Dunkirk®

EMPIRE

OIL-FIRED CAST IRON STEAM

BOILERS

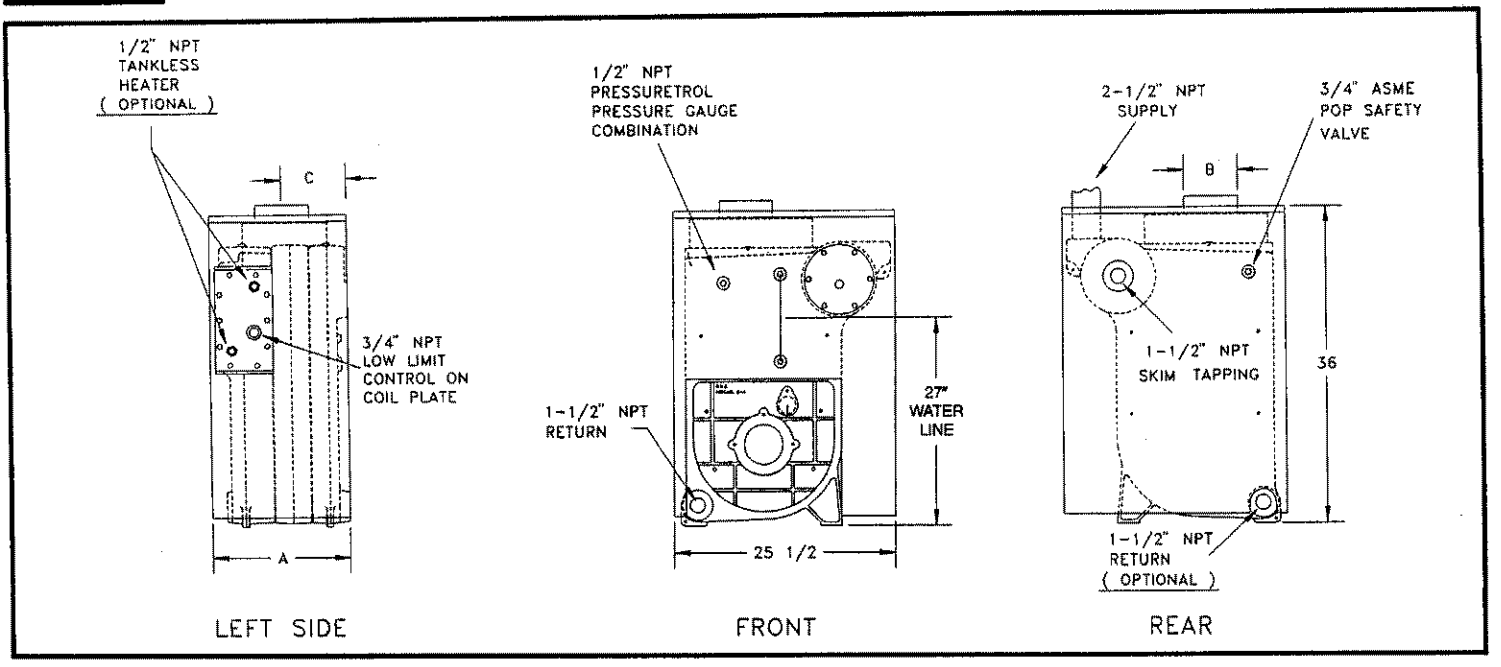
- **Installation**
- **Operation**
- **Repair Parts**

I=B=R®

These instructions must be affixed on or adjacent to the boiler. **DUNKIRK BOILERS**
DUNKIRK, NEW YORK 14048 - 716 366-5500
MEMBER: The Hydronics Institute

Boiler Ratings and Capacities

FIG. 1



EMPIRE OIL-FIRED STEAM BOILER RATINGS

BOILER MODEL NO.		No. Sec.	Input *MBH	** Heating Capacity *MBH	Net I=B=R Rating *MBH	Net I=B=R Rating Sq. Ft. Radiation	*Tankless Coil Ratings GPM*	Typical Chimney Size and Height	DIMENSIONS - INCHES		
With Tankless Coil	Without Tankless Coil								A	B	C
3ES1.00C	3ES1.00	3	140	118	89	371	2.75	8" × 8" × 15'	16⅛	7	9
3ES1.25C	3ES1.25	3	175	145	109	454	3.10	8" × 8" × 15'	16⅛	7	9
3ES1.35C	3ES1.35	3	189	156	117	488	3.25	8" × 8" × 15'	16⅛	7	9
4ES1.50C	4ES1.50	4	210	177	133	554	3.50	8" × 8" × 15'	20⅜	8	11
4ES1.75C	4ES1.75	4	245	204	153	638	3.85	8" × 8" × 15'	20⅜	8	11
4ES1.85C	4ES1.85	4	259	215	161	671	4.00	8" × 8" × 20'	20⅜	8	11

* MBH = 1,000 BTU per hour
BTUH = British Thermal Unit Per Hour
GPH = Gallons per Hour Oil at 140,000 BTU per Gallon

** Heating Capacity is based on a 13% CO_2 with a -.02" w.c. draft over fire, and a #1 smoke or less. The testing on the boilers was done in accordance with the D.O.E. (Department of Energy) test procedure

New York City MEA Number 134-98-E

Selection of boiler size should be based upon "Net 1=B=R Rating being equal to or greater than the sq. ft. of radiation already installed in the building.

The Net 1=B=R Ratings shown are based on an allowance of 1.333 in accordance with the factors shown on the 1=B=R Standard as published by The Hydronics Institute.

These boilers must have a non-combustible base if installed on a combustible floor. Two-inch cladlite pad may be used. These boilers are low pressure sectional cast iron boilers constructed and hydrostatically tested for a maximum working pressure of 15 psi in accordance with A.S.M.E. (American Society of Mechanical Engineers) Section IV Standards for cast iron heating boilers. They are capacity rated in accordance with the code of the 1=B=R (Hydronics Institute).

Rules for Safe Installation and Operation

1. Read the Owner's Manual for Safe Operation carefully. Failure to follow the rules for safe operation and the instructions can cause a malfunction of the boiler and result in death, serious bodily injury, and/or property damage.
2. Check your local codes and utility requirements before installation. The installation must be in accordance with their directives, or follow NFPA 31 - Installation of Oil Burning Equipment, latest revision.
3. Before servicing, allow boiler to cool. Always shut off any electricity and oil to boiler when working on it. This will prevent any electrical shocks or burns.
4. Inspect oil line and connections for leaks.
5. Be certain oil burner nozzle is size required. Overfiring will result in early failure of the boiler sections. This will cause dangerous operation.
6. Never vent this boiler into an enclosed space. Always vent to the outside. Never vent to another room or inside a building.
7. Be sure there is adequate air supply for complete combustion.
8. Follow a regular service and maintenance schedule for efficient and safe operation.
9. Keep boiler area clean and free of combustible material, gasoline and other flammable vapors and liquids.

WARNING

This boiler has been designed for residential installations. If used for commercial applications, all jurisdictional requirements must be met. This may require wiring and/or piping modifications. The manufacturer is not responsible for any changes to the original design.

Before You Start

Check to be sure you have the right size boiler before starting the installation. See rating and capacity table on preceding page. Check the rating plate on the boiler.

You must see that the boiler is supplied with the proper oil, fresh air for combustion, and a suitable electrical supply. Also, the boiler must be connected to a suitable venting system and an adequate piping system. Finally, a thermostat, properly located, is needed for control of the heating system. If you have any doubts as to the various requirements, check with local authorities and obtain professional help where needed. THE OPERATING INSTRUCTIONS and THE FINAL CHECKS AND ADJUSTMENTS are vital to the proper and safe operation of the heating system. Take the time to be sure they are all done.

The following steps are all necessary for proper installation and safe operation of your boiler.

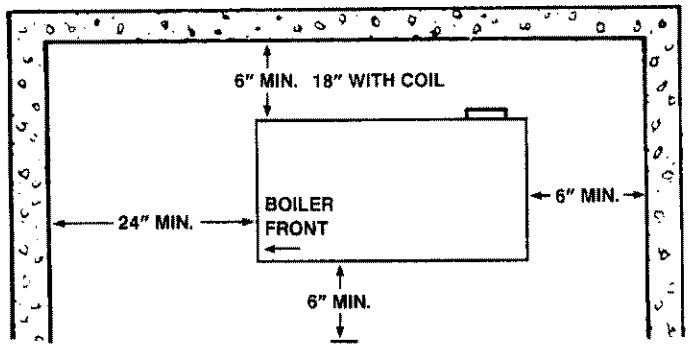
1. LOCATING THE BOILER
2. OIL SUPPLY AND PIPING
3. FRESH AIR FOR COMBUSTION
4. PIPING CONNECTIONS
5. CHIMNEY & VENT PIPE CONNECTIONS
6. ELECTRICAL WIRING
7. THERMOSTAT LOCATION
8. CHECKING & ADJUSTING
9. MAINTENANCE

Locating the Boiler

If your boiler is part of a planned heating system, locate it as nearly as possible where shown on your plan. If boiler is to be part of an existing system, it is usually best to put it where the old one was. If you plan to change location, you will need additional materials as well as an adequate base. The following rules apply:

