

# CBR

## 125-800 HP



Boiler Book  
03/2018



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## *FEATURES AND BENEFITS*

- 125-800hp.
- Steam and hot water.
- Same available pressures as equivalent Model CB/CBLE/CBW/4WI.
- Capable of firing natural gas, #2-#6 oil, bio-gas, digester gas or town gas.
- Low NOx capabilities—natural gas only.
- Containerization from 125-800 hp will reduce delivered to job site price for large boilers that would otherwise be shipped on flatracks.
- Enhanced heat transfer technology enables Cleaver-Brooks to reduce the number of tubes, thus reducing the overall weight and shell diameters while maintaining high fuel-to steam efficiency.
- Integral burner design.
- Allows interchangeability of burner spare parts for Models CB/CBLE/CBR.
- Enables us to offer 50/60Hz with no price surcharge.
- Corrugated furnace will be standard equipment.
- .095” tubes will be standard. (.105” tubes can be supplied at an additional cost.)
- Level master will be standard equipment.
- The CBR can be ordered with Hawk ICS as well as all other boiler extras which are available for Model CB/CBLE/4WI boilers.
- Same factory warranty as is applied to all other Cleaver-Brooks products.
- The CBR will be manufactured in the U.S. at our facility in Thomasville, Georgia.
- Locally available spare parts and after sales services through exclusive Cleaver-Brooks representatives around the world.

## *DIMENSIONS AND RATINGS*

Dimensions and ratings for the Model CBR boilers are shown in the following tables and illustrations:

- Table 1. Model CBR Steam Boiler Ratings
- Table 2. Model CBR Hot Water Boiler Ratings
- Table 5. Safety Valve Openings
- Table 6. Relief Valve Openings
- Figure 1. Model CBR Steam Boiler Dimensions
- Figure 2 Model CBR Hot Water Boiler Dimensions
- Figure 3. Space Required to Open Rear Head on Model CBR Boilers Equipped with Davits
- Figure 5. Model CBR Boiler Mounting Piers
- Figure 6. Lifting Lug Locations, Model CBR Boilers

**Table 1: Model CBR Steam Boiler Ratings**

BOILER H.P.	125	150	200	250	300	350	400	500	600	700	800
RATINGS - SEA LEVEL TO 700 FT.											
Rated Capacity (lbs-steam/hr from and at 212 °F)	4313	5175	6900	8625	10350	12075	13800	17250	20700	24150	27600
Btu Output (1000 Btu/hr)	4184	5021	6695	8369	10043	11716	13390	16738	20085	23433	26780
APPROXIMATE FUEL CONSUMPTION AT RATED CAPACITY BASED ON NOMINAL 80% EFFICIENCY											
Light Oil gph (140,000 Btu/gal)	37.4	44.8	59.8	74.7	89.7	104.6	119.5	149.4	179.3	209.2	239.1
Heavy Oil gph (150,000 Btu/gal)	34.9	41.8	55.8	69.7	83.7	97.6	111.6	139.5	167.4	195.3	223.2
Gas CFH (1000 Btu)	5230	6277	8369	10461	12553	14645	16738	20922	25106	29291	33475
Gas (Therm/hr)	52.3	62.8	83.7	104.6	125.5	146.5	167.4	209.2	251.1	292.9	334.8
POWER REQUIREMENTS - SEA LEVEL TO 700 FT. (60 HZ)											
Blower Motor hp (60 ppm) <sup>A</sup>	7 1/2	10	15	7 1/2	15	20	10	15	30	40	50
Blower Motor hp (30 ppm) <sup>A</sup>	10	15	20	15	20	30	15	25	40	60	75
Oil Pump Motor, hp, No. 2 Oil	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4	1	1
Oil Pump Motor, hp, No. 6 Oil	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4	3/4
Air Compressor Motor hp	3	3	3	5	5	5	7-1/2	7-1/2	7-1/2	7-1/2	7-1/2
Heavy Oil Heater kW <sup>B</sup>	5	5	5	7 1/2	7 1/2	7 1/2	7 1/2	7 1/2 <sup>C</sup>	7 1/2 <sup>C</sup>	7 1/2 <sup>C</sup>	7 1/2 <sup>C</sup>
BOILER DATA											
Heating Surface sq-ft. (Fireside)	459	459	641	764	966	1238	1226	1374	1794	2535	2535

Notes:

A. Blower motor size for boiler operating pressures 125 psig and less, contact your local Cleaver-Brooks authorized representative for higher pressures and altitude.

B. Oil heater sized as a combination steam-electric heater. For straight electric heaters, contact your local Cleaver-Brooks authorized representative.

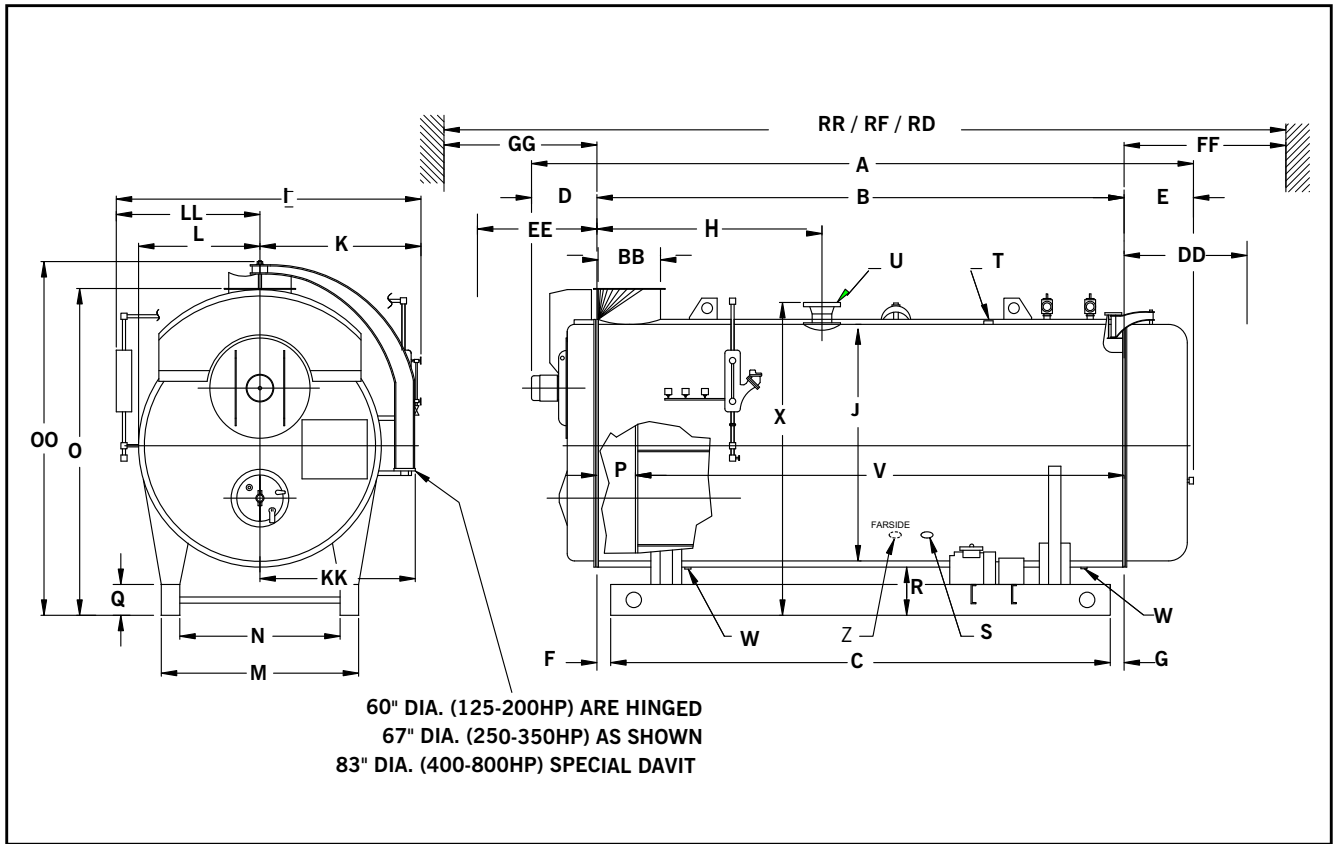
C. 10 KW Oil heater for low pressure.

**Table 2: Model CBR Hot Water Boiler Ratings**

BOILER H.P.	125	150	200	250	300	350	400	500	600	700	800
RATINGS - SEA LEVEL TO 700 FT.											
Btu Output (1000 Btu/hr)	4184	5021	6695	8369	10043	11716	13390	16738	20085	23433	26780
APPROXIMATE FUEL CONSUMPTION AT RATED CAPACITY BASED ON NOMINAL 80% EFFICIENCY											
Light Oil gph (140,000 Btu/gal)	37.4	44.8	59.8	74.7	89.7	104.6	119.5	149.4	179.3	209.2	239.1
Heavy Oil gph (150,000 Btu/gal)	34.9	41.8	55.8	69.7	83.7	97.6	111.6	139.5	167.4	195.3	223.2
Gas CFH (1000 Btu)	5230	6277	8369	10461	12553	14645	16738	20922	25106	29291	33475
Gas (Therm/hr)	52.3	62.8	83.7	104.6	125.5	146.5	167.4	209.2	251.1	292.9	334.8
POWER REQUIREMENTS - SEA LEVEL TO 700 FT. (60 HZ)											
Blower Motor hp (60 ppm)	7 1/2	10	15	7 1/2	15	20	10	15	30	40	50
Blower Motor hp (30 ppm)	10	15	20	15	20	30	15	25	40	60	75
Oil Pump Motor, hp, No. 2 Oil	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4	1	1
Oil Pump Motor, hp, No. 6 Oil	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4	3/4
Air Compressor Motor hp	3	3	3	5	5	5	7-1/2	7-1/2	7-1/2	7-1/2	7-1/2
Heavy Oil Heater kW <sup>A</sup>	5	5	5	7 1/2	7 1/2	7 1/2	10	10	10	10	10
BOILER DATA											
Heating Surface sq-ft. (Fireside)	459	459	644	764	966	1238	1226	1374	1794	2535	2535

Notes:

