

Model CBL

900-1800 HP



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FEATURES AND BENEFITS

The CBL 900-1800 HP Firetube boiler is designed, manufactured, and packaged by Cleaver-Brooks. All units are factory fire tested and shipped as a package, ready for quick connection to utilities. In addition to the features provided on all Cleaver-Brooks Firetube boilers, the following features apply to the CBL.

Three Pass or Four Pass Design:

- The packaged boiler offers high efficiency, flexibility, reliability, safety and ease of operation.

Front and Rear Doors:

- Davited, front and rear doors, all sizes.
- Provides access to front tube sheet and furnace.
- Large rear access plug for turnaround and furnace access.
- Rear door completely covers and insulates rear tube sheet.

Natural Gas, No. 2 Oil, No. 6 Oil, or Combination Burners Available:

- Combination gas/oil burners provide quick fuel changeover without burner adjustment.

PRODUCT OFFERING

Cleaver-Brooks CBL Boilers are available in low pressure and high pressure steam and hot water designs. Burners are available to fire natural gas, No. 2 oil, No. 6 oil, or a combination of oil and gas. Standard product offering is:

- 900 - 1800 hp.
- Three pass wetback design or four pass wetback design.
- 4 or 5 square foot of heating surface per boiler horsepower
- 15- 250 psig steam in most sizes.
- 30 & 125 psig hot water in most sizes.
- Full modulation, all sizes.

Available options include the following (contact your local Cleaver-Brooks authorized representative for option details).

- Boiler Options:
 - Additional screwed or flanged tappings.
 - Blowdown valves.
 - Non-return valves.
 - Feedwater valves and regulators.
 - Surface blowdown systems.
 - Surge load baffles.
 - Seismic design.
- Burner/Control Options:
 - Flame safeguard controllers.
 - Lead/lag system.

Special insurance and code requirements (e.g., IRI, FM, NFPA8501).

Alarm bell/silence switch.

Special motor requirements (TEFC, high efficiency).

Special indicating lights.

Main disconnect.

Elapsed time meter.

NEMA enclosures.

Remote emergency shut-off (115V).

Circuit breakers.

Day/night controls.

Special power requirements.

Low NOx Equipment.

HAWK ICS

- Fuel Options:

Gas strainer.

Gas pressure gauge.

Future gas conversion.

Oversized/undersized gas trains.

Optional Oil Pumps.

DIMENSIONS AND RATINGS

Dimensions and ratings for the CBL Boilers are shown in the following tables and illustrations. The information is subject to change without notice.

- Table A5-1. CBL Steam Boiler Ratings
- Table A5-2. Heating Surface
- Figure A5-1. CBL Steam Boiler Dimensions
- Figure A5-2. CBL Boiler Space Requirements to Open Rear Door
- Figure A5-3. Lifting Lug Location, CBL Boilers
- Figure A5-4. CBL Boiler Mounting Piers

Table A5-1. CBL Steam Boiler Ratings

BOILER HP	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
RATINGS - SEA LEVEL TO 1000 FT ^B											
Rated Capacity (lbs-steam/hr from and at 212 °F)	27600	31050	34500	37950	41400	44850	48300	51750	55200	58650	62100
Btu Output (1000 Btu/hr)	26780	30125	33475	36820	40170	43515	46865	50210	53550	56905	60255
POWER REQUIREMENTS — SEA LEVEL TO 1000 FT (60 HZ)											
Blower Motor, hp ^A (Gas and Oil)	60	60	60	75	75	100	100	100	Contact Factory		
Oil Pump Motor hp (#2 oil)	1	1	1	1	1-1/2	1-1/2	1-1/2	1-1/2			
Oil Pump Motor hp (#6 oil)	1	1	1	1	1	1	1	1-1/2			
Air Comp. Motor, hp (#2 oil)	7-1/2	15	15	15	15	15	15	15			
Oil heater Kw (#6 oil)	10	10	10	15	15	15	15	15			
NOTES:											
A. Blower motor HP may increase if a low NOx option is added											
B. Ratings based on nominal 80% efficiency.											
C. Ratings based on 60 hertz, please verify 50 hertz ratings with factory.											

Table A5-2. CBL Input Ratings (3-Pass Boilers)

Boiler Square Foot Heating Surface	4000	4500	5000	5500	6000	6500	7000	7500
Approximate Fuel Consumption ^D								
Horsepower (5 sq.ft./bhp)	800	900	1000	1100	1200	1300	1400	1500
Natural Gas ^A (cfh)	33475	37660	41845	46025	50215	54395	58585	62765
No. 2 Oil ^B (gph)	239.3	269.0	299.0	329.0	359.0	388.5	418.0	447.5
No. 6 Oil ^C (gph)	223.4	251.1	279.0	307.0	335.0	363.0	390.0	417.0
Horsepower (4 sq.ft./bhp)	1000	1100	1200	1300	1500	1600	1700	1800
Natural Gas ^A (cfh)	41845	46025	50215	54395	62765	66950	71133	75318
No. 2 Oil ^B (gph)	299.0	329.0	359.0	388.5	447.5	477.3	507.2	537
No. 6 Oil ^C (gph)	279.0	307.0	335.0	363.0	417.0	444.8	472.6	500.4

Notes:

- A. Natural gas based on heating value of 1000 BTU/cu.ft
- B. No. 2 oil based on heating value of 140,000 BTU/gal.
- C. No. 6 oil based on heating value of 150,000 BTU/gal.
- D. Ratings based on nominal 80% efficiency.

Table A5-3. CBL Input Ratings (4-Pass Boilers)

Boiler Square Foot Heating Surface	4000	4500	5000	5500	6000	6500	7000	7500
Approximate Fuel Consumption ^D								
Horsepower (5 sq.ft./bhp)	800	900	1000	1100	1200	1300	1400	1500
Natural Gas ^A (cfh)	32659	36741	40824	44906	48989	53071	57153	61236
No. 2 Oil ^B (gph)	233.3	262.4	291.6	320.8	349.9	379.1	408.2	437.4
No. 6 Oil ^C (gph)	217.7	244.9	272.2	299.4	326.6	353.8	381.0	408.2
Horsepower (4 sq.ft./bhp)	1000	1100	1200	1300	1500	1600	1700	1800
Natural Gas ^A (cfh)	40824	44906	48989	53071	57153	65317	69399	73481
No. 2 Oil ^B (gph)	291.6	320.8	349.9	379.1	437.4	466.6	495.7	524.9
No. 6 Oil ^C (gph)	272.2	299.4	326.6	353.8	408.2	435.4	462.6	489.9

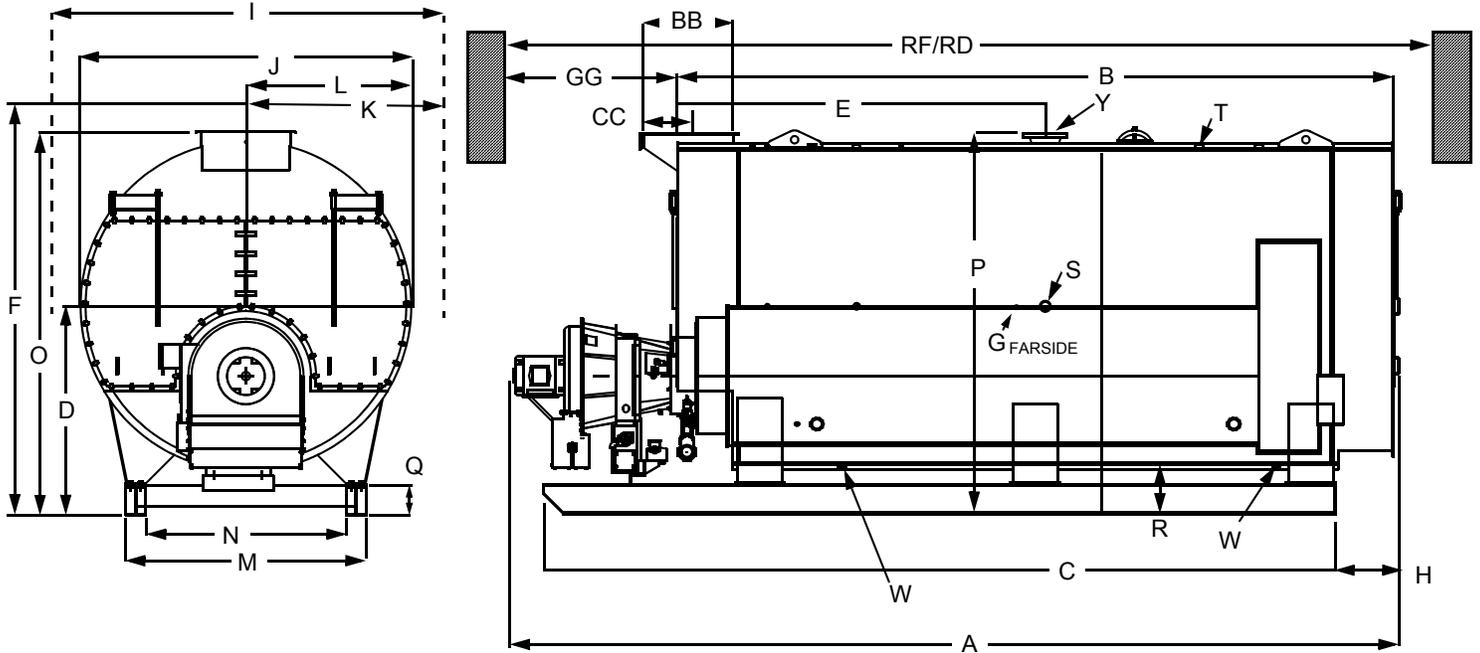
Notes:

A. Natural gas based on heating value of 1000 BTU/cu.ft

B. No. 2 oil based on heating value of 140,000 BTU/gal.

C. No. 6 oil based on heating value of 150,000 BTU/gal.

D. Ratings based on nominal 82% efficiency.



BOILER SQUARE FOOT HEATING SURFACE	DIM	4000	4500	5000	5500	6000	6500	7000	7500
Boiler Horsepower@ 5 ft ² /bhp		800	900	1000	1100	1200	1300	1400	1500
Boiler Horsepower @ 4 ft ² /bhp		1000	1100	1200	1300	1500	1600	1700	1800
LENGTHS									
Overall *B	A	367	394	386	411	434	387	406	425
Shell	B	293	323	288	312	335	304	323	342
Base Frame *	C	285	317	282	304	327	296	315	334
Base Frame to Rear Flange	H	26	26	26	26	26	26	26	26
Flange to Steam Nozzle	E	148	148	148	148	148	148	148	148
WIDTHS									
Overall With Trim	I	144	144	156	156	156	168	168	168
I. D. Boiler	J	114	114	126	126	126	138	138	138
Center to Water Column	K	72	72	78	78	78	84	84	84
Center to Lagging	L	59-1/2	59-1/2	65-3/4	65-3/4	65-3/4	71 3/4	71 3/4	71 3/4
Base Outside	M	96	96	96	96	96	96	96	96
Base Inside	N	80	80	80	80	80	80	80	80
* Approximate - varies with burner selection									
Boiler Horsepower@ 5 ft ² /bhp		800	900	1000	1100	1200	1300	1400	1500
Boiler Horsepower @ 4 ft ² /bhp		1000	1100	1200	1300	1500	1600	1700	1800

Figure A5-1. CBL Steam Boiler Dimensions, 4 Pass (Page 1 of 2)

BOILER SQUARE FOOT HEATING SURFACE	DIM	4000	4500	5000	5500	6000	6500	7000	7500
HEIGHTS									
Base to piping connections	F	149	149	161	161	161	168-1/8	168-1/8	168-1/8
Base to Boiler Centerline	D	77-1/2	77-1/2	83-3/4	83-3/4	83-3/4	86-1/2	86-1/2	86-1/2
Base to Vent Outlet	O	141	141	153-1/2	153-1/2	153-1/2	162-1/8	162-1/8	162-1/8
Base to Steam Outlet	P	141	141	153-1/2	153-1/2	153-1/2	162-1/8	162-1/8	162-1/8
Base Frame	Q	12	12	12	12	12	12	12	12
Base to Bottom Boiler	R	20	20	20	20	20	17	17	17
CONNECTIONS									
Chemical Feed	G	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Feedwater Inlet (Both Sides)	S	3	3	3	3	3	3	3	3
Steam Nozzle ^A (150 psig)	Y	10	10	10	12	12	12	12	12
Blowdown - Front & Rear	W	2	2	2	2	2	2	2	2
Surface Blowoff	T	1	1	1	1	1	1	1	1
Vent Stack Diameter (Flanged)	BB	32	32	36	36	36	42	42	42
Flange to Center Vent	CC	17-1/2	17-1/2	19-1/2	19-1/2	19-1/2	24	24	24
MISCELLANEOUS									
Rear Door Swing ^C	AA	-	-	-	-	-	-	-	-
Tube Removal - Front Only	GG	246	276	217	241	264	233	252	271
Min. Boiler Room Length For Tube Removal Front	RF	537	597	538	586	632	665	703	741
Min. Boiler Room Length For Tube Removal Thru Door	RD	484	514	489	513	536	528	547	566
Normal Water Weight (Lbs)		43800	49400	49300	54000	60000	61000	66000	71000
Flooded Water Weight (Lbs)		54500	61300	65300	71900	78300	83000	89000	96000
Approx. Shipping Wt. 15/30 psig (Lbs.)		58000	63000	73100	77200	82200	87000	91700	96600
Approx. Shipping Wt. 150 psig (Lbs.)		65000	71000	79600	85300	90900	97300	102600	108200
Approx. Shipping Wt. 200 psig (Lbs.)		73500	82200	88600	95000	101500	107800	115500	121000
Approx. Shipping Wt. 250 psig (Lbs.)		81300	89000	97200	104000	110000	118000	124000	132000
<p>NOTES:</p> <p>Accompanying dimensions, while sufficiently accurate for layout purposes, must be confirmed for actual option requirements.</p> <p>A. 300 psig Flange. See recommended steam nozzle size chart for operating pressure greater than 125 psig.</p> <p>B. Add 11 1/2 inches to dimension "B" for a three pass boiler.</p> <p>C. Reference Figure A11-2.</p>									

Figure A5-1. CBL Steam Boiler Dimensions, 4 Pass (Page 2 of 2)