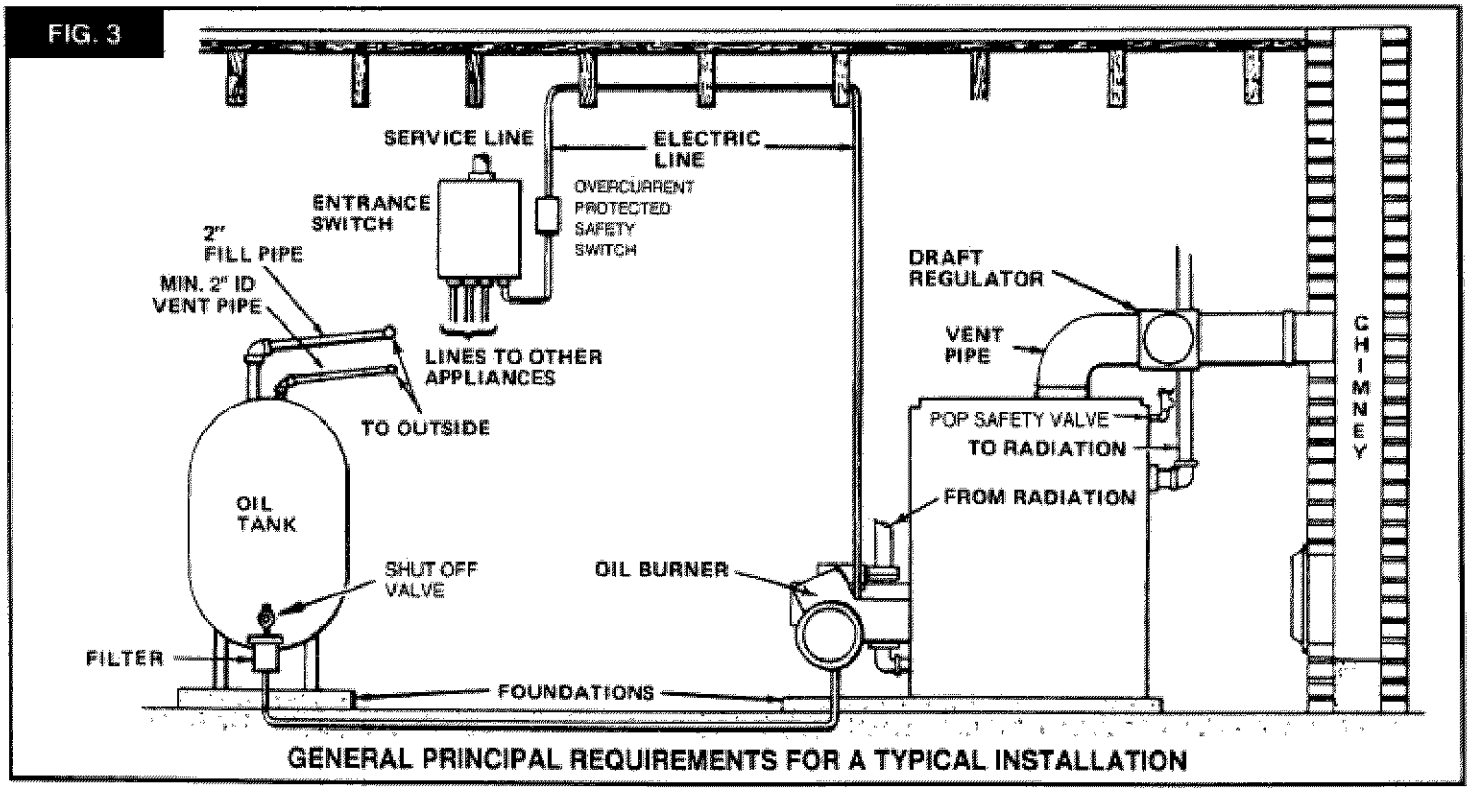
1. The boiler must be level and located near piping.
2. Use a raised base if floor can become wet or damp.
3. The vent pipe connection should be as short as possible.
4. Maintain clearances for fire safety as well as servicing. See Figure 2 for minimum clearances. 18" clearance must be maintained at a side where passage is required for access to another side for cleaning, servicing, inspection, or replacement of any parts that normally may require such attention. Boilers must be installed at least 6" from combustible material on all sides and above. Allow at least 24" front clearance for servicing. Allow at least 18" left side clearance for servicing boilers equipped with a tankless coil.
5. FRESH AIR for combustion must be available at the front of the boiler. FRESH AIR for ventilation must be available to the front AND rear of the boiler. Air passages must be free of obstructions at all times. Ventilating and combustion air must enter boiler room without restrictions.
6. The floor supporting the boiler must be non-combustible. If it is combustible, place the boiler on 2" cladlite pad. The pad must be under the entire boiler to protect the floor.
7. Be sure installation is in accordance with the requirements of the local authorities having jurisdiction. Compliance with these regulations is required. In the absence of local codes, follow NFPA 31 - Installation of Oil Burning Equipment.

FIG. 2 - MINIMUM CLEARANCE DIMENSIONS



Installation Requirements

FIG. 3



GENERAL PRINCIPAL REQUIREMENTS FOR A TYPICAL INSTALLATION

WARNING

Be sure to provide enough fresh air for combustion. Enough air ensures proper combustion and **assures that no hazard will develop due** to the lack of oxygen.

You must provide for enough fresh air to assure proper combustion. The fire in the boiler uses oxygen. It must have a continuous supply. The air in a house contains only enough oxygen to supply the burner for a short time. Outside air must enter the house to replace that used by the burner. Study following examples 1 and 2 to determine your fresh air requirements.

EXAMPLE 1: **Boiler Located in Unconfined Space**

If your boiler is in an open area (unpartitioned basement) in a conventional house, the air that leaks through the cracks around doors and windows will usually be adequate to provide air for combustion. The doors should not fit tightly. Do not caulk the cracks around the windows.

An unconfined space is defined as a space whose volume is not less than 50 cubic feet per 1,000 Btu per hour of the total input rating of all appliances installed in that space.

EXAMPLE 2: **Boiler Located in Confined Space**

A. All Air from Inside the Building: The confined space shall be provided with two permanent openings communicating directly with an additional room(s) of sufficient volume so that the combined volume of all spaces meets the criteria for an unconfined space. The total input of all combustion equipment installed in the combined space shall be considered in making this determination. Each opening shall have a minimum free area of one square inch per 1,000 Btu per hour of the total input rating of all combustion equipment in the confined space, but not less than 100 square inches. One opening shall be within 12 inches of the top and one within 12 inches of the bottom of the enclosure. See Figure 4.

Example: Your boiler is rated at 100,000 Btu per hour. The water heater is rated at 30,000 Btu per hour. The total is 130,000 Btu per hour. You need two grilles, each with 130 square inches of FREE opening. Metal grilles have about 60% FREE area. To find the louvered area needed, multiply the FREE area required by 1.7 (130 x 1.7 = 221.0 sq. in. louvered area). In this example two grilles, each having an 8" x 30" (240 sq. in,) louvered area would be used. Fig. 4 shows the grille locations.

B. **All Air from Outdoors:** The confined space shall be provided with two permanent openings, one commencing within 12 inches of the top and one commencing within 12 inches of the bottom of the enclosure. The openings shall communicate directly, or by ducts, with the outdoors or spaces (crawl or attic) that freely communicate with the outdoors.

1. When directly communicating with the outdoors, each opening shall have a minimum free area of one square inch per 4,000 Btu per hour of total input rating of all equipment in the enclosure.
2. When communicating with the outdoors through vertical ducts, each opening shall have a minimum free area of one square inch per 4,000 Btu per hour of total input rating of all equipment in the enclosure.

NOTE

If you use a fireplace or a kitchen or bathroom exhaust fan, you should install an outside air intake. These devices will rob the boiler and water heater of combustion air.

3. When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of one square inch per 2,000 Btu per hour of total input rating of all equipment in the enclosure.
4. When ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be not less than three inches.

FIG. 4 - AIR OPENINGS FOR CLOSET OR UTILITY ROOM INSTALLATIONS

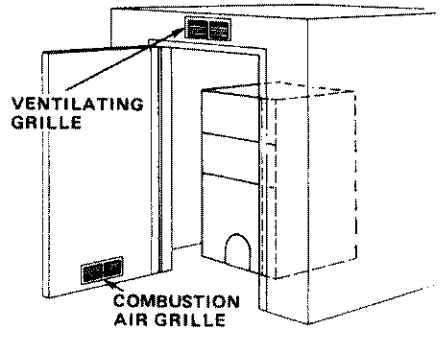


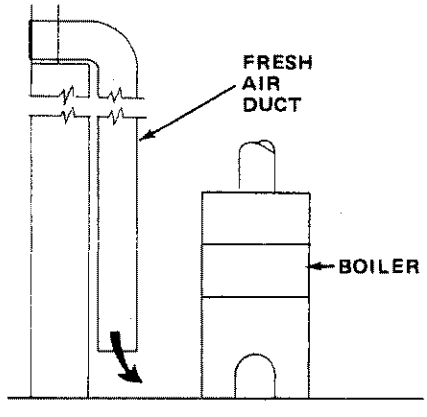
FIG. 5 - FRESH AIR DUCT CAPACITIES

Fresh Air Duct Capacities for Ducts Supplying Fresh Air to boiler in tightly constructed houses. British Thermal Units per hour Input (Btuh)*.

Fresh Air Duct Size	¼" Mesh Screen Btuh	Wood Louvers Btuh	Metal Louvers Btuh
3½" × 12"	144,000	36,000	108,000
8" × 8"	256,000	64,000	192,000
8" × 12"	384,000	96,000	288,000
8" × 16"	512,000	128,000	384,000

*Based on opening covered by ¼" mesh screen, wood louvers, or metal louvers.

FIG. 6 FRESH AIR DUCT FOR TIGHTLY SEALED HOUSE



60206A

Boilers With Tankless Heater Coil

Boilers may be factory packaged with a tankless heater coil. The use of this coil eliminates the need for a hot water storage tank. Instantaneous heating of water in the coil will provide a flow of hot water for domestic use - if proper water supply line controls are used.

IMPORTANT

Do not use a tankless coil if your water is excessively hard with lime or other deposits which will accumulate inside the coil.

For summer running with coil you need to fill boiler with water and add the L6006 limit control to the coil. This will maintain water temperature in the boiler and bring the burner on when necessary.

TANKLESS COIL PIPING

Piping is shown in Figure 7B. A tempering valve (mixing valve) is recommended.
Low Limit (when used) - 140° F

These settings can be changed after you have some idea how the system responds. If more domestic hot water is required, the low limit setting can also be raised.

