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# Model CBEX Premium 100-800 HP



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## FEATURES AND BENEFITS

The CBEX Premium 100-800 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 CBEX.

### **Extended Heat Surface Technology:**

- EX technology results in increased efficiency and lower emissions with a smaller footprint and 2-pass design
- The packaged boiler offers flexibility, reliability, safety and ease of operation.

### **Front and Rear Access:**

- Davited smoke box doors provide access to front tube sheet.
- Burner housing swings open for service and maintenance.
- Large rear access plug for turnaround and furnace access.

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

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

## PRODUCT OFFERING

Burners are available to fire natural gas, No. 2 oil, or a combination of oil and gas. Standard product offering for 100-800 HP CBEX boilers is:

- Two pass wetback design.
- 150, 200, or 250 psig steam
- 30 and 125 psig hot water
- Full modulation, all sizes.

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

- Boiler Options:
  - Low NOx emission levels at 30 PPM.
  - 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.

- Fuel Options:  
Gas strainer.  
Gas pressure gauge.  
Future gas conversion.  
Oversized/undersized gas trains.  
Optional Oil Pumps.

## ***DIMENSIONS AND RATINGS***

Dimensions and ratings are shown in the following tables and illustrations.

**NOTE:** The following information is subject to change without notice.

Table 1 - CBEX Premium steam boiler ratings

Table 2 - CBEX Premium hot water boiler ratings

Figure 1/Table 3 - CBEX Premium steam boiler dimensions

Figure 2/Table 4 - CBEX Premium hot water boiler dimensions

**Table 1. CBEX Premium Steam Boiler Ratings**

BOILER H.P.	100	125	150	200	250	300	350	400	500	600	700	800
Burner Model (Standard)	VLG-42	VLG-54	VLG-63	VLG-84	ELG-105	ELG-126	ELG-147	ELG-168	ELG-210	ELG-252	ELG-294-3	ELG-336-3
Burner Model (30 ppm)	LNVLG-42	LNVLG-54	LNVLG-63	LNVLG-84	LNELG-105	LNELG-126	LNELG-147	LNELG-168	LNELG-210	LNELG-252	LNELG-294-3	LNELG-336-3
RATINGS - SEA LEVEL TO 700 FT.												
Rated Capacity (lbs-steam/hr from and at 212 °F)	3450	4313	5175	6900	8625	10350	12075	13800	17250	20700	24150	27600
Btu Output (1000 Btu/hr)	3348	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)	29.9	37.4	44.8	59.8	74.7	89.7	104.6	119.6	149.4	179.3	209.2	239.1
Gas CFH (1000 Btu)	4184	5230	6277	8369	10461	12553	14645	16738	20922	25106	29291	33475
Gas (Therm/hr)	41.8	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 (Standard) <sup>A</sup>	2	3	5	7 1/2	5	7 1/2	10	15	15	15	20	25
Blower Motor hp (30 ppm) <sup>A</sup>	3	5	5	7 1/2	7 1/2	7 1/2	10	15	20	25	30	40
Circulating Oil Pump Motor hp <sup>B</sup>	1/2	3/4	3/4	1	1/2	3/4	3/4	3/4	3/4	3/4	1	1
Oil Metering Pump Motor hp <sup>B</sup>	n/a	n/a	n/a	n/a	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4
Air Compressor Motor hp <sup>B</sup>	**	**	**	**	3	3	5	5	5	7 1/2	7 1/2	7 1/2
BOILER DATA												
Heating Surface sq-ft. (Fireside)	398	423	518	671	737	768	933	1128	1325	1424	1776	1776

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. Required for #2 Oil Firing.
  - C. All fractional hp motors will be single phase voltage except oil metering pump motors which are three phase. Integral hp motors will be three phase voltage.
- \*\* Air compressor not required for 100-200hp as these burners are pressure atomized.

**Table 2. CBEX Premium Hot Water Ratings**

BOILER H.P.	100	125	150	200	250	300	350	400	500	600	700	800
Burner Model (Standard)	VLG-42	VLG-54	VLG-63	VLG-84	ELG-105	ELG-126	ELG-147	ELG-168	ELG-210	ELG-252	ELG-294-3	ELG-336-3
Burner Model (30 ppm)	LNVLG-42	LNVLG-54	LNVLG-63	LNVLG-84	LNELG-105	LNELG-126	LNELG-147	LNELG-168	LNELG-210	LNELG-252	LNELG-294-3	LNELG-336-3
RATINGS - SEA LEVEL TO 700 FT.												
Btu Output (1000 Btu/hr)	3348	4184	5021	6695	8369	10043	11716	13390	16738	20085	23433	26780
APPROXIMATE FUEL CONSUMPTION AT RATED CAPACITY BASED ON NOMINAL 83% EFFICIENCY												
Light Oil gph (140,000 Btu/gal)	28.8	36.0	43.2	57.6	72.0	86.4	100.8	115.2	144.0	172.8	201.7	230.5
Gas CFH (1000 Btu)	4033	5041	6050	8066	10083	12099	14116	16133	20166	24199	28232	32265
Gas (Therm/hr)	40.3	50.4	60.5	80.7	100.8	121.0	141.2	161.3	201.7	242.0	282.3	322.7
POWER REQUIREMENTS - SEA LEVEL TO 700 FT. (60 HZ)												
Blower Motor hp (Standard)	2	3	5	7 1/2	5	7 1/2	10	15	15	15	20	25
Blower Motor hp (30 ppm)	3	5	5	7 1/2	7 1/2	7 1/2	10	15	20	25	30	40
Circulating Oil Pump Motor hp <sup>A</sup>	1/2	3/4	3/4	1	1/2	3/4	3/4	3/4	3/4	3/4	1	1
Oil Metering Pump Motor hp <sup>A</sup>	n/a	n/a	n/a	n/a	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4
Air Compressor Motor hp <sup>A</sup>	**	**	**	**	3	3	5	5	5	7 1/2	7 1/2	7 1/2
BOILER DATA												
Heating Surface sq-ft. (Fireside)	398	423	518	671	737	768	933	1128	1325	1424	1776	1776

NOTES:

- A. Required for #2 Oil Firing.
  - B. All fractional hp motors will be single phase voltage except oil metering pump motors which are three phase. Integral hp motors will be three phase voltage.
- \*\* Air compressor not required for 100-200hp as these burners are pressure atomized.

