwise (ccw) limit, opening all the load switches. The recycle relay then energizes, pulling in the load contact, and finally the camshaft rotates clockwise (cw) to the position called for by the pressure controller energizing, in sequence, the required load stages.



Sequencer (5-Step)

### TESTING OPERATION OF SEQUENCER

1. With boiler off, remove wiring from pressure control on sequencer low voltage terminal board.
2. Turn on boiler to supply the voltage to the sequencer. Short terminal R and B for counterclockwise rotation and terminal R and W for clockwise rotation.
3. If sequencer operates under this test procedure, but when rewired to pressure controller and does not function, check pressure control. Note that wiring is W-B and B-W-R-R between sequencer and pressure controller

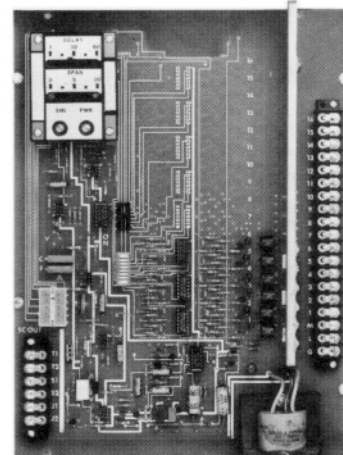
### BOILER SEQUENCE — SOLID STATE

#### Solid State Progressive Sequencer

The solid state progressive sequencer provides accurate electronic control of multi-stage loads of the type used in Chromalox steam boilers. It features progressive sequencing (first on-first off) which equalizes the operating time of each load. This control gives visual indication of each energized stage by means of integral solid state light emitting diodes. In the event of power interruption, all heating elements are immediately de-energized for safety. When power resumes, the control will restage the loads one at a time.

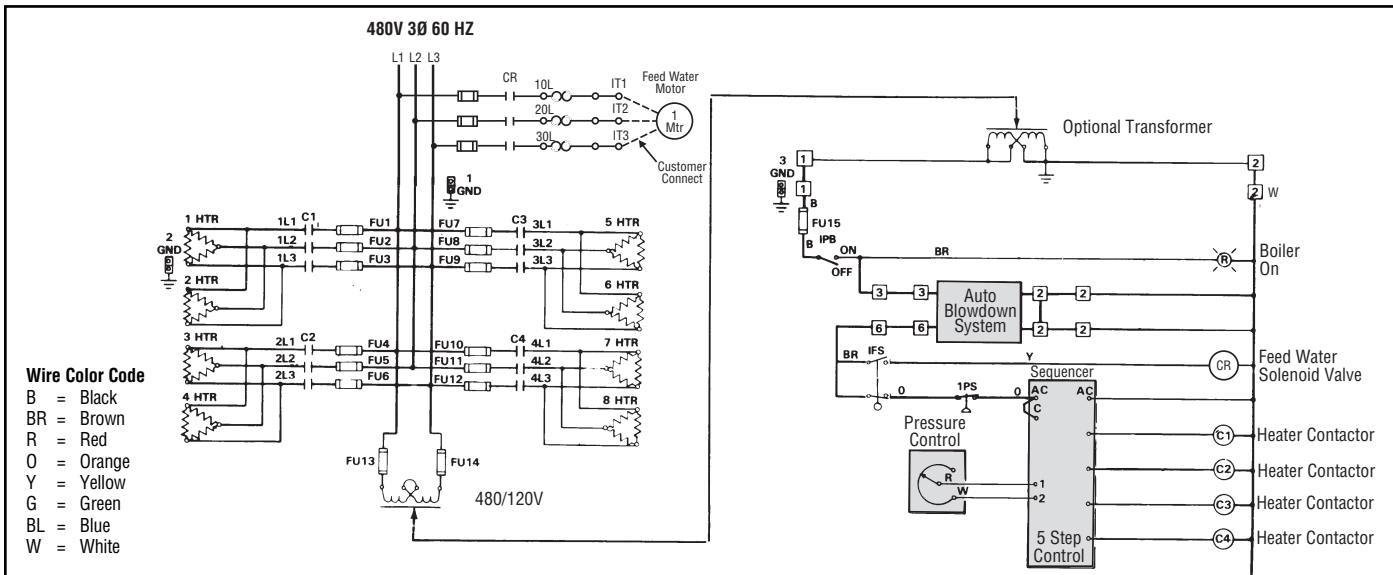
The solid state sequencer operates on 120V AC/60 Hz and each output is relay switched with a load rating of 125 VA at 120V AC.