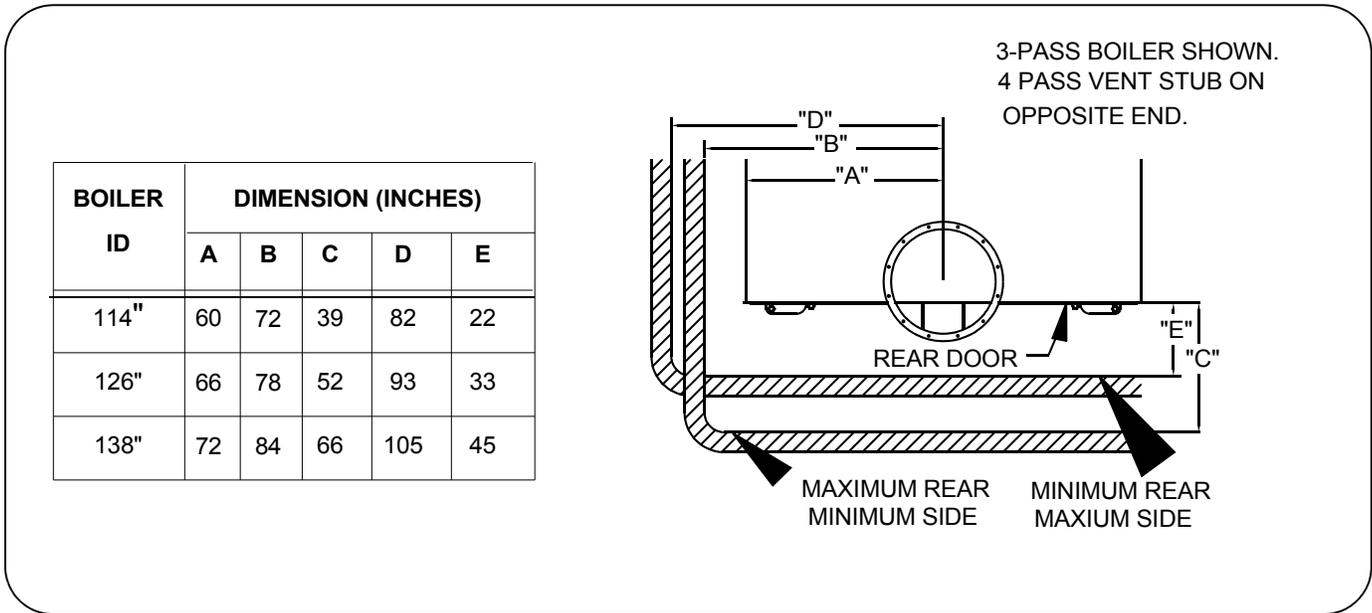


Figure A5-2. Space Required to Open Rear Doors on CBL Boilers

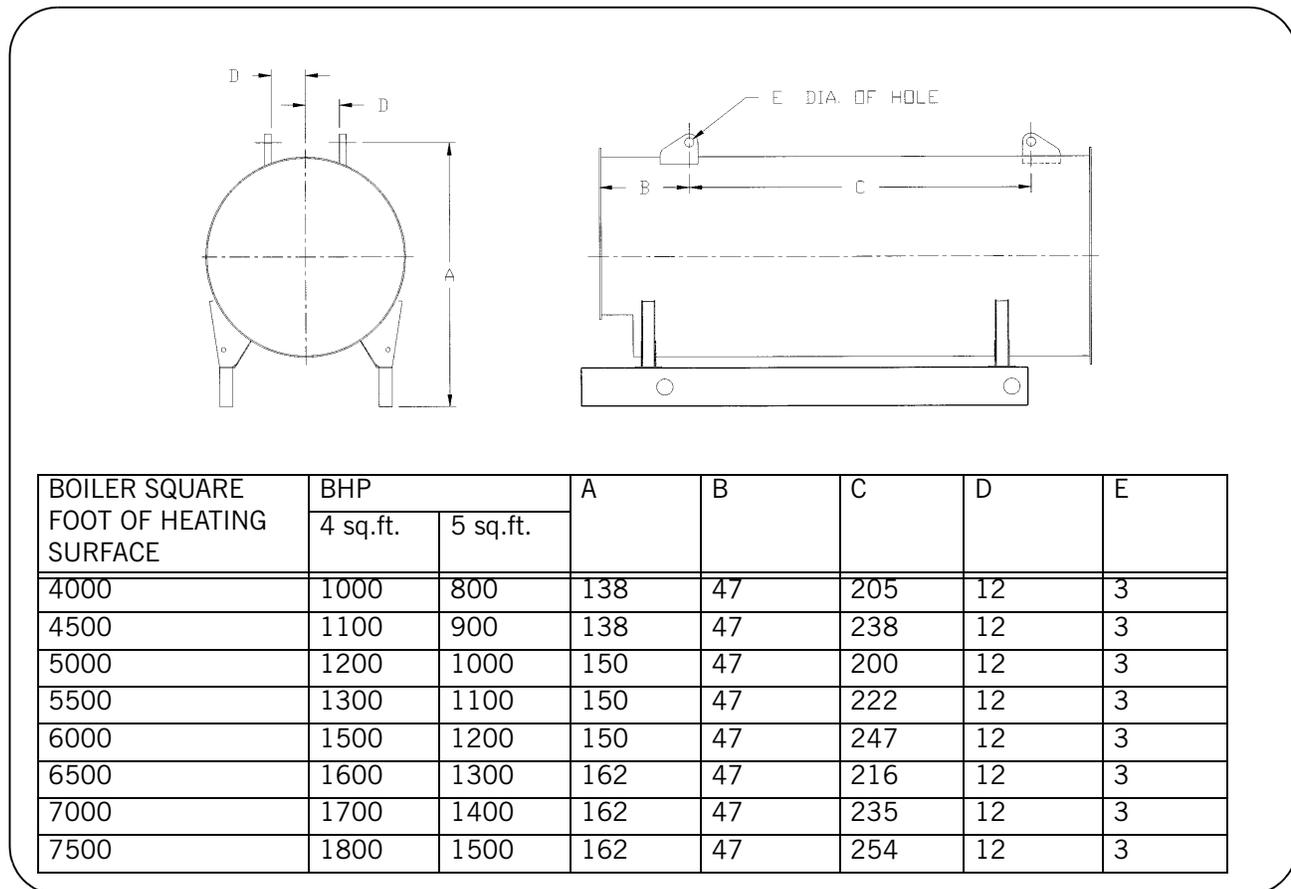
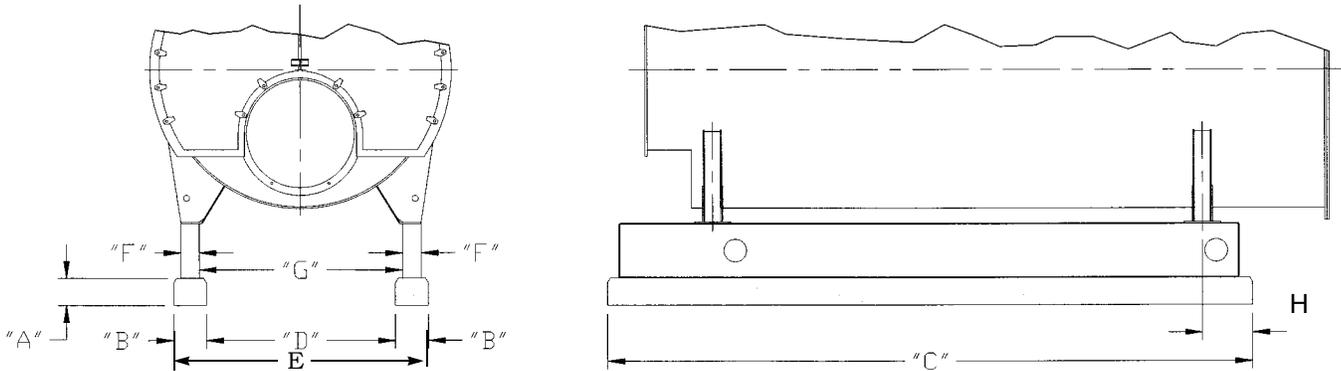


Figure A5-3. CBL Boilers Lifting Lug Location



BOILER SQUARE FOOT OF HEATING SURFACE	BHP		A	B	C	D	E	F	G	H
	4 sq-ft	5 sq-ft								
4000	1000	800	6	12	*	76	100	8	80	12
4500	1100	900	6	12	*	76	100	8	80	12
5000	1200	1000	6	12	*	76	100	8	80	15
5500	1300	1100	6	12	*	76	100	8	80	15
6000	1500	1200	6	12	*	76	100	8	80	15
6500	1600	1300	6	12	*	76	100	8	80	15
7000	1700	1400	6	12	*	76	100	8	80	15
7500	1800	1500	6	12	*	76	100	8	80	15

NOTE: All numbers in table are in inches.

6-inch high mounting piers recommended for beneath the boiler frame. The use of these piers provides increased inspection accessibility to the piping beneath the boiler and added height for washing down the area beneath the boiler.

The (*) varies with horsepower rating and burner selection, see Dimension Diagram for job-specific mounting pier length.

Figure A5-4. CBL Boiler Mounting Piers

PERFORMANCE DATA

Efficiency

Tables A5-4, A5-5, A5-6, A5-7, A5-8, and A5-9 show predicted fuel-to-steam efficiencies (including radiation and convection losses) for Cleaver-Brooks CBL Firtube boilers. For specific efficiencies on firtube boiler offerings not listed here, contact your local Cleaver-Brooks authorized representative.

Cleaver-Brooks offers an industry leading fuel-to-steam boiler efficiency guarantee for CBL Firtube Boilers. The guarantee is based on the fuel-to-steam efficiencies shown in the efficiency tables and the following conditions. The efficiency percent number is only meaningful if the specific conditions of the efficiency calculations are clearly stated in the specification (see Cleaver-Brooks publication CB-7767 for a detailed description of efficiency calculations).

The boiler manufacturer shall guarantee that, at the time of startup, the boiler will achieve fuel-to-steam efficiency (as shown in the tables listed above) at 100% firing

rate (add efficiency guarantees at 25%, 50%, and 75% of rating, if required). If the boiler(s) fail to achieve the corresponding guaranteed efficiency as published, the boiler manufacturer will rebate, to the ultimate boiler owner, five thousand dollars (\$5,000) for every full efficiency point (1.0%) that the actual efficiency is below the guaranteed level. The specified boiler efficiency is based on the following conditions.

1. Fuel specification used to determine boiler efficiency:
 - Natural Gas
 - Carbon,% (wt) = 69.98
 - Hydrogen,% (wt) = 22.31
 - Sulfur,% (wt) = 0.0
 - Heating value, Btu/lb = 21,830
 - No. 2 Oil
 - Carbon,% (wt) = 85.8
 - Hydrogen,% (wt) = 12.7
 - Sulfur,% (wt) = 0.2
 - Heating value, Btu/lb = 19,420
 - No. 6 Oil
 - Carbon,% (wt) = 86.6
 - Hydrogen,% (wt) = 10.9
 - Sulfur,% (wt) = 2.09
 - Heating value, Btu/lb = 18,830
2. Efficiencies are based on ambient air temperature of 80 °F, relative humidity of 30%, and 15% excess air in the exhaust flue gas.
3. Efficiencies are based on the following radiation and convection losses. Firing rate of 25% - 1.2%, 50% - 0.6%, 75% - 0.4%, and 100% - 0.3%.

