CHAPTER 3
OPERATION

SECTION I. PRELIMINARY OPRATING PROCEDURES

3-1. PLANT OPERATION CONSIDERATIONS

Plant operation is considered to be satisfactory if the needed energy is produced safely with minimum operating expenses. Operating expenses include manpower, fuel, utilities, supplies, and maintenance of the plant and equipment. Proper daily operation requires inspection and preventive maintenance, discussed in chapter 5. Maximizing efficiency of operation requires an understanding of the basic principles of combustion, steam or hot water generation, and equipment operation. Good operation makes the best use of facilities provided, while avoiding practices which waste fuel, steam, utilities, supplies, or manpower.

3-2. STANDING OPERATING PROCEDURES

Standing operating procedures (SOP) should be prepared and posted in the boiler room. The SOP should clearly indicate the sequence of actions to be performed for each unusual condition which could create a hazard or operational interruption. Examples of such unusual conditions include flame failure, loss of water, tube failure, sudden loss of load, steam line failure, loss of electric power, or control malfunction. The exact order in which each valve, control, and piece of equipment should be operated for a particular type of failure should be stated in the SOP. Valves and equipment should be marked for easy identification. The SOP may also be used to describe normal actions necessary to maximize boiler and plant efficiency.

3-3. DAILY AND MONTHLY BOILER PLANT OPERATING LOGS

The Daily Boiler Plant Operating Log, DA Form 3995 (figure 3-1), provides a means of recording continuous data on boiler plant performance. The data on this form can be used to analyze plant operation. It is arranged for use over a 24-hour period consisting of three 8-hour shifts. Entries are made in columns, with the explanation of each column provided on the back of the form. A monthly operating log must also be kept at each boiler plant in addition to the daily log. DA Form 3967, shown in figure 3-2, is the standard form for reporting monthly boiler plant operations. Data contained on the Daily Log is compiled at the end of each month and reported on the Monthly Log.

3-4. INSPECTION

A boiler is subject to damage and must be periodically inspected by a qualified inspector to ensure that it is in safe operating condition. All boilers must be inspected as required by AR 420-49. Details are included in chapter 5. Daily operation requires the operator to be aware of normal operation and to perform daily inspections to ensure that equipment is operating properly and safely. Abnormal operation should be logged and reported.

3-5. APPLICABLE CODES

The following codes provide rules and practical guidance for the safe and effective opration of boilers and boiler accessories:

- ASME Boiler and Pressure Vessel Code Section VI, "Recommended Rules for Care and Operation of Heating Boilers."
- ASME Boiler and Pressure Vessel Code Section VII, "Recommended Rules for Care of Power Boilers."
- NFPA National Fire Codes, NFPA 85A, "Standard for Prevention of Furnace Explosions in Fuel Oil- and Natural Gas-Fired Single Burner Boiler-Furnaces."
- NFPA National Fire Codes, NFPA 85B, "Standard for Prevention of Furnace Explosions in Natural Gas-Fired Multiple Burner Boiler-Furnaces."
- NFPA National Fire Codes, NFPA 85D, "Standard for Prevention of Furnace Explosions in Oil-Fired Multiple Burner Boiler-Furnances."
- NFPA National Fire Codes, NFPA 85E, "Standard for Prevention of Furnace Explosions in Pulverized Coal-Fired Multiple Burner Boiler-Furnaces."
- INFPA National Fire Codes, NFPA 85F, "Standard for Installation and Operation of Pulverized Fuel Systems."

3-6. BASIS FOR COMMENTS

Chapter 3 discusses the operation of equipment that has been described in chapter 2. Operational recommendations are made for steam andhot water boilers with capacities less than 200,000 pounds per hour of steam or less than 250 million Btu per hour output. Comments are generally

DAILY BOILER PLANT OPERATING LOG

For use of this form, see AR 420-49; the proponent agency is Office of the Chief of Engineers.