FIG. 7A

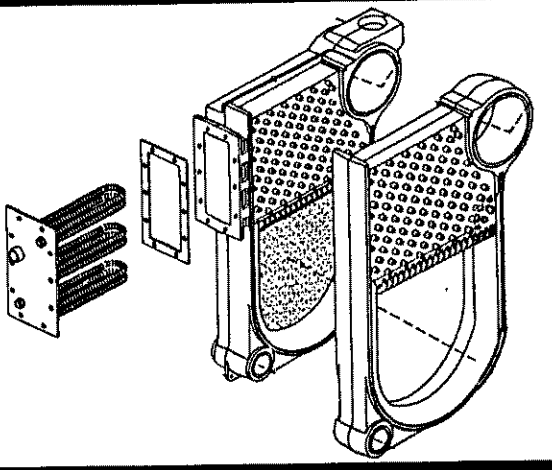
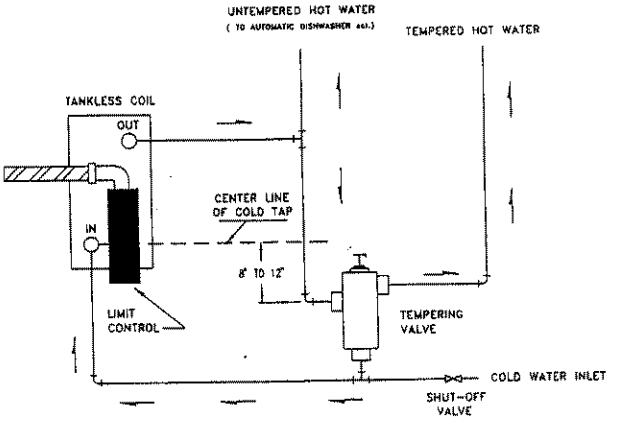


FIG. 7B



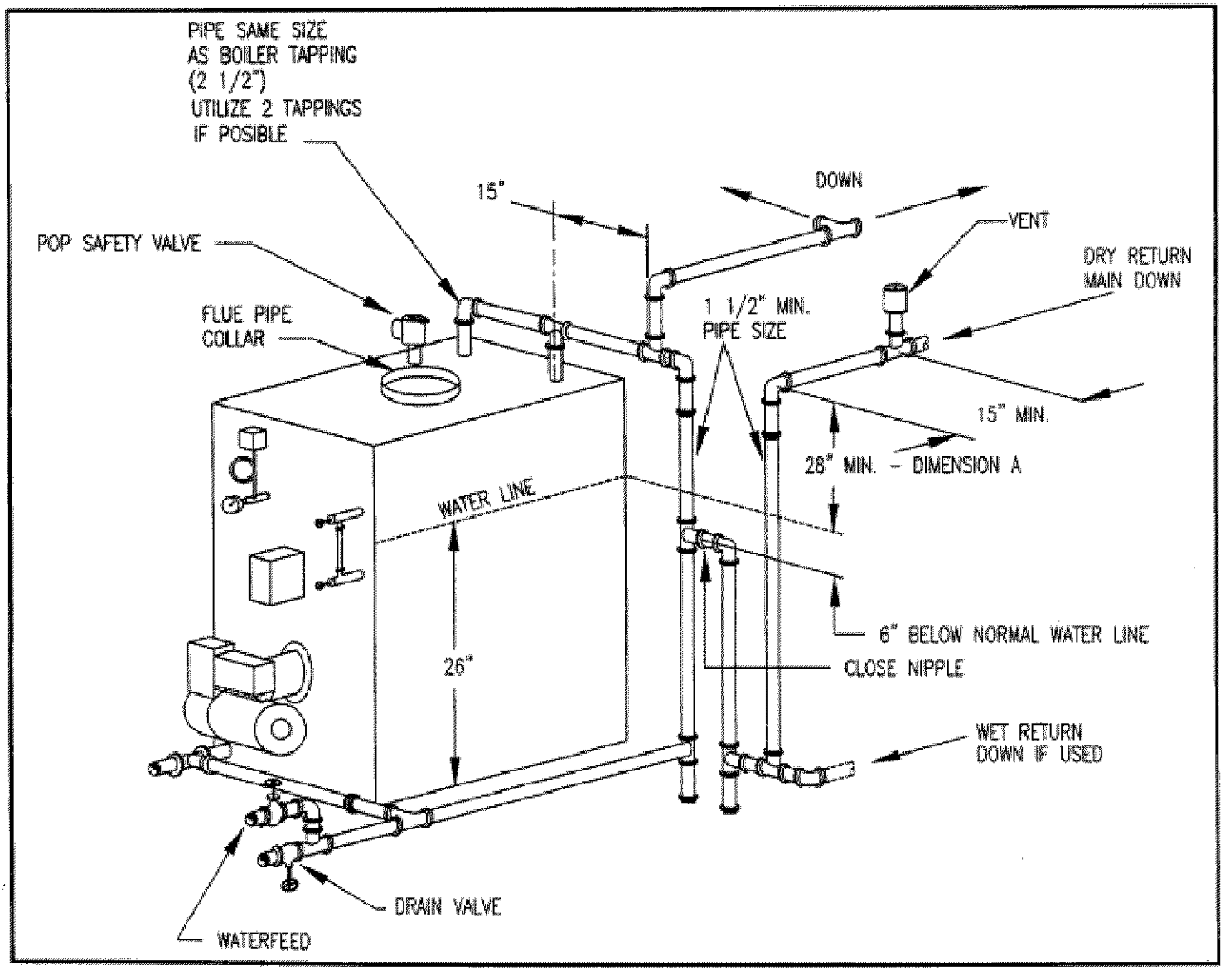
Installation-System Piping

The near boiler piping, that is the piping around the boiler, must be considered as part of the boiler for proper water level control, and to produce dry steam. Correct near boiler piping is crucial to the proper operation of the boiler and the heating system. Follow these recommendations carefully.

1. Place boiler in the selected location, as near chimney as possible.
2. Install the pop safety valve, using the furnished 3/a" 90° ell, into the 3/4" pipe nipple on the back of the boiler. Make a discharge pipe, using 3/4" pipe (not furnished) to carry the water or steam to a nearby drain. Do not connect the discharge pipe directly to a drain but leave an air gap. No shutoff of any description shall be placed between the pop safety valve and the boiler, or on discharge pipes between such safety valves and the atmosphere. Installation of the pop safety valve shall conform to the requirements of the ANSI/ASME Boiler and Pressure Vessel Code, Section IV The manufacturer is not responsible for any water damage.
3. This boiler is equipped with two 2'/2" supply connections on top and two 1'/2' return connections, one each on front and back sides of the boiler. Unused connections must
4. Recommended near boiler piping for gravity return sys-tems is shown in Figure 8. This configuration uses one supply and one return tapping. Piping off both boiler tap-pings is recommended on units 5 section and larger.

Note: Use both supply tappings on boilers 5 section and larger.

FIG. 8 - RECOMMENDED NEAR BOILER PIPING USING ONE SUPPLY TAPPING



5. For installers choosing to use both supply tappings, Figure 8A shows the correct way to pipe this system. Figure 8B shows the wrong way to pipe a header with two risers.
   - Headers must be fitted with header offsets or swing joints, or be equipped with expansion joints, so that thermal expansion and contraction of the header will not damage the boiler. Headers shall not be welded.
   - System takeoffs from the header must be between the equalizer and the riser to the header nearest the equalizer. System takeoffs must never be between two risers.
6. System takeoffs from the header must never be bull-headed. If the steam main goes in two directions, there must be two takeoffs from the header, one for each main.
7. All boilers in gravity return systems must be equipped with a Hartford Loop as shown in Figures 8 and 8A.
8. When piping the vertical risers from the boiler to the header, the bottom of the header must be a minimum of 24 inches above the water level line on the right side of the boiler (i.e. 51 inches above the floor).
9. Steam riser(s) and header shall be 2'/2" pipe size.
10. Equalizer line shall be minimum 1 1/2" pipe size.
11. The boiler has a 1'/2" tapping in rear section for skimming.