A. Oil heater sized as a straight electric heater.



*Figure 1. CBR Steam Boiler Dimension Diagram*

**Table 3: CBR Steam Boiler Dimensions and Weights**

BOILER H.P.	DIM	125	150	200	250	300	350	400	500	600	700	800
<b>LENGTHS</b>												
Overall Length (60 PPM system)	A	196.5	199.5	231.5	207	226	258	224	230	266	300	301
Overall Length (30 PPM system)	A	199.5	200.5	233.5	211	228	260	225	234	267	302	303
Shell	B	149	149	180	156	171	201	167.75	168	200	233	233
Base Frame	C	136	136	167	143	158	188	150	155	187	220	220
Front Head Extension (60 PPM system)	D	28	31	32	28	32	34	29	30	34	35	36
Front Head Extension (30 PPM system)	D	31	32	34	32	34	36	30	34	35	37	38
Rear Head Extension	E	19.5	19.5	19.5	23	23	23	32	32	32	32	32
Shell Ring Flange to Base	F	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Rear Ring Flange to Base	G	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Shell Flange to Steam Nozzle 15 psi	H	90	90	96	96	98	112	101	101	96	112	112
Shell Flange to Steam Nozzle 150 psi	H	84	84	96	96	98	112	100	100	96.25	112.75	112.75
Front Shell Extension	P	12	12	12	15	15	15	17	17	17	17	17
Over Tubesheets	V	137	137	168	141	156	186	146	151	183	216	216
<b>WIDTHS</b>												
Overall Width	I	85	85	85	92	92	92	109	109	109	109	109
I.D. Boiler	J	60	60	60	67	67	67	83	83	83	83	83
Center to Water Column	K	45	45	45	48.5	48.5	48.5	56.5	56.5	56.5	56.5	56.5
Center to Outside Davit/Hinge	KK	35	35	35	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5
Center to Lagging	L	33	33	33	36.5	36.5	36.5	44.5	44.5	44.5	44.5	44.5
Center to Auxiliary LWCO	LL	40	40	40	43.5	43.5	43.5	52.5	52.5	52.5	52.5	52.5
Base Outside	M	52.5	52.5	52.5	51	51	51	60	60	60	60	60
Base Inside	N	44.5	44.5	44.5	43	43	43	47	47	47	47	47
<b>HEIGHTS</b>												
Overall Height	OO	87	87	87	102.5	102.5	102.5	120.5	120.5	120.5	120.5	120.5
Base to Vent Outlet	O	87	87	87	94.5	94.5	94.5	112	112	112	112	112
Height of Base Frame	Q	12	12	12	12	12	12	14	14	14	14	14
Base to Bottom of Boiler	R	16	16	16	14	14	14	16	16	16	16	16
Base to Steam Outlet	X	82.375	82.375	82.375	90.25	90.25	90.25	108	108	108	108	108
<b>BOILER CONNECTIONS</b>												
Feedwater Inlet (Both Sides)	S	1.5	1.5	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5
Surface Blowoff (150 lb only)	T	1	1	1	1	1	1	1	1	1	1	1
Steam Nozzle 15 lb (See Note "A")	U	8	8	10	12	12	12	12	12	12	12	12
Steam Nozzle 150 lb (See Note "B")	U	4	4	4	6	6	6	6	8	8	8	8
Blowdown-Front & Rear (15 lb)	W	1.5	1.5	2	2	2	2	2	2	2	2	2
Blowdown-Front & Rear (150 lb)	W	1.5	1.5	1.5	1.5	1.5	1.5	2	2	2	2	2
Chemical Feed	Z	1	1	1	1	1	1	1	1	1	1	1
<b>VENT STACK</b>												
Vent Stack Diameter (Flanged)	BB	16	16	16	20	20	20	24	24	24	24	24
<b>MINIMUM CLEARANCES</b>												
Rear Door Swing	DD	32	32	32	36	36	36	45	45	45	45	45
Front Door Swing	EE	67	67	67	75	75	75	80	80	80	80	80
Tube Removal - Rear	FF	139	139	170	143	157	187	147	152	184	217	217
Tube Removal - Front	GG	127	127	158	128	142	172	130	135	167	200	200
<b>MINIMUM BOILER ROOM LENGTH ALLOWING FOR DOOR SWING AND TUBE REMOVAL FROM:</b>												
Thru Window or Door	RD	248	248	279	267	282	312	288	293	325	358	358
Front of Boiler	RF	308	308	370	320	349	409	338	348	412	478	478
Rear of Boiler	RR	355	355	417	374	403	463	390	400	464	530	530
<b>WEIGHTS IN LBS</b>												
Normal Water Weight		6,950	6,950	8,350	8,400	9,050	10,550	11,650	11,900	14,150	15,700	15,700
Approx. Shipping Weight - (15 psig)		11,850	11,850	13,550	15,400	17,550	19,750	26,450	27,100	30,700	35,700	35,700
Approx. Shipping Weight - (150 psig)		13,000	13,000	14,850	18,100	19,300	20,750	29,050	29,750	32,400	37,600	37,600
Approx. Shipping Weight - (200 psig)		13,200	13,200	15,100	19,250	20,300	23,300	29,800	30,150	34,850	38,800	38,800

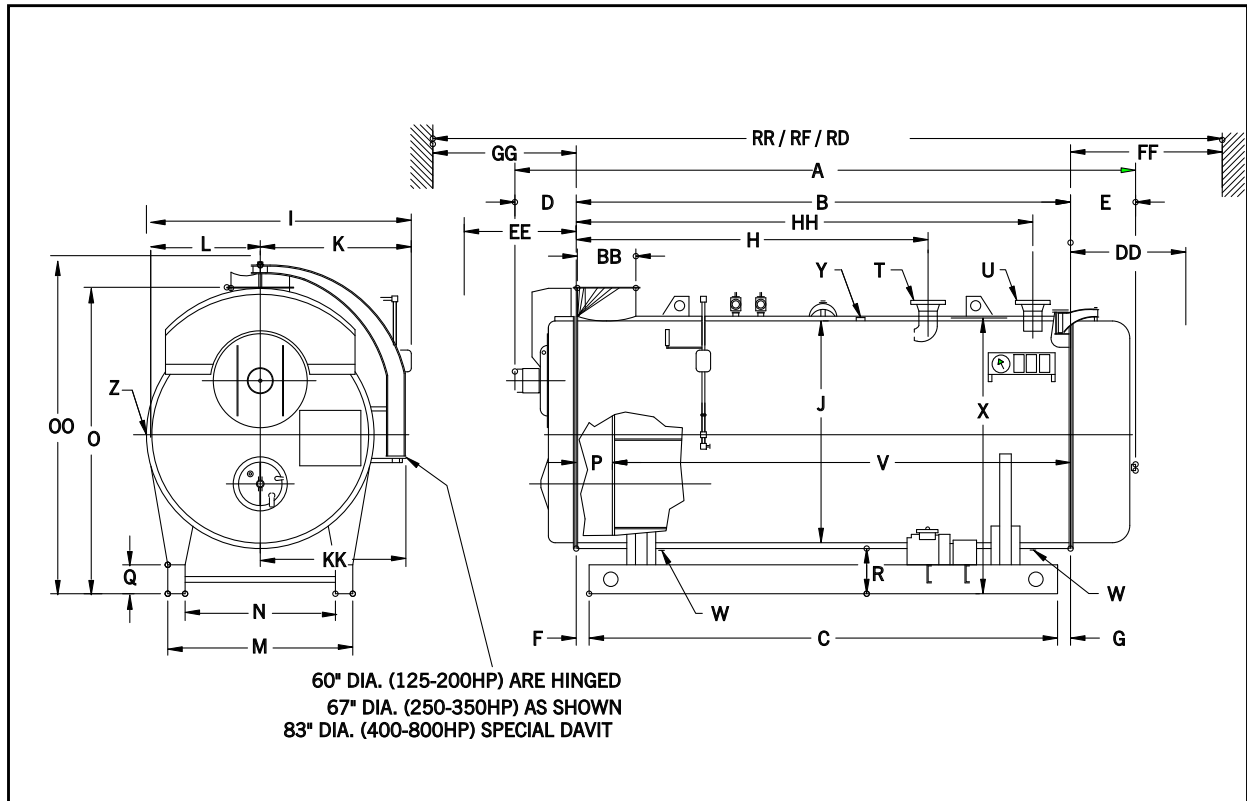
**NOTES:**

Accompanying dimensions, while sufficiently accurate for layout purposes, must be confirmed for construction by certified dimension

All Connections are Threaded Unless Otherwise Indicated:

Note "A": ANSI 150 psig Flange

Note "B": ANSI 300 psig Flange



**Figure 2. CBR Hot Water Boiler Dimension Diagram**

**Table 4: CBR Hot Water Boiler Dimensions and Weights**

BOILER H.P.	DIM	125	150	200	250	300	350	400	500	600	700	800
<b>LENGTHS</b>												
Overall Length (60 PPM system)	A	196.5	199.5	231.5	207	226	258	224	230	266	300	301
Overall Length (30 PPM system)	A	199.5	200.5	233.5	211	228	260	225	234	267	302	303
Shell	B	149	149	180	156	171	201	163	168	200	233	233
Base Frame	C	136	136	167	143	158	188	150	155	187	220	220
Front Head Extension (60 PPM system)	D	28	31	32	28	32	34	29	30	34	35	36
Front Head Extension (30 PPM system)	D	31	32	34	32	34	36	30	34	35	37	38
Rear Head Extension	E	19.5	19.5	19.5	23	23	23	32	32	32	32	32
Shell Ring Flange to Base	F	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Rear Ring Flange to Base	G	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Shell Flange to Return	H	102	102	131	115.5	130.5	160.5	124.75	124.75	151.25	184.75	184.75
Shell Flange to Outlet	HH	136	136	167	143	157	187	151.75	151.75	182.75	216.25	216.25
Front Shell Extension	P	12	12	12	15	15	15	17	17	17	17	17
Over Tubesheets	V	137	137	168	141	156	186	146	151	183	216	216
<b>WIDTHS</b>												
Overall Width	I	75.5	75.5	75.5	82	82	82	100	100	100	100	100
I.D. Boiler	J	60	60	60	67	67	67	83	83	83	83	83
Center to Entrance Box	K	42.5	42.5	42.5	45.5	45.5	45.5	55.5	55.5	55.5	55.5	55.5
Center to Outside of Davit/Hinge	KK	35	35	35	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5
Center to Lagging	L	33	33	33	36.5	36.5	36.5	44.5	44.5	44.5	44.5	44.5
Base Outside	M	52.5	52.5	52.5	51	51	51	60	60	60	60	60
Base Inside	N	44.5	44.5	44.5	43	43	43	47	47	47	47	47
<b>HEIGHTS</b>												
Overall Height	OO	87	87	87	102.5	102.5	102.5	120.5	120.5	120.5	120.5	120.5
Base to Vent Outlet	O	87	87	87	94.5	94.5	94.5	112	112	112	112	112
Height of Base Frame	Q	12	12	12	12	12	12	14	14	14	14	14
Base to Bottom of Boiler	R	16	16	16	14	14	14	16	16	16	16	16
Base to Return & Outlet	X	82.375	82.375	82.375	90.25	90.25	90.25	108	108	108	108	108
<b>BOILER CONNECTIONS</b>												
Water Return (See Note "A")	T	6	6	6	8	8	8	10	10	12	12	12
Water Outlet (See Notes "A & B")	U	6	6	6	8	8	8	10	10	12	12	12
Drain-Front & Rear	W	1.5	1.5	2	2	2	2	2	2	2	2	2
Air Vent	Y	1.5	1.5	1.5	1.5	1.5	1.5	2	2	2	2	2
<b>VENT STACK</b>												
Vent Stack Diameter (Flanged)	BB	16	16	16	20	20	20	24	24	24	24	24
<b>MINIMUM CLEARANCES</b>												
Rear Door Swing	DD	32	32	32	36	36	36	45	45	45	45	45
Front Door Swing	EE	67	67	67	75	75	75	80	80	80	80	80
Tube Removal - Rear	FF	139	139	170	143	157	187	147	152	184	217	217
Tube Removal - Front	GG	127	127	158	128	142	172	130	135	167	200	200
<b>MINIMUM BOILER ROOM LENGTH ALLOWING FOR DOOR SWING AND TUBE REMOVAL FROM:</b>												
Thru Window or Door	RD	248	248	279	267	282	312	288	293	325	358	358
Front of Boiler	RF	308	308	370	320	349	409	338	348	412	478	478
Rear of Boiler	RR	355	355	417	374	403	463	390	400	464	530	530
<b>WEIGHTS IN LBS</b>												
Normal Water Weight	10,80	10,800	13,050	11,750	12,750	15,000	16,900	17,150	20,500	23,250	23,250	
Approx. Shipping Weight - (30 psig)	11,85	11,850	13,550	15,400	17,550	19,750	26,400	27,100	30,700	35,700	35,700	
Approx. Shipping Weight - (125 psig)	13,20	13,200	15,100	18,350	18,400	20,700	29,400	28,150	31,900	37,050	37,050	

**NOTES:**

Accompanying dimensions, while sufficiently accurate for layout purposes, must be confirmed for construction by certified dimension diagram/drawing.