ENGINEERING DATA

The following engineering information is provided for CBL Boilers. Additional detail is available from your local Cleaver-Brooks authorized representative.

Boiler Information

Table A5-12 shows steam volume and disengaging area for CBL boilers.

Table A5-10 lists quantity and outlet size for safety valves supplied on CBL boilers.

Table A5-11 gives recommended steam nozzle sizes on CBL Boilers.

Table A5-13 shows recommended non-return valve sizes for CBL Boilers.

Blowdown Water Requirements

Some local codes require blowdown tanks to be constructed in accordance with recommendations of the National Board of Boiler and Pressure Vessel Inspectors.

The National Board's recommendations base the size of the blowdown tank on the removal of at least 4 inches of water from the boiler.

Table A5-14 lists the approximate quantity of water represented by 4 inches of water at normal operating level for Cleaver-Brooks CBL Boilers.

Burner/Control Information

Burner Characteristics

Note that altitude correction and burner changes are required for higher altitudes

which may alter dimensions, motor hp and gas pressures. Also 50 Hz applications and low NOx options should be reviewed by the Cleaver-Brooks authorized representative.

Gas-Fired Burners

Table A5-15 gives gas train connection sizes and gas pressure requirements.

Table A5-16 shows correction factors for gas pressure at elevations over 1000 ft. above sea level.

For oversized or undersized gas trains or altitude above 1,000 feet, contact your local Cleaver-Brooks authorized representative.

Fuel Connections - Gas

The local gas company should be consulted for requirements and authorization for installation and inspection of gas supply piping. Installation of gas supply piping and venting must be in accordance with all applicable engineering guidelines and regulatory codes. All connections made to the boiler should be arranged so that all components remain accessible for inspection, cleaning and maintenance.

A drip leg should be installed in the supply piping before the connection to the gas pressure regulator. The drip leg should be at least as large as the inlet fitting supplied with the boiler. Consideration must be given to both volume and pressure requirements when choosing gas supply piping size. Refer to the boiler dimension diagram provided by Cleaver-Brooks for the particular installation. Connections to the burner gas train should be made with a union, so that gas train components or the burner may be easily disconnected for inspection or service. Upon completion of the gas piping installation, the system should be checked for gas leakage and tight shutoff of all valves.

Fuel Connections - Oil

Oil-fired burners are equipped with an oil pump, which draws fuel from a storage tank and supplies pressurized oil to the burner nozzle(s). The burner supply oil pump has a greater capacity than the burner requires for the maximum firing rate. Fuel not delivered to the nozzle is returned to the storage tank. A two-pipe (supply and return) oil system is recommended for all installations. Figure A5-5 shows a typical fuel oil supply arrangement. Oil lines must be sized for the burner and burner supply oil pump capacities.

The burner supply oil pump suction should not exceed 10" Hg. If a transfer pump is used, it must have a pumping capacity at least equal to that of the burner pump(s). Supply pressure to the burner pump should not exceed 3 psig.

A strainer must be installed in the supply piping upstream of the burner supply pump in order to prevent entry of foreign material into the pump, fuel control valves, or burner nozzle(s). The strainer must be sized for the burner supply pump capacity. A strainer mesh of 150 microns (0.005") is recommended.

Install a check valve in the line to prevent draining of the oil suction line when the burner is not in operation. Location of the check valve varies with the system, but usually it is located as close as possible to the storage tank.

Installation of a vacuum gauge in the burner supply line between the burner oil pump and the strainer is recommended. Regular observation and recording of the gauge indication will assist in determining when the strainer needs servicing.

Boiler Room Information

Upon completion of the oil piping installation, the system should be checked for oil or air leakage and tight shutoff of all valves.

Figure A5-7 shows typical boiler room length requirements.

Figure A5-8 shows typical boiler room width requirements.

Stack Support Capabilities

CBL Boilers can support up to 2000 lbs. without additional support.

CBL Boilers can be reinforced to support up to 3000 lbs.

Boiler Room Combustion Air

When determining boiler room air requirements, the size of the room, air flow, and velocity of air must be reviewed as follows:

1. Size (area) and location of air supply openings in boiler room.
 - A. Two (2) permanent air supply openings in the outer walls of the boiler room are recommended. Locate one (1) at each end of the boiler room, preferably below a height of 7 feet. This allows air to sweep the length of the boiler.
 - B. Air supply openings can be louvered for weather protection, but they should not be covered with fine mesh wire, as this type of covering has poor air flow qualities and is subject to clogging by dust or dirt.
 - C. A vent fan in the boiler room is not recommended, as it could create a slight vacuum under certain conditions and cause variations in the quantity of combustion air. This can result in unsatisfactory burner performance.
 - D. Under no condition should the total area of the air supply openings be less than one (1) square foot.
 - E. Size the openings by using the formula:

$$\text{Area (sq-ft)} = \text{CFM/FPM}$$

2. Amount of air required (cfm).
 - A. Combustion Air = Rated bhp x 8 cfm/bhp.
 - B. Ventilation Air = Maximum bhp x 2 cfm/bhp or a total of 10 cfm/bhp - up to 1000 feet elevation. Add 3 percent more per 1000 feet of added elevation.
3. Acceptable air velocity in Boiler Room (fpm).
 - A. From floor to (7) foot height - 250 fpm.
 - B. Above (7) foot height - 500 fpm.

Example: Determine the area of the boiler room air supply openings for (1) 1000 hp boiler at 800 feet altitude. The air openings are to be 5 feet above floor level.

- Air required: $1000 \times 10 = 10000$ cfm (from 2B above).
- Air velocity: Up to 7 feet = 250 fpm (from 3 above).
- Area Required: $\text{Area} = \text{cfm/fpm} = 10000/250 = 40$ Sq-ft total.
- Area/Opening: $40/2 = 20$ sq-ft/opening (2 required).

Notice

Consult local codes, which may supersede these requirements.

Stack/Breeching Size Criteria

The design of the stack and breeching must provide the required draft at each boiler flue gas outlet. Proper draft is critical to burner performance.

Although constant pressure at the flue gas outlet of the CBL is not required, it is necessary to size the stack/breeching to limit flue gas pressure variation. The allowable pressure range is $-0.50''$ W.C. to $+0.50''$ W.C. The maximum pressure variation at any firing rate for the boiler is $0.50''$ W.C.

The low NOx option allowable pressure range is -0.25" W.C. to +0.25" W.C. The maximum pressure variation at any firing rate for the boiler is 0.25"W.C.

For additional information, please review Section I4, General Engineering Data (Stacks) and Section F, Stacks. Stack and breeching sizes should always be provided by a reputable stack supplier who will design the stack and breeching system based on the above criteria. Your local Cleaver-Brooks authorized representative is capable of assisting in your evaluation of the stack/breeching design.

Table A5-4. Predicted Fuel-to-Steam Efficiencies (%) CBL Boilers- 125 psig, Natural Gas, 5sq. ft./BHP, 4 Pass

BOILER HP	FIRING RATE (%)			
	25	50	75	100
800	82.0	82.3	82.7	82.5
900	82.3	82.0	82.5	82.5
1000	82.0	82.6	82.7	82.6
1100	82.3	82.7	82.7	82.7
1200	82.2	83.0	83.2	83.2
1300	82.5	82.8	83.0	83.0
1400	82.3	82.3	82.8	82.8
1500	82.0	83.0	83.0	83.0

Table A5-5. Predicted Fuel-to-Steam Efficiencies (%) CBL Boilers- 125 psig, No. 2 Oil, 5sq. ft./BHP, 4 Pass

BOILER HP	FIRING RATE (%)			
	25	50	75	100
800	85.2	85.9	85.9	86.0
900	85.3	85.8	86.0	86.0
1000	85.8	86.0	86.0	86.2
1100	85.5	85.6	85.6	86.0
1200	85.8	86.0	86.3	86.5
1300	85.3	86.0	86.4	86.6
1400	85.9	86.0	86.4	86.5
1500	86.0	86.6	86.5	86.6

Table A5-6. Predicted Fuel-to-Steam Efficiencies (%) CBL Boilers- 125 psig, No. 6 Oil, 5sq. ft./BHP, 4 Pass

BOILER HP	FIRING RATE (%)			
	25	50	75	100
800	86.5	86.0	86.5	86.8
900	86.6	86.5	86.5	86.9
1000	86.5	86.6	86.5	86.8
1100	86.5	86.7	86.6	86.9
1200	86.5	87.0	87.0	87.0
1300	86.3	86.6	87.0	87.0
1400	86.0	86.5	86.8	86.7
1500	86.0	86.5	86.8	86.6

