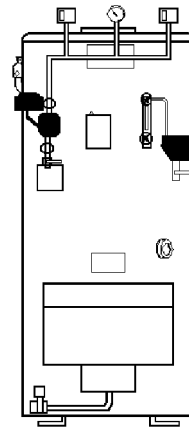




**OPERATIONS
AND
MAINTENANCE
MANUAL**



**STEAM Boilers
SERIES 300
SERIES 600
SERIES 900
SERIES 1600**

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TRIAD BOILER SYSTEMS, INC.

**Operations and Maintenance Manual For
Steam Boiler Models**

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Retain this manual and keep it readily available, typically near the boiler.

TRIAD BOILER SYSTEMS, INC.

Section I

BASIC BOILER WARNINGS



STOP: Do not go on without reading all of this section first.

TRIAD STRONGLY RECOMMENDS THAT THE SYSTEM DESIGN ENGINEER THOROUGHLY REVIEW THIS MANUAL AND THE BURNER MANUFACTURER'S MANUAL BEFORE INSTALLATION AND STARTUP.



WARNING: The first and most critical step in the installation and startup procedure for any boiler system is to carefully read and understand the WARNINGS in this section.



CAUTION: The second step is to review this entire manual including the original equipment manufacturer's (OEM) component instruction information included in Section VI and the burner manufacturer's installation and instruction manual included with the boiler or burner.

The third and very important step is to ensure that the system and in particular the water, fuel, air supply, venting and breeching components have been properly installed and meet local codes before placing the boiler in operation.

The fourth and ongoing step is to ensure that the system is properly maintained.

TRIAD Boilers can provide years of dependable service with proper maintenance and by carefully following the instructions and information provided in this manual and the burner manual. Failure to follow the directions and warnings can result in property damage or serious injury.

Independent Operation -- the boiler controls and accessories are activated by the "Call For Heat" circuit. As a result these components can be supplied with electricity and/or operate without warning. It is imperative that all power is removed

and the control signal(s) is "locked out" before any maintenance is done on the boiler system.

Breeching, Fuel and Burner Operations -- The burner manual provided by the manufacturer contains a number of warnings concerning proper operation. Failure to follow these instructions, improper maintenance, improper or inadequate combustion air, fuel supply systems or breeching can result in exposure to Carbon Monoxide or other hazards that can result in property damage, possible explosion, serious injury, or death.

Operating Limits -- Boilers heat water under pressure. In addition, "dry firing a boiler" (firing the burner without adequate water in the boiler) can result in an extremely destructive and hazardous condition caused by the rapid and potentially explosive buildup of extreme pressures and temperatures. The boiler contains several limit controls to prevent excessive temperatures when properly set and maintained.

Boiler controls must NEVER be bypassed. If any manual reset control device has "tripped", the boiler control must NEVER be reset until the system has been thoroughly checked by a qualified technician. Failure to follow this warning can result in damage to the vessels and serious personal injury.

The following is a list of *Recommendations for a Boiler Room* derived from the National Board of Boiler and Pressure Vessel Inspectors (NBBI -- Bulletin, Fall, 1997)

- 1) Keep the boiler room clean and clear of all unnecessary items. The boiler room should not be considered a storage area. The burner requires proper air circulation to prevent incomplete fuel combustion and the production of carbon monoxide.
- 2) Ensure that all personnel who operate or maintain the boiler room are properly trained on all equipment, controls, safety devices and up-to-date operating procedures.

3) Before startup, ensure that the boiler room is free of all potentially dangerous items like flammable materials that could cause a fire. Clear intakes and exhaust vents. Check for deterioration and possible leaks.

4) Conduct a thorough inspection by a properly qualified inspector such as one who holds a National Board commission.

5) After any extensive repair or new installation of equipment, make sure a qualified boiler inspector re-inspects the entire system.

6) Monitor all new equipment during startup to ensure it proper operation according to the manufacturer's specifications.

7) Establish a preventive maintenance schedule based upon the manufacturer's recommendations and a safety testing program that follows CSD-1-1995, Part CM and the manufacturer's recommendations

8) Establish a checklist for proper startup and shutdown of boilers and all related equipment according to the manufacturer's recommendations.

9) Observe equipment extensively before allowing automatic operating systems to be used without supervision.

TRIAD reminds end-users that boilers and boiler rooms may fall under many code and regulatory requirements with local jurisdiction usually controlling. However, NEC, ANSI, ASHRAE, UL/IRI/FM, NFPA, state, insurance, and BOCA recommendations must also be considered. Mandatory compliance with ASME code as administered by the National Board may be required in some instances.

TRIAD very strongly recommends that a competent and knowledgeable system design engineer be given design and implementation responsibility.

ALL OPERATORS SHOULD BE FAMILIAR WITH THIS MATERIAL -- THIS MANUAL SHOULD BE READ; ITS MATERIAL UNDERSTOOD; AND ITS INSTRUCTIONS FOLLOWED. THIS MANUAL SHOULD BE READILY AVAILABLE IN THE BOILER ROOM AS A REFERENCE.

TRIAD BOILER SYSTEMS, INC.

Section II

STEAM BOILER MODEL INFORMATION

This section includes a copy of the packing list for the boiler system that shows the model number and input firing rate that defines the size and capacity, and a wiring diagram for future reference.

If you should have a question or need service, it is important to provide the following information:

Boiler Model, Serial Number, Burner Model, Burner Serial Number, Date of Installation and Job Number which is shown on the packing list.

The boiler model and serial numbers can be found on the boiler registration tags on the front of the boiler..



WARNING: Please read the manual completely before attempting to place the boilers into service. It is extremely important that all of information in this manual and the burner manufacturer's manual be studied before attempting to operate the boilers. Failure to follow the directions and warnings can result in property damage or serious injury.

Each TRIAD Boiler is certified to meet or exceed the requirements of the American Society of Mechanical Engineers (ASME) Code for pressure vessels. Each boiler is registered with the National Board of Boiler and Pressure Vessel Inspectors (National Board, NBBI). All Series 900 and 1600 steam boilers are UL Listed as a complete boiler/burner package. All boilers feature UL listed controls.

TRIAD Boiler Systems, Inc. is not responsible for general system design including venting and breeching.

The boiler is only one component of the entire heating system.

Only trained and qualified individuals experienced in boiler room mechanics and local code requirements should be used to install the system.

APPLICATIONS

A typical application of a TRIAD steam boiler is for

1-10 psig and 240°F. Maximum operating pressure is 15 psig with a temperature of 250°F.

Steam pressure is directly related to the temperature – the higher the temperature, the greater the pressure of the steam generated and vice versa.

Series 300 fires at 300 – 399MBH.
Series 600 fires at 600 – 700MBH
Series 900 fires at 800 – 1000MBH
Series 1600 fires at 1100 – 1700MBH

Specifications are subject to change without notice.