All Connections are Threaded Unless Otherwise Indicated:

Note "A": ANSI 150 psig Flange

Note "B": Water Outlet includes 2" Dip Tube



**Table 5: Steam Boiler Safety Valve Openings**

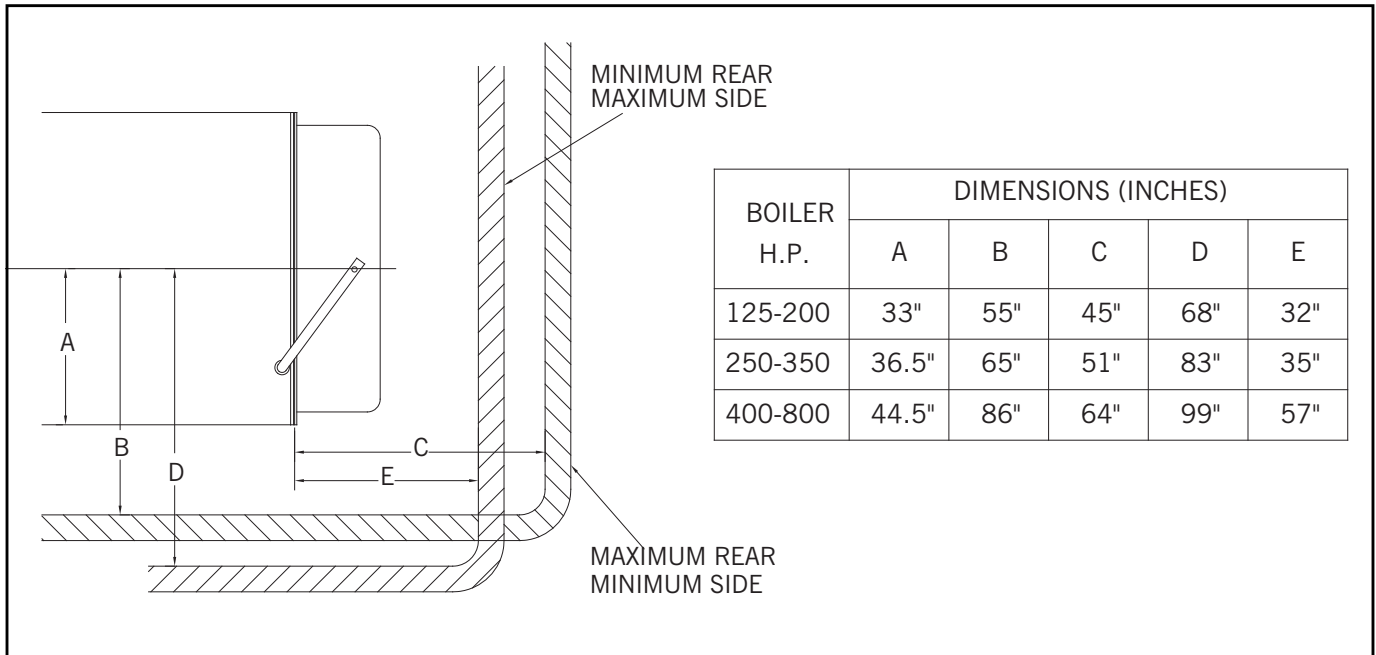
VALVE SETTING BOILER HP	15 PSIG STEAM		150 PSIG STEAM		200 PSIG STEAM		250 PSIG STEAM	
	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)
125	1	2-1/2	1	2	1	1-1/2	1	1-1/2
150	1	3	2	(1) 1-1/2 (1) 1-1/4	2	(1) 1-1/4 (1) 1	2	1
200	1	3	2	1-1/2	2	(1) 1-1/2 (1) 1-1/4	2	1-1/4
250	2	2-1/2	2	(1) 2 (1) 1-1/2	2	(1) 1-1/2 (1) 1-1/4	2	(1) 1-1/2 (1) 1-1/4
300	2	(1) 2-1/2 (1) 3	2	(1) 2 (1) 1-1/2	2	1-1/2	2	(1) 1-1/2 (1) 1-1/4
350	2	3	2	2	2	(1) 2 (1) 1-1/2	2	1-1/2
400	2	3	2	(1) 2-1/2 (1) 2	2	(1) 2 (1) 1-1/2	2	(1) 2 (1) 1-1/2
500	3	(2) 3 (1) 2-1/2	2	(1) 2-1/2 (1) 2	2	(1) 2 (1) 2-1/2	2	(1) 2 (1) 1-1/2
600	3	3	2	2-1/2	2	(1) 2 (1) 2-1/2	2	2
700	4	(3) 3 (1) 2-1/2	3	(2) 2-1/2 (1) 2	2	2-1/2	2	(1) 2-1/2 (1) 2
800	4	3	3	(2) 2-1/2 (1) 2	2	2-1/2	2	(1) 2-1/2 (1) 2

NOTE: Valve manufacturers are Kunkle, Consolidated or Conbraco, depending on availability. Table revised 03/2018.

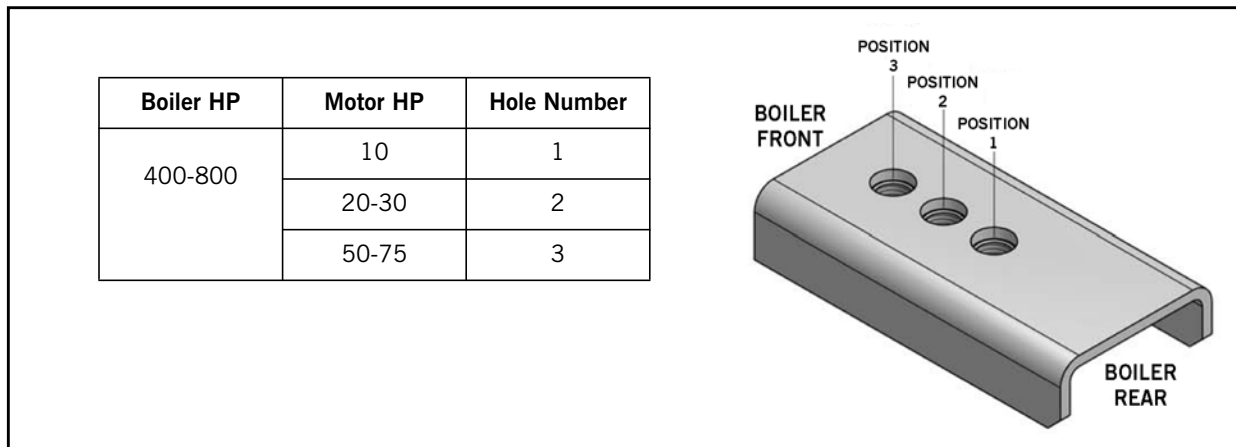
**Table 6: Hot Water Boiler Safety Valve Openings**

VALVE SETTING BOILER HP	30 PSIG HW		125 PSIG HW		150 PSIG HTHW	
	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)
125	1	2-1/2	1	1-1/4	2	1-1/2
150	1	2-1/2	1	1-1/4	2	(1) 1-1/2 (1) 2
200	2	2	1	2	2	2
250	2	(1) 1-1/2 (1) 2-1/2	1	2	2	(1) 2 (1) 2-1/2
300	2	(1) 2 (1) 2-1/2	1	2	2	(1) 2 (1) 2-1/2
350	2	2-1/2	1	2-1/2	2	2-1/2
400	3	(2) 2 (1) 2-1/2	1	2-1/2	2	(1) 2 (1) 3
500	3	(1) 2 (2) 2-1/2	1	2-1/2	2	(1) 2-1/2 (1) 3
600	3	(3) 2-1/2	2	(1) 1 (1) 2-1/2	2	3
700	4	(1) 2 (3) 2-1/2	2	(1) 1 (1) 2-1/2	3	(1) 3 (2) 2-1/2
800	4	2-1/2	2	(1) 2 (1) 2-1/2	3	(2) 3 (1) 2-1/2

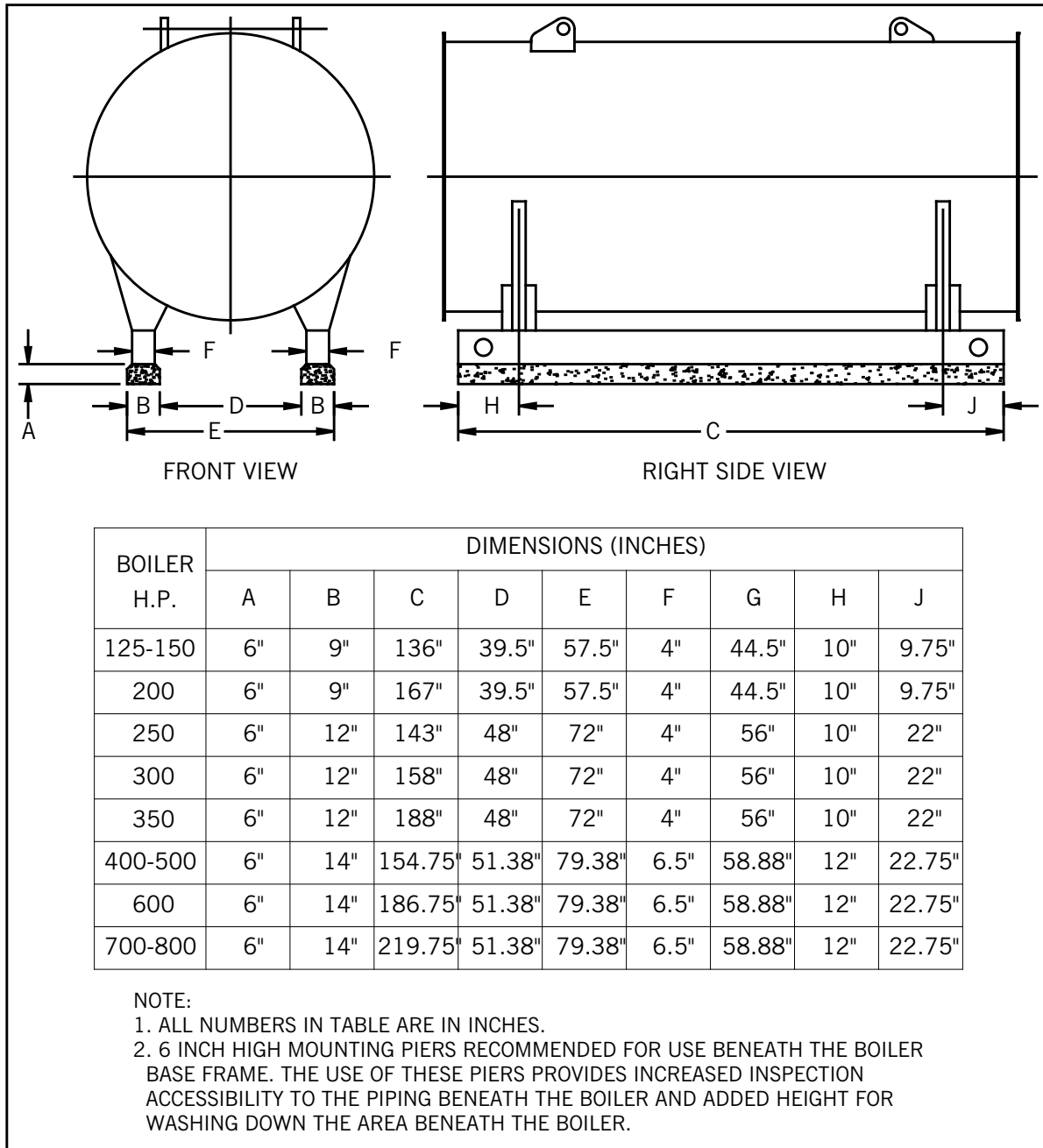
NOTE: Relief valve is Kunkle #537 for 30# & 125#(Section IV) boiler and is Kunkle #927 for 150# HTHW(Section I) boiler.