Table A5-7. Predicted Fuel-to-Steam Efficiencies (%) CBL Boilers- 125 psig, Natural Gas, 4 sq. ft./BHP, 3 Pass

BOILER HP	FIRING RATE (%)			
	25	50	75	100
1000	81.4	81.5	81.5	81.5
1100	81.3	81.6	82.0	82.0
1200	81.2	81.4	82.0	82.0
1300	81.0	81.3	81.6	82.0
1400	81.0	81.3	81.4	81.8
1500	81.0	81.4	81.4	81.9

Table A5-8. Predicted Fuel-to-Steam Efficiencies (%) CBL Boilers- 125 psig, No. 2 Oil, 4 sq. ft./BHP, 3 Pass

BOILER HP	FIRING RATE (%)			
	25	50	75	100
1000	84.8	85.0	85.0	85.0
1100	84.7	85.0	85.0	85.0
1200	85.0	85.2	85.4	85.2
1300	85.0	85.0	84.8	85.5
1400	85.0	85.6	84.8	85.5
1500	85.0	85.5	84.9	85.6

Table A5-9. Predicted Fuel-to-Steam Efficiencies (%) CBL Boilers- 125 psig, No. 6 Oil, 4 sq. ft./BHP, 3 Pass

BOILER HP	FIRING RATE (%)			
	25	50	75	100
1000	86.2	86.2	85.8	85.6
1100	86.3	86.4	86.1	85.9
1200	86.2	86.2	85.8	86.0
1300	86.0	86.4	86.1	85.8
1400	86.0	86.4	86.0	85.8
1500	86.0	86.3	86.2	85.9

Table A5-10. CBL Steam Boiler Safety Valve Outlet Size

VALVE SETTING	15 PSIG STEAM		150 PSIG STEAM		200 PSIG STEAM		250 PSIG STEAM	
BOILER HP	NO. OF VALVES REQ'D	OUTLET SIZE ("FPT)	NO. OF VALVES REQ'D	OUTLET SIZE ("FPT)	NO. OF VALVES REQ'D	OUTLET SIZE ("FPT)	NO. OF VALVES REQ'D	OUTLET SIZE ("FPT)
800	-	-	2	1 - 3 1 - 4	2	1 - 2 1/2 1 - 3	2	2 1/2
900	-	-	2	1 - 3 1 - 4	2	3	2	1 - 2 1/2 1 - 3
1000	3	2 - 8 1 - 6	2	4	2	3	2	1 - 2 1/2 1 - 3
1100	3	2 - 8 1 - 6	2	4	2	1 - 3 1 - 4	2	3
1200	2	8	2	4	2	1 - 3 1 - 4	-	-
1300	3	8	3	2 - 3 1 - 4	3	1 - 2 1/2 2 - 3	-	-
1400	3	8	3	1 - 3 2 - 4	3	3	-	-
1500	3	8	3	1 - 3 2 - 4	3	3	-	-

NOTES:
 Table A11-8 only applies to 5 Sq Ft/BHP units.
 Valve manufacture is Kunkle.
 Valve requirements can vary with special pressure settings.

Table A5-11. CBL Recommended Steam Nozzle Size

BOILER HP											
OPERATING PRESSURE PSIG	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
12	18	18	20	20	24	24	24	24	24	24	24
30	14	16	16	16	18	18	18	20	20	20	20
50	12	12	12	14	16	16	16	16	16	16	16
75	10	10	12	12	12	12	12	14	14	14	14
100	10	10	10	10	12	12	12	12	12	12	14
125	8	10	10	10	10	10	12	12	12	12	12
150	8	8	8	10	10	10	10	10	10	10	12
200	8	8	8	8	10	10	10	10	10	10	10
225	6	8	8	8	8	10	10	10	10	10	10

NOTES:
 Steam nozzle sizes given in inches.
 All standard steam nozzle sizes for the 150 psig design pressure or greater are the same as 125 psig operating pressure on the above table. To increase or decrease the standard size, request the change with your local Cleaver-Brooks authorized representative.

Table A5-12. CBL Steam Volume and Disengaging Areas

BOILER SQUARE FOOT OF HEATING SURFACE	BHP		STEAM VOLUME (CU-FT)	STEAM RELIEVING AREA (SQ-IN)
	4 SQ.FT.	5 SQ.FT.	HIGH PRESSURE (A)	HIGH PRESSURE (A)
4000	1000	800	155	20566
4500	1100	900	174	23105
5000	1200	1000	250	24141
5500	1300	1100	273	26372
6000	1500	1200	300	28908
6500	1600	1300	352	28918
7000	1700	1400	379	31079
7500	1800	1500	405	33242

NOTES:

Based on normal water level.

Values are based on standard controls. Optional controls may result in different values.

A. Based on 150 psig design pressure.

Table A5-13. CBL Recommended Non-Return Valve Size

BOILER HP	CAPACITY LBS.PER HR.	OPERATING PRESSURE							
		50	75	100	125	150	175	200	225
900	31050	8	6	6	6	6	6	6	5
1000	34500	8	6*	6	6	6	6	6	5
1100	37950	8	8	6	6	6	6	6	6
1200	41400	8	8	8	6	6	6	6	6
1300	44850	8	8	8	8	6	6	6	6
1400	48300	8	8	8	8	8	6	6	6
1500	51750	8	8	8	8	8	8	6	6
1600	55200	10	10	8	8	8	8	8	6
1700	58650	10	10	8	8	8	8	8	8
1800	62100	10	10	10	8	8	8	8	8

NOTE:

Valve sizes (300# flanges) given in inches).

Standard non-return valve selections limited to a maximum 2 to 1 turndown (50% of full boiler output); selection based on typical valve sizing recommendations. For final valve selection contact your authorized C-B representative. For high turndown applications see Boiler Book Section I3, Table I3-3.

*Indicates pressure drop of less than 7.5 psig. All other selections are less than 6 psig pressure drop.

Table A5-14. CBL Blowdown Tank Sizing Information

BOILER SQUARE FOOT OF HEATING SURFACE	BHP		WATER (GAL)
	4 SQ.FT.	5 SQ.FT.	
4000	1000	800	356
4500	1100	900	400
5000	1200	1000	418
5500	1300	1100	460
6000	1500	1200	500
6500	1600	1300	500
7000	1700	1400	538
7500	1800	1500	575

NOTE: Quantity of water removed from boiler by lowering normal water line 4".
Optional level controls can alter water quantities.

Table A5-15. CBL gas train connection size and gas pressure requirements

Boiler HP	4 ft ² /bhp							
	3 pass				4 pass			
	std		30 ppm		std		30 ppm	
	Gas train connection	Pressure required	Gas train connection	Pressure required	Gas train connection	Pressure required	Gas train connection	Pressure required
1000	2.5	8.2	2.5	8.3	2.5	8.1	2.5	8.2
1100	3	5.4	3	5.4	3	5.4	3	5.6
1200	3	6.3	3	6.3	3	6.3	3	6.4
1300	3	7.2	3	7.3	3	7.2	3	7.3
1400	3	8.4	3	8.5	3	8.3	3	8.5
1500	4	5.4	4	5.5	4	5.6	4	5.8

Boiler HP	4.5 ft ² /bhp							
	3 pass				4 pass			
	std		30 ppm		std		30 ppm	
	Gas train connection	Pressure required	Gas train connection	Pressure required	Gas train connection	Pressure required	Gas train connection	Pressure required
900	2.5	7.4	2.5	7.4	2.5	7.3	2.5	7.4
1000	2.5	8.2	2.5	8.3	2.5	8.1	2.5	8.2
1100	3	5.3	3	5.4	3	5.3	3	5.4
1200	3	6.3	3	6.3	3	6.2	3	6.4
1300	3	7.2	3	7.3	3	7.2	3	7.3
1400	3	8.4	3	8.4	3	8.2	3	8.3
1500	4	5.4	4	5.5	4	5.4	4	5.6

Boiler HP	5 ft ² /bhp							
	3 pass				4 pass			
	std		30 ppm		std		30 ppm	
	Gas train connection	Pressure required	Gas train connection	Pressure required	Gas train connection	Pressure required	Gas train connection	Pressure required
800	2.5	6.0	2.5	6.1	2.5	5.9	2.5	6.0
900	2.5	7.4	2.5	7.4	2.5	7.3	2.5	7.4
1000	2.5	8.2	2.5	8.2	2.5	7.9	2.5	8.0
1100	3	5.3	3	5.4	3	5.3	3	5.4
1200	3	6.3	3	6.3	3	6.2	3	6.3
1300	3	7.2	3	7.2	3	7.1	3	7.2
1400	3	8.4	3	8.4	3	8.2	3	8.3
1500	4	5.4	4	5.5	4	5.4	4	5.6

Notes: 3 pass boilers are based on 80% efficiency
 4 pass boilers are based on 82% efficiency
 Pressure shown is minimum required and is listed as psi
 Incoming pressure is not to exceed 10 psi
 Ultra Low Nox (9 and 15ppm) are handled on a case by case basis

Table is based on Siemens gas train, which includes a regulating actuator.