FIG. 8A - RECOMMENDED NEAR BOILER PIPING USING TWO SUPPLY TAPPINGS

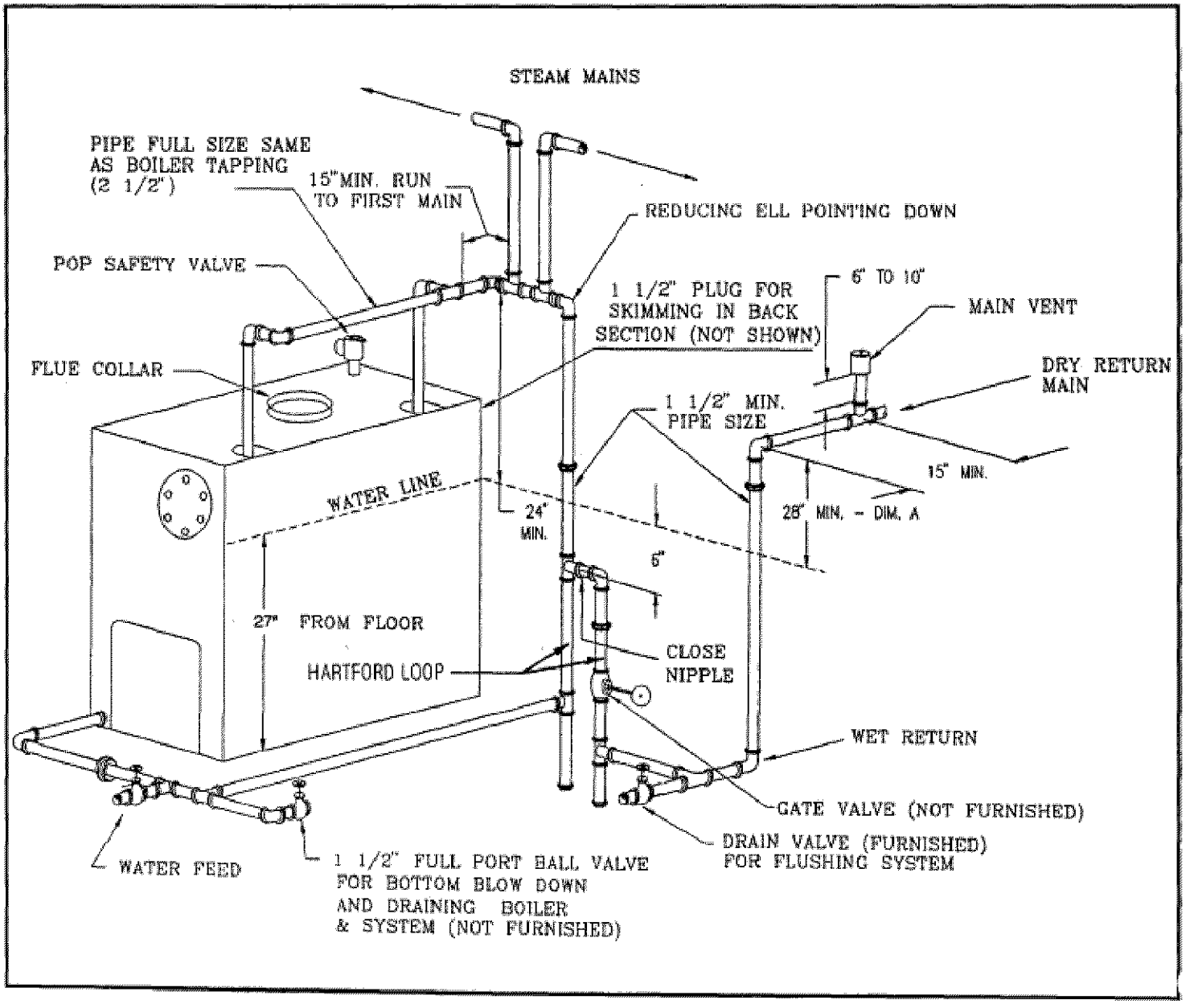
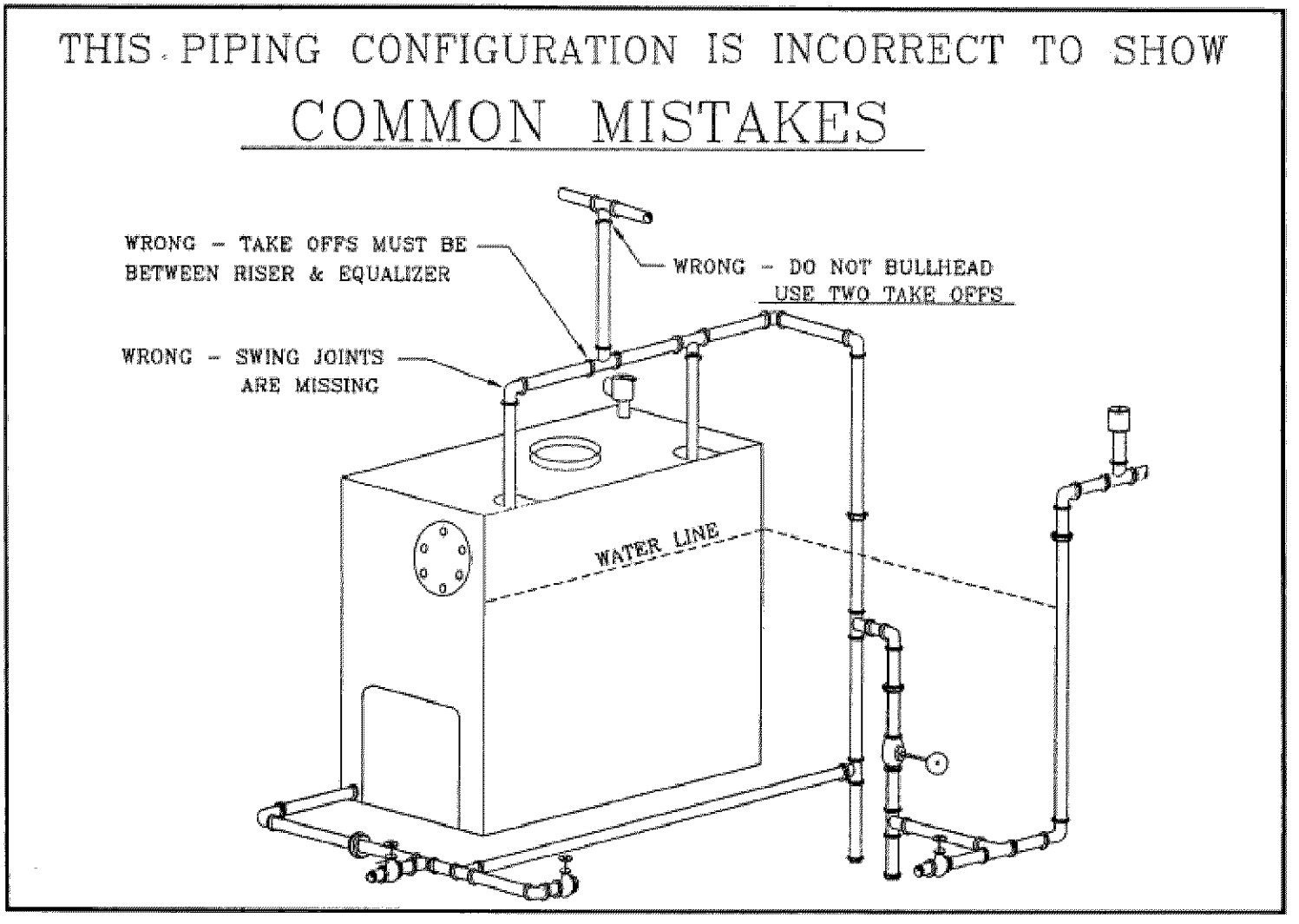


FIG. 8B - COMMON NEAR BOILER PIPING MISTAKES



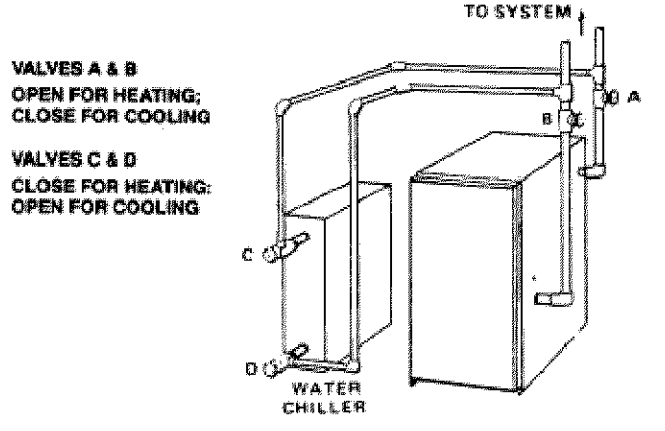
12. The near boiler piping shall include a 1 1/2" ball valve in the return piping as shown in Figure 8A for bottom blowdown and draining.
13. For gravity return systems, the bottom of the lowest steam carrying pipe, be it a dry return, or the end of the steam main, must be at least 28" above the normal water level line on the right side of the boiler. This is known as "Dimension A."
14. For pumped return systems, follow the condensate pump or boiler feed pump manufacturer's instructions for proper installation and hookup.
15. In connecting the cold water supply to the water inlet valve, make sure that a clean water supply is available. When the water supply is from a well or pump, a sand strainer should be installed at the pump.

FOR USE WITH COOLING UNITS

A. This boiler, when used in connection with chilled water systems, must be installed so that the chilled water is piped in parallel with the heating boiler. Appropriate valves must be used to prevent the chilled water from entering the heating boiler (Fig. 9).

B. When this boiler is connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation, the piping system shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

FIG. 9 - CHILLED WATER PIPING



CHECK YOUR CHIMNEY

Follow local codes. In the absence of local codes, follow ANSI/NFPA 31 Installation of Oil Burning Equipment, latest edition.

This is a very important part of your heating system. No boiler, however efficient its design, can perform satisfactorily if the chimney that serves it is inadequate. Check your chimney to make certain that it is the right size, properly constructed and in sound condition.

It is cheaper to rebuild a poor chimney than to pay excessive fuel bills. If yours is an old masonry chimney, a new steel liner or a new prefabricated chimney may be the best solution. The following chart shows recommended minimum chimney sizes based on Table 3 and Figure 6 of the **1=B=R Testing and Rating Standard for Heating Boilers,** Sixth Edition, June 1989.

RECOMMENDED MINIMUM CHIMNEY SIZES

FIRING RATE (gph)	CHIMNEY HEIGHT (ft)	NOMINAL CHIMNEY AREA	ROUND LINER-INSIDE DIAMETER	SQUARE LINER-INSIDE DIMENSIONS
.60-1.30	15	8" × 8"	6"	6¾ × 6¾"
1.31-1.80	15	8" × 8"	7"	6¾" × 6¾"
1.81-2.00	20	8" × 8"	8"	6¾" × 6¾"

For elevations above 2,000 ft. above sea level, add 3 feet to chimney heights. (Refer to Figure 10.)

For additional chimney design and sizing information, consult the ASHRAE 1996 HVAC Systems and Applications Hand-book, Chapter 30, Chimney, Gas Vent and Fireplace Systems; or the National Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, ANSI/NFPA 211.

CHIMNEY CONNECTOR AND DRAFT REGULATOR

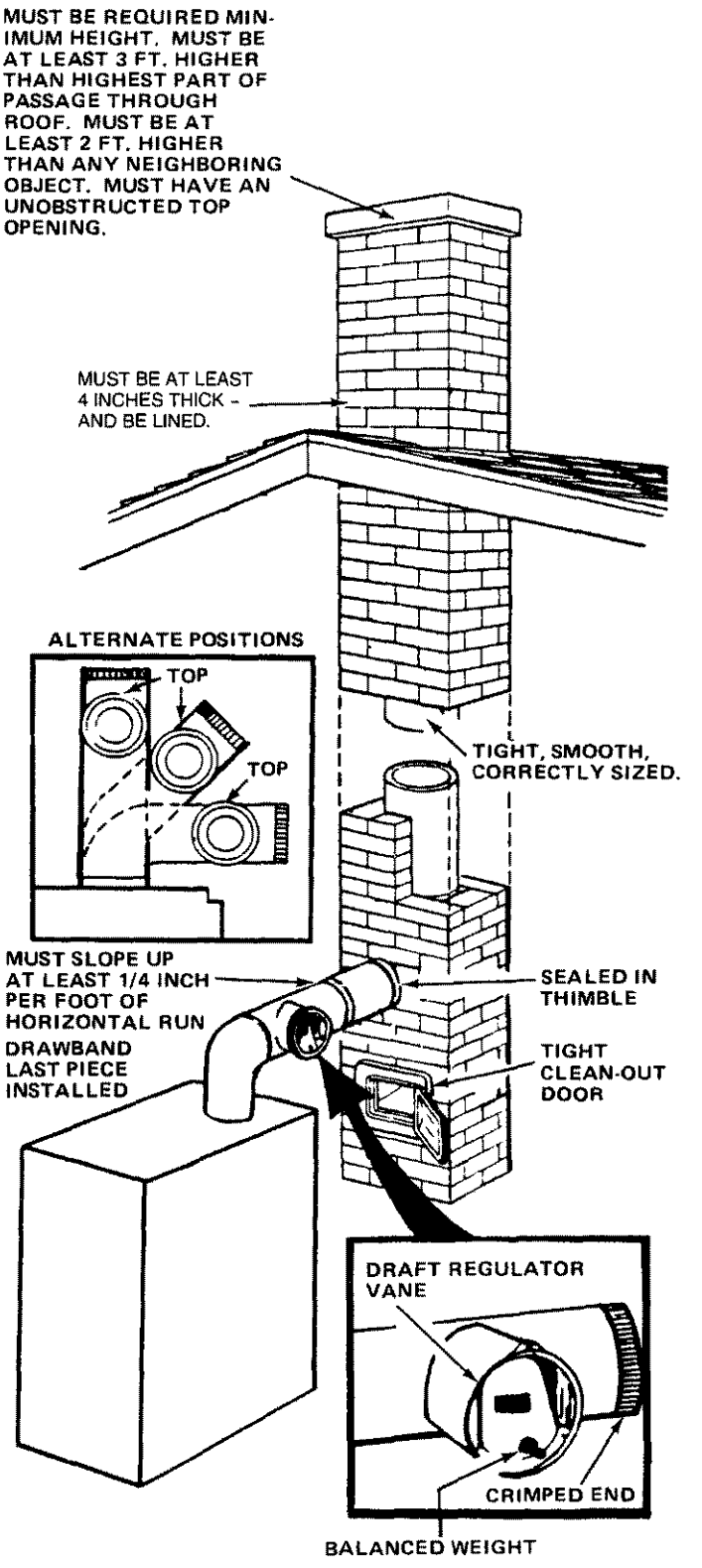
Your boiler requires 7" diameter chimney connector pipe on 3 section, 8" diameter chimney connector pipe on 4 section. You must also use a draft regulator packed with boiler. Properly installed, the regulator will control the draft automatically. It is better to install it in a horizontal section of the pipe; but it may be in an angled or vertical section. Just make certain that the "top" is at top - and that the short pipe section which holds the Vane is horizontal. Install it as close as practicable to the boiler.