BOILER PLANT NUMBER 1520

STATION FT GOOD

DATE APRIL 1, 1988

TIME (Hour)	STEAM PRESSURE	STEAM FLOW PER HOUR CHART	FEEDWATER HEATER PRES.	FEEDWATER HEATER TEMP.	FEED PUMP PRES.	DRAFT I FORCE	DRAFT I FURNACE	DRAFT I GAS PASS	DRAFT II FORCE	DRAFT II FURNACE	DRAFT II GAS PASS	DRAFT III FORCE	DRAFT III FURNACE	DRAFT III GAS PASS	% CO2 FLUE GAS No. 1	% CO2 FLUE GAS No. 2	% CO2 FLUE GAS No. 3	FLUE GAS TEMPERATURES No. 1	FLUE GAS TEMPERATURES No. 2	FLUE GAS TEMPERATURES No. 3	FUEL (Coal lbs. Gas MCF Oil Gals.)	OUTSIDE TEMPERATURE	MAKEUP WATER (Gals.)	WATER PRESSURE	HOT WATER STORAGE TEMPERATURE	WATER SOFTENERS No. 1 METER Evening	No. 1 METER Start	No. 1 METER Total	No. 2 METER Evening	No. 2 METER Start	No. 2 METER Total	TOTAL GALS. THRU ALL METERS	POUNDS OF SALT USED	REMARKS
1st SHIFT	100	22000	4	224	150	3.9	1.2	0.2										480				55		60											
0100	100	23000	4	224	150	3.9	1.2	0.2										480				54		60											
0200	100	23000	4	224	150	4.0	1.2	0.2										480				52		60											
0300	100	22000	4	224	150	3.9	1.2	0.2										470				52		60											
0400	100	22000	4	224	150	3.9	1.2	0.2										470				47		60											
0500	100	25000	4	224	150	4.1	1.3	0.2										460				48		60											
0600	100	28000	4	224	150	4.4	1.4	0.3										500				49		60											
0700	100	29000	4	224	150	4.5	1.4	0.3										520				53		60											
0800	100	30000	4	224	150	4.6	1.4	0.3										520				53		60											
TOTAL			4	224														490				52	1930												
AVERAGE																																			
1st SHIFT	100	30000	4	224	150	4.6	1.4	0.3										520				53		60											
0900	100	30000	4	224	150	4.6	1.4	0.3										520				56		60											
1000	100	26000	4	224	150	4.1	1.2	0.2										510				60		60											
1100	100	25000	4	224	150	4.0	1.2	0.2								4.3		510				63		60											
1200	100	26000	4	224	150	4.0	1.2	0.2										510				66		60											
1300	100	25000	4	224	150	4.0	1.2	0.2										500				67		60											
1400	100	27000	4	224	150	4.1	1.3	0.2										470				68		60											
1500	100	26000	4	224	150	4.0	1.3	0.4										470				70		60											
1600	100	26000	4	224	150	4.0	1.3	0.2										480				70		60											
TOTAL																4.3		500					2230												
AVERAGE			4	224																		64													
1st SHIFT	100	24000	4	224	150	4.0	1.2	0.2										480				70		60											
1700	100	20000	4	224	150	3.4	1.0	0.1										470				68		60											
1800	100	19000	4	224	150	3.3	0.9	0.1										470				66		60											
1900	100	18000	4	224	150	3.2	0.9	0.1										470				64		60											
2000	100	20000	4	224	150	3.4	1.0	0.1										480				64		60											
2100	100	21000	4	224	150	3.5	1.0	0.1										470				63		60											
2200	100	20000	4	224	150	3.4	1.0	0.1										470				61		60											
2300	100	19000	4	224	150	3.4	1.0	0.1										470				59		60											
2400	100	20000	4	224	150	3.4	1.0	0.1										480				55		60											
TOTAL																							2200												
AVERAGE			4	224														475				63													
TOTAL																							2760												
AVERAGE			4	224																		60													

STEAM FLOW STOP (Telegraph)	X 1000	SHIFT NUMBER ONE: 170840	SHIFT NUMBER TWO: 170840
STEAM FLOW START	X 1000		171075
TOTAL STEAM FLOW	X 1000	190443	235
POUNDS OF STEAM PER UNIT OF FUEL		177	
STOKER FEED PUMP OR VALVE		0430	1330
SOOT BLOWER - TIME			
BLOW DOWN -			
PHOSPHATE ADDED	SEE WATER LOG		
SODA ASH ADDED			
TANNIN ADDED			
OPERATOR		S Tanner	C Jones
FIREMAN			

SHIFT NUMBER THREE: 191267 / 191095 / 172 / 2130 / T Crowe

TOTAL: 624

REMARKS:

PH Check — OK CJ

Continuous Blowdown Set at Position 4

DA FORM 1 DEC 77 3995

REPLACES DA FORM 6-88, 1 JUL 47 WHICH IS OBSOLETE.