ABBREVIATIONS AND TERMS

ASME -- American Society of Mechanical Engineers -- boiler engineering code specifications.
BTU/hr -- British Thermal Unit per hour, heat to raise 1 gallon of water 1°F.
Barometric damper -- device for controlling stack draft; individual per boiler recommended.
Blow-Down -- cleaning, opening a valve to release quantities of steam and water.
Boiler Control Center -- activates burner control on "Call For Heat."
Breeching - sheet metal ducts that carry exhaust from the boiler to the stack.
Burner relay -- control circuit through Boiler Control Center to burner.
Call For Heat -- completion of the thermostat control loop T-TY circuit.
Category I -- non-condensing gas appliance that operates with a non-positive vent pressure.
Combustion Air -- outside air required for correct burner operation.
Condensate -- condensed steam, phase changed back to water giving up latent heat.
Cycle -- from Call For Heat to burner shut-off after call is satisfied.
Dry Fire -- heating a vessel with insufficient water, extremely hazardous.
Fire Tube -- the connector between the firebox and vent, water surrounded, heat inside.
Flash -- water heated above boiling will convert violently to steam on loss of pressure.
Fuel Train -- connects gas or oil supply to burner, controls pressure, contains shut-off valves.
Gauge Glass -- special glass tube displaying internal boiler water level.
HEP -- Power draft burner; Note: Category I venting in a TRIAD boiler.
L.W.C.O. -- Low Water Cut Off -- controls boiler by monitoring water level.
Latent Heat -- heat associated with phase conversion from liquid to steam.
Lever Test -- safety relief valve, raise manual lever to check operation, releases steam and water.
Low Pressure -- 0 to 15 psig steam system.
MBH -- 1000 btu per hour.
NBBI -- National Board of Boiler and Pressure Vessel Inspectors, aka: The Board.
Near Boiler Piping -- equalizer, header, feed, drain, and Hartford loop connections.
Nominal -- under all conditions being within expected parameters.
OEM -- Original Equipment Manufacturer, a purchased product component.
Operator -- someone trained and competent to monitor in-use boiler systems.
Pigtail -- special pipe connector (siphon loop, steam trap) to gauges and controls.
Pressure Bound Vessel -- NBBI registered ASME code built boiler shell.
Pressure Controller -- limits boiler operating pressure, part of burner control circuit.
PSIG -- pounds per square inch gauge (vs absolute), typically used as just psi.
Raw Water -- untreated for ph, solids, dissolved minerals and gasses, and organics.
Remove From Service -- properly disconnect and render inoperative.
Safety Relief Valve -- ASME rated steam relief valve matched for pressure and heat capacity (15 psig max.).
Scale - the solidification of dissolved minerals from water, typically carbonates.
Short Cycle -- frequent turning on and off of burner, which is inefficient.
Sight glass -- glass port for viewing firebox.
Skim Tap -- a flange at the water line for the cleaning process required for new (and dirty) boilers.
Solenoid -- electrically controlled valve used to allow makeup water to return to vessel.
Staging -- the controlled firing in sequence of modular boilers to meet varying demands.
System Design Engineer -- responsible for system compliance and specifications.
Technical Service -- knowledgeable, licensed, trained, experienced, and qualified.
Thermal Shock -- cyclic metal fatigue caused by excessive heat differentials.
Tripped -- a device that has been activated and must be physically re-set.
Tube Sheet -- part of the pressure vessel that retains the tube ends.
Turbulator -- in-firetube device provides cleaning and heat transfer from the firetubes.
UL -- Underwriters Laboratories.
Venting -- to release to atmospheric pressure, commonly also used to mean breeching.
Water Hammer -- water driven at high speeds by steam and trapped air.
Water Treatment -- controls ph, hardness, dissolved minerals and gasses, and organics.

TRIAD MODULAR STEAM BOILERS

Series 300 fires at 300 – 399MBH.
 Series 600 fires at 600 – 700MBH
 Series 900 fires at 800 – 1000MBH
 Series 1600 fires at 1100 – 1700MBH

STANDARD COMPONENTS:

Series Number	300	600	900	1600
X4-400 Powerflame Gas Burner	X			
X4-700 Powerflame Gas Burner		X		
JR30A Powerflame Gas Burner			X	
JR50A Powerflame Gas Burner				X
Other Components				
L404A-1354 Pressuretrol - operating	X	X	X	
L404C-1147 Pressuretrol – safety	X	X	X	
Operating Light	X	X	X	
P7810C – Solid State/dual function Pressure Control with operating light				X
30# Pressure Gauge	X	X	X	X
15 psi Pressure Relief Valve	X	X	X	X
150 Water Level Control	X	X	X	X
67 Low Water Cut-Off – Manual reset	X	X	X	X
Gauge Glass Assembly	X	X	X	X
R845A Control Center	X	X	X	X
Boiler Drain	X	X	X	X

OPTIONAL COMPONENTS:

Notes

Barometric Dampers:

MG1-8"

For Gas or Gas/Oil, Field Mounted.

RC-6"

For Oil-fired 300 model Boiler only, Field Mounted.

Burners:

Series 300:

Dual Fuel – S4.GO(Gordon Piatt)

Natural Gas or #2 Oil (Requires Gas Pilot For Firing).

Oil-Fired - F10 #2 (Riello)

Series 900 or 1600:

Dual Fuel – CR1GO for the 900

Natural Gas and #2 Oil (Requires Gas Pilot, LP Gas or GPDS Spark Ignition System For Firing).

Dual Fuel – CR2GO for the 1600

Spark Ignition System

GPDS Spark Ignition

Oil-Fired: CR1-O

For No. 2 Oil.

Low Nox - NPM 30 or NPM 50

Low Nox natural gas burner

Combustion Intake flange

For Sealed Combustion/Side-Wall Venting.

CSD-1

For R6.3 Burner.

IRI Gas Train

Motorized Gas Valves, Alarm Bell.

Low-High Gas Train

Motorized Gas Valves.

Cleanout Openings:

CLNOUT 22

2 Nipples and Caps – installed top-front only

CLNOUT 44

4 Nipples and Caps.

Fan/Damper Relay – FDR

Harness, Plastic Coated Metal

Wire harness with power and control wiring.

Lifting Lugs

When forklift or elevator is insufficient.

Rail Legs

3" Channel used in lieu of boiler legs.

TRIAD BOILER SYSTEMS, INC.

Section III

STEAM BOILER SYSTEM COMPONENTS

TRIAD boilers are designed to very strict standards; certified to meet and exceed American Society of Mechanical Engineers (ASME) codes; and registered with the National Board of Boilers and Pressure Vessel Inspectors (NBBI).

TRIAD uses only UL listed controls and UL or AGA listed burners and gas trains. Every boiler is a Category I non-condensing gas appliance that operates with non-positive pressure non-condensing at the vent collar.

TYPICAL BURNERS

Series 300:	Power Burners
Gas	Powerflame X4-400 or Gordon-Piatt GR4
Dual fuel	Gordon-Piatt S4GO
Straight Oil	Riello F10
Series 600:	
Gas	Powerflame X4-700
Series 900:	
Gas	Powerflame JR30 or Gordon-Piatt R6.3
Oil or Dual	Powerflame CR1 GO or Gordon-Piatt R6.3
Low Nox	Powerflame NPM 30
Series 1600:	
Gas	Powerflame JR50
Oil or Dual	Powerflame CR2 GO
Low Nox	Powerflame NPM 50

ELECTRICAL

Standard - 120 volts, 60 Hz, single phase
Series 300 -- 20 amps per boiler
Series 600, 900 and 1600 -- 30 amps per boiler



CAUTION Some local codes require a master power off switch for boiler room equipment and may specify its location. Electrical service and connections must meet all applicable codes.

WATER

Properly treated vessel water is required for normal boiler service life. This is water free of excessive minerals and gases with a nominal ph of 7.8 ± 0.5 .

A thorough review by a qualified water treatment system specialist is strongly recommended

Raw makeup water contains oxygen, some dissolved gases, minerals and organic materials that can cause corrosive failure and a buildup of scale inside the boiler. Scale is a very effective insulator that will cause a loss of heat transfer efficiency and eventually tube sheet failure. This condition is not covered under the boiler warranty.

Soft water is even more aggressive, so a minimum hardness is usually recommended.

INDIVIDUAL BOILER CONTROLS

Individual component product information is included in Section VI. The configuration for your specific boilers is shown in Section II. Burner manuals are sent with the burner.

ELECTRICAL WIRING BOX

The electrical box with a screw-on cover contains various electrical wiring components for each boiler - ON/OFF switch; fuses, terminals and relays for fan damper control, lockout control, etc.

The boiler limit control circuit starts & ends in this box.

Field wiring connections for line voltage service power and low voltage (TT) thermostat/control are provided in this box via clearly marked, screw-in terminals.

R845A - CONTROL CENTER

Used on Steam boilers in conjunction with Low Water Cut-offs (LWCO) and pressure controls to manage the overall operation of the boiler, cycle the burner and illuminate the "Call For Heat" light.

The R845A control is activated by closing the circuit between the two low voltage terminals (T-T) via a 24 vac 2-wire thermostat or a control panel otherwise known as a "Call For Heat".

The R845A control is wired in series with the Low Water Cut-off controls (LWCO) and the Pressuretrols and will activate the boiler control circuit only if a low water condition does not exist and the high pressure limit has not been exceeded.