To install the chimney connector, start at the boiler and preferably take off from the flue collector collar with an elbow - then install the draft regulator next, making it horizontal. When the regulator is in place, start at the chimney and work back to the regulator. Join the two sections with a Drawband. The horizontal pipe must slope up toward the chimney at least 1/4 inch per foot. It must not leak and must be firmly supported. Join sections with at least two sheet-metal screws. Support every second section with a stovepipe wire.

MINIMUM VENT PIPE CLEARANCE

Wood and other combustible materials must not be closer than 18" from any surface of the vent pipe.

FIG. 10 - CHIMNEY REQUIREMENTS



POP SAFETY VALVE

You must have a pop safety valve on your boiler. Steam expands as it is heated. If there is no place for the steam to expand into, pressure will build up inside the boiler and system. Should this happen, the pop safety valve will automatically open at a pre-determined pressure. This will relieve the strain on the boiler and system. Run a pipe from the safety valve outlet (pipe must be same size as outlet and the open end must not be threaded) to an open drain, tub or sink, or other suitable drainage point not subject to freezing. Failure to do so may cause water damage or injury should relief valve release. Do not cap off the drain line from this valve! Each pop safety valve is provided with a lifting device for testing and should be tested monthly during the heating season. Refer to safety valve manufacturer's instructions packaged with safety valve.

STEAM PRESSURE GAUGE

Every system should have a pressure gauge installed in the boiler. This gauge enables you to monitor the pressure in the system. If the safety devices fail to shut off your boiler at the proper settings, notify your service technician immediately

WATER LEVEL GAUGE

The water level in the boiler can be seen through the glass tube in the water level gauge at side of boiler. Correct cold boiler water level is stamped on side jacket panel. When making steam, the water level will drop one to three inches. The water level should be checked regularly.

STEAM PRESSURE CONTROL

The steam pressure limit control (pressuretrol) shuts off the oil to the burner if the steam pressure in the boiler reaches the cut-off setpoint (i.e. the sum of the cut-in and the differential setpoints). Burner refires when the steam pressure drops to the cut-in setpoint. System pressure requirements are based on the size and condition of the pipes, and the load.

For good system operation, the cut-in setting of the pressuretrol should never be less than twice the system pressure drop. In a typical single family residence with a clean one pipe heating system and cast iron radiation, this means that the cut-in will usually be set at the minimum setting, i.e. 1/2 psi.

Steam radiation is usually sized based on square feet of equivalent direct radiation (EDR). This is based on a steam pressure in the radiator of just less than 1 psi. Therefore, in our example system from above, we would set the differential adjustment at 1 psi, i.e. the steam pressure required in the radiators. This will give us a cut-off setpoint of 1112 psi.

The above is an example of a typical one pipe system. For larger systems or other types of systems such as two pipe systems, or systems with convectors or fan coil units, the pressuretrol settings will need to be determined on a system-by-system basis.

The cut-in setpoint is determined by the system pressure drop to the furthest radiator or terminal unit. Double the system pressure drop as a safety factor, resulting in the rule that the cut-in setting should never be less than twice the system pressure drop.

The differential setpoint is the steam pressure required at the terminal heating units.

Now your boiler will operate in the correct pressure range. It will maintain enough steam pressure to send the steam out to the furthest radiator, and not go over the optimum steam pressure that is required at the radiators.

67D-1 LOW WATER CUT-OFF

The float-type low water cut-off shuts off the burner when the water level is below a safe point. The burner will start when the water is refilled to a minimum safe level.

WATER FEEDER (Optional)

A water feeder works with the low water cut-off (LWCO) to maintain a minimum safe level of water for boiler operation. It's used to keep the boiler running by compensating for minor evaporative steam leaks, and to prevent freeze-ups if the homeowners are away and a return line should spring a leak. **The automatic water feeder is a safety device, not a convenience item.** It is not designed to maintain a "normal" water line. The water feeder does not take the place of a responsible person monitoring and maintaining the "normal" water line. **Steam boilers require personal attention.**

Four electric water feeders are offered by McDonnell-Miller which are compatible with the 67D-1 LWCO. The model #101A and #WF 2-U-120 water feeders are used with 120 volt wiring circuits, as found on this steam boiler. The McDonnell-Miller model #101A-24 and #WF2-U-24 are used with 24 volt circuits, which may be useful in a retrofit installation which already has a 120 volt to 24 volt transformer.

The WF2-U-120 and WF2-U-24 (Uni-Match) water feeders are equipped with a solid state electronic control which feeds water when signaled by the LWCO. The water feed rate is field adaptable for 1, 2, or 4 gpm. These water feeders have an adjustable slide switch to match the timing cycle on the *LWCO.* When using a McDonnell-Miller *LWCO* the slide switch needs to select position #1. The timing cycle creates an initial dwell period of one minute to allow condensate to be returned to the boiler. If after the dwell period the water has not reached the minimum safe level and completed the LWCO circuit, then water is fed at the selected flow rate for one minute. The dwell period is then initiated again for one minute. If the water level has still not reached the minimum safe level, then water is added again at the selected flow rate for one minute. This cycle continues until water reaches the minimum safe level and the circuit is completed. Dunkirk Radiator recommends using a Uni-Match water feeder at a flow rate of 1 or 2 gpm. If the steam boiler requires higher flow rates on a regular basis a service technician should be notified.

The 101A water feeder may be used, however the water feed rate is too high and needs to be regulated or throttled. The 101A will feed up to 6 gpm, much greater than the desired flow rate of 1-2 gpm. Also, there is no dwell period to provide a margin for condensate to return to the boiler. These two factors increase the chances of over feeding water to the steam boiler. Excessive water in the steam boiler will produce noise

Consult the water feeder manufacturer's installation guidelines for more details on water feeder selection, recommended piping arrangement, and start up procedures. Dunkirk Radiator supports McDonnell-Miller's recommendation to arrange the installed piping so a broken union test can be implemented.

DRAIN VALVE

This manual valve provides a means of draining all water from the boiler and system. It should be installed in the 3/a" tee where the water supply line enters the boiler (Fig. 8). You can also use this valve to lower the water level if it is too high.

STEAM VENTS

Before a steam system will operate properly, suitable steam vents must be installed in each radiator as well as the return main. Some systems require steam traps in the return line at the radiation unit.

The "Hartford loop" is a piping arrangement which must be included (Fig. 8) for proper operation of the steam system.

BOILERS WITH TANKLESS COILS ONLY Flow Regulator and Water Tempering Valve

If you have a Tankless Coil for domestic hot water, these two parts can be used. This will provide you instantaneous hot water that is neither scalding hot nor merely tepid. The Flow Regulator is placed in the cold water line to the coil. It assures a steady flow of water so that the coil can properly heat it. It prevents "spurts" of "half-heated" water. This isimportant where the water pressure is excessively high or variable. The Water Tempering Valve is a tee which is connected at a junction between the hot water line from the coil and a cold water branch from the supply line. It mixes hot and cold water as required to furnish a tempered supply of water to the house. The water will be just the right temperature for your use. This is important on a steam system to prevent scalding temperatures at the faucets. Both parts are self-contained and automatic.

Starting Your Boiler

HOW A STEAM SYSTEM OPERATES

The water in the boiler is heated until it reaches the boiling point. As the water boils it turns into steam. The steam rises from the top of the water through the supply main to the radiation units. As it passes through the radiators it releases its heat and condenses into water. The water returns to the boiler through the return main.

FILLING SYSTEM WITH WATER

On steam heating systems the boiler is partially filled with water. It is very important to the proper operation of the entire system that your boiler be filled to the proper level. The correct water level on cold start condition is about halfway up the glass water level gauge as marked on the boiler jacket. To fill:

1. Close the boiler drain valve.
2. Open the valves at the top and bottom of the glass water level gauge. Also open the drain valve at the bottom of the gauge.
3. Open the fill valve and allow water to run into the boiler.

WARNING - Never run water into a hot empty boiler.

4. Allow boiler to fill until water runs out the gauge drain valve. Then close the gauge drain valve.
5. Continue to fill boiler until water reaches the indicated water line. This is about halfway up the glass tube. Always keep the water at this level when system is off.

IMPORTANT

Skimming a new steam boiler on an existing system must be done **several** times to remove all oil, grease and sediment. There should be a tee with a plug piped to the supply line of the boiler in order to properly skim the boiler. Whenever the water in the glass gauge becomes discolored, your boiler should be skimmed.

When skimming, make sure to pipe the open end of the tee to the floor or a drain to prevent anyone from being burned by the steam and hot water which will be released.

The Float Low Water Cut-Off should be blown down after skimming. Following blowdown, allow the boiler to cool and then add fresh water slowly.

The float chamber of the low water cut-off must be flushed clean and maintained clear of sediment to allow free movement of the float. This must be done frequently during initial operation of the boiler and at least once per week thereafter. Follow instructions on tag attached to control. Never throttle a steam radiator valve on a one-pipe system. It must be fully open or fully closed. Otherwise water is held in the radiator units. This will cause knocking sounds. Skimming may be required again after a few days operation.

Checking and Adjusting

CHECKING CONTROLS

To check the Low Water Cut-Off, turn off power to the boiler or turn the thermostat down to the lowest setting. Drain water to below the visible bottom of the water gauge glass. Turn power on and turn the thermostat to call for heat. When the boiler is equipped with the float type LWCO, the oil burner should not run on a call for heat when the water is low.