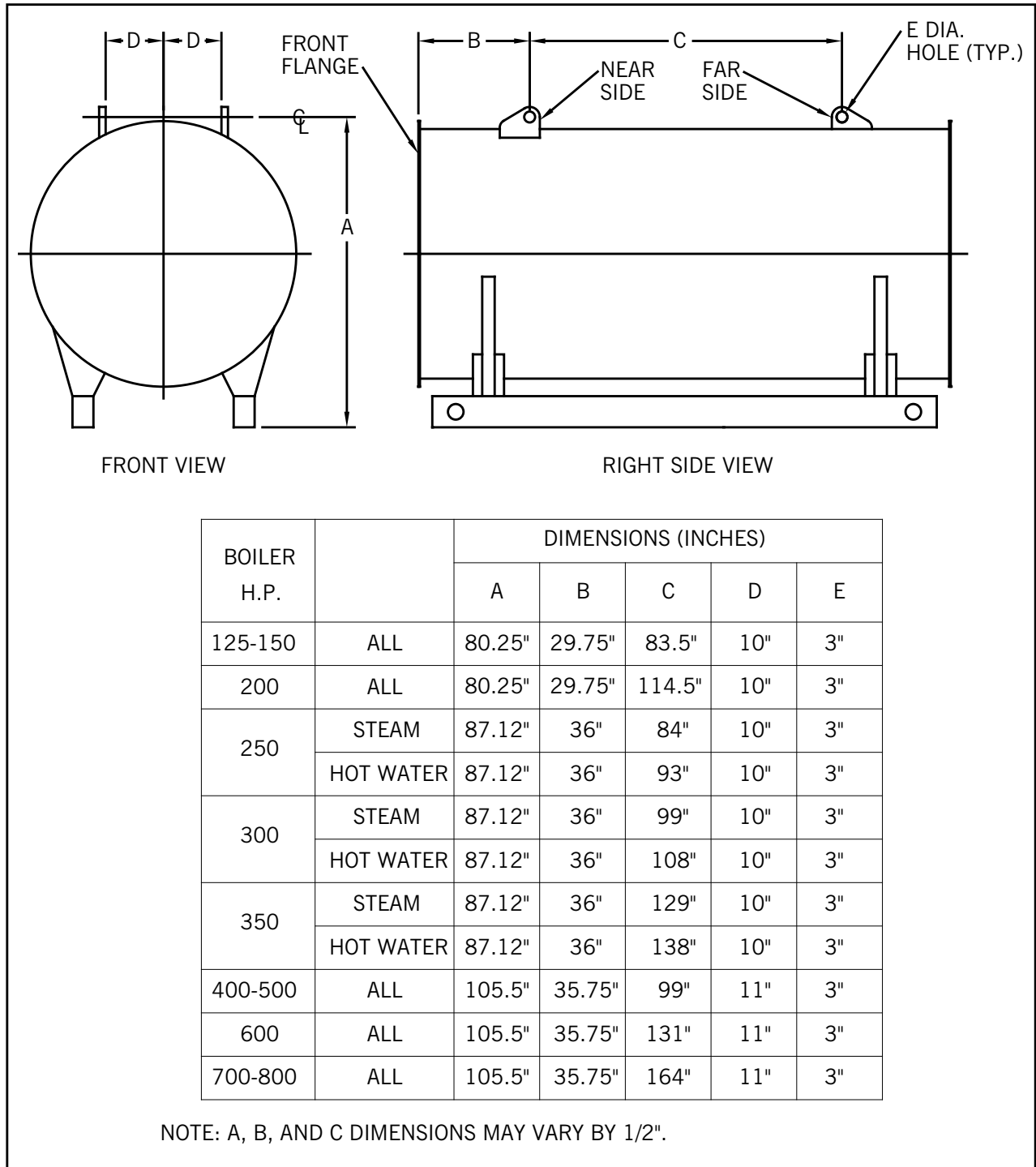
**Figure 3. Space Required to Open Rear Head on Model CBR Boilers Equipped with Davits**



**Figure 4. Front Davit Support**



**Figure 5. Model CBR Boiler Mounting Piers**



**Figure 6. Lifting Lug Locations, Model CBR Boilers**

## PERFORMANCE DATA

### Efficiency

Tables 7 - 9 show predicted fuel-to-steam efficiencies (excluding radiation and convection losses) for Cleaver-Brooks Model CBR Firetube boilers. For specific efficiencies on firetube boiler offerings not listed here, contact your local Cleaver-Brooks authorized representative.

### Emissions

The emission data included in this section consists of typical uncontrolled emission levels for Cleaver-Brooks Model CBR Firetube Boilers.

Guaranteed emission levels are available from your local Cleaver-Brooks authorized representative.

**Table 7: Predicted Fuel-to-Steam Efficiencies (%), Model CBR Boilers, Natural Gas**

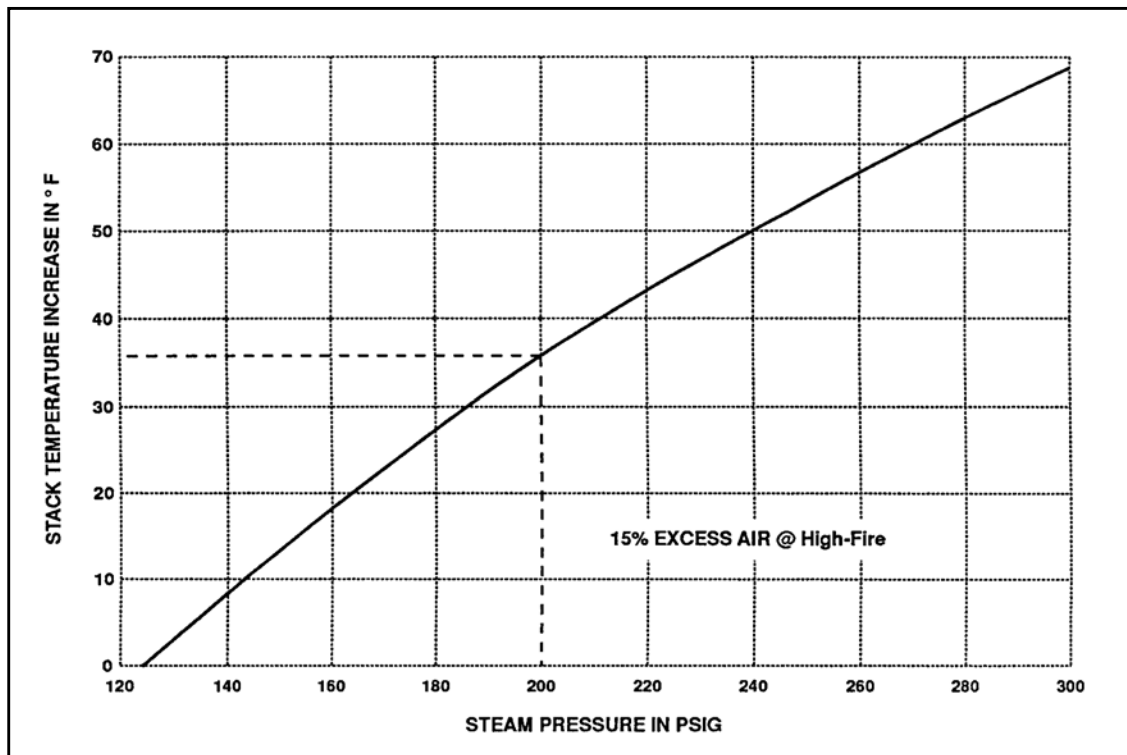
BHP	OPERATING PRESSURE = 10 psig				OPERATING PRESSURE = 125 psig			
	% OF LOAD				% OF LOAD			
	25%	50%	75%	100%	25%	50%	75%	100%
125	84.4	84.5	84.0	83.4	81.6	81.8	81.5	81.0
150	84.3	84.4	83.7	83.0	81.5	81.6	81.2	80.7
200	84.5	84.9	84.5	84.1	81.7	82.2	82.0	81.7
250	84.2	84.2	83.5	82.6	81.4	81.5	80.9	80.3
300	84.4	84.5	84.0	83.4	81.5	81.8	81.5	81.0
350	84.6	85.1	84.8	84.5	81.8	82.4	82.3	82.1
400	84.8	84.3	83.6	82.7	82.0	81.8	81.1	80.4
500	84.7	84.2	83.4	82.5	82.0	81.7	81.0	80.1
600	85.0	84.8	84.4	83.8	82.3	82.3	81.9	81.4
700	85.3	85.3	85.1	84.8	82.6	82.8	82.7	82.4
800	85.2	85.3	85.0	84.6	82.5	82.7	82.6	82.3

**Table 8: Predicted Fuel-to-Steam Efficiencies (%), Model CBR Boilers - No.6 Oil**

BHP	OPERATING PRESSURE = 10 psig				OPERATING PRESSURE = 125 psig			
	% OF LOAD				% OF LOAD			
	25%	50%	75%	100%	25%	50%	75%	100%
125	88.3	88.4	87.8	87.2	85.3	85.6	85.2	84.7
150	88.2	88.2	87.5	86.8	85.2	85.4	84.9	84.3
200	88.4	88.8	88.4	87.9	85.5	85.9	85.7	85.5
250	88.1	88.0	87.3	86.4	85.1	85.2	84.6	84.0
300	88.3	88.4	87.8	87.1	85.3	85.5	85.2	84.7
350	88.5	89.0	88.7	88.3	85.6	86.1	86.1	85.9
400	88.6	88.1	87.3	86.5	85.8	85.5	84.8	84.0
500	88.6	88.0	87.2	86.2	85.7	85.4	84.6	83.8
600	88.9	88.7	88.2	87.6	86.1	86.1	85.7	85.1
700	89.2	89.2	89.0	88.6	86.3	86.6	86.4	86.2
800	89.1	89.1	88.9	88.5	86.3	86.5	86.3	86.0

**Table 9: Predicted Fuel-to-Steam Efficiencies (%), Model CBR Boilers - No. 2 Oil**

BHP	OPERATING PRESSURE = 10 psig				OPERATING PRESSURE = 125 psig			
	% OF LOAD				% OF LOAD			
	25%	50%	75%	100%	25%	50%	75%	100%
125	87.8	88.0	87.4	86.8	85.0	85.2	84.9	84.5
150	87.7	87.8	87.2	86.4	84.9	85.1	84.6	84.1
200	88.0	88.3	88.0	87.5	85.2	85.6	85.4	85.2
250	87.6	87.6	86.9	86.1	84.8	84.9	84.3	83.7
300	87.8	88.0	87.4	86.8	85.0	85.2	84.9	84.4
350	88.1	88.5	88.3	87.9	85.3	85.8	85.7	85.6
400	88.2	87.7	87.0	86.1	85.5	85.2	84.5	83.8
500	88.1	87.6	86.8	85.9	85.4	85.1	84.4	83.6
600	88.5	88.3	87.8	87.2	85.7	85.7	85.4	84.9
700	88.7	88.8	88.5	88.2	86.0	86.2	86.1	85.8
800	88.7	88.7	88.4	88.1	85.9	86.2	86.0	85.7



**Figure 7. Predicted Stack Temperature Increase for Pressure >125 psig**

**Table 10: Model CBR Boiler Emission Data**

POLLUTANT		ESTIMATED LEVELS - UNCONTROLLED				
		NATURAL GAS		NO. 2 OIL <sup>B</sup>		NO. 6 OIL <sup>C</sup>
		60 PPM System	30 PPM System	60 PPM SYSTEM	30 PPM SYSTEM	
CO	ppm <sup>A</sup>	50/150 <sup>B</sup>	50/150 <sup>B</sup>	50	50	95
	Lb/MMBtu	0.04/0.11	0.04/0.11	0.04	0.04	0.075
NO <sub>x</sub>	ppm <sup>A</sup>	60	30	185	140	502
	Lb/MMBtu	0.07	0.035	0.25	0.187	0.67
SO <sub>x</sub>	ppm <sup>A</sup>	1	1	278	278	278
	Lb/MMBtu	0.001	0.001	0.52	0.52	0.52
HC/VOCs	ppm <sup>A</sup>	10	10	4	4	70
	Lb/MMBtu	0.004	0.004	0.002	0.002	0.035
PM	ppm <sup>A</sup>	-	-	-	-	-
	Lb/MMBtu	0.01	0.01	0.025	0.256	0.160

**NOTES:**

Refer to Section E for detailed emission information.