L404A – Operating Pressure On/Off Control

This line voltage, pressure-sensing switch has an adjustable differential and automatic reset. When boiler steam pressure rises past the control set point, the switch opens, stopping the burner operation. When the boiler pressure falls to the set point minus differential, the switch closes to restart the burner.

L404C – Safety Pressure High Limit Control with Manual Reset

This is a line voltage, steam pressure sensing switch with a manual reset trip function. When the boiler's steam pressure rises above the set point of the control, its switch opens and the manual reset trips to shut down burner operation.

If the manual reset is tripped OPEN then a serious problem exists with your boiler. The boiler should not be put back into service until the problem has been identified and corrected

P7810C – Operating Pressure On/Off Control and Safety Pressure High Limit Control with Manual Reset.

The P7810C is a line voltage control that performs the same functions as the L404A and L404C above but in one control.

For On/Off Control, it uses a separate integral electronic pressure sensor with an adjustable set point, an adjustable differential and automatic reset. When boiler steam pressure rises past the control set point, the switch opens, stopping the burner operation. When the boiler pressure falls to the set point minus differential, the switch closes to restart the burner.

For High Limit Control, it uses a different and separate integral electronic pressure sensor with an adjustable set point and has a manual reset trip function. When the steam pressure rises past the control set point, the switch opens and the manual reset trips, which shuts down the operation of the burner. When the boiler pressure falls below the set point, the burner will not restart operation until this control has been reset manually.

If the manual reset is tripped OPEN then a serious problem exists with your boiler. The boiler should not be put back into service until the problem has been identified and corrected

150 BMD - LOW WATER CUT OFF (LWCO)

This two stage control senses the water level within the vessel shell to switch the power for both the feed water solenoid and the burner. When the water level has dropped approximately $\frac{3}{4}$ of an inch below the nominal operating water level (about 2 to 3 gallons), the first stage switch closes providing line voltage to the boiler feed water solenoid. This circuit will remain powered until the water level returns to normal. If the water level continues to fall, the second stage switch opens which stops the burner operation. The burner switch will be closed once the necessary feed water has been provided to the boiler.

NEVER "dry fire" (operate a boiler with insufficient water). It is an extremely destructive and a dangerous practice.

67M – SAFETY LOW WATER CUT OFF (LWCO) with MANUAL RESET,

This control senses the water level within the vessel shell to shut down the burner in a low water condition. If the vessel water level drops below the minimum, the control switch opens, tripping the manual reset and stopping the operation of the burner. This control requires a manual reset.

If the manual reset is tripped OPEN then a serious problem exists with your boiler. The boiler should not be put back into service until the problem has been identified and corrected

NEVER "dry fire" (operate a boiler with insufficient water) It is an extremely destructive and dangerous practice.

ON/OFF SWITCH & FUSES

The ON/OFF switch and dual fuses provide a safe way of removing power from the boiler.

NOTE: Replace fuses only with the same type as specified inside the wiring box cover and then only after determining why the fuse(s) blew.

RELIEF VALVE

The relief valve should NEVER function under normal operations. If it has then something needs to be adjusted. Many codes require periodic testing and replacement of relief valves -- the user must meet local code requirements. Many codes require that the safety relief valve be freely vented to the outside atmosphere (potential line freezing must be considered). Relief valves are sized for both their pressure rating and their BTU/hr load. Replace only with properly sized, ASME approved units designed for steam systems -- SEE MANUFACTURER'S TAG ATTACHED TO THE VALVE.

PRESSURE GAUGE

Indicates boiler vessel operating pressure.

LIFTING LUGS (optional on some boilers)

Lifting point of boiler for ease of installation.

FAN DAMPER RELAY (optional)

SQUARE D 8501 DPDT -- with line voltage coil

BAROMETRIC DAMPER (optional) FIELD MG1-8, RC-6

TRIAD recommends one barometric damper be installed for each boiler or at least one be installed in the breeching between the first boiler and the stack.

OPERATING LIGHT

"Call For Heat" indicator mounted on Boiler Control Center. Integral to the P7810C control.

CLEAN-OUT OPENINGS (Optional)

Nipples and caps for easier inspection and boiler vessel service.

OTHER SYSTEM COMPONENTS

In addition to the boiler and burner, a complete heating system may include the following:

Near Boiler Piping -- field installed piping that connects the boiler to the main steam header. Typically incorporates a Hartford loop. The separation between the equalizer and the condensate return loop should always be kept to a minimum; use a close nipple whenever possible.

Steam Header -- Connects to near boiler piping. The header then transfers steam to heating zones. Header MUST always be a minimum of 24" above the top of the boiler -- this helps to ensure dry steam production.

Air Separation System -- Removes dissolved gases from recirculating system water, which TRIAD highly recommends for open systems.

Water Treatment System -- Helps ensure water quality and control of ph, hardness and dissolved materials.

Vent and Expansion System -- Typically part of the boiler feed water and condensate return system.

Water Pressure Reducing Valve -- Drops supply water to system pressure and maintains a minimum (18 psig) pressure within the system.

Gas Line Pressure Valve -- Lowers supply gas pressure to gas train range (typically less than 14" WC -- 0.5 psi).

Oil Supply System -- Allows single or two line transfer of fuel oil from the supply tank to the burner train.

Thermostat Control -- Varies between a simple two wire thermostat to a microprocessor outdoor reset control panel. Some applications may use a remote application sensor that closes the boiler thermostat "Call For Heat" control circuit.

TRIAD BOILER SYSTEMS, INC.

Section IV

GENERAL OPERATIONS

Prior to starting your boiler system, please familiarize yourself with each boiler control by reviewing both Sections III and VI or this manual

Series 300 fires at 300 – 399MBH.
Series 600 fires at 600 – 700MBH
Series 900 fires at 800 – 1000MBH
Series 1600 fires at 1100 – 1700MBH

TRIAD steam boilers may be used in many different applications. The boiler is designed to convert water to steam under controlled pressure. The amount of steam produced is in direct proportion to the BTU/hr (British Thermal Units per hour) rating of the burner. The steam temperature and the pressure – pounds per square inch gauge (typically referred to as psi) are always directly related.

For example, in a typical space heating application, a boiler fired at 900,000 BTU/hr will produce up to 749 pounds of steam per hour. The same boiler firing at 600,000 BTU/hr would produce approximately 512 pounds of steam per hour. The difference between the two examples is the firing rate of the burner and thus the heat produced. In either case, the steam pressure and temperature would be the same - the volume of steam produced would be different.

Since virtually all of the thermal output is carried as “latent heat” (heat required to convert water to steam) the heat transfer is not controlled by the steam pressure.

It is imperative that the initial setting for each control (i.e. Operating Pressure Limit, Safety Pressure High Limit, etc.) be made before attempting to start up any boiler

All TRIAD Steam boilers are equipped with a Control Center; two low water cutoff (LWCO) controls - one with a manual reset and dual pressure limit controls - one with a manual reset. Other controls may be installed as add-on options

Unless otherwise noted, all control circuits and wiring connections are line voltage.

The R845A Control Center requires a “Call For Heat”

to activate it. This is accomplished by closing the circuit between the two low voltage terminals (T-T) via a 24 vac 2-wire thermostat; an outdoor reset control panel; or a simple temperature control.



Power is supplied to the boiler by setting the ON/OFF switch to the ON position.

With this switch in the ON position, all of the controls on the boiler are “live” and great caution must be taken before touching any wiring. Turning the ON/OFF switch to OFF means only that the power to the boiler mounted controls is off.

NOTE: Power to controls and systems not mounted on the boiler (fan dampers, induced draft fans, etc.) is not provided by the boiler controls even though these “off boiler” systems may be activated by boiler mounted relays, etc. Extreme caution must be taken before attempting to service any “off-boiler” systems as there may still be electricity present in them even with the boiler ON/OFF switch in the OFF position.

NORMAL Operating Conditions are when the vessel steam pressure is not above the operating high limit - see L404A or P7810C Pressure Control **and** a low water condition does not exist - see LWCO controls.