The input to the sequencer is a 0-135 OHM potentiometer supplied on the operating pressure control. The sequencer has a sensitivity control which is adjustable from min. to max. This sensitivity control defines the amount of resistance (pressure) deviation allowed before adding or subtracting a load. Potentiometer resistance should decrease with increasing pressure. Connections are made to red and white terminals of proportional pressure control. See Wiring Diagram 337-300164-452 for Boiler With Solid State Sequencer.



Solid State Sequencer

## OPTIONAL EQUIPMENT FOR STEAM BOILERS



**Typical wiring for boilers equipped with Auto Blowdown System and/or Solid State Sequencer**

## WATER FEED SYSTEMS

### HIGH PRESSURE FEED

High pressure makeup water pumps are used when water pressure does not exceed boiler pressure by more than 10 psi and when condensate water is not returned to the boiler. **Note:** Consult factory or sales office for motor/pump sizing for appropriate water feed system.

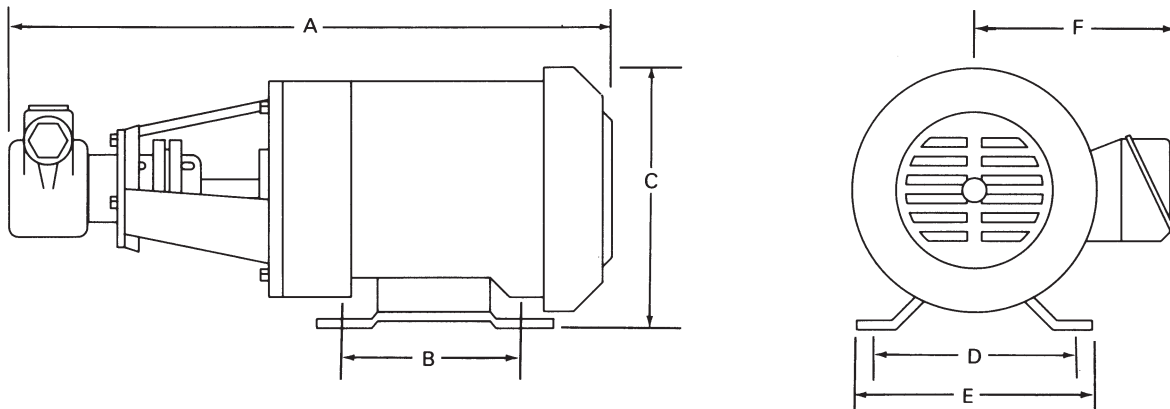
#### Installation

**WARNING: Hazard of Electric Shock. Water feed system must be effectively grounded in accordance with the National Electrical Codes to eliminate shock hazard.**

1. Locate feed on level floor or platform.
2. Connect water line to tagged fitting on feed.
3. Connect piping from discharge to water inlet check valve on boiler with minimum of 90° bends or other restrictions.
4. All electrical wiring should be done by licensed electricians in accordance with local and national electrical codes. Refer to boiler instruction for manual wiring diagram.
5. If pump is located less than 30 feet from boiler, a second check valve is required.

### Automatic High Pressure Water Feed Pump/Motor Assembly

#### Pump Motor Dimensions



Assembly Model	HP	Pressure Range	Pipe Size (NPT)	Dimensions (In.)					
				A	B	C	D	E	F
ES-38020	3/4	0-200	1/2	16-1/4	3	7-3/16	4-7/8	6-1/2	6-1/8



## WATER FEED SYSTEMS

### CONDENSATE RETURN SYSTEMS

Chromalox condensate return systems are used wherever condensed steam can be collected for reuse in the boiler. Significant energy can be saved by returning condensate to the boiler. The condensed water is free from corroding minerals and carries a substantial amount of heat which does not have to be replenished.