A. ppm levels are given on a dry volume basis and corrected to 3% oxygen (15% excess air)

B. CO emission is 50 ppm when boiler is operating above 50% of rated capacity. CO emission is 150 ppm when boiler is operating below 50% of rated capacity.

Based on fuel constituent levels of:

Fuel-bound nitrogen content = 0.05% by weight

Sulfur content = 0.5% by weight

Ash content = 0.01% by weight

Conradson carbon residue = 16% by weight

**ENGINEERING DATA**

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

**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.

**Sound Level**

Table 11 summarizes predicted sound pressure levels for Model CBR Boilers. These values are based on standard motors. Optional motor types and altitude conditions can increase sound levels.

The units for the sound level tables are dBA (decibels, measured on the A-weighted scale) in reference to 0.0002 microbars (20 micro-Newtons per square meter). They are standardly referenced in specifying and reporting sound pressure levels on industrial equipment.

The sound pressure levels in Table 11 were obtained from tests in accordance with the "ABMA Test Code for the Measurement of Sound from Packaged Boilers." In accordance with this code, the sound pressure levels reported were measured on the boiler centerline 4-1/2 feet vertically above the bottom of the base rails and 3 feet horizontally in front of the end of the blower motor or front surface of the electrical cabinet.

The sound level meter used complies with ANSI S1.4, Type 1 (Precision). The readings are taken with the meter set for slow response.

On large size boilers, the need for auxiliary equipment, and the necessary interconnecting piping, make it impractical (and sometimes impossible) to provide a boiler testing environment that is suitable for obtaining the data needed to develop Sound Pressure Power levels.

Sound pressure levels (dBA) for identical boilers will vary between boiler rooms. In addition, variations will occur between different people using different sound meters on the same boiler. And finally, no two boilers can be expected to give precisely the same sound levels. For these reasons, we can only predict, but not guarantee, sound levels (dBA).

When predicting sound pressures in octave bands (e.g., dBA at 125 Hz), even greater variations between boilers, between sound meters, and between operators can be expected. These larger variations in the low and high frequencies make octave band levels a less reliable method of reporting than A-scale sound levels. (Since A-scale sound levels are dominated by mid-frequency sounds, the A-scale sound levels between two boilers can be in reasonable agreement even though the low and high frequencies of octave band measurement do not closely correspond).

**Table 11: Predicted Sound Levels (30 ppm NOx Systems) at High Fire**

BHP	Sound Level-dBA
125	84
150	84
200	84
250	83
300	84
350	85
400	84
500	85
600	85
700	88
800	90

**Table 12: Steam Volume and Disengaging Area**

BOILER HP	STEAM VOLUME CU-FT		STEAM RELIEVING AREA SQ-IN	
	HIGH PRESSURE (A)	LOW PRESSURE (B)	HIGH PRESSURE (A)	LOW PRESSURE (B)
125	61.8	67.7	7675	7790
150	61.8	67.7	7675	7790
200	75.8	83	9403	9561
250	53.7	64.7	8093	8453
300	59.4	71.5	8957	9345
350	70.8	85.3	10670	11145
400	84.7	98.8	10627	11016
500	84.7	98.8	10627	11016
600	102.6	119.7	12873	13363
700	121.1	141.3	15206	15768
800	121.1	141.3	15206	15768

NOTE:

1. Based on normal water level.
- A. Based on 150 psig design pressure.
- B. Based on 15 psig design pressure.



**Table 13: Recommended Steam Nozzle Size (for 4000 to 5000 fpm Nozzle Velocity)**

OPERATING PRESSURE PSIG	BOILER HP										
	125	150	200	250	300	350	400	500	600	700	800
15	8	8	10	10	12	12	12	12	12	12	12
30	6	6	8	8	8	10	10	10	12	12	12
40	6	6	6	8	8	8	10	10	10	12	12
50	6	6	6	6	8	8	8	10	10	10	12
75	4	4	6	6	6	8	8	8	8	10	10
100	4	4	6	6	6	6	6	8	8	8	10
125	4	4	4	6	6	6	6	8	8	8	8
150	3	4	4	4	6	6	6	6	6	8	8
200	2.5	3	4	4	4	4	6	6	6	6	6
250	2.5	3	3	4	4	4	4	6	6	6	6

NOTES:

1. Steam nozzle sizes given in inches.
2. Standard nozzle size for 15-psi steam boiler is as listed above for 15-psig operating pressure
3. Standard steam nozzle for a 150-psig or higher design steam boiler is listed above for 125-psig operating pressure. It will be changed only if requested at the time of order.
4. Shaded area denotes special surge load baffles must be installed.

**Table 14: Recommended Non-Return Valve Size**

BOILER HP	BOILER CAPACITY (LBS/HR)	OPERATING PRESSURE (PSIG)							
		50	75	100	125	150	175	200	250
125	4313	3	2-1/2	2-1/2	2-1/2	NA	NA	NA	NA
150	5175	3	3	2-1/2	2-1/2	2-1/2	2-1/2	NA	NA
200	6900	3*	3	3	3	3	2-1/2	2-1/2	2-1/2
250	8625	4	3*	3	3	3	3	3	3
300	10350	4	4	4	3*	3	3	3	3
350	12025	4	4	4	4	4	3*	3	3
400	13800	5	4	4	4	4	4	4	3*
500	17210	6	5	5	4	4	4	4	4
600	20700	6	6	5	5	5	4	4	4
700	24150	6	6	6	5	5	5	5	4
800	27600	6	6	6	6	6	5	5	5

NOTE:

Valve sizes (300 psig flanges) given in inches.

Standard Non-Return valve selections limited to a maximum 2 to 1 turndown (50% of full boiler output)

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

Selection based on typical valve sizing recommendations. For final valve selection contact your authorized C-B representative.

**Table 15: Model CBR Blowdown Tank Sizing Information**

BOILER HP	WATER (GAL)
125	136
150	136
200	167
250	145
300	161
350	191
400	190
500	190
600	230
700	272
800	272

NOTE: Quantity of water removed from boiler by lowering normal water line 4".

### Gas-Fired Burners

Table 16 shows gas pressure requirements for Model CBR Boilers.

Table 17 shows minimum required gas pressure altitude conversion.

Figure 11 shows typical gas train piping layouts for multiple boiler applications.

### Oil-Fired Burners

Fuel oil consumption information is shown on the boiler rating sheets in the Dimensions and Ratings Section.

Figures 12-13 show typical oil systems and layouts.

### No. 6 Oil Piping, Storage Tank Heating

If the oil viscosity exceeds 4,000 SSU at the pumping temperature, tank preheating is required.

Based on the climate conditions for the job location, the minimum pumping temperature can be predicted, and the viscosity for the particular oil at this pumping temperature can be determined.

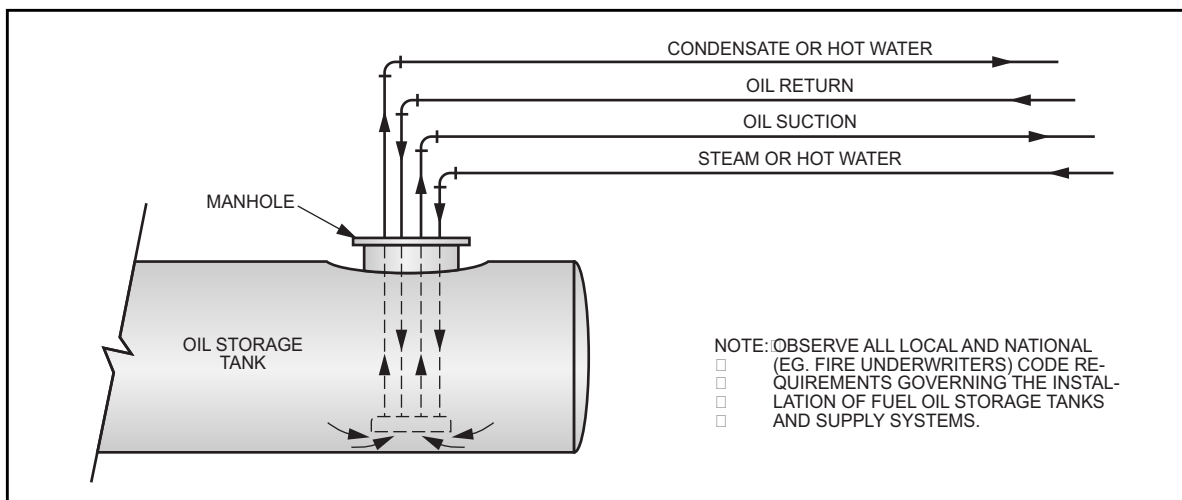
It is recommended to provide for tank and/or line heating on all No. 6 oil installations to ensure against high viscosities at decreased pumping temperatures. The following are two common methods:

1. Provide a tank suction heater and bundle the steam or water “tracers” from the tank to the oil heater.
2. Provide electric heating equipment on the oil lines and/or in the storage tank.

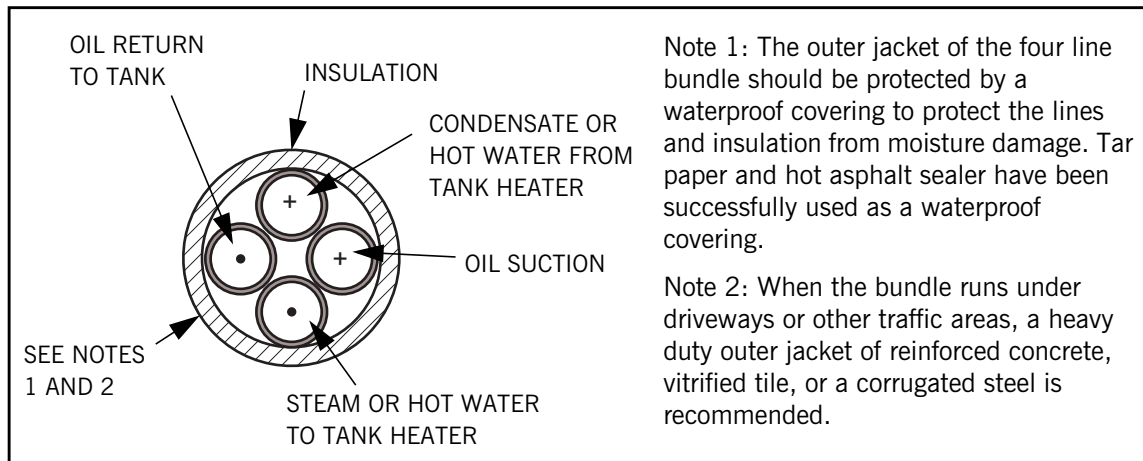
***The temperature in the oil suction line should not exceed 130 °F as higher temperatures could cause vapor binding of the oil pump and decreased oil flow.***

See Figure 9 for an example of (No. 1 above) tank heating method.