ABNORMAL Operating Conditions would include but not be limited to: electrical failure; fuel interruptions; vessel steam pressure that exceeds the control set points, a low water condition; a malfunctioning control; etc.

Specific wiring diagrams for your boiler system are included in Section II of this manual.

Descriptions of controls and their operations are generic. See Section VI of this manual for the manufacturer’s instructions. Specifications and configurations are subject to change without notice.

ALL STEAM MODELS

These single function boilers provide low pressure steam – max 15 pounds.

SETTINGS

Nominal system design pressure is established by the pipe size chosen by the design engineer. Typical systems are 2 to 4 psi. Once the initial setting is established, adjustment may be required based on system performance and design criteria.

Operating Pressure Limit Control (L404A)

Typical operating pressure for a heating application is 2 to 4 psi - plus/minus 1 to 2 psi. Other applications may be quite a bit higher.

Safety Pressure High Limit Control - Manual Reset L404C or P7810C.

Nominal operating pressure that is set as the Operating Pressure Limit (above) plus 2 to 3 psi.

OPERATION

Under Normal Operating Conditions a "Call For Heat" to the R845A Control Center would activate the burner control circuit that starts the burner ignition cycle (see burner manufacturer's instruction manual) and illuminates the operating light on top of the control or in the P7810C. The heat applied to the vessel water increases the vessel water temperature to boiling converting the water to steam. As the water is "steamed-off", "makeup water" must then be supplied by the boiler feed water make-up system.

Boiler Feed Water Control (150BMD) - : A float in this control senses when the actual water level in the boiler reaches 3/4" below the normal water level of the vessel and closes a contact to provide power to the field installed, normally closed, feed water solenoid. When powered, this solenoid opens to provide "make-up" water to the boiler until the float senses that the water level in the boiler has reached its nominal level again at which time power is cutoff to the solenoid which then closes, stopping the flow of "make-up" water.

This cycle will repeat as the boiler water level rises and falls during the normal operation of making steam.

NOTE 1 - At times the boiler pressure may rise above the setting of the Operating Pressure On/Off Control - L404A or P7810C, which will open the contacts in the control stopping the burner from firing.

Once the vessel pressure drops below the differential set point in this control, the contacts in the control will close and the burner ignition will start again. Typically this condition may occur when the system is approaching dynamic balance near the nominal system operating temperature -- the entire output for the boiler exceeds the current system needs. It may also occur if - the boiler sequencing is too aggressive or the boiler has been oversized for the system.

NOTE 2 - If the manual reset circuit of the Safety Pressure High Limit Control - L404C or P7810C - is tripped - this indicates a serious problem with your boiler. It is mandatory that the boiler be immediately removed from service and the cause be identified and corrected. It is possible that the other high limit pressure control was set wrong or has malfunctioned (very serious condition). One or both controls may need to be replaced. The system may have to be inspected before the boiler is returned to operation. .

NOTE 3 - Low Water Cut-Offs (LWCO) limits are not adjustable - their control limits are fixed. If the manual reset circuit of the LWCO - (67M) has "tripped", this indicates a serious problem with your boiler. It is mandatory that the boiler be removed from service and the problem be identified and corrected. It is likely that the other LWCO (150BMD) has malfunctioned (very serious). One or both controls may need to be replaced.

The boiler will continue to operate until the "Call For Heat" is satisfied and the control is deactivated by opening the circuit (T-T) OR an ABNORMAL Operating Condition has developed.

TRIAD BOILER SYSTEMS, INC.

Section V

INSTALLATION & STARTUP INSTRUCTIONS



STOP: Before proceeding with this section, carefully read the other Sections in this manual.

A. UNPACKING

Always protect boilers from the weather.

All cartons and crates should immediately be inspected for any damage. If any damage is found at the time of delivery, proper notation should be made on the carrier's Bill of Lading before signing for delivery. Damage claims should be filed immediately with the carrier. Claims of shortages should be filed in writing with TRIAD Boiler Systems, Inc. within five (5) days of receipt.

For those boilers with leveling legs, the boiler is shipped with leveling bolts to be field installed into the leveling legs. .

The burner carton contains the manufacturer's instruction manual and gas train components. .

The wiring diagram(s) for the boiler are included in this manual and copies are included in the electrical wiring box. Suggested "near boiler piping" diagrams are available in TRIAD's Boiler Manual.

The boiler tags should be checked to confirm the boiler model, the serial number the burner model and burner rating. These should agree with the information shown on the Packing Slip found in Section II of this manual.

B. WHERE TO LOCATE

Boilers must be protected from weather and should not be exposed to potentially freezing temperatures.

Boilers should be located as near as possible to the stack of the breeching system. Consideration should be given to water drainage for the relief valve and LWCO's and access for boiler service.

Install the boiler only on a level, non-combustible surface and level it with the leveling bolts provided.

Sufficient clearance is required for operation and service. Suggested minimum clearances for service access are: 48" in the front; 18" for the rear; and 18" on one side where there are multiple boilers; and 24" up to the breeching and header connections.

Boilers are intended to be installed on center lines of 24" for Series 300; 36" for Series 900; and 42" for Series 1600.

The near boiler piping and the rise to the header are particularly important for proper boiler operation. Do not reduce the size of the steam supply opening. Ensure that the near boiler piping is as specified by the design engineer.

The rise in the connector from the boiler to the breeching system can be its most effective part. Generally, the longer the rise, the better the draft. A draft hood or barometric damper for each boiler is generally recommended. At a minimum, one damper should be located in the breeching between the first boiler and the stack. Additional information is available in the TRIAD Boiler Manual. Also, the installation must comply with local codes.

Adequate combustion air must be provided to the boiler room. Provisions must be made for adequate water supply and treatment - the condensate return/makeup water/ boiler feed system. Fuel supply and electrical service must be provided. Stack and breeching components must be provided. Typically, burner startup service will be required.

C. INSTALLATION – WARNINGS/CAUTIONS



CAUTION: Before connecting the fuel supply and burner, be sure to read the burner manufacturer's manual.



WARNING: BEFORE ATTEMPTING ANY ELECTRICAL SERVICE DISCONNECT POWER FROM THE BOILER.

1. TRIAD does not design boiler rooms. TRIAD recommends that a competent system design

engineer be retained to design the heating system, supervise the installation and oversee the startup

2. Only a qualified individual such as a licensed electrician should attempt to service electrical or control circuits. Only a qualified HVAC technician should attempt to service or to start up a burner. .

3. The installation must conform to the local codes having jurisdiction over your area and this type of equipment. Without local codes, refer to the National Fuel Gas Code. At a minimum BOCA code compliance must be met.

Where required the American Society of Mechanical Engineers (ASME) Safety Code for Controls and Safety Devices for Automatically fired Boilers (CSD-1) must be met. User insurance requirements may be a factor in the installation requirements.

Connections to water, breeching and electrical service must meet all applicable codes. These may include but are not necessarily limited to the National Electrical Code, BOCA standards on Combustion Air and local water, power and fuel supplier requirements. On-site inspection by local, state or third party insurance agents may be required before placing the system in operation.

4. TRIAD recommends that a MASTER POWER DISCONNECT SWITCH AND A FUEL SYSTEM CUT OFF VALVE be installed for each boiler room.

5. NEVER "dry fire" a boiler - operate the burner without full and sufficient water in the boiler.

Verify that the combustion air, breeching, venting, fuel supply, water supply, boiler feed and makeup system, and the condensate tank(s) have been properly installed before attempting to fire the burner.

Burner startup procedures are found in the respective burner manufacturer's instruction book. Be sure to read, understand and heed all warnings.

Improperly installed or maintained boiler systems can cause high levels of Carbon Monoxide, risk of boiler damage or personal injury.

D. INSTALLATION – FIRST, THE BOILERS

1. TRIAD recommends that all water connections be completed prior to the connection of fuel and electrical power. This will help ensure that a dry fire situation is avoided and reduce the possibility of spraying water over live electrical components. All

fittings should be tight and an appropriate sealant (pipe dope) applied.

2. The safety relief valve should be plumbed in accordance local code and compliant with the manufacturer's recommendations. See the tag attached to the relief valve. Many codes require venting to the outside atmosphere.