**IMPORTANT:** Vacuum breaker is required whenever using a condensate return system.

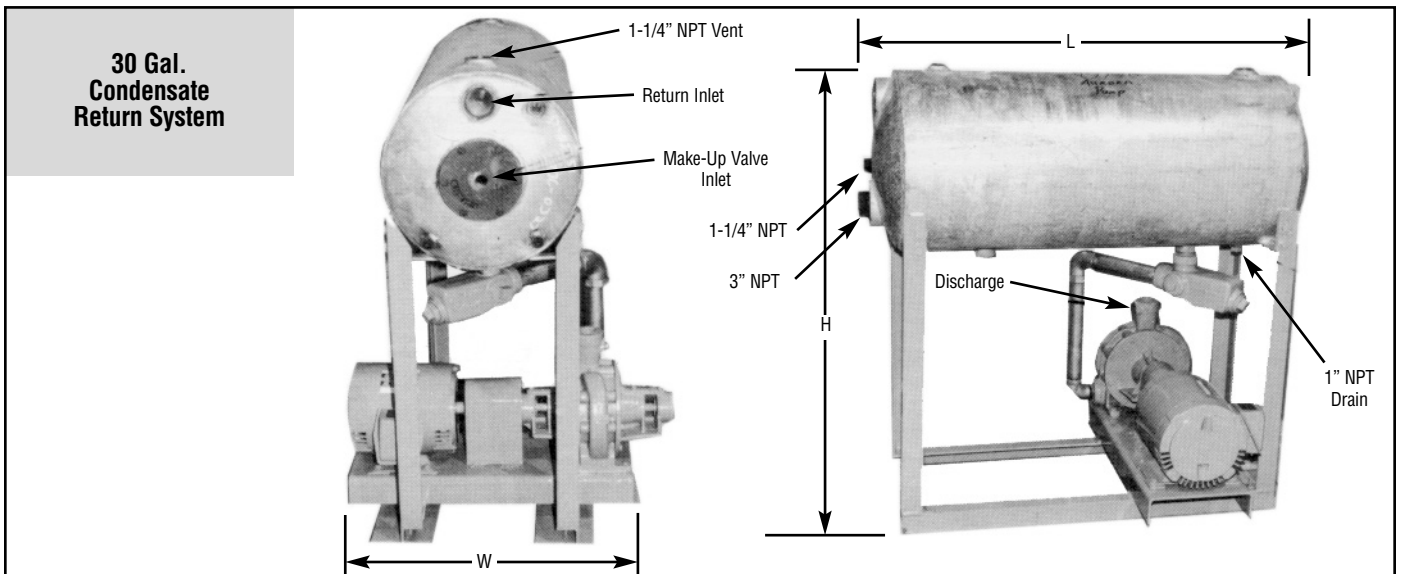
#### Installation — Wiring

- A. Check the voltage of the motor before making the wiring connection. Some Chromalox boilers are supplied with dual voltage systems. The motor should always match the voltage of the control circuit.

- B. The motor circuit should be wired into the pump control located on the boiler. See boiler instruction sheet for wiring diagram.  
 C. All electrical wiring should be done by licensed electrician.  
 D. Be sure to use the proper wire. Electrical wiring to boiler should be in accordance with National Electrical Code or local wiring code following wiring diagram supplied.

#### Plumbing

- A. Connect water line to tagged fitting on the motor and pump assembly control feeder.  
 B. Interconnecting piping between boiler and condensate return system should be installed with a minimum of 90° bends or other restrictions.