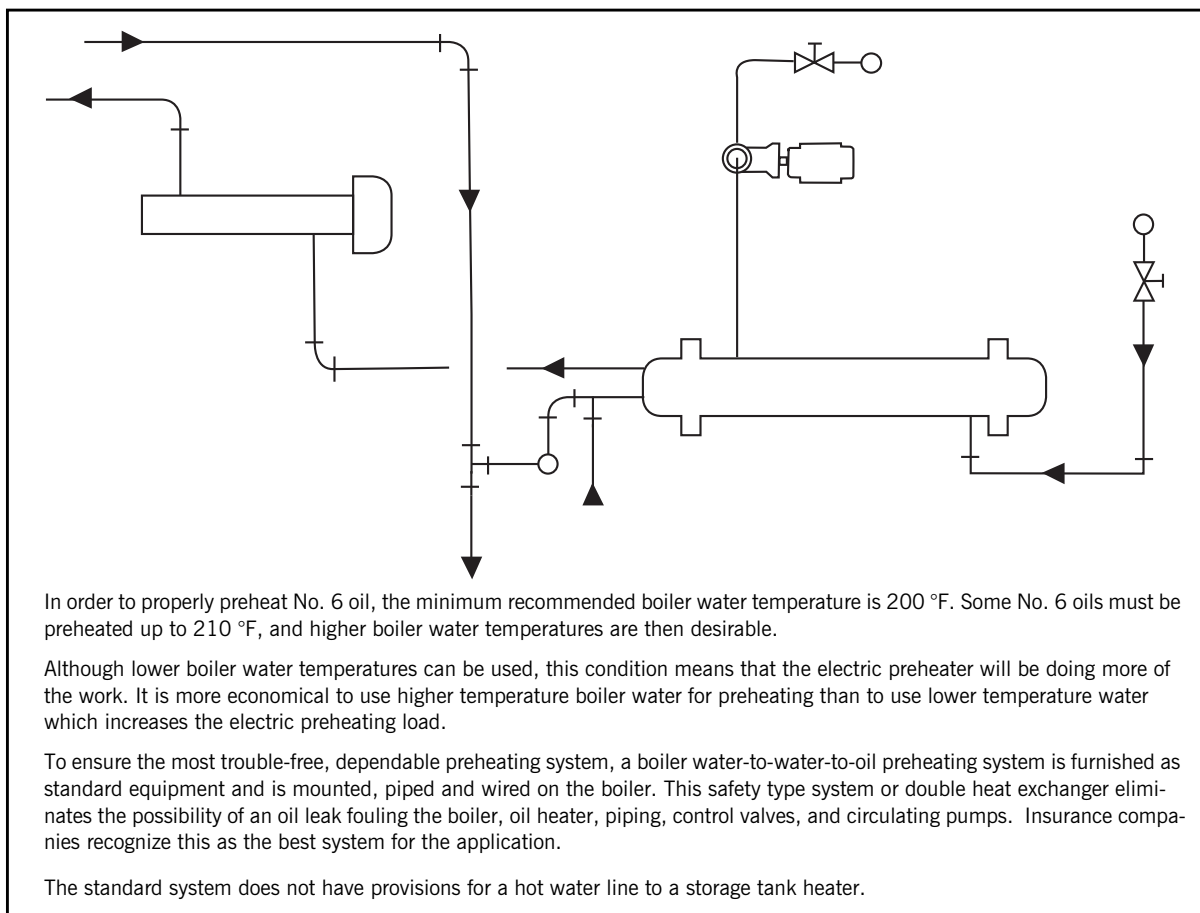
See Figure 10 for an example of a preheating system.



**Figure 8. Typical Fuel Storage Tank Arrangement**



**Figure 9. Typical Cross Section of Bundled Lines**



**Figure 10. Standard Alstrom Preheating System**

**Table 16: CBR Gas Pressure Requirements**

BOILER HP	GAS TRAIN SIZE	UPSTREAM VALVE*	DOWNSTREAM*	EMISSIONS LEVEL		
				30 ppm	60 ppm	UC
125 HP	1.5 in	BB	BB	0.8 - 5.0 psi	0.7 - 5.0 psi	0.7 - 5.0 psi
125 HP	1.5 in	PC	PC	0.9 - 5.0 psi	0.8 - 5.0 psi	0.8 - 5.0 psi
125 HP	2.0 in	BB	BB	0.6 - 0.8 psi	0.5 - 0.7 psi	0.5 - 0.7 psi
125 HP	2.0 in	PC	PC	0.6 - 0.9 psi	0.6 - 0.8 psi	0.6 - 0.8 psi
125 HP	2.5 in	PC	PC	0.4 - 0.6 psi	0.4 - 0.5 psi	0.4 - 0.5 psi
150 HP	1.5 in	BB	BB	1.0 - 5.0 psi	1.0 - 5.0 psi	1.0 - 5.0 psi
150 HP	1.5 in	PC	PC	1.1 - 5.0 psi	1.1 - 5.0 psi	1.1 - 5.0 psi
150 HP	2.0 in	BB	BB	0.7 - 1.0 psi	0.7 - 1.0 psi	0.7 - 1.0 psi
150 HP	2.0 in	PC	PC	0.7 - 1.1 psi	0.7 - 1.1 psi	0.7 - 1.1 psi
150 HP	2.5 in	PC	PC	0.5 - 0.7 psi	0.5 - 0.7 psi	0.5 - 0.7 psi
200 HP	1.5 in	BB	BB	1.6 - 5.0 psi	1.6 - 5.0 psi	1.6 - 5.0 psi
200 HP	1.5 in	PC	PC	1.9 - 5.0 psi	1.8 - 5.0 psi	1.8 - 5.0 psi
200 HP	2.0 in	BB	BB	1.1 - 1.6 psi	1.1 - 1.6 psi	1.1 - 1.6 psi
200 HP	2.0 in	PC	PC	1.2 - 1.9 psi	1.1 - 1.8 psi	1.1 - 1.8 psi
200 HP	2.5 in	PC	PC	0.7 - 1.1 psi	0.7 - 1.1 psi	0.7 - 1.1 psi
200 HP	3.0 in	PC	PC	0.6 - 0.7 psi	0.6 - 0.7 psi	0.6 - 0.7 psi
250 HP	1.5 in	BB	BB	2.7 - 2.9 psi	2.7 - 2.9 psi	2.7 - 2.8 psi
250 HP	1.5 in	PC	PC	3.0 - 4.6 psi	3.0 - 4.6 psi	3.0 - 4.5 psi
250 HP	2.0 in	BB	BB	1.8 - 2.7 psi	1.8 - 2.7 psi	1.8 - 2.7 psi
250 HP	2.0 in	PC	PC	1.9 - 3.0 psi	1.9 - 3.0 psi	1.9 - 3.0 psi
250 HP	2.5 in	PC	PC	1.3 - 1.8 psi	1.3 - 1.8 psi	1.3 - 1.8 psi
250 HP	3.0 in	PC	PC	1.1 - 1.3 psi	1.1 - 1.3 psi	1.1 - 1.3 psi
300 HP	1.5 in - 2.0 in	BB	BB	3.4 - 5.0 psi	3.4 - 5.0 psi	3.4 - 5.0 psi
300 HP	1.5 in - 2.0 in	PC	PC	3.8 - 5.0 psi	3.8 - 5.0 psi	3.7 - 5.0 psi
300 HP	2.0 in	BB	BB	2.5 - 3.4 psi	2.5 - 3.4 psi	2.4 - 3.4 psi
300 HP	2.0 in	PC	PC	2.6 - 3.8 psi	2.6 - 3.8 psi	2.5 - 3.7 psi
300 HP	3.0 in	PC	PC	1.6 - 2.5 psi	1.6 - 2.5 psi	1.6 - 2.4 psi
350 HP	1.5 in - 2.0 in	BB	BB	4.0 - 5.0 psi	4.0 - 5.0 psi	3.9 - 5.0 psi
350 HP	1.5 in - 2.0 in	PC	PC	4.4 - 5.0 psi	4.4 - 5.0 psi	4.4 - 5.0 psi
350 HP	2.0 in	BB	BB	3.0 - 4.0 psi	2.9 - 4.0 psi	2.9 - 3.9 psi
350 HP	2.0 in	PC	PC	3.1 - 4.4 psi	3.1 - 4.4 psi	3.1 - 4.4 psi
350 HP	2.5 in	PC	PC	1.8 - 3.0 psi	1.8 - 2.9 psi	1.7 - 2.9 psi
350 HP	3.0 in	PC	PC	1.4 - 1.8 psi	1.3 - 1.8 psi	1.3 - 1.7 psi
400 HP	1.5 in - 2.0 in	BB	BB	4.7 - 5.0 psi	4.7 - 5.0 psi	4.6 - 5.0 psi
400 HP	1.5 in - 2.0 in	PC	PC	5.2 - 8.2 psi	5.2 - 8.2 psi	5.2 - 8.2 psi
400 HP	2.0 in	BB	BB	3.2 - 4.7 psi	3.2 - 4.7 psi	3.2 - 4.6 psi
400 HP	2.0 in	PC	PC	3.5 - 5.0 psi	3.4 - 5.0 psi	3.4 - 5.0 psi
400 HP	2.5 in	PC	PC	1.8 - 3.2 psi	1.8 - 3.2 psi	1.8 - 3.2 psi
400 HP	3.0 in	PC	PC	1.3 - 1.8 psi	1.3 - 1.8 psi	1.3 - 1.8 psi
500 HP	2.0 in - 2.5 in	BB	PC	4.9 - 5.0 psi	4.9 - 5.0 psi	4.9 - 5.0 psi
500 HP	2.0 in - 2.5 in	PC	PC	5.1 - 7.6 psi	5.1 - 7.6 psi	5.1 - 7.6 psi
500 HP	2.5 in	PC	PC	2.7 - 4.9 psi	2.6 - 4.9 psi	2.6 - 4.9 psi
500 HP	3.0 in	PC	PC	2.0 - 2.7 psi	1.9 - 2.6 psi	1.9 - 2.6 psi
600 HP	2.0 in - 2.5 in	BB	PC	7.1 - 10.7 psi	7.1 - 10.6 psi	7.1 - 10.6 psi
600 HP	2.0 in - 2.5 in	PC	PC	7.4 - 11.0 psi	7.3 - 11.0 psi	7.3 - 11.0 psi
600 HP	2.5 in	PC	PC	3.9 - 5.0 psi	3.8 - 5.0 psi	3.8 - 5.0 psi
600 HP	2.5 in - 3.0 in	PC	PC	3.7 - 3.9 psi	3.7 - 3.8 psi	3.7 - 3.8 psi
600 HP	3.0 in	PC	PC	2.7 - 3.7 psi	2.7 - 3.7 psi	2.7 - 3.7 psi
700 HP	2.0 in - 3.0 in	BB	PC	9.5 - 14.3 psi	9.5 - 14.2 psi	9.5 - 14.2 psi
700 HP	2.0 in - 3.0 in	PC	PC	9.8 - 14.7 psi	9.8 - 14.7 psi	9.8 - 14.7 psi
700 HP	2.5 in - 3.0 in	PC	PC	4.9 - 5.0 psi	4.9 - 5.0 psi	4.8 - 5.0 psi
700 HP	3.0 in	PC	PC	3.6 - 4.9 psi	3.6 - 4.9 psi	3.5 - 4.8 psi
700 HP	4.0 in	PC	PC	2.6 - 3.6 psi	2.6 - 3.6 psi	2.6 - 3.5 psi
800 HP	2.5 in - 3.0 in	PC	PC	6.2 - 9.0 psi	6.2 - 9.0 psi	6.2 - 9.0 psi
800 HP	3.0 in	PC	PC	4.7 - 5.0 psi	4.7 - 5.0 psi	4.6 - 5.0 psi
800 HP	4.0 in	PC	PC	3.4 - 4.7 psi	3.4 - 4.7 psi	3.3 - 4.6 psi

\* BB = Butter Ball; PC = Plug Cock

NOTE: In cases where the gas train increases in size after the regulating valve, two diameters are listed. The first number is the customer connection size.