3. The LWCO's should be plumbed according to local code and the manufacturer's instructions. Typically the discharge lines must not be restricted or downsized; and should be aimed to reduce the potential exposure of steam and hot water release. The ends of the discharge lines should have no fitting. The relief valve line should be left clearly visible so that if it should operate it will be evident that a discharge has occurred.

4. Flush, connect and test all system water lines.

5. Fill the boiler(s) and verify that the boiler water level is met and there are no leaks in the system.

4. Verify that the water treatment, boiler feed, makeup and condensate systems are properly set to the manufacturers and system design engineer's requirements.

E. NEXT - THE FUEL DELIVERY SYSTEM

Specific limits and procedures covering fuel line installation, piping, and pressure and leak detection are important to review and understand.

Generally, gas burners should not receive over 0.5 psi (14 inches water column) of gas supply pressure from lines of sufficient volume to avoid an undue pressure drop (see the burner manufacturer's manual). This typically requires the installation of a gas line pressure regulator before the gas train.

Oil supply systems may be one or two line type depending on the burner and system design.

LP systems require pressure regulators and LP specific burners.

Use extreme caution while working on fuel lines to avoid ignition sources. Fuel lines should be checked with an appropriate leak detection fluid or procedure. Many fuel supply companies can provide assistance with appliance connections

Ensure that the fuel supply is shut off at its source before performing any work on the delivery system.

F. NEXT - THE BURNER

The burner should not be connected to the fuel supply line until all testing and leak detection of the fuel delivery system is completed

STOP The burner connections warrant special attention. Verify that the recommendations and warnings in the burner manufacturer's manual are followed.

1. Verify that the fuel supply is shut off at its source.
2. Verify that the firebox is clear of all foreign material or fuel and that the refractory is intact
3. Mount the burner on the adapter plate supplied with the boiler using the gasket or insulating rope supplied with the burner.
4. Connect the wiring harness to the burner contacts as shown on the wiring diagrams included with the boiler and in this manual.
5. Connect the fuel source to the burner.
6. The burner must be properly adjusted and set up for each site before operation. All burners use both automatic pilot ignition and some form of flame detection. NEVER try to manually light a burner.
7. Make sure all fuel feed valves remain closed.

G. NEXT - ELECTRICAL CONNECTIONS

FIRST – Verify that the line voltage power is off and the Call For Heat control (thermostat) is off.

1. Connect the line voltage service to L1 and L2 terminals in the electrical wiring box on the boiler.
2. Connect the low voltage (thermostat) circuit to the T1 terminals in the wiring box on the boiler.

H. IMMEDIATELY PRIOR TO STARTUP

Verify that:

- The breeching has no leaks.
- The combustion air requirements are met.
- No combustibles or vapors are present in the boiler room area.
- All ventilation and combustion air openings and louvers are clean and free of debris

- All stack and breeching dampers are set

- All flue and breeching passages are clear of any fuel accumulations

Test the safety relief valve.

Test the LWCO. ("blow down") valves.

Confirm that the system design engineer has completed all mandatory code installation requirements including necessary inspections.

Verify that air separation, water treatment, boiler feed, makeup water and condensate return loop components are operating correctly as per manufacturers' instructions.

Verify that all operating controls are set.

Verify that all safety controls are set.

Verify that the burner pre-purge cycle, ignition and ignition confirmation circuits are functional before opening fuel feed valves.

I. START-UP

Apply fuel, power and control signals as directed in the burner manufacture's manual and after all system and pre-start checks have been completed

J. IMMEDIATELY AFTER FIRING:

Monitor the first ignition cycle carefully for proper operation

Continue to monitor initial operations and adjust the burner as required for correct operation. Note the combustion products readings for future performance monitoring and ensure operations are on the correct side of the curve - excess oxygen.

Continue with a normal shutdown. Observe the burner for correct response and physically inspect the burner and firebox sight glass to ensure that the flame has been completely cut off.

Closely monitor several complete cycles to confirm proper operation. Ensure that all of the steps in the burner manufacturer's instructions have been completed.

Complete Operator training. Begin keeping a Maintenance Log -- record all startup readings.

New steam boilers need to be thoroughly cleaned before being placed into normal operations. This process is called "Surface Skimming" and involves removing any residual oil and contaminants that are floating on the surface of the boiler water.

Failure to completely clean a new boiler will result in wet steam production and erratic boiler performance. The oil in the water will lead to foaming, and surges ("priming") in the water level, typically visible through the gauge glass.

The gauge glass should always be dry above the water line and the water line should be stable. Changes in the gauge glass water level or the presence of visible moisture above the water line or water droplets carrying over from the top suggest the need for a good cleaning.

It is usually best to let the boiler operate for several days to clear out the system before doing the initial cleaning operation. See section VII.

The manual blow-down valves on the LWCO controls should be operated at least 2 to 3 times a day during the first two weeks of boiler operation. After that, manual blow-down should be performed at least daily on all operating boilers – see LWCO manufacturer's instructions and Section VII.

Balance the system to the design engineer's specifications by adjusting control pressure settings. Some "trial and error" is inevitable.

Section IV covers typical boiler operating sequences and controls.

Section VII covers Maintenance and Section VIII Troubleshooting (for qualified technical support only).

TRIAD BOILER SYSTEMS, INC.

Section VI

OEM COMPONENT PRODUCT DATA

It is imperative that the documentation in this section be thoroughly reviewed before placing the boiler in operation.

These materials include specific operating warnings that must be followed for proper boiler operations.

Failure to follow the directions and warnings can result in serious personal injury and/or damage to the boilers and other property.



CAUTION: It is important to pay special attention to the burner manufacturers installation and operation manual.

TRIAD BOILER SYSTEMS, Inc.

Section VII

GENERAL MAINTENANCE



CAUTION: Start with a review of the warnings, cautions, notes and NBBI recommendations found in Section I of this manual.

Maintain a clean boiler room. Provide “clean” water to the boiler. Maintain a planned program of proactive preventive maintenance.

WARNING: NEVER “dry fire” the boiler - operate the boiler and burner without the boiler being completely filled with water.



NEVER operate the boiler without a functional Low Water Cut Off control.

NEVER operate the boiler without a functional High Pressure Limit control.

NEVER reset a “tripped” manual shut-off without first removing the boiler from service, determining the cause of the problem and correcting the cause.

WARNING: NEVER operate the boiler without an ASME approved, steam rated safety relief valve matched for both BTU/hr and pressure relief values.



Test and inspect the relief valve at least annually. Replace defective valves immediately or as required by code. See Safety Relief Valve manufacturer's tag.

NEVER operate a boiler if the safety relief valve has discharged. If the safety relief valve has discharged, something is wrong. Immediately remove the boiler from service and have a trained service technician investigate and correct the problem.

Warning: “Blow-down” – flush – the Low Water Cut Off controls at least daily during service periods. Failure to thoroughly flush the controls can render them inoperative.



If the burner continues to operate during a blow-down, the boiler needs to be removed from service and the controls inspected immediately.

NEVER add water to an overheated boiler. This can cause an immediate conversion of the water to steam with an explosive increase in volume. Turn OFF the burner and allow the boiler to cool slowly.

NEVER fire a boiler without the turbulators installed in the fire tubes.

NEVER fire the boiler if the firebox or tubes have excessive buildup or there appears to be signs of water leakage in the combustion chamber. .

NEVER bypass any of the controls on the boiler, fuel train or burner. If a control is considered defective, REPLACE it before using the boiler/burner again.

NEVER fire a boiler above its rated input.

NEVER allow a boiler to be exposed to freezing conditions. If used outdoors, properly protect the system from the weather.

All TRIAD boilers are built to meet or exceed the Section IV ASME standard and are registered with the National Board to perform at a maximum of 15 psi at 250°F. The boilers and their controls are designed only for heating water.

NEVER expose a boiler to thermal shock. Thermally induced stress cycling can result in metal fatigue or failure. Maintain a minimum temperature differential between boiler feed water and vessel water. NEVER introduce “cold” water into a hot boiler. Boiler feed water should be a nominal 160°F before entering a hot boiler. NEVER exceed a maximum differential of 140°F. Thermal shock voids the boiler warranty.