SIGNATURE Chief Operating Engineer

FIGURE 3-1. DAILY BOILER PLANT OPERATING LOG

FACILITIES ENGINEERING OPERATING LOG *(Boiler Plant)*

For use of this form, see AR 420-49; the proponent agency is the Corps of Engineers.

INSTALLATION: FT GOOD | PLANT: CENTRAL | BLDG. NO.: 1520 | MONTH: APRIL, 1988

DATE	STEAM PRODUCED: STEAM PRESSURE	BOILER 1	BOILER 2	BOILER 3	TOTAL	FEED-WATER TO BOILER	FUEL USED ~~LB OR CU. FT.~~ GAL.	EVAP. LB. PER UNIT (9)	OUTSIDE TEMP. AV.	FEEDWATER HEATER: PRESS.	TEMP.	MAKEUP GAL.	% ~~CO2~~ O2: BOILER 1	BOILER 2	BOILER 3	FLUE GAS TEMPERATURE: BOILER 1	BOILER 2	BOILER 3	TEMP. H.W. SUPPLY	TUBES CLEANED NUMBER OF TIMES	PREVENT MAINT. CHECK		
	LB	1,000 LB.	1,000 LB.	1,000 LB.	1,000 LB.	1,000 LB.	#6		°F.	LB.	°F.					°F.	°F.	°F.	°F.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
1	100	624			624		5010	125	60	4	224	6760	4			490				3	CJ		
2	100	540			540		4340	124	64	4	224	5700	5			455				3	ST		
3	100	532			532		4270	125	61	4	224	5760	5			455				3	ST		
4	100	600			600		4820	124	65	4	224	6500	4			480				3	CJ		
5	100	621			621		4990	124	58	4	224	6590	4			485				3	CJ		
6	100	628			628		5005	126	57	4	224	6600	4			490				3	CJ		
7	100	635			635		5050	126	58	4	224	6710	4			500				3	CJ		
8	100	607			607		4800	126	60	4	224	6640	4			480				3	RG		
9	100	511			511		4100	125	63	4	224	5540	4			460				3	ST		
10	100	491			491		4050	121	67	4	224	5440	5			450				3	ST		
11	100	588			588		4720	125	68	4	224	6600	5			475				3	LC		
12	100	597			597		4750	126	65	4	224	6510	4			480				3	LC		
13	100	567			567		4630	122	70	4	224	6400	5			470				3	LC		
14	100	575			575		4700	122	67	4	224	6450	5			470				3	LC		
15	50	560			560		4500	124	70	4	224	6370	5			430				3	RG		
16	50	482			482		3780	128	66	4	224	5200	5			410				1	ST		
17	50	470			470		3720	126	72	4	224	5010	5			410				1	ST		
18	50	545			545		4120	127	71	4	224	5300	5			415				1	CJ		
19	50	500			500		3920	128	71	4	224	5150	5			405				1	CJ		
20	50	425			425		3330	128	68	4	224	4310	7			380				1	CJ		
21	50	410			410		3250	126	72	4	224	4200	7			375				1	CJ		
22	50	400			400		3200	125	70	4	224	4150	7			375				1	RG		
23	50	390			390		3060	127	74	4	224	4010	7			370				1	LC		
24	50	382			382		3040	126	70	4	224	4050	7			364				1	LC		
25	50	405			405		3180	127	72	4	224	4100	7			370				1	ST		
26	50	401			401		3180	126	71	4	224	4070	7			370				1	ST		
27	50	403			403		3170	127	67	4	224	4050	7			370				1	ST		
28	50	410			410		3250	126	70	4	224	4070	7			370				1	ST		
29	50	380			380		2980	128	75	4	224	3830	7			360				1	RG		
30	50	363			363		2850	127	72	4	224	3710	8			360				1	LC		
31	—																						
TOTAL		15042			15042		119760					154010											
MAXIMUM	100	635			635		5050	128	75	4	224	6760	8			500							
MINIMUM	50	363			363		2850	121	57	4	224	3710	4			360							
AVERAGE	73	501			501		3992	125.6	66	4	224	5334	5.5			426							