Condensate Model	For Boiler Model	Max. Pressure (psig)	Storage Tank Capacity (Gals.)	Pump (Hp)	Motor (Volts/Phase)	Pump Discharge Conn. (NPT)	Condensate Ref. Conn. (NPT)	Dimensions (In.)		
								L	H	W
HPCS-3003	All CHPES	250	30	3	240 / 480 1	1-1/4	2	36	42-3/16	24

## MAINTENANCE

**WARNING: Hazard of Shock. Disconnect all power before working on boiler.**

Chromalox Electric Steam Boilers are designed for years of trouble-free performance. To establish a good preventative maintenance program, we suggest the building maintenance man or engineer familiarize himself with these simple rules:

- The use of specific boiler cleaning compounds cannot be recommended. We do recommend that a reputable firm of water treatment engineers be consulted regarding conditioning boiler water. Proper selection must be made of a compound to prevent damage to copper sheath heating elements.
- The sight glass should be checked daily to ensure the boiler has adequate water.
- A monthly inspection should be made of internal wiring. All electrical connections should be checked for tightness. A check for water or steam leaks should also be made and any loose fittings immediately tightened.
- If boiler is equipped with Solid State Auxiliary Low Water Cutoff, every four months the probe should be checked for deposits and cleaned, if necessary. This is accomplished by removing inspection plate, removing the probe (with a standard sparkplug wrench) cleaning and replacing.

**Note:** The system will not operate if the boiler is using distilled, demineralized or deionized water. At the same time, one of the bottom heating elements should be removed. If scale has begun to form, all elements should be cleaned and boiler drained and flushed.

- IMPORTANT:** The Manufacturers' Data Report enclosed within the instruction sheet is very important and must be put in a safe place. You may be called upon to produce it by a state agency.

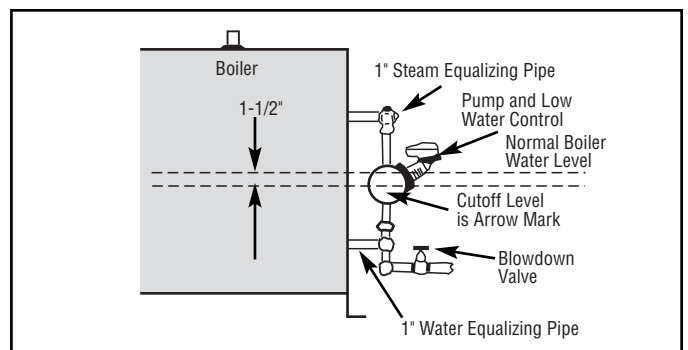
### INSTRUCTIONS FOR ELEMENT REPLACEMENT

**WARNING: Before installing your new elements, be sure the McDonnell-Miller low-water cut-off is operating perfectly and the float chamber and lower equalizer column are completely clear of sludge or other foreign matter.**

Failure to do this may cause the immediate burnout of the new elements.

All elements are thoroughly checked before shipment. The manufacturer cannot be responsible for burnouts caused by a faulty low-water cut-off.

The lower equalizer column can best be examined by breaking the unions on either side and then visually and manually examining the piping with your fingers or probes to see if it is clear and clean.



## MAINTENANCE

### READ COMPLETELY BEFORE STARTING WORK

1. Disconnect boiler from electric power supply at **main safety switch or fuse panel**. Then, turn boiler switch to "off" position.
2. On automatic feed units, close valve on incoming water line. Drain boiler completely of water.
3. Open boiler door to expose heating element.
4. Disconnect wire (electric) leads connecting element to main power system of boiler. Again note wire connections to facilitate reassembly. Proceed to remove (6) 5/16-18 bolts from flange.
5. Thoroughly clean boiler flange of all foreign material. Be certain no part of old gasket remains on boiler flange.
6. Apply "Slic-Tite" Gasket Compound or equal to both surfaces of new gasket with supplied replacement element. Proceed to install element flange assembly with gasket between boiler flange and element flange. In doing this, be careful to align flange holes so wire connection terminals on element assembly are in line with previously disconnected wire leads to facilitate easy connections.