In a steam system, good water quality and treatment are very important. The introduction of new water into a steam system also introduces oxygen (possibly with other dissolved gasses, minerals, particulates and organic material).

This can cause internal corrosion, scaling and fouling material to build up in the boiler and system. Establish a suitable boiler water treatment program to reduce oxygen, scale, sludge buildup, corrosion and to control ph.

Regularly verify that all ventilation, combustion air openings and louvers are clean and free of debris.

OPERATORS & TRAINING

Operators should be trained in and develop a thorough familiarity of the system and its controls.

Operators should be trained in the use of fire prevention equipment.

Operators should review and become familiar with all manuals, diagrams and warnings related to the system, the boiler and the burner.

Written site procedures should be developed and be readily accessible to all operators.

A permanent log book should be maintained in the boiler room to record maintenance work, inspections, tests and other pertinent data.

Only a qualified service technician should make burner or system adjustments and perform heating season start up.

The boiler should normally operate on its own controls once it receives the "Call For Heat" signal. If the burner should fail to light after a "Call For Heat", a system malfunction has probably occurred. A qualified service technician should determine the problem and correct it before putting the boiler back into service.

PREVENTIVE MAINTENANCE – SUMMARY

NOTE: Read the tag attached to the Safety Relief Valve -- FOLLOW THE MANUFACTURER'S INSTRUCTIONS COVERING INSPECTION, TESTING, AND REPLACEMENT.

WARNING: Protect yourself when testing Safety Relief Valves and performing blow-down of Low Water Cut-Off valves – hot water and steam will flow from the drain pipes. If the burner does not shut-off during blow-down procedure, remove the boiler from service, determine the cause and correct it before returning this boiler to service. .

Safety relief valves should be inspected and tested at the start of each service period and monthly during the service period.

During the annual boiler inspection and cleaning, remove the valve and check for deposits in the valve

and plumbing. If the valve has buildup, fails to operate or leaks, replace the valve only with an ASME approved steam relief valve of both the same pressure and BTU/hr rating. NEVER operate a boiler without a functional safety relief valve.

Under normal service conditions, replace the valve every three to five years

Blow-down valves should be inspected and tested at the beginning of each service period. Blow-downs should be performed at least daily during service period. See manufacturer's tag.

The boiler room area should be kept as clean as possible and free of all debris. The boiler room should be thoroughly washed down at least weekly to eliminate all dust and dirt which will help extend the intervals between boiler fireside cleanings. .

DAILY/WEEKLY PROCEDURES – VERIFY:

- Boiler operation on "Call For Heat".
- Normal burner light-off.
- Pump and boiler feed solenoid operations.
- Fuel supply is not restricted. .
- Feed water temperature to a nominal 160°F.
- Water treatment and expansion tank operations.
- Damper operations.
- Combustion air supply.
- Gauge glass is clear.

WEEKLY/MONTHLY PROCEDURES

- A thorough wash down of the boiler room.
- Check the safety relief and blow-down valves.
- Check and lubricate all system motors.
- Check and clean any strainers.
- Check all venting and breeching.
- Review burner combustion readings.
- Verify that the air separation, water treatment and makeup/feed/condensate systems are operating per manufacturer's instructions.

ANNUALLY or during a lay-up period:

Shut down the boiler by following the procedure in "REMOVING A BOILER FROM SERVICE" below in this section.

The waterside and fireside of the boiler should be inspected to determine their condition. Boilers out of service for extended periods (more than seasonal) should be properly laid-up dry. Ensure that idle boilers are protected from freezing conditions if laid-up wet.

The frequency of cleaning will depend on the effectiveness of the water treatment program, the fuel type, efficiency of the burner, characteristics of the site combustion air supply and breeching effectiveness.

A coating of 1/8" of scale on the lower tube sheet can cause a loss of 13 percent of BTU/hr transfer and may lead to tube failure from thermal shock.

Inspection of the boiler vessel should occur at least annually or whenever a 1/8 inch of scale has built up in the vessel. Initial 30 and 90 day inspections are recommended.

WATERSIDE CLEANING

SURFACE SKIMMING: After the first several days of operations, a new boiler needs the water level surface to be skimmed. Anytime there is evidence of moisture above the water line in the gauge glass, surging ("priming"), frothing, or violent changes in the water line, or carry over into the top of the gauge glass, the boiler should be skimmed. Since this requires some plumbing and operating the boiler under controlled and monitored conditions, it is covered in the technical support section of this manual – see Section VIII.

ANNUAL INSPECTION: Drain and flush the vessel. Remove all inspection clean-out caps. Inspect interior surfaces for signs of corrosion or pitting. If advanced corrosion is evident, remove all supply/return lines and arrange for boiler pressure testing or replacement.

A light coating of scale is acceptable, but deposits or evidence of sludge must be cleaned and water treatment procedures set up/improved immediately. High pressure water spray should be directed at any deposits. Deposits are typically easier to remove while still warm and wet as long as the boiler has drained and cooled enough for maintenance. Chemical agents may be used, but follow the chemical agents manufacturer's instructions.

Inspect the safety relief valve.

MAINTENANCE

If the boiler is not to be returned to service soon, dry the inside with forced warm air and minimize exposure to humidity and moisture..

If the boiler is to be laid-up wet, then run through at least one full cycle after filling before isolating it from the system to drive off excess oxygen. This will help limit corrosion exposure.

FIRESIDE CLEANING

Fireside cleaning is critical because a 1/16" coating of soot which is essentially unburned fuel may present a fire hazard and can cause a 25 percent loss of efficiency of the boiler.

A qualified service technician should perform the following maintenance items:

Remove the burner, the burner adapter, the boiler jacket top, insulation disk and smoke hood. Inspect surfaces including turbulators, interior of fire tubes, and firebox for evidence of soot. Brush clean each fire tube; wipe clean each turbulator, vacuum the entire firebox of soot.

Replace turbulators that are worn or damaged or that have their lower portion burned off.

Burned-off turbulators and excessive sooting indicates problems with the fuel supply, burner settings, combustion air supply, and/or breeching.

Clean, check and adjust the burner. .

Inspect firebox refractory for cracks or deterioration. Repair with suitable refractory material if required, following the manufacturer's instructions.

Inspect all sealing gaskets and rope and replace as required.

Re-install the burner, burner adapter, smoke hood, insulation disk and jacket top

AFTER CLEANING

Leak test the fuel train.

Verify the operation of all boiler mounted controls and gauges. Replace as necessary.

Lubricate all mechanical equipment such as fans and pumps and verify motor rotation.

Check all plumbing for leaks or missing insulation.

SECTION VII

Check all venting and breeching for leaks.

Have the water retested and the water treatment system serviced.

If required, have the boiler inspected by an authorized inspector. Local/state codes may apply.

RESTARTING THE BOILER

WARNING: NEVER "dry fire" the boiler - operate the burner without the boiler completely filled with water.



Do not operate the boiler without a functional Low Water Cut Off control.

Do not operate the boiler without a functional High Pressure Limit control.

Follow the initial startup procedures as outlined in Section V above and in particular refilling the boiler with water, properly re-connecting the fuel source and properly re-connecting the electric wiring.

Follow the burner manufacturer's startup instructions.

Monitor the boiler through several complete cycles to confirm proper operation. Check burner for normal light-offs and complete shutdown

Record combustion product readings and compare with initial values. Investigate significant changes.

Return the boiler to service.

Update all maintenance information in the log book.

REMOVING A BOILER FROM SERVICE

WARNING: Verify that the burner has completed its cycle and that it has turned itself OFF.



Turn the power switch on the burner to OFF.

1. Turn the ON/OFF switch on the boiler to OFF.
2. Turn off the control signal to the boiler (thermostat).
3. Allow the boiler to cool slowly and then relieve any residual pressure (check the gauge and

carefully open the safety relief valve) before performing maintenance

4. Disconnect the fuel supply from the burner and the power to the boiler and all its accessories.

5. Isolate the boiler by cutting off the make-up water to the vessel and closing the gate valve to the steam header.

If the boiler has been taken out of service due to an operational problem, ensure that the necessary repairs/services have been completed before putting it back into service. If required, arrange to have the boiler inspected. Follow the initial startup procedures as outlined in Section V above.