EVAPORATION LB. STEAM PER ~~LB FUEL~~ GALLON: 125.6

FUEL USED DURING MONTH (STANDARD TONS): 119760 Gal. (719 STD TNS)

REMARKS: START SUMMER OPERATION 4/16 CLOSE SOUTH HDR 4/19

SEE REVERSE SIDE FOR INSTRUCTIONS

PREPARED BY: Charles A Jones | DATE: 5/2/88

APPROVED BY: Robert L Greene | DATE: 5/3/88

POST ENGINEER: James R. Wolf | DATE: 5/6/88

DA FORM 1 NOV 72 3967 REPLACES DA FORM 8-98, 1 JUN 69, WHICH WILL BE USED.

FIGURE 3-2. MONTHLY BOILER PLANT OPERATING LOG

based upon steam boilers producing saturated steam, although in some cases, specific differences are noted for hot water boilers. ASME Code Sections VI or VII, NFPA 85 series standards, and manufacturers operating and maintenance instructions should be carefully considered in addition to the following text. Safe and reliable operation is dependent to a large extent upon the skill and attentiveness of the operation and maintenance personnel. Operating skill requires knowledge of fundamentals, familiarity with equipment, and a suitable background of training and experience.

3-7. PREPARATION FOR STARTUP

Specific plant SOPs should be prepared and followed in preparing for boiler startup. In general, before lighting a fire in a boiler the following steps should be taken.

a. Instrumentation. Check all instrumentation. If possible, operate control devices to prove operation, freedom of movement, and function of limit switches. Check that the boiler pressure gage cock is open.

b. Internal Inspection. Check that all personnel and tools have been removed from the boiler. Inspect furnace walls, boiler tubes, and flues to confirm that they have been cleared of slag, soot, and deposits which could act as insulation, reducing heat transfer and boiler efficiency. Slag, soot, and ash should be removed as discussed in paragraphs 3-16 and 5-1. Check that all doors and openings are closed.

c. Combustion Equipment. Inspect and test operation of the combustion equipment without lighting a fire. Careful inspection of a stoker or burner and their accessories helps to prevent forced outages.

d. Fuel Supply. Check the fuel storage system to ensure that there is enough fuel to meet the boiler requirements. For solid fuels, check the fuel level in the hopper, as well as its size and moisture content. For oil, measure the quantity of fuel oil by stick or gage. Ensure that the valves are properly aligned, and that necessary pumps and regulating valves are in operation. Check that fuel oil is available at the required pressure and temperature. If atomizing air or steam is required, confirm its availability. For gas fuel, check for correct gas pressure and valve positions, and for any signs of gas leakage from piping or valves.

e. Water Supply. Ensure that an adequate supply of treated feedwater is available at the proper temperature. Check the level and temperature of the water storage tanks or deaerator. Check valve alignments and boiler feedwater pump availability.

g. Water Column and Gage Glass. Check operation and close blowoff valves, water column, gage glass drains, and gage cocks. Ensure that the gage glass is clean and well lighted. Open drum vent and drain valve between header and nonreturn valves. Open feedwater valves and admit water to boiler slowly until water level is just below center line of gage glass. Blow down water column and operate try cock as a further check of water level and to ensure that these appliances are in good working condition. If provided, check the operability of the low-water fuel cutoff. On forced circulation hot water boilers, start the circulating pump and, if a proof of water flow switch is provided, prove switch operating by shutting off and then restarting the pump.

h. Boiler Safety Control. Clean the flame scanner lens when provided. Check limit switches to prove operation.

i. Furnace Purge. The furnace, boiler bank, economizer, air heater, ducts, and pollution equipment must be adequately purged before starting a fire.

CAUTION

MANY DISASTROUS EXPLOSIONS ARE CAUSED BY FAILURE TO VENT THE FURNACE AND SETTING COMPLETELY BEFORE ATTEMPTING TO START A FIRE. EXPLOSIVE MIXTURES OF AIR AND GASES MAY ACCUMULATE AND IGNITE IF A FIRE IS STARTED WITHOUT FIRST VENTING THE FURNACE AND SETTING. TO AVOID THIS DANGER, OPEN THE STACK DAMPER AND OPERATE NECESSARY FANS AND DAMPERS TO PURGE THE FURNACE AND ATTACHED EQUIPMENT.