To check the pressure limit, run the boiler until the pressure reaches system demand. Then turn the pressure screw and drop the pressure setting until the boiler shuts down. This will show that the pressure limit is operating properly.

If you have installed your own boiler, we recommend that you call for an inspection by a service technician. The peace of mind and assured performance are well worth the cost involved. He can quickly make the necessary checks and adjustments.

OIL BURNER ADJUSTMENT

Suggested nozzles and preliminary burner settings are found on page 20. Refer to your oil burner owners manual for checking and adjusting the burner.

ADJUST OPERATING CONTROLS Instructions for each control and burner are included.

Set thermostat heat anticipator at .20. Instructions for the final adjustment of the thermostat are packaged with the thermostat.

CHECK THERMOSTAT OPERATION

When set above temperature indicated on the thermometer, boiler burner should start. Make certain the thermostat turns off the boiler when room temperature reaches the selected setting and starts the boiler operating when room temperature falls a few degrees.

Finally, set the thermostat for the desired temperature. Special conditions in your home and the location of the thermostat will govern this setting.

Check the water level every day or two. Verify the water line shown by operating the drain valve on the gauge. Be **sure top and bottom valves on gauge are always open so that actual water level will be shown at all times.**

POP SAFETY VALVE

This valve should open automatically when the steam pressure exceeds the safe limit (per instructions packaged with valve). Should it ever fail to open under these conditions, shut down your system. Have the valve replaced immediately. The pop safety valve should be tested monthly during the heating season. Refer to the valve manufacturer's instructions packaged with the pop safety valve.

LOW WATER CUT-OFF

The Low Water Cut-Off will interrupt the electrical current to the burner when the water line in the boiler drops to a low level. It is very important to keep the float chamber free from sediment, a condition essential to dependability. To keep any accumulation from interfering with float action is to "BLOW DOWN" or flush out the control regularly. This must be done two-three times the first week after installation and once a week thereafter during the heating season. Do it while the boiler is in operation. First note water level in gauge glass. Open blow-off valve at bottom of control, water will pour out, flushing away sediment. Drain until water is clear, about a pail, then close valve. If water level in gauge glass has dropped, add water to boiler to restore level. Consult low water cut-off manufacturer's instructions included with boiler.

NOTE: Opening blow-off valve checks cut-off operation too. As float drops with falling water level, burners will shut off. After valve is closed and normal operating conditions are restored, burners will resume firing.

Boilers should not be drained between heating seasons. Only when the water in the system becomes dirty should the boiler be drained, flushed or boiled out, and refilled. Steam boilers may be entirely filled with water during the summer months to exclude air.

CLEANING YOUR BOILER

Under normal operating conditions, with the burners properly adjusted, we recommend that you have the flue passages, burner adjustment, and operation of the controls checked ***once each year*** by a Service Technician.

Before the start of each season (or whenever system has been shut down for some time) recheck the whole system for leaks ... and recheck the boiler and vent pipe for leaks. Replace or patch any boiler seals that are faulty.

BOILER FLUE PASSAGES

Flue Passages between sections should be examined yearly and cleaned. Remove vent pipe. Raise top panel of boiler and swing out to expose flue collector. Remove flue collector top. Clean passageways between sections with a flexible handle wire brush. Remove dirt fom the bottom of the boiler and reassemble all parts. Be sure vent pipe connections to chimney are secure and no obstructions are present.

FOAMING, PRIMING OR SURGING

These terms are used to describe a fluctuating water line - when water leaves the boiler.

It is caused by any combination of the following:

1. Threading oil and organic matter in the boiler water. (Mineral oil, or core sand does not cause surging.)
2. Faulty quick vents that do not release air until a sizeable pressure is built up - replace. If dirty, clean so that you can easily blow through valve.
3. Improper header design - when steam flows in opposite direction of equalizer line on "Hartford loop." Generally a 15" horizontal run between riser and main takeoff will allow entrained water to fall out of the steam vapor so it can return to boiler. (See page 7, Fig. 8)
4. Adjustment of steam limit control to a wide differential increases difficulty if quick vents are old style, slow-releasing type or dirty. Always set steam limit control differential as low as possible.
5. Soap and detergents cause extreme surging - clean thoroughly by skimming the boiler.

CAUTION

Never refill a hot boiler with cold water - the danger of thermal shock may crack a section.

CAUTION

Never allow electrician or oil burner mechanics to try out their work by turning on oil burner for even one second unless boiler is filled to the proper operating level.

SYSTEM CHECKS AFTER FIRST STARTING - STEAM SYSTEMS

Read the instructions packaged with your controls and make checks and adjustments accordingly. Start the burner and set the Thermostat for the desired room temperature. When adjusting the Steam Pressure control, watch the steam Pressure Gauge and use its pressure reading - as it will be more accurate than the control. (Any difference between the two will be due to their different location.)

BOILER WATER TREATMENT

In closed hot water heating systems, negligible amounts of make up water are used, and water treatment is not required. In steam systems where the system is tight, free from leaks, and all the steam is returned to the boiler as condensate, the amount of make up water is small. Again, water treatment is not required.

On steam systems with less than 90% of the steam being returned as condensate, or with very hard or corrosive make up water, treatment may be desirable. Follow the recommen-dations of the ASME (American Society of Mechanical Engineers) Boiler and Pressure Vessel Code, Section VI, latest version.

BETWEEN HEATING SEASONS

Boilers should not be drained between heating seasons. Boilers in closed hot water heating systems may be left as is. Steam boilers should be entirely filled with water during the summer months to exclude air.

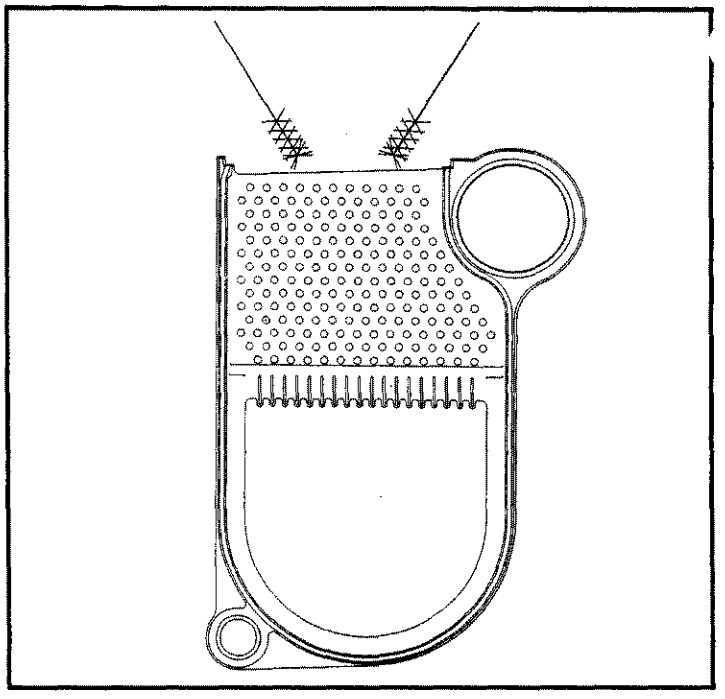
Oil Boiler/Burner Cleaning Instructions

1. Shut off all electrical power to the boiler/burner and shut off fuel supply.
2. Remove the sheet metal smoke pipe from the top of the boiler. Inspect pipe and chimney for signs of corrosion and deterioration. Clean base of chimney.
3. Remove top jacket panel.

4. Remove the two brass wing nuts holding the flue collector top.
5. Check the gasket on the underside of the flue collector and replace as necessary.
6. Remove the oil burner (three cap screws). -OR-
   Remove the oil burner/fire door assembly (four hex nuts). This is the recommended method, as it allows full access to the combustion chamber and less potential damage to the target wall during the cleaning process.
7. Remove the burner drawer assembly. Clean any soot accumulations.
8. Replace the burner nozzle with the exact size and type recommended for us on this boiler.

Note: Changing to a different firing rate, other than is recommended, or type of nozzle may change the performance of this boiler and/or cause a hazardous condition.

9. Clean electrode assembly and set electrodes as per burner manufacturer's recommendations.
10. Reinstall drawer assembly and check for proper head location as per the manufacturer's recommendations.
11. Inspect the target wall, blanket, and fire door insulation for cracking and deterioration. If there is any signs of cracking or deterioration, replace before reassembling the boiler.
12. Remove soot from fireside surfaces by brushing diagonally through the flue passages (see drawing). Care should be taken so as not to damage the target wall with the flue brush.
13. Carefully vacuum soot accumulations from the combustion chamber area, being particularly careful not to damage the target wall and blanket with the vacuum. Target wall and blanket must be in good condition and correctly installed to insure proper combustion.



14. Reinstall the burner/fire door assembly.

15. Reinstall the flue collector top and secure with the two brass wing nuts.

16. Reinstall the top jacket panel. Reconnect the flue pipe.

17. Inspect and clean the oil burner blower wheel.
18. Oil the burner motor **(DO NOT OVER OIL).**

19. Remove the oil pump cover and clean/replace the pump screen. Carefully reassemble.

20. Replace the fuel filter (if applicable).

21. Reconnect the electrical and fuel supplies.

22. Fire the burner, checking for proper combustion using combustion test equipment, making adjustments as necessary.
23. Insure that all safety controls and operating controls are functioning properly.