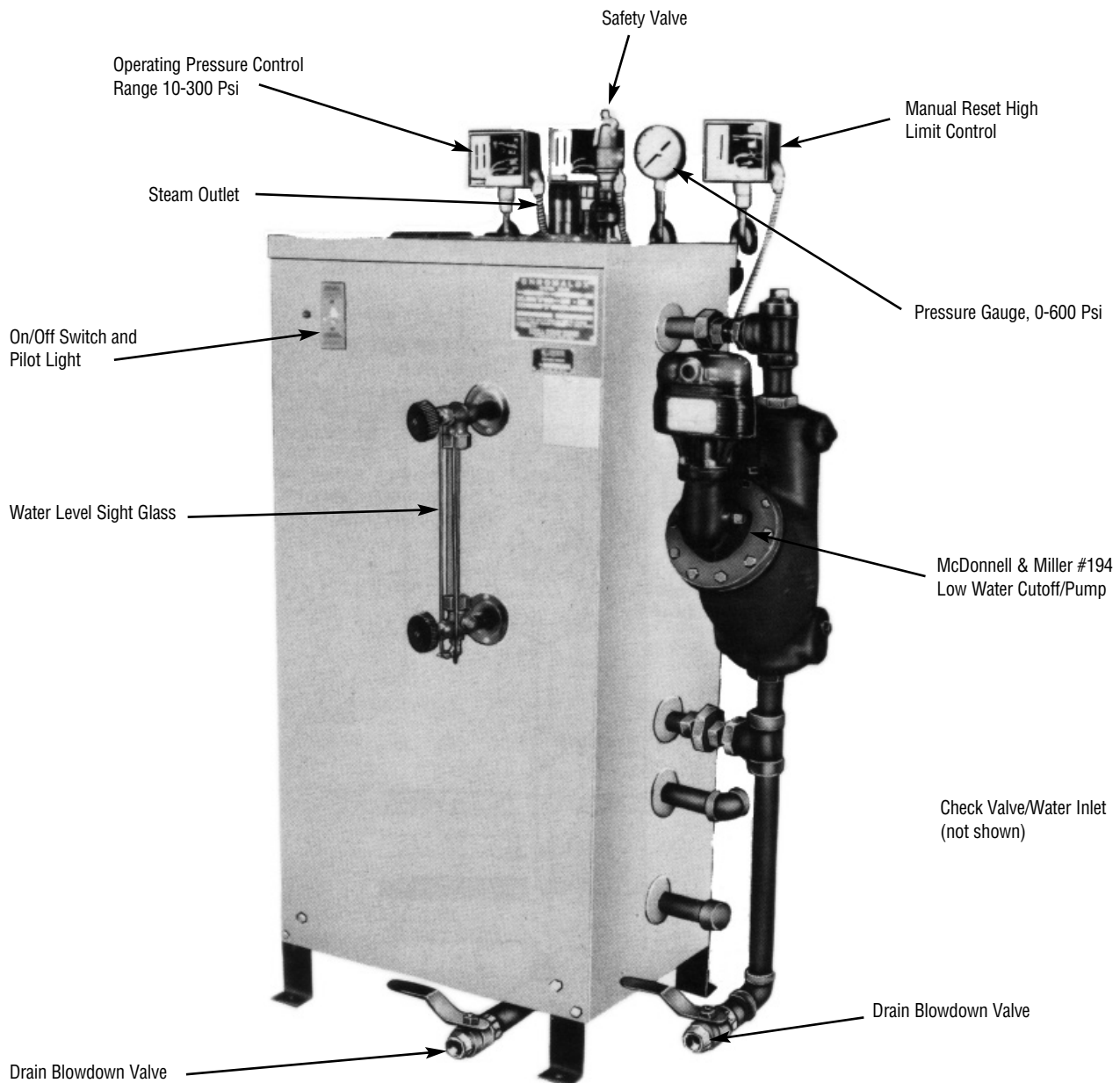
7. When all (6) flange bolts are tight, connect all wires to terminals. Make certain wires are clean and bright to assure good electrical contact and nuts on screws are firmly secured.