The purge air should be at a sufficient rate to provide adequate velocity to clear dead spots or inactive pockets and sweep the entire unit. Purge air flow rates of 25% to 75% and purge time of 3 to 5 minutes, or 8 air changes are considered adequate. A boiler must also be purged after an accidental loss of ignition.

3-8. STARTING FIRE

After completing the preparatory steps outlined above, combustion equipment may be started. Manufacturers' recommendations for equipment startup should be reviewed and carefully followed for each type of equipment and fuel. General recommendations are provided below.

a. Hand Firing Coal. Ensure that ashes and clinkers are removed from grates. If lump coal is available, spread a layer three to six inches thick on grates to prevent fines from sifting through. When ash content of coal is low (under about 7%), spread about an inch of ashes on grate before introducing coal. Spread dry wood, shavings, or live coals from an adjacent boiler on top of coal. Gasoline, naphtha, or other highly flammable liquids should never be used as kindling. Partly open the stack damper and ash-pit doors to induce air flow through the furnace. Light the kindling, leaving the fire door partly open to admit

air over the fire and reduce smoke. After the fire is started, regulate the damper and ash-pit doors to maintain a draft and accelerate combustion. Supply additional coal as required and control the rate of combustion by regulating air flow through the fuel bed.

b. Stoker Firing Coal. To start a fire on a mechanical stoker, supply coal to furnace by operating the feed mechanism or shoveling coal into the furnace. Place enough coal into the furnace to cover all the tuyeres of an underfeed stoker to a depth of about six inches, or the grates of a spreader stoker to about two inches. Place wood, shavings, or kindling on top of the coal, and open the stack damper or operate the induced-draft fan. Maintain a slightly negative furnace pressure to remove the products of combustion. Light shavings and regulate the draft as required to keep fire burning. In some plants, fires may also be started with live coals from another furnace. As soon as the coal burns freely, operate forced-draft fan and regulate air flow to the furnace with the blast gate or damper to control the rate of combustion. If the boiler heats up too rapidly, operate fans at lower ratings or stop them for a short time. Do not add more coal to furnance until the fire burns freely. When neither steam nor electric power is available to operate the fan and stoker, feed the coal by hand and use natural draft until steam pressure is high enough to operate the auxiliary equipment.

c. Pulverized Coal Firing. When firing pulverized coal follow the procedures outlined in NFPA Standards 85E and 85F, and reference the plant's specific SOPs. For additional information, reference the Navy Manual MO-205 and the ASME Code Section VII.

d. Oil Firing. Oil firing procedures vary with the type of burner, controls, and fuel oil. Some plants use No. 2 fuel oil with pressure or steam atomizing burners, automatic controls and electric-spark ignition. Most army installations use No. 4, 5, or 6 fuel oils with either manual, semi-automatic or automatic ignition procedures. In every procedure an important step is the purging of the boiler-furnace. If ignition is delayed, immediately determine the cause and correct the problems.

(1) **Preheating the Fuel Oil.** Heavy oils (Nos. 5 and 6, and sometimes 4) require heating to reduce the oil viscosity to a point where pumping is practical. Additional heating may also be required to optimize atomization. Pump and burner manufacturer viscosity recommendations should be followed. Steam or electric tank heaters are used to heat oil to a temperature of 90° to 110° F, with oil preheaters supplying the additional heat as needed. To determine the amount of preheat temperature necessary for a given oil, consult the burner manufacturer for an initial recommendation. Experimentation is often necessary to determine the temperature that works best for the particular installation. 100 to 300 saybolt seconds universal (SSU) viscosity is usually desirable for No. 5 and 6 fuel oils. No. 4 may also need some preheating depending on the type of atomizer/burner and the particular oil. No. 2 oil rarely needs preheating, but outside storage in cold climates may necessitate preheating to room temperature.

(2) **Lighting Burners.** Before lighting off a burner, always check for proper oil pressure, temperature, and atomizing air or steam pressure. Purge the unit and establish air flow suitable for light-off. To manually light an oil burner insert a lighted torch adjacent to the oil atomizer and admit oil and atomizing steam at their low fire rates. The trial for ignition of the main flame should not be longer than 15 seconds. If the trial for ignition fails, remove the torch and repurge the furnance before trying again. A torch for safe lighting of oil burners can be made from an iron rod of ¼-inch pipe of suitable length. Wrap 10 inches of the rod end closely with cloth and secure the cloth with wire. Store the torch in an oil container made from a 2- or 3-foot length of 3-inch pipe so that it is saturated with oil and ready for instant use. To light the torch, remove it from the container and ignite the oil-saturated rag. After the burner has been lit, extinguish the torch by immersing it in the oil container. Leave the torch in this position for future use.