IMPORTANT OPERATING AND MAINTENANCE REQUIREMENTS KEEP YOUR BOILER AND THE AREA AROUND IT CLEAN NEVER BURN REFUSE OR ANY MATERIAL OTHER THAN THE SPECIFIED FUEL IN YOUR BOILER HAVE YOUR BOILER CHECKED EACH YEAR BY A QUALIFIED TECHNICIAN

Service Hints

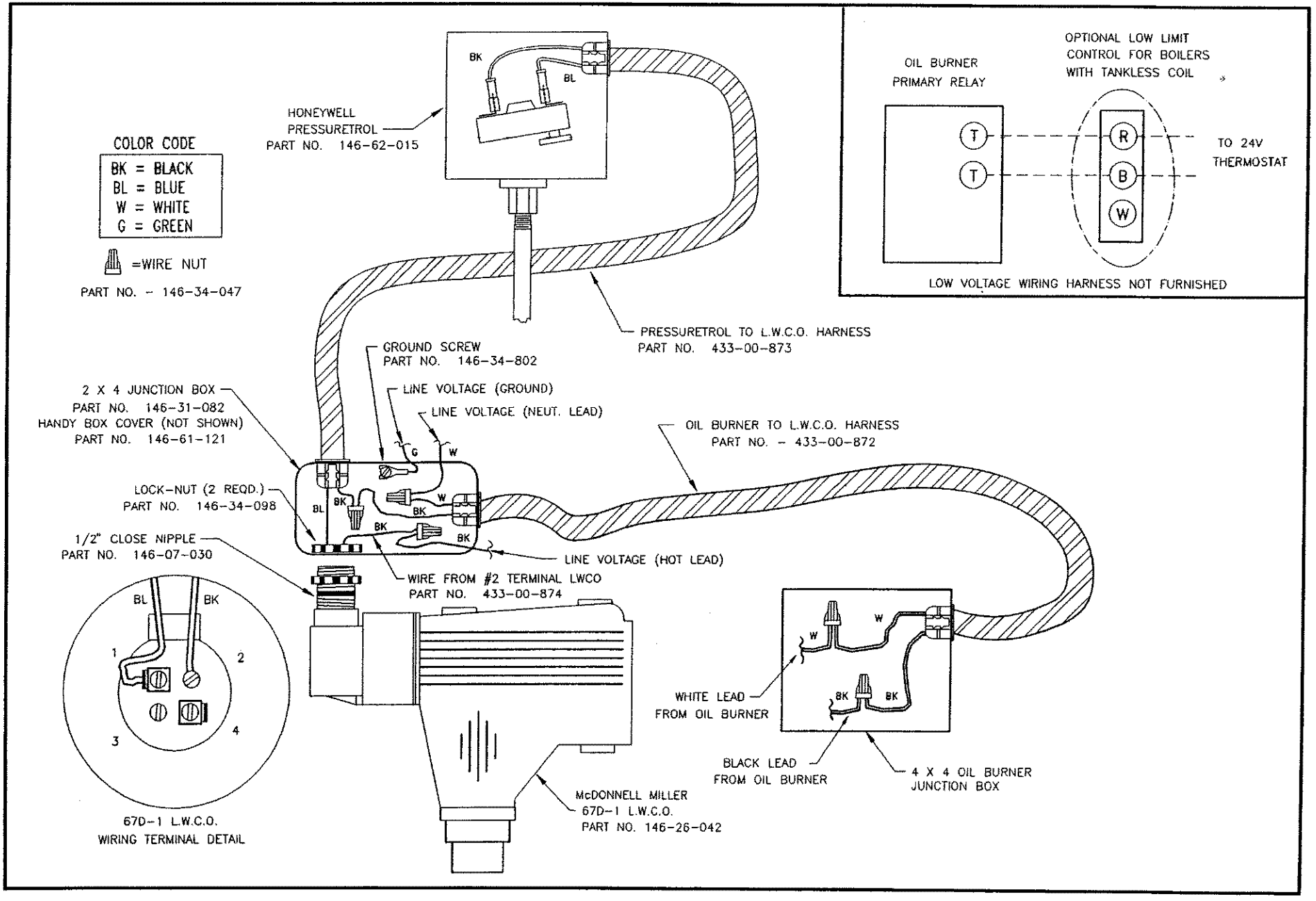
You may avoid inconvenience and service calls by checking these points before you call for service.

IF YOUR SYSTEM IS NOT HEATING OR NOT GIVING ENOUGH HEAT . . .	
Possible Cause	**What to do**
Thermostat is not set correctly	Reset thermostat above room temperature.
Boiler and/or Burner may be dirty	Clean all flue passages and the vent pipe. Have burner cleaned and readjusted.
Burner may not be firing at proper rate	Check nozzle size if there is any doubt. Have burner adjusted.
Burner may be short-cycling.	Short-cycling (too frequent off and on) of burner will cause sooting. If boiler and/or burner become dirty at frequent intervals, after correcting the "dirt condition" also correct the control setting (or other cause of the short-cycling). Check thermostat heat anticipator and correct setting, if necessary, per instruction sheet packed with thermostat.
No power to boiler	Check overcurrent protection. Check to be sure power supply circuit is "ON."
Controls out of adjustment	Reset according to instructions packed with controls.
Poor electrical contact	Check all control terminals and wire joints.

IF BURNER IS NOISY . . .	
Possible Cause	**What to do**
Oil burner fan wheel may be dirty	Clean fan wheel with a stiff brush and cleaning solvent. Readjust oil burner.
Draft regulator may be stuck	Check to see if vane swings freely. Clean, if vane is stuck.

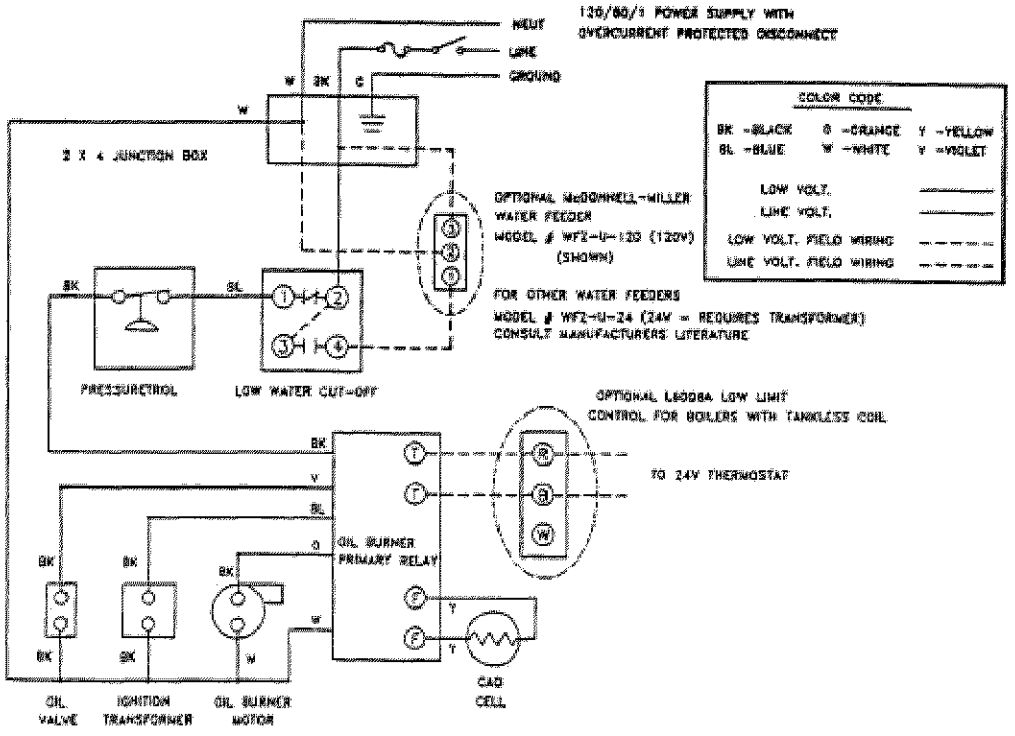
HAVE YOUR SERVICE TECHNICIAN CHECK ANY PROBLEM YOU ARE UNABLE TO CORRECT.