**WARNING: Avoid use of chemical cleaning compounds. Follow maintenance instructions.**

8. Open water valve so water supply can reach boiler feed mechanism.
9. Put main safety switch to "on" position.
10. Turn boiler to "on" position.
11. As boiler automatically refills, observe the new flange assembly for possible leaks. If water is noticed, to bolts must be retightened. Before doing this, turn the boiler off at the main fuse safety switch.
12. As boiler is heated to working pressure, check flange assembly again for leaks.

**WARNING: Avoid the use of chemical cleaning compounds. Follow maintenance instructions**

## RENEWAL PARTS IDENTIFICATION



## RENEWAL PARTS IDENTIFICATION

Part Description	Part Number
<b>VALVES &amp; GAUGES</b>	
1/4" Ball Valve (Pressure Gauge) .....	344-121194-007
Blowdown Valve 1" CHPES-24A through 180A .....	344-121194-042
Pressure Gauge 3-1/2" 0-600 psi CHPES-100A	
<b>CONTACTORS</b>	
through 180A .....	130-118661-012
<b>Fusible Contactors</b>	
30 amp with 35-60 amp 600V block .....	072-122686-003
40 amp with 35-60 amp 600V block .....	072-122686-006
50 amp with 35-60 amp 600V block .....	072-122686-009
<b>Non Fusible Contactors</b>	
60 amp without fuse block .....	072-047913-016
50 amp without fuse block .....	072-047913-019
<b>POWER FUSES AND TERMINAL BLOCKS</b>	
40 amp without fuse block .....	072-047913-012
30 amp without fuse block .....	072-047913-020
35 amp 600V .....	128-123459-012
40 amp 600V .....	128-123459-013
45 amp 600V .....	128-123459-014
50 amp 600V .....	128-123459-015
60 amp 600V .....	128-123459-016
Fuse Block 35-60 amp 60 amp 600V .....	129-047445-002
<b>Power Terminal Blocks</b>	
3 Pole 115 amp 1 line circuit 1 load circuits .....	303-071809-032
3 Pole 175 amp 1 line circuit 4 load circuits .....	303-071809-012
<b>HEATING ELEMENTS — SPECIFY VOLTAGE</b>	
3 Pole 335 amp 1 line circuit 4 load circuits .....	303-071809-014
3 Pole 335 amp 1 line circuit 8 load circuits .....	303-071809-016
<b>SINGLE PHASE</b>	
12kW 208V .....	155-554735-004
12kW 480V .....	155-554735-009
17kW 208V .....	155-554735-006
17kW 480V .....	155-554735-011
<b>THREE PHASE</b>	
12kW 208V .....	155-554735-003
12kW 240V .....	155-554735-001
12kW 346V .....	155-554735-012
12kW 380V .....	155-554735-017
12kW 480V .....	155-554735-008
17kW 208V .....	155-554735-005
17kW 240V .....	155-554735-002
17kW 346V .....	155-554735-013
17kW 380V .....	155-554735-018
17kW 480V .....	155-554735-010
22.5kW 240V .....	155-554735-021
<b>GAUGE GLASS ASSEMBLIES, CHECK VALVES &amp; SIGHT GLASSES</b>	
22.5kW 480V .....	155-554735-022
22.5kW 550V .....	155-554735-019
Check Valve 1/2" CHPES-6A through 18A .....	344-114590-013
Check Valve 3/4" CHPES-24A through 180A .....	344-114590-014
<b>Gauge Glass Assemble Valves</b> (O-ring gaskets included) .....	
Protector Rods (2 Required) CHPES-6A through 18A .....	344-120970-004
Protector Rods (2 required) CHPES-24A through 180A .....	242-121047-008
Protector Rods (2 required) CHPES-24A through 180A .....	242-121047-001
O-ring gaskets (2 required) .....	132-073284-003
Sight Glass Tubing, 7" CHPES-6A through 18A .....	374-121046-006
Sight Glass Tubing, 9" CHPES-24A through 72A .....	374-121046-038
Sight Glass Tubing, 11" CHPES-100A through 180A .....	374-121046-015
<b>SAFETY VALVE</b>	
250 psig 1/2" CHPES-6A through 180A .....	344-300032-006