(a) Gas igniters or pilots are usually used to light off modern light oil burners. These igniters typically use an electric spark to ignite the gas. If the igniter flame is seen by the flame scanner within a 10-second trial for ignition, the oil safety shut-off valve is opened, either manually or automatically. The oil control valve should be at its low fire position and is often interlocked in this position. Fifteen seconds after the oil shut-off valve is opened, the igniter is shut off. If the flame scanner still sees flame, the burner will continue to operate. If no main flame is seen at this time, the shut-off valve is closed. The boiler should be repurged before a second trial for ignition is made. Loss of main flame or other safety interlock limits as shown on figure 2-48 and figure 2-49 will result in the safety shutdown of a burner.

(b) High energy spark igniters are now being applied to some oil-fired burners. These igniters eliminate the use of gas igniters by directly igniting the oil with a low voltage, high amperage spark. Operational sequence is similar to the above, except that the igniter trial for ignition period is eliminated.

(c) Maintain a small, stable flame by adjusting the combustion air flow, oil flow, and furnace draft. Insufficient air is likely to cause smoke, while too much air can cause the flame to blow away from the burner. By experimentation, the proper fuel/air ratio for light-off of a cold furnance should be determined for each individual boiler.

(d) The burner and control manufacturer's recommended lighting off procedure for semi-automatic

operation should be rigidly followed. Step by step instructions should be posted in a convenient place near the burners.

e. Gas Firing. The ignition of a gas burner is always accomplished with the use of a gas igniter, flame scanner, and flame safeguard control. Purging the boiler is required before a trial for ignition. Proper gas pressure should be available to both the igniter and main burner, and the gas control valve should be in its low fire position. The semi-automatic or automatic light-off sequence is identical to that for oil burners except the trial for ignition of main flame is only 10 seconds. Loss of flame or boiler and burner limits shown on figure 2-49 or figure 2-50 will result in the shutdown of a burner. The boiler-furnace must be repurged before a new trial for ignition may be attempted.

3-9. WARM-UP TIME

The time required to bring a boiler up to line pressure or temperature is dependent on many things including the size and type of boiler, its operating pressure or temperature, the combustion equipment, and whether or not it is equipped with a superheater. Manufacturer's detailed instructions should be followed to minimize thermal stresses as the boiler heats up and expands. In general, boilers out of service long enough to cool down to room temperature require ½ to 2½ hours to reach line pressure. If a new boiler or one with extensive repairs to the furnace or setting is being placed in service, sufficient time must be allowed for the brickwork to dry out. Operate the boiler on low fire for several days before it is actually placed into service. If the boiler is equipped with a superheater, take extra precautions to prevent it from overheating by firing at a low rate during the warm-up period, and by allowing a small amount of steam to flow through the superheater. Leave the outlet drain from the superheater open so that some steam flows through the tubes as pressure builds up. This steam will help to cool the superheater metal, and prevent tube damage.

3-10. PLACING A HIGH PRESSURE STEAM BOILER IN SERVICE

When water in the drum begins to boil, steam is discharged from the drum vent. When the boiler pressure reaches about 25 psig, all air will have been removed, and the vent should be closed. If the boiler does not have a vent, use the gage cocks to allow air to escape. Carefully observe the fire while the pressure is increased, and maintain minimum stable firing conditions. If the firing rate is too high on multiple burner boilers, shut off some of the burners. Rotate operation of the burners to promote uniform heating. If the firing rate is too high on a stoker fired boiler, shut off the forced draft fan for a period and operate on natural or induced draft only.

a. Control of Water Level. Observe water level frequently during the warmup period. Increasing temperature and the formation of steam causes the boiler water to expand. To avoid high water levels, start the boiler with the water level just above the lowest safe level. If necessary, open the blowdown valves and remove water to prevent high level conditions.