Empire Steam Field Wiring Connections

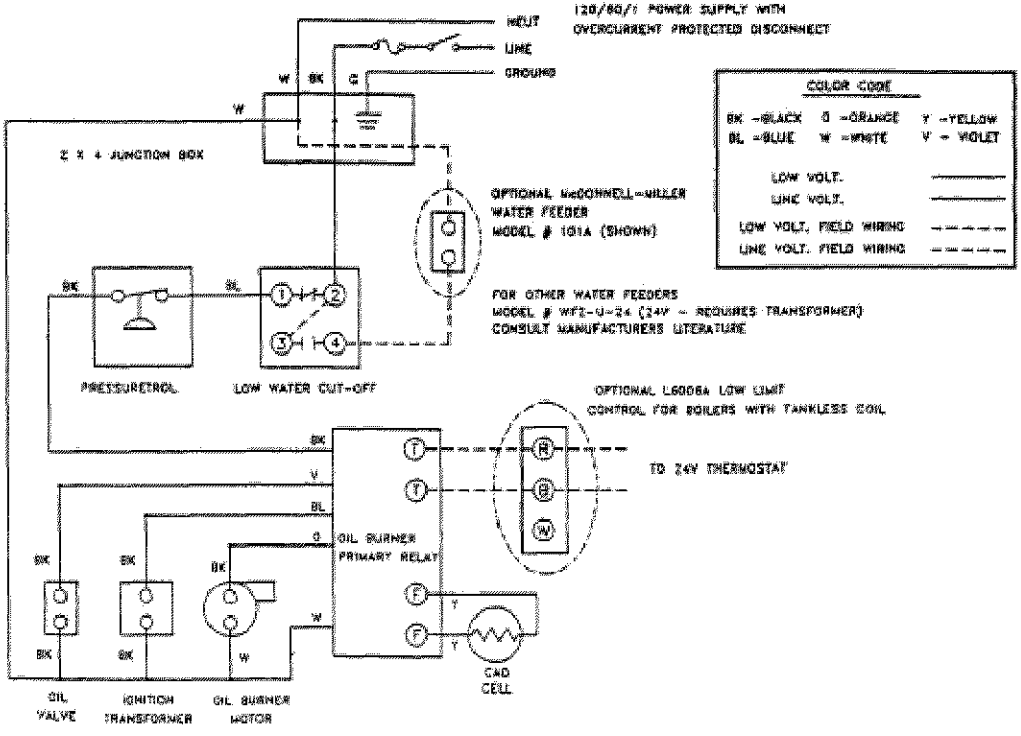


Empire Steam Wiring Diagrams

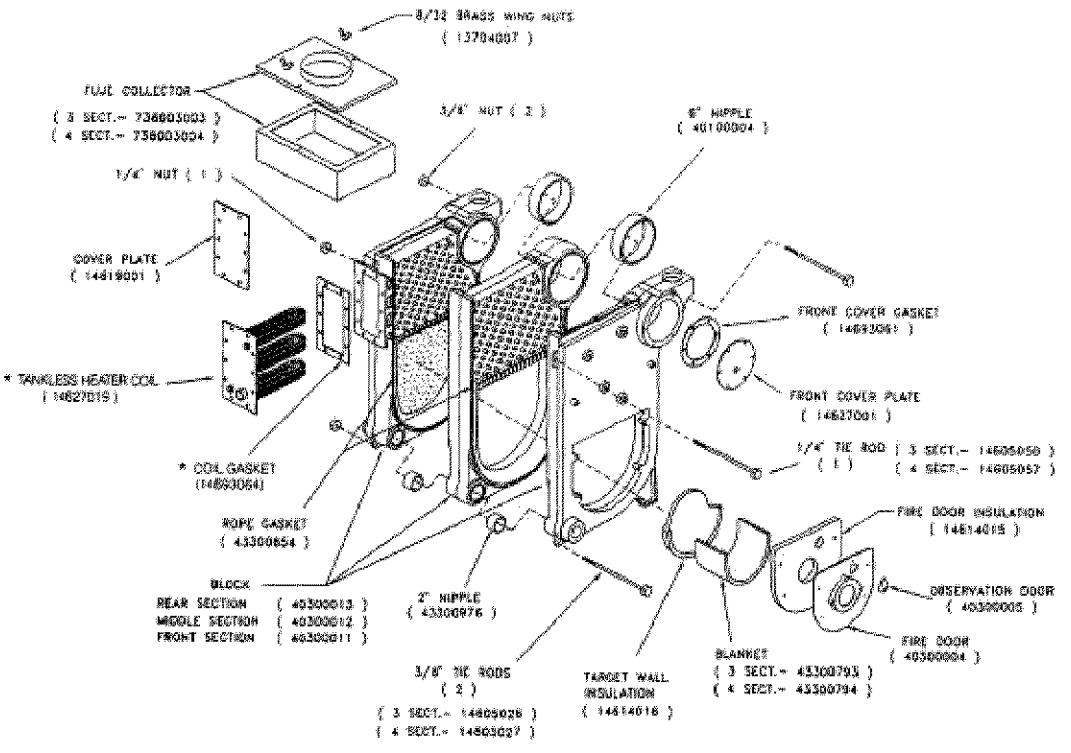
WITH OPTIONAL WF2-U-120 WATER FEEDER



WITH OPTIONAL 101A WATER FEEDER

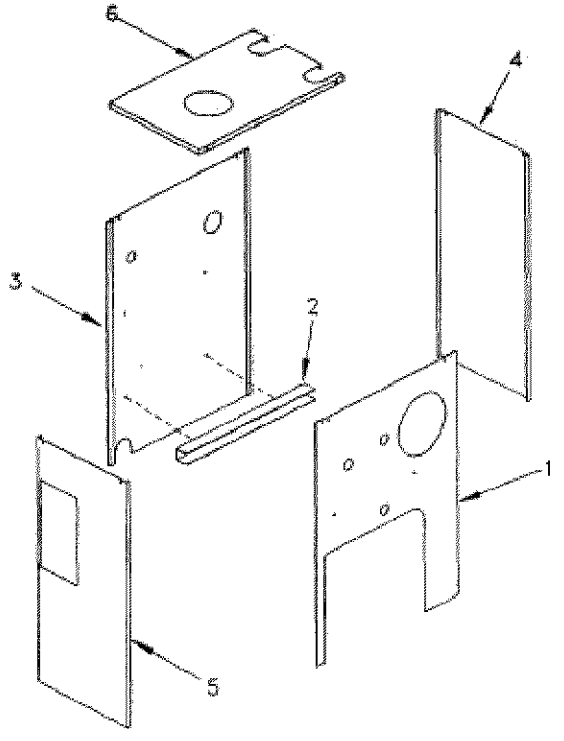


Empire Steam Block Assembly



*Replacement Tankless Coil Kit 43400014 (includes coil, gasket, and bolts)

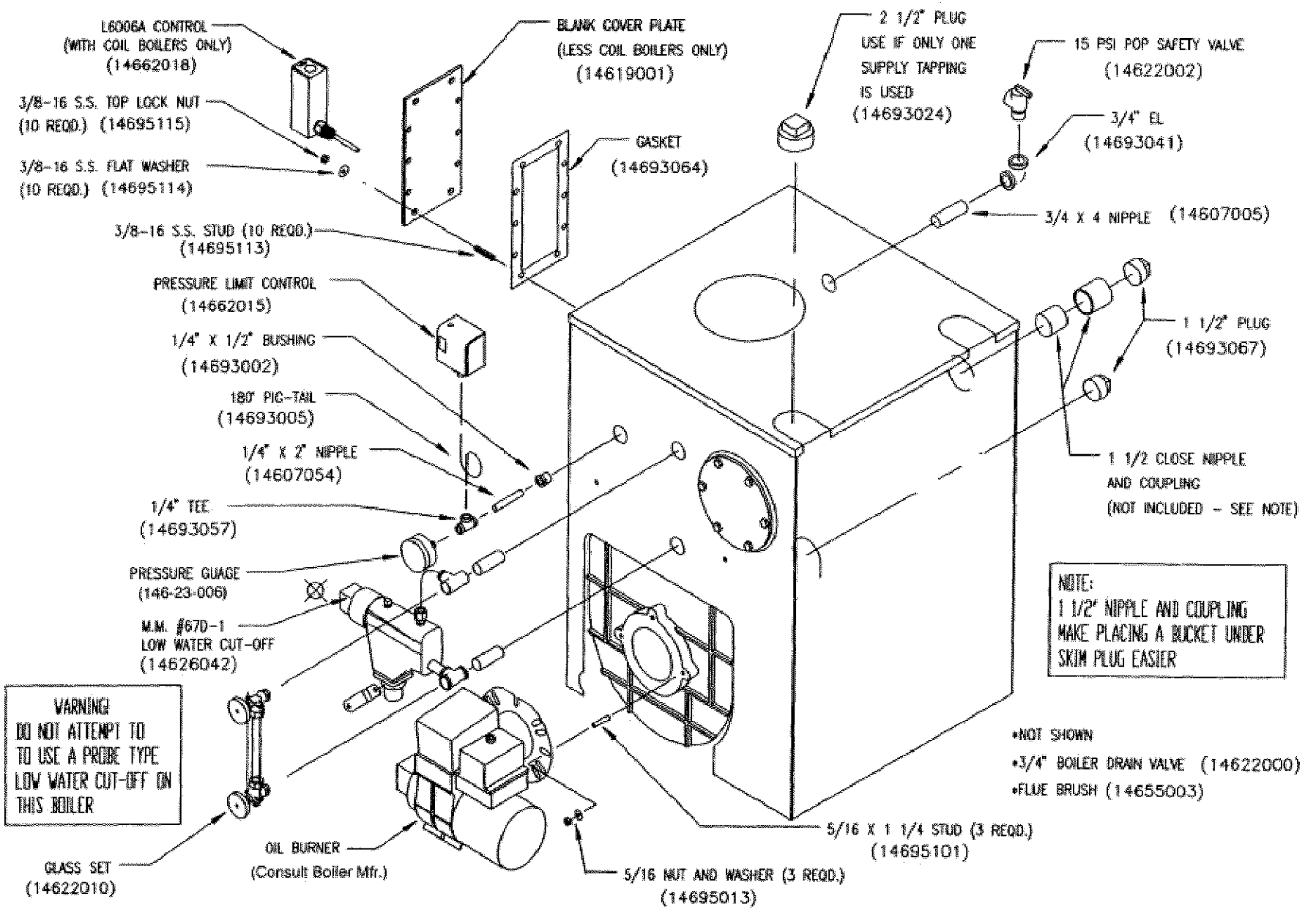
Empire Steam Jacket Assembly



KEY NO.	MODEL NUMBERS		DESCRIPTION
	3 SECTION	4 SECTION	
1	738001030	738001030	FRONT PANEL
2	638001220	638001220	TIE BAR
3	738001020	738001020	REAR PANEL
4	738001053	738001054	R. S. PANEL
5	738001043	738001044	L. S. PANEL
6	738001013	738001014	TOP PANEL

Empire Steam Controls & Piping

SEE FIELD WIRING CONNECTIONS FIGURE ON PAGE 16 FOR JUNCTION BOX AND WIRING HARNESS DETAILS AND PART NUMBERS.



SUGGESTED NOZZLES AND SETTINGS FOR BECKETT AFG-M OIL BURNER SERIES

BOILER MODEL	NOZZLE (DELEVAN)	ACTUAL INPUT RATE (gph)	PUMP PRESSURE (psig)	HEAD ADJUSTMENT	AIR SHUTTER	AIR BAND	OIL BURNER MODEL
3ES1.00(C)	0.85-60°W	1.00	140	—	10	1	AFG-50MB
3ES1.25(C)	1.10-70°B	1.25	140	1	10	1	AFG-50MD
3ES1.35(C)	1.20-70°B	1.35	140	1	10	2	AFG-50MD
4ES1.50(C)	1.25-60°B	1.50	140	1	10	2	AFG-50MD
4ES1.75(C)	1.50-60°B	1.75	140	3	10	3	AFG-50MD
4ES1.85(C)	1.75-60°B	1.85	140	3	10	4	AFG-50MD

FOR RIELLO R40 OIL BURNER SERIES

BOILER MODEL	NOZZLE (DELEVAN)	ACTUAL INPUT RATE (gph)	PUMP PRESSURE (psig)	TURBULATOR SETTING	AIR GATE SETTING	OIL BURNER MODEL
3ES1.00(C)	0.85-60°W	1.00	150	2.0	3.00	F5
3ES1.25(C)	1.00-60°W	1.25	165	2.5	3.60	F5
3ES1.35(C)	1.10-60°W	1.35	165	3.5	4.25	F5
4ES1.50(C)	1.25-60°W	1.50	160	1.5	2.60	F10
4ES1.75(C)	1.50-60°W	1.75	145	1.5	3.25	F10
4ES1.85(C)	1.50-60°W	1.85	160	2.0	3.40	F10

FOR CARLIN EZ OIL BURNER SERIES

BOILER MODEL	NOZZLE (DELEVAN)	ACTUAL INPUT RATE (gph)	PUMP PRESSURE (psig)	HEAD SETTING	AIR BAND SET POINT	OIL BURNER MODEL
3ES1.00(C)	0.85x70°W	1.00	150	0.85-1.00	0.65	EZ-1 HP
3ES1.25(C)	1.00x70°W	1.25	150	0.85-1.00	0.90	EZ-1 HP
3ES1.35(C)	1.10x70°W	1.35	150	1.10-1.25	1.10	EZ-1 HP
4ES1.50(C)	1.25x60°W	1.50	150	1.10-1.25	1.10	EZ-1 HP
4ES1.50(C)	1.25x60°W	1.50	150	0.85-1.00	1.65	EZ-2 HP
4ES1.65(C)	1.35x60°W	1.65	150	1.50	1.65	EZ-2 HP
4ES1.85(C)	1.50x60°W	1.85	150	1.50	2.00	EZ-2 HP

All burners fired at an over fire pressure of -0.02"wc.

Burner insertion depth of 2-1/8" allows burner tip to be 1/4" behind insulation.

NOTE: These settings are intended for initial start up only. Final adjustment must be made using combustion test instruments.