TRIAD BOILER SYSTEMS, INC.

Section VIII

TROUBLESHOOTING



CAUTION: Start with a review of the OEM equipment information found in Section VI of this manual and the burner manufacturer's manual -- note all WARNINGS.



WARNING: BEFORE ATTEMPTING ANY ELECTRICAL CIRCUIT ANALYSIS REMOVE BOILER FROM NORMAL SERVICE AND REMOVE POWER FROM THE BOILER. Failure to use the required care and caution can result in electrical shock, injury, and extensive property damage.



WARNING: Make sure the burner is rendered inoperative before cutting off the waterside of a boiler -- never dry fire a boiler.

NOTE: ASME's CSD-1 requires that only listed controls be used on boilers. Rebuilt controls do not comply with this standard and are never recommended.

These suggested guidelines are for general troubleshooting only by qualified individuals such as a licensed electrician or HVAC technician with both the appropriate technical training and the necessary experience to work on powered systems. See warnings in Section I.



If you are not a professional repair person qualified to work on HVAC equipment stop here and call for service.

IF BOILER WON'T FIRE:

Please follow these steps in the order presented.

A. CHECK POWER TO BOILER and BURNER

Check to see if the power switch on the boiler's electrical junction box is in the ON position. If not, then switch it ON! If this does not correct the problem then turn OFF the ON/OFF power switch and remove the screw on cover. Verify that service

power to the boiler is present. Check the fuse(s)! Turn ON the power.

Check to see if the power switch on the burner's panel is in the ON position. If not, then switch it ON

B. IF - NO "CALL FOR HEAT" - CHECK THE R845A CONTROL CENTER

Terminals 1 & 2 should have line voltage present. If there is no power to the control, check the source of the neutral and line voltage. Correct the problem.

If there is power to the Control Center, then check the "Call For Heat" terminals -T-T for 24VAC. If T-T are without power, possibly this control is defective.

If there is low voltage power at T-T, then check the circuit between T-T in the Control Center and the actuating device that completes this connection - a thermostat; a control panel; a temperature control; or an on/off switch. Correct the problem.

**** For boilers with L404 Pressuretrol Controls,** check for line voltage at terminals 4 and 2. The "Call For Heat" light should be "ON". If not, it may be burned out. If not possibly the jumper between terminals 1 and 3 is not properly connected. Verify that terminals 5 and 6 are "closed" and "dry". If not, possibly this control is defective.

**** For boilers with an R7810C Pressuretrol Control,** you must check the "Call For Heat" light on the control itself. There is not a "Call For Heat" light on the Control Center in this case. Check terminal 6 for line voltage. If none, check terminal 5 for line voltage. If line voltage is present on terminal 5 but not 6, the relay connecting the load between terminals 5 and 6 is not functioning properly. The Control Center may be defective. If terminal 5 has no voltage, there is a power problem further upstream of the Control Center.

If the Control Center is operating correctly, proceed to the next step. .

C. IF - NO “CALL FOR HEAT” –

WITH AN R7810C PRESSURETROL

The R7810C control requires line voltage power to operate. Power is provided by a limit circuit that connects through both low water cut off controls.

FIRST - CHECK FOR LOW WATER CONDITION

Check the water level in the gauge glass mounted on the front of the boiler. If the water level appears to be correct, verify that both low water controls are functioning correctly.

If the manual reset circuit of the 67M LWCO has “tripped” this indicates a serious Low Water condition for the boiler. Immediately take the boiler out of service until the cause of the problem is identified and corrected

CHECK FOR A HIGH PRESSURE CONDITION

Check the pressure gauge mounted on the front of the boiler. If the pressure gauge reading appears to be correct, verify that the R7810C Pressuretrol is operating correctly.

The R7810C is a dual function control that provides the Operating Pressure On/Off control and the Safety Pressure High Limit control - each with separate electronic sensors

Verify that the vessel pressure has not exceeded the Safety Pressure High Limit of the R7810C control. If the manual reset circuit of the R7810C has “tripped” this indicates a serious High Pressure condition for the boiler. Immediately take the boiler out of service until the cause of the problem is identified and corrected

The Operating Pressure side of the control should have stopped the boiler operation before the High limit side of the control with manual reset was tripped. Verify that the set point for the Operating Pressure limit is set lower than the Safety Pressure High Limit. If so, then possible the Operating Pressure electronic sensor may be defective

If the vessel steam pressure is not above the operating high limit **and** a low water condition does not exist, there may be a problem with the P7810C control. .

To diagnose this control, refer to the OEM Components section of this manual for this specific

control. Refer to the heading “checkout” for trouble shooting assistance.

D. THERE IS A “CALL FOR HEAT” -- BUT THE BURNER WON'T FIRE

If the vessel steam pressure is not above the operating pressure limit **and** a low water condition does not exist **and** there is no service power problems:

CHECK THE FUEL

There could be a fuel sufficiency problem. Ensure that there are no interruptions in the burner fuel source such as low gas pressure, inadequate gallons per hour of #2 oil, etc. Resolve as necessary.

E. THERE IS A “CALL FOR HEAT” -- BUT THE BURNER WON'T FIRE

WITH L404 CONTROLS

FIRST - CHECK FOR LOW WATER CONDITION

Check the water level in the gauge glass mounted on the front of the boiler. If the water level appears to be correct, verify that both low water controls are functioning correctly.

If the manual reset circuit of the 67M LWCO has “tripped” this indicates a serious Low Water condition for the boiler. Immediately take the boiler out of service until the cause of the problem is identified and corrected

CHECK FOR A HIGH PRESSURE CONDITION

Check the pressure gauge mounted on the front of the boiler. If the pressure gauge reading appears to be correct, verify that the L404 Pressuretrols are operating correctly.

Verify that the vessel pressure has not exceeded the Safety Pressure High Limit of the L404C control. If the pressure exceeds this limit setting and has tripped the manual reset, do not reset the control but immediately take the boiler out of service until the cause of the problem is identified and corrected.

The L404A control should have stopped the boiler operation before the L404C – manual reset was tripped. Verify that the set point for the Operating

Pressure limit is set lower than the Safety Pressure High Limit. If so, the L404A control may be defective and should be replaced

E TROUBLESHOOTING THE CONTROLS

If you have reached this point in your trouble shooting, then probably one of the controls on the boiler has failed. Refer to the wiring diagrams in Section II and the OEM Component Product Data information in section VI for specifics about testing each control.

LWCO - 150BMD - test for line voltage to terminal 2 and neutral. If there is power here, then check for continuity in the burner control limit circuit (gray wires) at each point. This circuit must be "on" in order for the burner to fire.

67M, L404A, L404C - these controls are switches only and do not require any power. If the circuit is not complete through them, then one of these controls may be malfunctioning or defective.

The boiler should not be put back into service until the problem has been identified and corrected.

If the functions of the all the controls have been verified as working properly, then check the burner for the following items:

- power switch is ON
- power light is ON
- that there is line voltage to terminals 1-2 in the control panel
- that the circuit to terminals 3-4 in the control panel is complete

If all of the controls seem to be operating properly and there is power to the burner and the burner control circuit (gray wire system), then there is probably a malfunction with the burner itself. Consult the manufacturer's burner manual for assistance.

E. BOILER "SHORT CYCLING":

Modular boilers are designed to provide a balanced response to the existing heat load. At some point in any cycle, the load will be matched or exceeded by the boiler(s) response. It is normal for the burners, under such situations, to shut down temporarily and cycle on the limit controls similar to a household furnace.

Excessive cycling is usually indicative of a primary

circulation system that is unable to carry away the BTU/hr output of the boilers. The causes can range from misadjusted controls to sensor location.

Excessive cycling will inevitably occur if the boiler output has been oversized. Interconnection lengths between primary and secondary loops should be kept to a minimum so that loops can act as independent circuits.