Part Description	Part Number
<b>PRESSURE CONTROLS &amp; SEQUENCES</b>	
Operating Pressure Control .....	429-300038-009
Hi-Limit Control (Manual Reset) 15 psi .....	429-300038-008
Proportional Pressure Control .....	429-300039-004
5-Step Motor-Driven Sequencer .....	323-121505-001
10-Step Motor-Driven Sequencer .....	323-121505-002
6-Step Solid State Sequencer .....	323-300107-015
10-Step Solid State Sequencer .....	323-300107-015
Siphon Tube for Pressure Controls .....	215-300026-002
<b>LOW WATER CUTOFF &amp; PUMP CONTROLS</b>	
MM-94 Control Complete (Auto Reset) .....	292-300065-007
MM-94M Control Complete (Manual Reset) .....	292-300065-008
<b>CONTROL VOLTAGE TRANSFORMERS (120V SECONDARY)</b>	
1KVA 208V Primary .....	315-300088-020
1KVA 240/480V Primary .....	315-300088-021
1-1/2 KVA 208V Primary .....	315-300088-025
1-1/2 KVA 240/480V Primary .....	315-300088-026
<b>COLD WATER INJECTION PUMPS (0-100 PSIG)</b>	
Motor and Pump used in ES-38020 HP .....	226-300177-009
Pump only used in ES-38020 HP .....	226-300173-011
Motor and Pump used in ES-38020 HP .....	193-121843-020
Strainer used in ES-38020 HP .....	351-118664-001
V-Band Mount used in ES-38020 HP .....	355-300174-001
Solenoid Valve used in ES-38020 HP .....	344-121780-002
<b>CONDENSATE RETURN SYSTEMS</b>	
Hose Assembly 18" Long used in EES-38020 HP .....	349-300181-002
Fuse .....	128-121133-053
Overload .....	359-122688-031
Condensate Return System .....	296-300222-026
<b>AUX LOW WATER CUT-OFF (OPTIONAL EQUIPMENT)</b>	
Pump/Motor .....	Contact Factory
Probe Spark Plug .....	346-300035-001
Aux Low Water Cut-off Board with Relay .....	323-300033-016
Aux Low Water Cut-off Board Without Relay .....	323-300033-017
Relay for Aux Low Cut-off Board .....	072-300047-003
Probe 7-15/16" CHPES 6A through 18A .....	242-300036-019
<b>MISCELLANEOUS PARTS</b>	
Probe 9-1/2" CHPES 24A through 72A .....	242-300036-002
Probe 10-15/16" CHPES-100A through CHPES-180A .....	242-300036-017
ON-OFF Switch with Pilot Light .....	292-053223-002
Control Circuit Fuse .....	128-072576-027
Control Circuit Terminal Block 4 Pole 250V 20AMP .....	303-075443-003
Control Circuit Fuse Block .....	129-300029-001
Blank Flange .....	121-300199-001
Element Gasket .....	132-146012-001
<b>AUTO BLOWDOWN PARTS</b>	
Stainless Steel Bolts (6 required) for Element .....	345-072565-428
Vacuum Breaker Assembly .....	344-300149-003
Motorized Valve 1/2" CHPES-6A through CHPES-18A .....	344-300089-009
Motorized Valve 1" CHPES-24A through CHPES-180A .....	344-300089-010
Timer .....	292-300101-002
Relay SPST No. 2 .....	072-300072-002
Relay Interval Delay .6-60 Sec. 3 .....	072-300148-001
Switch Momentary Contact DPDT 4 .....	292-300146-001
Switch Rocker SPDT 5 .....	272-300147-001
Pilot Light Red 6 .....	213-300145-001
Terminal Block 4 Pole .....	303-075444-003
Terminal Block 5 Pole .....	303-075444-004
Fuse Block 30A .....	129-024494-001
Fuse 15A .....	128-121133-072

**Limited Warranty:**  
Please refer to the Chromalox limited warranty applicable to this product at  
<http://www.chromalox.com/customer-service/policies/termsofsale.aspx>.

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