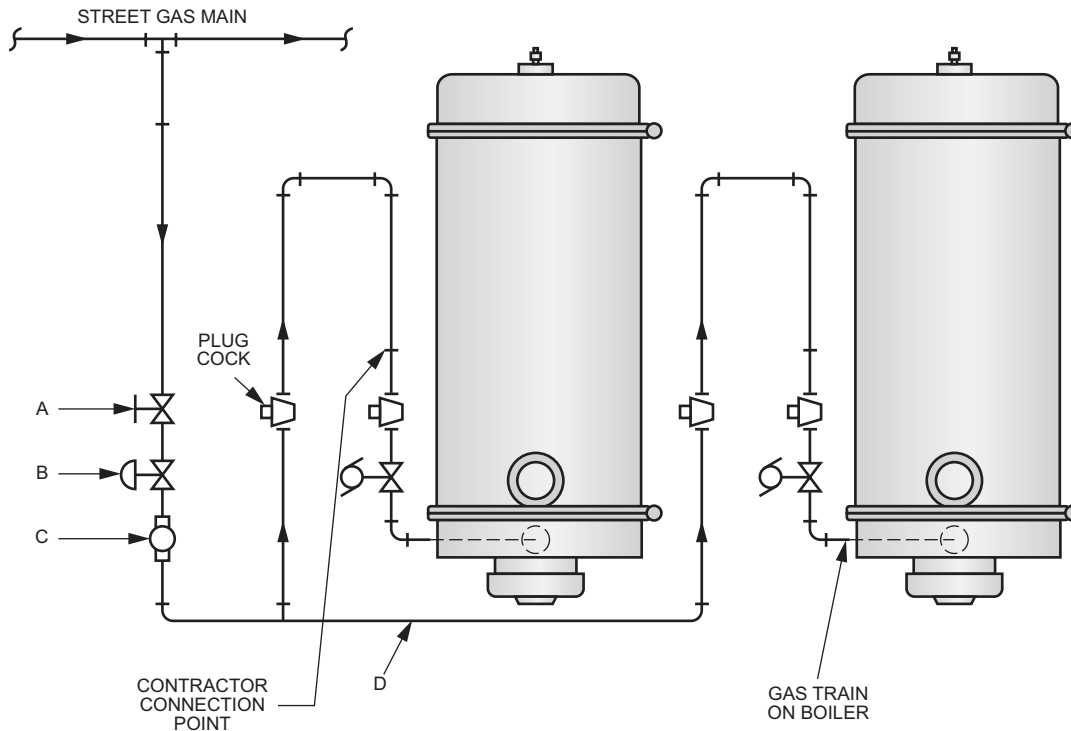
**Standard Gas Train size is highlighted**

**Table 17: Minimum Required Gas Pressure Altitude Conversion**

ALTITUDE (FT)	CORRECTION FACTOR	ALTITUDE (FT)	CORRECTION FACTOR
1000	1.04	6000	1.25
2000	1.07	7000	1.30
3000	1.11	8000 </td <td>1.35</td>	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.

*This figure illustrates the basic gas valve arrangement on Cleaver-Brooks Model CBR Boilers and shows the contractor's connection point. The valves and controls between the contractor connection point and the gas main in the street are representative of a typical installation. Actual requirements may vary depending on local codes or local gas company requirements which should be investigated prior to preparation of specifications and prior to construction.*



- A. Utilities service valve.
- B. Utilities service regulator.
- C. Gas meter.
- D. Piping from meter to boiler.

The size of the gas line from the meter to the gas pressure regulator at the boiler can be very important if gas pressures are marginal. The gas line sizing is dependent on:

1. Gas pressure at outlet of gas meter (C)
2. Rate of gas flow required, CFH
3. Length of pipe run (D)
4. Pressure required at contractor connection point.

The local gas utility will advise the pressure that is available at the outlet of their meter.

**Figure 11. Typical Gas Piping Layout, Multiple Boilers**

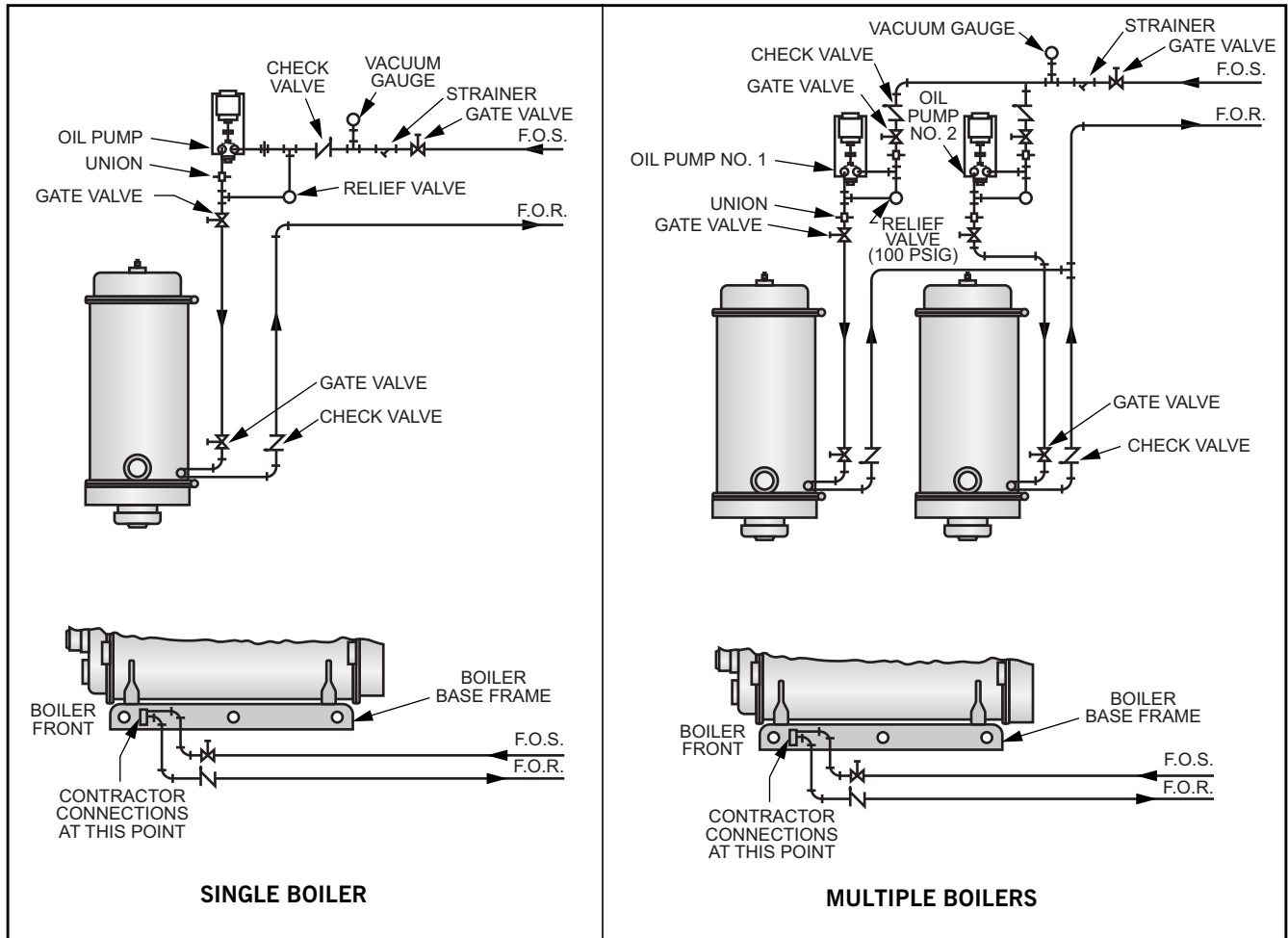
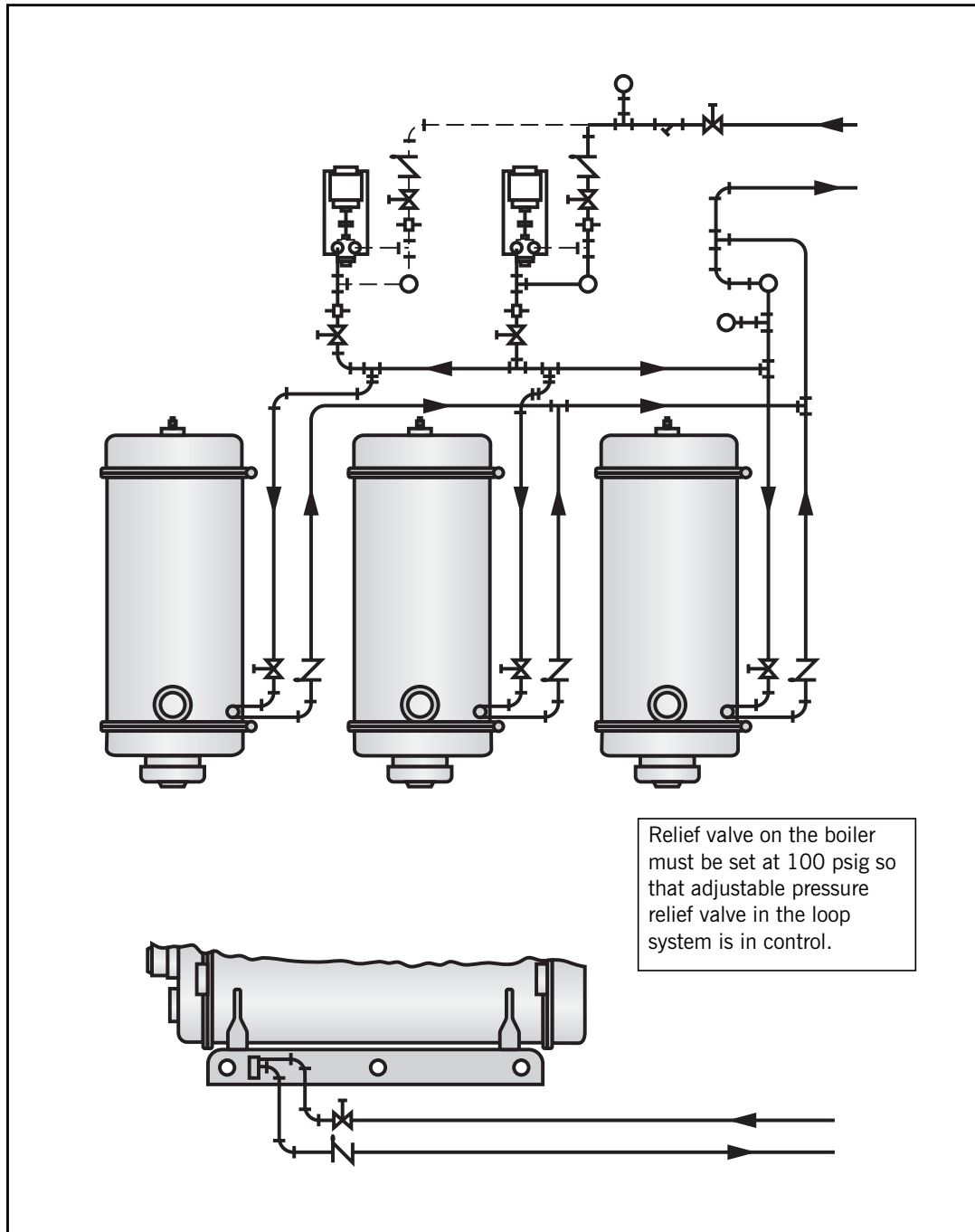


Figure 12. No. 2 Oil Piping, Remote Oil Pump(s)



**Figure 13. No. 2 Oil Piping, Multiple Boiler Installation**

### **Boiler Room Information**

Figure 14 shows typical boiler room length requirements.