Table A5-16. Altitude Correction for Gas

ALTITUDE (FT)	CORRECTION FACTOR	ALTITUDE (FT)	CORRECTION FACTOR
1000	1.04	6000	1.25
2000	1.07	7000	1.30
3000	1.11	8000	1.35
4000	1.16	9000	1.40
5000	1.21	-	-

To obtain minimum required gas pressure at altitudes above 700 feet, multiply the pressure by the listed factors:
 inches WC x 0.577 = oz/sq-in.
 oz/sq-in x 1.732 = inches WC.
 inches WC x 0.0361 = psig.
 oz/sq-in x 0.0625 = psig.
 psig x 27.71 = Inches WC.
 psig x 16.0 = oz/sq-in.

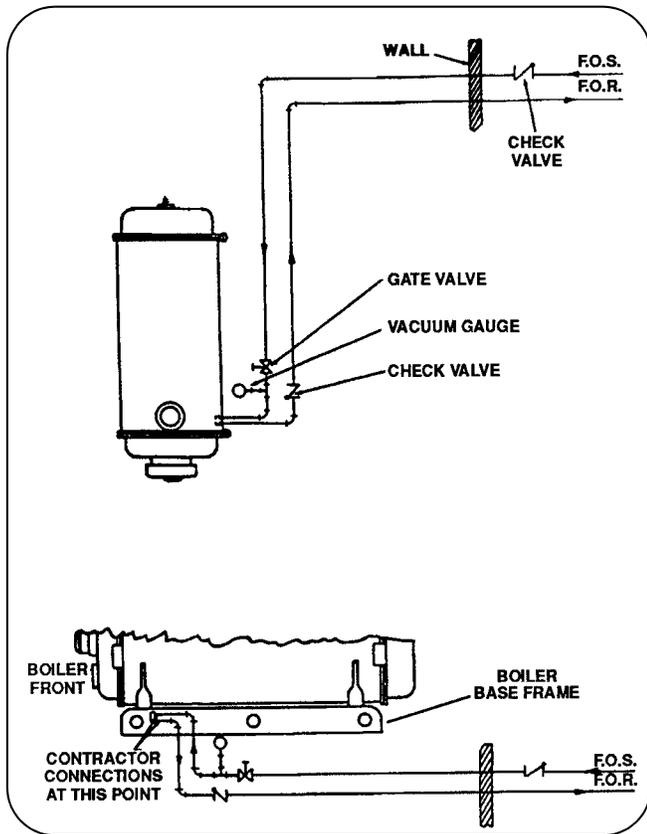


Figure A5-5. No. 2 Oil Piping, Single Boiler Installation, Oil Pump Integral With Boiler

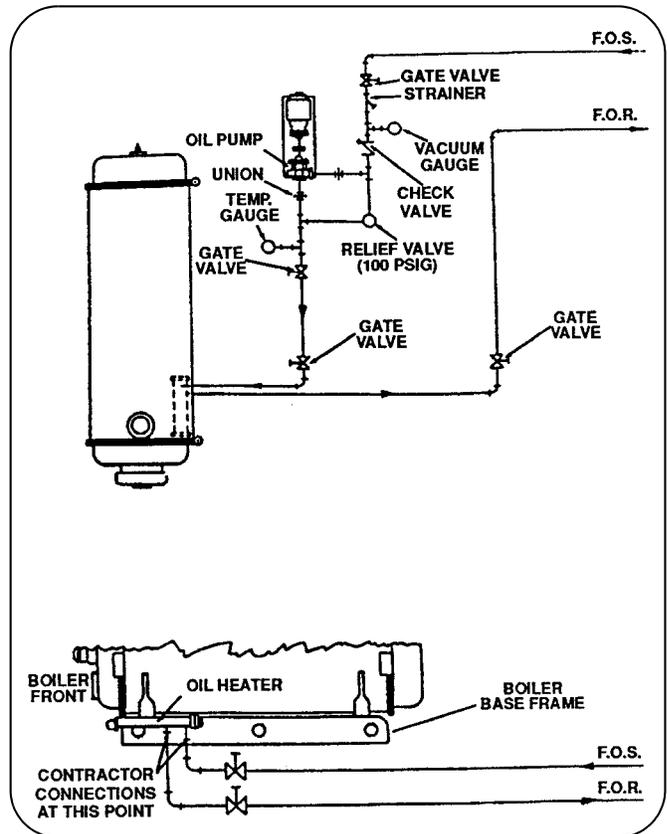
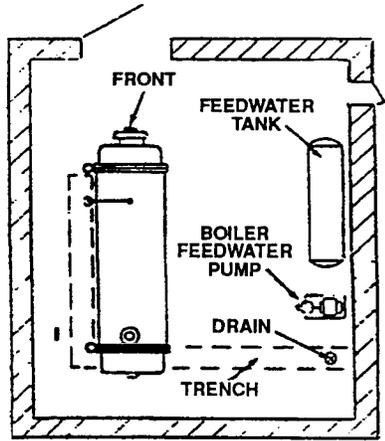


Figure A5-6. No. 6 Oil Piping, Single Boiler Installation, Remote Oil Pumps

BOILER SQUARE FOOT OF HEATING SURFACE	BHP		A	B
	4 sq.ft.	5 sq.ft.		
4000	1000	800	610	484
4500	1100	900	670	514
5000	1200	1000	606	489
5500	1300	1100	654	513
6000	1500	1200	700	536
6500	1600	1300	642	515
7000	1700	1400	680	534
7500	1800	1500	718	553

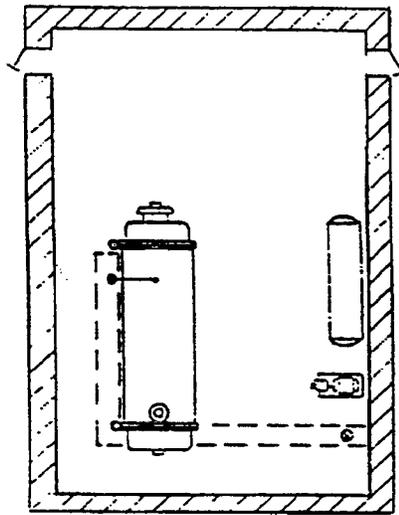
NOTES:
 A = Minimum length based on removing tubes in the boiler room.
 B = Minimum length based on removing tubes through a wall opening.

Figure A5-7. Boiler Room Length (Typical Layout)



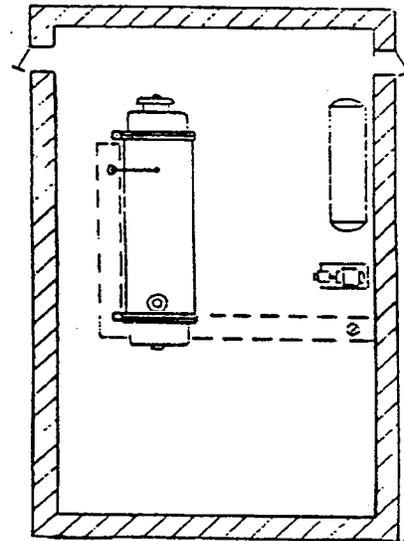
DRAWING A

1. Shortest boiler room length (Dwg A) is obtained by allowing for possible future tube replacement from front of boiler through a window or doorway. Allowance is only made for minimum door swing at each end of the boiler. This arrangement provides sufficient aisle space at the front of the boiler but a "tight" space condition at the rear.



DRAWING B

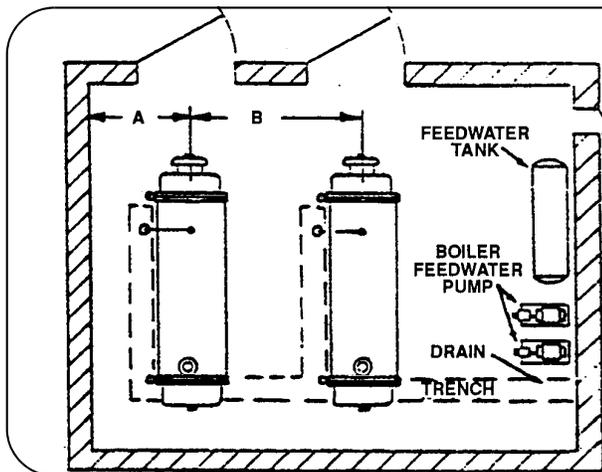
2. Next shortest boiler room length (Dwg B) is obtained by allowing for possible future tube replacement from the front of the boiler. Allowance is only made for minimum door swing at the rear.