Staging works best with boilers of approximately the same size. In the event that major differences in size exist, adjustments to cycle length times, and staging "null" (boiler stages that do not have boilers) positions can sometimes help. Contact the system design engineer.

OVERHEATING



WARNING: boilers heat water under pressure. When water is heated above its boiling point it can flash to steam if the pressure is removed -- maintain 2 psig minimum.

Should the manual high pressure limit control, low water cutoff, or safety relief valve activate, the boiler should immediately be removed from service. It is very important that the cause of the situation be identified as soon as possible and corrective actions be taken immediately.

Several malfunctions must usually occur before the safety relief valve is triggered. Should a boiler overheat, the response procedures should optimize the safety to people, and of the boiler and building. A readily accessible power disconnect and fuel cut off valve are recommended.

When a boiler has a severe pressure or over-heating condition causing large volumes of water, or any amount of steam, to blow out the pressure relief valve, do not assume the operating and safety controls have control of the boiler.

The response to a severely over heating boiler should be to shut off the power and fuel supply and allow the boiler to cool slowly. NEVER introduce cold water into an overheated boiler. Adding water to an overheated boiler can produce explosive expansion as the water converts to steam.

The boiler should be thoroughly inspected for damage. Once the situation is corrected, the boiler should only be restarted by a qualified technician.

Its operation must be fully monitored to confirm that the problem has been corrected before the boiler is returned to normal service.

BURNERS

WARNING: Review the burner manufacturer's instruction manual for specific warnings and for technical and service information.

TRIAD boilers and burners are matched for optimum performance. Difficulty in setting the burner or in achieving smooth operation is usually indicative of a site problem - particularly if affecting more than one unit. Contact the system design engineer. Then, begin by checking the combustion air and breeching.

Venting and breeching have very significant effects on boiler and burner operations.

Condensation in the venting suggests a burner adjustment, combustion air, or breeching problem.

Sometimes "rumble" can occur in a system. Check that the fuel supply system is within the burner manufacturer's specification. Also check for proper combustion airflow, faulty breeching and loose venting. It may be worthwhile to extend the distances between the gas train components: regulators and controls. This lengthening allows a longer run that may help dampen supply pressure fluctuations.

WATER SURFACE SKIMMING

Skimming the water surface is a method of cleaning a steam boiler and the system to remove oils and contaminants from the water. It is performed by heating the boiler to temperature and then skimming off the top of the water at the water line. New boilers require repetitive cleaning during the first few weeks of continuous operation. Existing boilers need cleaning whenever the water level begins to surge, prime or bubble.

The skim tapping (flange) on the rear of the boiler should be piped with a shut-off valve and discharge line to a suitable drain (local code permitting).

Three possible methods are suggested depending on the conditions, age and size of the systems. .

1. The simplest method is to run the system and dispose all condensate for several days until it runs

clear (if allowed by local code).

2. A more common method is the following:

A. Run the boiler to a low boil temperature - slightly above 217°F or 2 psig. Then turn the burner off.

B. Isolate the boiler from the rest of the system and allow the boiler to cool until no pressure is showing on the gauge.

C. Open the skim tap shut-off valve carefully to "skim" off the top level of water – be careful of flash. Power the boiler feed water solenoid open to replace the water being "skimmed-off"

D. Capture a sample of the spill into a suitable container about 2 inches across and 9 inches deep and heat it to a boil. If the water foams, surges or forms large bubbles, then dirt and oil remain in the system.

3. A third method is chemical cleaning. Refer to the instructions in Section 7 of the ASME Boiler Code.

Depending on the age and condition of the system, the system may require several cleaning cycles

BOILER LEAKS



WARNING: If the pressure vessel should develop a leak, repairs should be made only by an ASME certified shop. Only a qualified individual such as a licensed plumber or HVAC technician should service plumbing.

In the event that water is found around a boiler, a thorough investigation is warranted. There are typically two sources of leaks: fitting leaks and pressure vessel failure. .

Fitting leaks are typically evidenced by released steam or water accumulation around the outer perimeter of the vessel below the jacket. Because it can be difficult to determine which fitting is leaking, removal of the jacket may be required.

FITTING REPAIR

After removing the boiler from service, do not simply try to tighten the fitting. Instead, remove the fitting; thoroughly clean the threads; apply new sealant (pipe dope) and re-tighten the connection. This also is the typical procedure required for a control replacement. Welded joints that develop a leak will need to be drained and re-welded.

PRESSURE VESSEL REPAIR

In the rare instance of a leak of the pressure vessel such as a crack in the material or a failed weld, only an NBBI registered "R" (repair) stamp technician should attempt to repair the shell. The repaired shell must be pressure checked and inspected before the boiler is returned to service. Local and state code may also apply

Any such repairs must only be made according to the ASME Code and within the requirements of the NBBI as authorized and approved by a commissioned inspector.

The inspector must pre-approve the method for repair and the materials to be used and establish the inspection stages before repair work begins

A leak involving the fire tubes is usually the result of thermal shock that may have been caused through the introduction of water at an excessive temperature differential, or as the result of the accumulation of scale or sludge from untreated water.

Such damage is not covered under the warranty.

It is possible to re-expand the tubes in place, but this should only be attempted by a NBBI registered "R" (repair) stamp technician. The repaired shell must be pressure checked and reinspected before the boiler is returned to service. Welding of the tubes to the tube sheet is not acceptable.

Problems with leaks, etc. will continue to develop unless the cause of the initial problem is identified and permanently corrected.

TRIAD Boiler Systems, Inc. – Steam Systems Check Sheet (Daily check of gauge glass and blow-down recommended)

Site/System:		Boiler Model:		Date: - to -	
Week 1:		Week 3:		Monthly:	
	Boiler operation.		Boiler operation.		Boiler operation.
	Normal burner light-off.		Normal burner light-off.		Normal burner light-off.
	Pump & makeup solenoid.		Pump & makeup solenoid.		Pump & makeup solenoid.
	Check the fuel supply.		Check the fuel supply.		Check the fuel supply.
	Feed water and temperature.		Feed water and temperature.		Feed water and temperature.
	Water treatment system.		Water treatment system.		Water treatment system.
	Damper operations.		Damper operations.		Damper operations.
	Combustion air supply.		Combustion air supply.		Combustion air supply.
	Visual check of gauge glass.		Visual check of gauge glass.		Visual check of gauge glass.
	Perform manual blow-down		Perform manual blow-down		Perform manual blow-down
	Check:		Check:		Wash down boiler room.
Week 2:		Week 4:			
	Boiler operation.		Boiler operation.		Check (lubricate) all motors and pumps.
	Normal burner light-off.		Normal burner light-off.		Check and lever test safety relief valve.
	Pump & makeup solenoid.		Pump & makeup solenoid.		Check and clean strainers.
	Check the fuel supply.		Check the fuel supply.		Check all venting and breeching.
	Feed water and temperature.		Feed water and temperature.		Check burner combustion readings.
	Water treatment system.		Water treatment system.		Check water treatment system.
	Damper operations.		Damper operations.		Check condensate return system.
	Combustion air supply.		Combustion air supply.		Check:
	Visual check of gauge glass.		Visual check of gauge glass.		Check:
	Perform manual blow-down		Perform manual blow-down		Check:
	Check:		Check:		Check:

WAYS TO PREVENT WET STEAM:

Follow the near boiler piping suggestions.

The steam header **MUST** be at least 24” above the boiler.

Connection to the supply header should be through the top of the header.

Do not alter the steam tap at the rear of the boiler.

Skim the surface multiple times before placing boiler into normal service.

Skim the surface whenever there is surging, priming or carryover into the gauge glass.

Blow-down the LWCO’s daily – which helps eliminate solids buildup.

Use proper water treatment – too much or too little can be harmful.

Avoid sudden or surge loads due to quick opening steam valves.

Avoid consistent boiler overloading – balance the staging of multiple boilers.

AND REMEMBER TO:

- A. Follow the recommendations on preventive maintenance.
- B. Keep a clean boiler room.
- C. Low pressure steam travels faster - when in doubt, reduce the pressure.
- D. Operators: Review the operating manual at least **ANNUALLY!**