Figure 15 shows typical boiler room width requirements.

Figure 16 shows typical breeching arrangements.

### **Stack Support Capabilities**

Cleaver-Brooks Firetube Boilers 125 hp through 800 hp can support up to 2,000 lbs without additional support.

Firetube sizes 250 hp through 800 hp can be reinforced to support 3,000 lbs.

### **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 Model CBR is not required, it is necessary to size the stack/breeching to limit flue gas pressure variation. For boiler sizes 125 – 800 horsepower, the allowable pressure range is –0.25" W.C. to +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.

### **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 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 (1) square foot.
  - E. Size the openings by using the formula:

Area (sq-ft.) = cfm/fpm

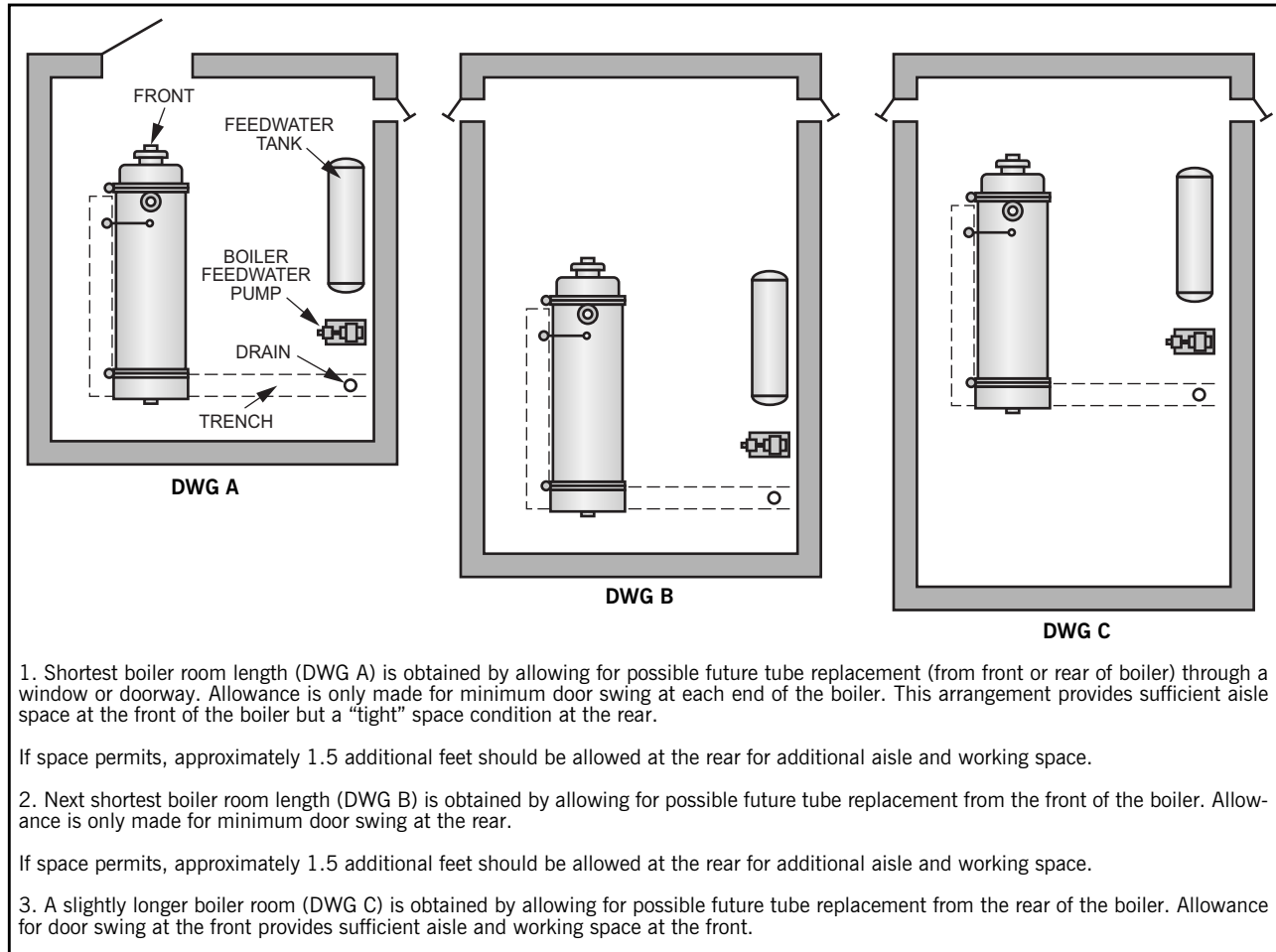
2. Amount of air required (cfm).
  - A. Combustion Air = Rated bhp x 8 cfm/bhp.
  - B. Ventilation Air = Maximum bhp x 2 cfm/bhp
  - C. Total recommended air, 10 cfm/bhp - up to 1000 feet elevation. Add 3 percent more per 1000 feet of added elevation.
3. Acceptable air velocity in boiler room (fpm).
  - 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) 300 hp boiler at 800 feet altitude. The air openings are to be 5 feet above floor level.

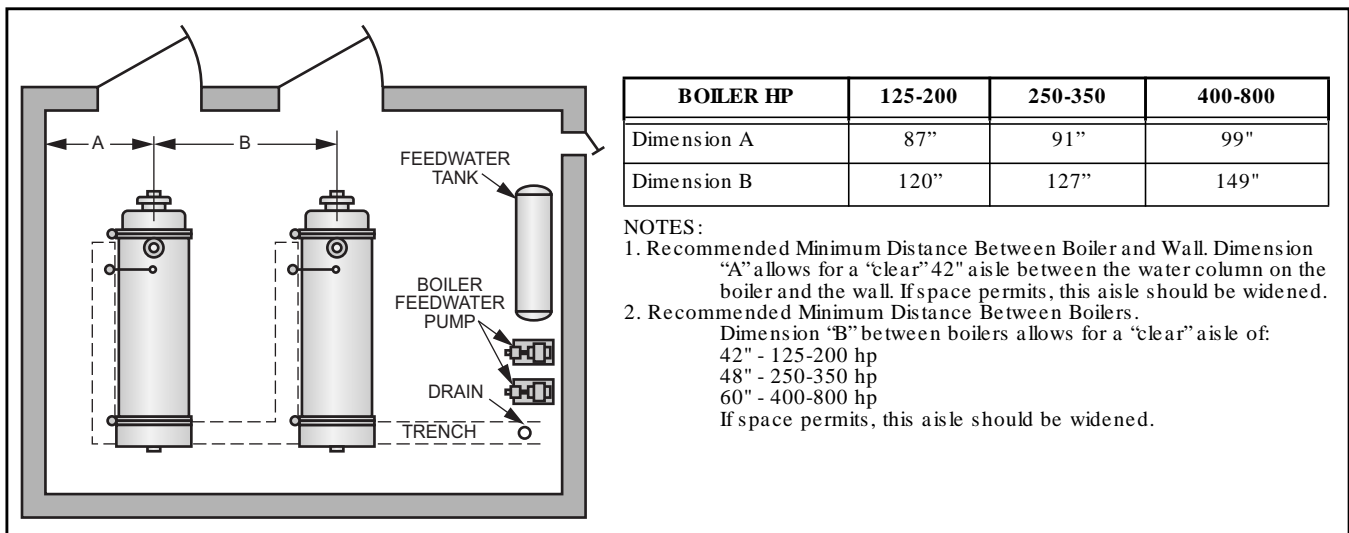
- Air required:  $300 \times 10 = 3000$  cfm (from 2B above).
- Air velocity: Up to 7 feet = 250 fpm (from 3 above).
- Area Required:  $\text{Area} = \text{cfm} / \text{fpm} = 3000 / 250 = 12$  Sq-ft total.
- Area/Opening:  $12 / 2 = 6$  sq-ft/opening (2 required).

***Consult local codes, which may supersede these requirements.***

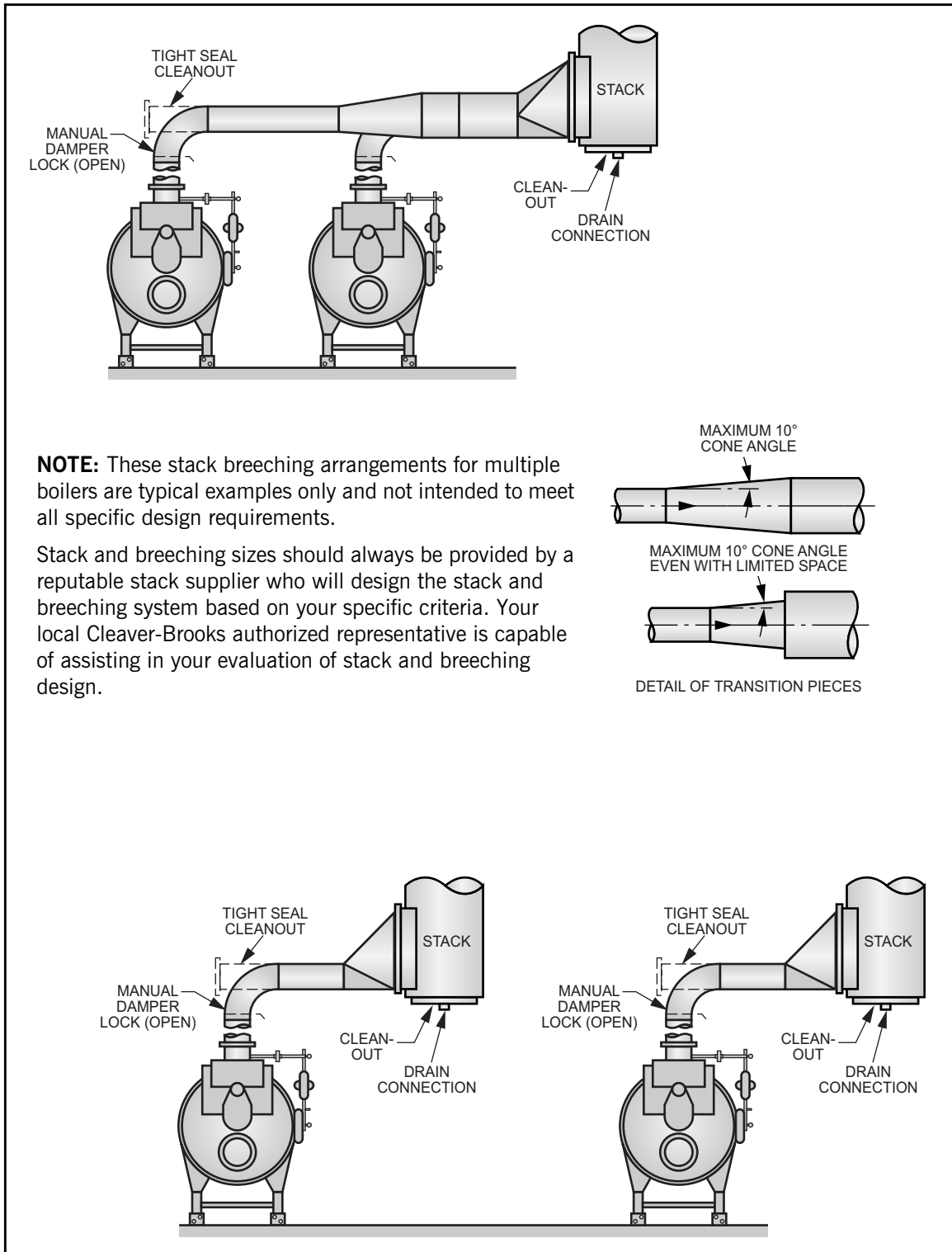




**Figure 14. Boiler Room Length (Typical Layout)**



**Figure 15. Boiler Room Width (Typical Layout)**



**Figure 16. Breaching Arrangement**