DRAWING C

If space permits, approximately 1.5 additional feet should be allowed at the rear for additional aisle and working space.

If space permits, approximately 1.5 additional feet should be allowed at the rear for additional aisle and working space.



Boiler Square Foot of Heating Surface	4000-4500	5000-6000	6500-7500
Dimension A (inches)	117	123	129
Dimension B (inches)	198	210	222

Figure A5-8. Boiler Room Width (Typical Layouts)

SECTION A5

SAMPLE SPECIFICATIONS MODEL CBL

PART 1 GENERAL..... A5-22

1.1 Boiler Characteristics (Steam)..... A5-22

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PART 3 EXECUTION..... A5-27

3.1 Warranty..... A5-27

3.2 Shop Tests..... A5-27

SAMPLE SPECIFICATIONS

The following sample specifications are provided by Cleaver-Brooks to assist you in meeting your customer's specific needs and application.

The detailed burner and control specifications, and detailed control specifications for CB100E Flame Safeguard control are provided.

The Sample Specifications are typically utilized as the base template for the complete boiler specification. Contact your local Cleaver-Brooks authorized representative for information on special insurance requirements, special code requirements, optional equipment, or general assistance in completing the specification.

PART 1 GENERAL

CBL Steam Boiler (900-1800 hp, Steam 15-250 psig)

1.1 Boiler Characteristics (Steam)

- A. The Steam Boiler shall be Cleaver-Brooks Fuel Series _____ (100, 200, 400, 600, 700), _____ hp designed for _____ psig (15, 150, 200, or 250 psig steam). The maximum operating pressure shall be _____ psig and the minimum operating pressure shall be _____ psig.
- B. The boiler shall have a maximum output of _____ Btu/hr, or _____ horsepower when fired with CS12-48 _____ oil and/or natural gas, _____ Btu/cu-ft. Electrical power available shall be _____ Volt _____ Phase _____ Cycle.

PART 2 PRODUCTS

2.1 General Boiler Design

- A. The boiler shall be a three pass or four pass horizontal firetube updraft boiler with _____ square feet of heating surface per rated boiler horsepower. It shall be mounted on a heavy steel frame with integral forced draft burner and burner controls.
 1. The boiler shall be completely preassembled and fire tested at the factory. The unit shall be ready for immediate mounting on floor or simple foundation and ready for attachment of water, fuel, electrical, vent, and blowdown connections.
 2. The boiler shall be built to comply with the following insurance and codes _____ (Factory Mutual, Industrial Risk Insurance, ASME, NFPA 8501).
- B. Boiler Shell (Steam)
 1. The boiler shell must be constructed in accordance with ASME Boiler Code and must receive authorized boiler inspection prior to shipment. A copy of the inspection report shall be furnished to the purchaser.
 2. The boiler shall be furnished with a manhole and handholes to facilitate boiler inspection and cleaning. Two lifting lugs must be located on top of the boiler.
 3. The front door shall be davited and the rear door shall be davited. Doors are to be sealed with fiberglass tadpole gaskets and fastened tightly using heavy capscrews that thread into replaceable brass nuts.
 4. The boiler tubes shall not include turbulators, swirlers, or other add-on appurtenances.
 5. The rear door shall be insulated with a blanket material with a steel covering to give the surface a hard durable finish.
 6. The exhaust gas vent shall be located at the front or rear of the boiler and be capable of supporting 2000 lbs. The boiler vent shall contain a stack thermometer.
 7. Observation ports for the inspection flame conditions shall be provided at each end of the boiler.
 8. The boiler insulation shall consist of 2 inch blanket under a sectional pre-formed sheet metal lagging. The insulation must be readily removable and capable of being reinstalled, if required.

9. The entire boiler base frame and other components shall be factory-painted before shipment, using a hard-finish enamel coating.
10. The boiler shall contain a chemical feed connection.

2.2 Steam Boiler Trim

- A. Water Column

A water column shall be located on the right-hand side of the boiler complete with gauge glass set, and water column blowdown valves.

 1. Modulating feedwater Control

The boiler modulating feedwater control and valve shall be included to automatically maintain the boiler water level within normal limits.
 2. Low Water Cutoff

The low water cutoff shall be included as an integral part of the boiler feedwater control and wired into the burner control circuit to prevent burner operation if the boiler water level falls below a safe level.
- B. Auxiliary Low Water Cut-off

Auxiliary low water cut-off shall be included, piped to the vessel, and wired to the burner control circuit. A manual reset device shall be used on this control.
- C. Steam Pressure Gauge

The steam pressure gauge shall be located at the front of the boiler and include cock and test connection.
- D. Safety Valves

Safety valves of a type and size to comply with ASME Code requirements shall be shipped loose.
- E. Steam Pressure Controls

The steam pressure control to regulate burner operation shall be mounted near the water column. Controls shall be a high limit (manual reset), operating limit (auto reset), and firing rate control.

2.3 Burner and Controls

- A. Mode of Operation
 1. Burner operation shall be full modulation principle. The burner shall always return to low fire position for ignition.
 2. A low fire hold temperature control is mounted and wired on the boiler.
- B. Blower
 1. All air for combustion shall be supplied by a forced draft blower mounted on the burner, to eliminate vibration and reduce noise level.
 2. Maximum sound level of the boiler/burner package shall not exceed _____ dbA (when measured in accordance with ABMA Sound Test Standards).
 3. The impeller shall be fabricated aluminum with radial blade, carefully balanced, and directly connected to the blower motor shaft.
- C. Combustion Air Control

Combustion air damper and cam-operated fuel metering valve shall be operated by a single damper control motor that regulates the flame according to load demand. Potentiometer type position controls shall be provided to regulate operation of the damper control motor.

2.4 Fuel Specification and Piping

Select one of the following fuel types:

- Fuel series 700 - Gas-fired.
- Fuel series 100 - Light oil (No. 2) fired.
- Fuel series 200 - Light oil or gas-fired.
- Fuel series 600 - No. 6 oil-fired.
- Fuel series 400 - No. 6 oil or gas-fired.

A. Fuel Series 700 - Gas-Fired

1. **Burner Type** - The burner shall be mounted at the front of the boiler and of high radiant multi-port type gas entry. The burner shall be approved for operation on natural gas fuel.
2. **Gas Pilot** - The gas pilot shall be a premix type with automatic electric ignition. An electronic detector shall monitor the pilot so that the primary gas valve cannot open until pilot flame has been established. The pilot train shall include one manual shut-off valve, solenoid valve, pressure regulator and one (1) plugged leakage test connection (Canada only).
3. **Gas Burner Piping** - Gas burner piping on all units shall include a gas pressure regulator, a primary gas shutoff valve, motor operated with proof of closure switch and plugged leakage test connection. The main gas valves shall be wired to close automatically in the event of power failure, flame failure, low water or any safety shutdown condition. A lubricating plug cock shall be provided as a means for a tightness check of the primary shutoff valve. An additional plug cock shall be furnished at entrance to gas train. High and low gas pressure switches shall be provided. A second motorized safety shutoff valve, plus an additional plugged leakage test connection shall be provided. A vent valve shall be located between the safety shutoff valves.
4. **Burner Turndown**: Turndown range shall be 8:1 when firing natural gas on standard burners with uncontrolled emissions (100 ppm NOx). Consult Cleaver-Brooks representative regarding turndown capability for low NOx burners 30 ppm and less.

B. Fuel Series 100 - Light Oil-Fired

1. **Burner Type** - The burner shall be mounted at the front of the boiler, and shall be a low pressure air atomizing type approved for operation with CS12-48, Commercial No. 2 oil.
2. **Gas Pilot** - The gas pilot shall be a premix type with automatic electric ignition. An electronic detector shall monitor the pilot so that the primary oil valve cannot open until pilot flame has been established. The pilot train shall include one manual shut-off valve, solenoid valve, pressure regulator and one (1) plugged leakage test connection (Canada only).
3. **Oil Pump** - An oil pump with a capacity of approximately twice the maximum burning rate shall be included. The motor-driven pump set, shipped loose, to be installed in a location favorable to the oil storage tank, shall be provided.
4. **Oil Burner Piping**
 - a. Fuel oil piping on the unit shall include oil pressure regulating devices, oil metering controls, low oil pressure switch, two (2) motorized oil valves and pressure gauges, all integrally mounted on the unit.