b. Checking Safety Valves. The safety valves should be tested periodically by hand lifting them. Do this when the steam pressure in the boiler is at least 75 percent of the set pressure of the lowest safety valve. Care should be taken to hold the valve open wide and release the hand lever briskly, so that the valve closes with a snap. At intervals, as required by the Authorized Inspector, the safety valves must be tested by raising the boiler pressure to the set pressure of the safety valve to ensure that it pops and reseats correctly. When a safety valve fails to operate, do not attempt to free it by striking the body or other parts of the valve. If a saftey valve leaks or fails to operate properly remove the boiler from service immediatley and repair or replace the valve. Checking of safety valves by raising pressure on the boiler must b under direct supervision of a designated, qualifie employee.

c. Operation of Header Valves. When placing a boiler inter service, care must be taken to avoid water hammer and expansion stresses associated with large temperature differentials. When other boilers on a header are already operating, the steam line from the boiler being started must be brought up to temperature by operating the bypass and drain valves to create a flow of steam from the header. When the line is up to temperature and pressure, the header gate valve may be opened wide and the bypass closed. The nonreturn valve should be opened to a 25 percent position until the boiler starts to supply steam to the header, after which it may be fully opened. In the absence of a nonreturn valve, the boiler stop valve should be opened slowly when the pressure in the boiler land header are approximately equal. If a boiler is being put into service on a header which is not under pressure, it is desirable to warm up both the boiler and steam line/header together. In this case, open both the stop and nonreturn valves and make sure the steam header drain valves are open to remove any condensate formed.

d. Activate Controls. When the boiler is producing steam and properly coinnected to the header, place the feedwater and combustion controls into automatic operation, in accordance with the manufacturer's recommendations and instructions.

3-11. PLACING A HOT WATER BOILER IN SERVICE

The following general procedures should be followed for placing a single LTW or HTW boiler into service. Procedures are also included for placing additional boilers into service on multiple boiler installations.

a. Procedure for a Single Boiler. When starting a boiler after layup, proceed as follows.

(1) Review manufacturer's recommendations for startup of burner and boiler.
(2) Fill boiler and system; vent air at high point in system.
(3) Check altitude gage and expansion tank to assure system is properly filled.
(4) Set control switch in "OFF" position.
(5) Make sure fresh air to boiler room is unobstructed and manual dampers are open.
(6) Check availability of fuel.
(7) Vent combustion chamber to remove unburned gases.
(8) Clean glass on flame scanner, if provided.
(9) Observe proper functioning of water pressure regulator and turn circulator pumps on electrically.
(10) Check temperature control(s) for proper setting.
(11) Check manual reset button on low-water fuel cutoff and high-limit temperature control.
(12) Set manual fuel oil supply or manual gas valve in"OPEN" position.
(13) Place circuit breaker or fuse disconnect in "ON" position.
(14) Place all boiler emergency switches on "ON" position.
(15) Place boiler control starting switch in "ON" or "START" position. (Do not stand in front of boiler doors or breeching.)
(16) Do not leave boiler unattended until it reaches the established cutout point to ensure that controls shut off the burner.
(17) During the temperature and pressure buildup period, walk around the boiler frequently to observe that all associated equipment and piping is functioning properly. Visually check burner for proper combustion.
(18) Immediately after burner shuts off, inspect water pressure and open the highest vent to determine that system is completely full of water.
(19) Enter in log book:
  (a) date and time of startup
  (b) any irregularities observed and corrective action taken
  (c) time when controls shut off burner at established temperature, tests performed etc.
  (d) ignature of operator
(20) Check safety relief valve for evidence of leaking. Perform try lever test. (Reference Exhibit C in ASME Code Section VI, "Recommended Rules for Care and Operation of Heating Boilers.")

b. Action in Case of Abnormal Conditions. If any abnormal conditions occur during light off or temperature buildup, immediately open emergency switch. Do not attempt to restart the unit until difficulties have been identified and corrected.

c. Placing Additional Boilers into Service. When placing a boiler on the line with other boilers which are already in service, start the boiler using the above procedures, but have its supply and return stop valves closed. Bring the second boiler to the same temperature as the operating boiler and partially open the supply valve(s). If there is no unusual disturbance, such as noise, vibration, etc., continue to open the valve slowly until it is fully open. Open the valve in the return line.

CAUTION

When the stop valve at the boiler outlet is closed, the stop valve in the return line of that boiler must also be closed.