5. Low Pressure Air Atomizing: Separate air compressor module, “shipped loose” with burner mounted low atomizing air pressure switch.
 6. Turndown range shall be 6:1 when firing No. 2 oil on standard burners with uncontrolled emissions. Consult Cleaver-Brooks representative regarding turndown capability for low NOx burners.
- C. Fuel Series 200 - Light Oil or Gas-Fired
1. Burner Type - The burner shall be mounted at the front of the boiler and shall be a combination of the low pressure air atomizing type for oil and multi-port type for gas. The burner shall be approved for operation with either CS12-48 Commercial No. 2 Oil or natural gas.
 2. Gas Pilot - The gas pilot shall be premix type with automatic electric ignition. An electronic detector shall monitor the pilot so that the primary fuel valve cannot open until flame has been established. The pilot train shall include one manual shut-off valve, solenoid valve, pressure regulator and pressure gauge and one (1) plugged leakage test connection (Canada only).
 3. Oil Burner
 - a. Oil Pump - An oil pump with a capacity of approximately twice the maximum burning rate shall be included. The motor-driven pump set, shipped loose, shall be provided, to be installed in a location favorable to the oil storage tank.
 - b. Oil Burner Piping - Fuel oil piping on the unit shall include oil pressure regulating devices, oil metering controls, low oil pressure switch, two (2) motorized oil valves, and pressure gauges all integrally mounted on the unit.
 - c. Low pressure Air Atomizing - Separate air compressor module, “shipped loose” with burner-mounted low-atomizing air pressure switch.
 - d. Burner Turndown - Turndown range shall be 6:1 when firing No. 2 oil on standard burners with uncontrolled emissions. Consult Cleaver-Brooks representative regarding turndown capability for low NOx burners.
 4. Gas Burner
 - a. Gas Burner Piping - Gas burner piping on all units shall include a gas pressure regulator, and a primary gas shutoff valve, motor-operated with proof-of-closure switch and plugged leakage test connection. The main gas valves shall be wired to close automatically in the event of power failure, flame failure, low water or any safety shutdown condition. A lubricating plug cock shall be provided as a means for a tightness check of the primary shutoff valve. An additional plug cock shall be furnished at entrance to gas train. High and low gas pressure switches shall be provided. A second motorized safety shutoff valve, plus an additional plugged leakage test connection shall be provided. A vent valve shall be located between the safety shutoff valves.
 - b. Burner Turndown - Turndown range shall be 8:1 when firing natural gas on standard burners with uncontrolled emissions (100 ppm NOx). Consult Cleaver-Brooks representative regarding turndown capability for low NOx burners 30 ppm and less.
- D. Fuel Series 600 - No. 6 Oil-Fired
1. Burner Type - The burner shall be mounted at the front of the boiler and low pressure air atomizing type approved for operation with CS12-48, Commercial No. 6 Oil.
 2. Gas Pilot - The gas pilot shall be a premix type with automatic electric ignition. An electronic detector shall monitor the pilot so that the primary oil valve cannot

- open until pilot flame has been established. The pilot train shall include one manual shut-off valve, solenoid valve, pressure regulator and pressure gauge and one (1) plugged leakage test (Canada only).
3. Oil Pump - An oil pump set with a capacity of approximately twice the maximum burning rate shall be included.
 - The motor driven pump set, shipped loose, to be installed in a location favorable to the oil storage tank shall be provided.
 4. Oil Burner Piping - Fuel oil piping on the unit shall include oil pressure regulating devices, oil metering controls, low oil pressure switch, two (2) motorized oil valves and pressure gauges all integrally mounted on the unit.
 5. Low Pressure Air-Atomizing - Separate air compressor module, "shipped loose" with the burner-mounted low-atomizing air pressure switch.
 6. Oil Preheat
The oil shall be preheated by a steam heater and electric heater, each with thermostatic control. Both heaters shall be installed in a single compact shell; mounted, piped, and wired. The thermostatic controls shall be set to cut-out the electric heater when steam is available.
 7. Burner Turndown - Turndown range will be 4:1 when firing No. 6 oil on standard burners with uncontrolled emissions. Consult Cleaver-Brooks representative regarding turndown capability for low NOx burners.
- E. Fuel Series 400 - No. 6 Oil or Gas-Fired
1. Burner Type - The burner shall be mounted at the front the boiler and shall be a combination of the low pressure atomizing type for oil and multi-port type for gas. The burner shall be approved for operation with either CS12-48 Commercial No. 6 oil or natural gas.
 2. Gas Pilot - The gas pilot shall be a premix type with automatic electric ignition. An electronic detector shall monitor the pilot so that the primary fuel valve cannot open until pilot flame has been established. The pilot train shall include one manual shut-off valve, solenoid valve, pressure regulator and pressure gauge, and one (1) plugged leakage test connection. (Canada only.)
 3. Oil Burner
 - a. Oil Pump - An oil pump with a capacity of approximately twice the maximum burning rate shall be included. The motor driven pump set, shipped loose, shall be provided to be installed in a location favorable to the oil storage tank.
 - b. Oil Burner Piping - Fuel oil piping on the unit shall include oil pressure regulating devices, oil metering controls, low oil pressure switch, two (2) motorized oil valves, and pressure gauges all integrally mounted on the unit.
 - c. Low Pressure Air-Atomizing: Separate air compressor module "shipped loose" with burner mounted low atomizing air pressure switch.
 - d. Oil Preheat - The oil shall be preheated by a steam heater and electric heater, each with thermostatic control. Both heaters shall be installed in a single compact shell mounted, piped, and wired. The thermostatic controls shall be sent to cut-out the electric heater when steam is available.
 - e. Burner Turndown - Turndown range will be 4:1 when firing No. 6 oil on standard burners with uncontrolled emissions. Consult Cleaver-Brooks representative regarding turndown capability for low NOx burners.
 - f. Gas Burner
 - 1) Gas Burner Piping - Gas burner piping on all units shall include a gas pressure regulator, and a primary gas shutoff valve, motor-operated with proof-of-closure switch and plugged leakage test connection. The main

gas valves shall be wired to close automatically in the event of power failure, flame failure, low water or any safety shutdown condition. A lubricating plug cock shall be provided as means for a tightness check of the primary shutoff valve. An additional plug cock shall be furnished at entrance to gas train. High and low gas pressure switches shall be provided. A second motorized safety shutoff valve, plus an additional plugged leakage test connection shall be provided. A vent valve shall be located between the safety shutoff valves.

- 2) Burner Turndown - Turndown range shall be 6:1 when firing natural gas on standard burners with uncontrolled emissions (100 ppm NO_x). Consult Cleaver- Brooks representative regarding turndown capability for low NO_x burners 30 ppm and less.

2.5 Boiler Flame Safeguard Controller and Control Panel

A. CB100E Flame Safeguard

1. Each boiler shall be factory-equipped with flame safeguard controller providing technology and functions equal to the Cleaver-Brooks Model CB100E. Flame safeguard shall be a Cleaver-Brooks Model CB 100E microprocessor-based control to monitor all critical boiler and burner interlocks, control and supervise burner light-off sequence, and initiate an orderly safety procedure in the event of interlock or flame failure. The system shall provide status, fault history, and diagnostic information by means of a BACKLIT LCD display. The system shall be approved by UL, FM, and CSA, and shall be acceptable by IRI.

B. Control Panel

A factory prewired control panel shall be supplied with the boiler/burner package. Panel may be mounted on the burner or boiler.

1. The panel will have a NEMA 1A rating and contain the flame safeguard controller, burner motor starter, air compressor motor starter, oil-metering pump motor starter, control circuit transformer and fuses, selector switches, indicating lights and terminal strips. Lights shall indicate load demand, flame failure, low water, and fuel valve open.
2. The panel shall contain over-current protection for the burner motor, air compressor motor, and oil metering pump.

2.6 Efficiency Guarantee

- A. The boiler must be guaranteed to operate at a minimum fuel-to-steam efficiency of _____ percent at 100 percent of rating when burning natural gas and _____ fuel-to-steam efficiency at 100% firing rate when burning oil (Contact your local Cleaver-Brooks authorized representative for efficiency details).

PART 3 EXECUTION

3.1 Warranty

- A. All equipment is to be guaranteed against defects in materials and/or workmanship for a period of 12 months from date of start-up, or 18 months from date of shipment; whichever comes first.

3.2 Shop Tests

- A. The packaged boiler must receive factory tests to check the construction, controls, and operation of the unit. All tests may be witnessed by the purchaser, if desired.

B. Start-up Service

1. After boiler installation is completed, the manufacturer shall provide the services of a field representative for starting the unit and training the operator at no additional costs.
 - a. A factory-approved and authorized start-up report shall be submitted to the customer/user at the time of start-up.