Figure 1. CBEX Premium Steam Boiler Dimensions, 100-800 HP

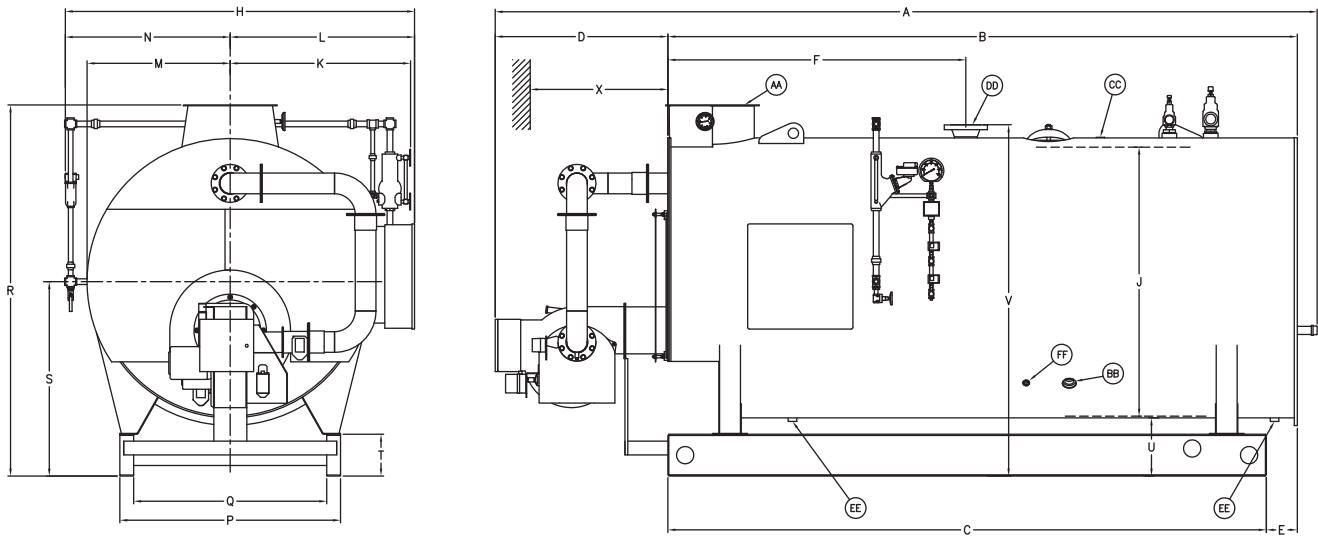


Table 3. CBEX Premium Steam Boiler Dimensions, 100-800 HP

BOILER H.P.	DIM	100	125	150	200	250	300	350	400	500	600	700	800
<b>LENGTHS</b>													
Overall Length	A	179.5	184.5	190	213	232	238	238.5	258.5	261	267	287	287
Shell	B	132.5	137.5	140	163	174	180	182.5	190.5	193	199	207	207
Base Frame	C	125.5	130.5	131	154	164	170	173.5	181.5	183.5	189.5	197.5	197.5
Burner Extension	D	41	41	44	44	52	52	50	62	62	62	74	74
Rear Ring Flange to Base	E	7	7	9	9	10	10	9	9	9.5	9.5	9.5	9.5
Shell Flange to Steam Nozzle	F	60.5	63	64.5	74.5	80.5	83.5	86.5	90.5	110.5	183.5	104.5	104.5
<b>WIDTHS</b>													
Overall Width	H	81	81	86	86	94	94	105	105	112	112	119	119
I.D. Boiler	J	55	55	60	60	67	67	78	78	85	85	92	92
Center to Water Column	K	42.5	42.5	45	45	48.5	48.5	54	54	57.5	57.5	61	61
Center to Panel	L	44.5	44.5	47	47	50.5	50.5	56	56	59.5	59.5	63	63
Center to Lagging	M	30.5	30.5	33	33	36.5	36.5	42	42	45.5	45.5	49	49
Center to Auxilliary LWCO	N	36.5	36.5	39	39	43.5	43.5	49	49	52.5	52.5	56	56
Base Outside	P	47.5	47.5	52.5	52.5	51	51	64	64	60	60	68	68
Base Inside	Q	39.5	39.5	44.5	44.5	43	43	56	56	47	47	55	55
<b>HEIGHTS</b>													
Base to Vent Outlet	R	81	81	87	87	94.5	94.5	108	108	114.5	114.5	122.5	122.5
Base to Boiler Centerline	S	41	41	46	46	50	50	56.5	56.5	61	61	65.5	65.5
Height of Base Frame	T	12	12	12	12	12	12	12	12	12	12	12	12
Base to Bottom of Boiler	U	13	13	15.5	15.5	16	16	17	17	18	18	19	19
Base to Steam Outlet	V	78.5	78.5	82.5	82.5	90	90	102	102	110	110	118	118
<b>BOILER CONNECTIONS</b>													
Feedwater Inlet (Both Sides)	BB	1.25	1.5	1.5	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5
Surface Blowoff	CC	1	1	1	1	1	1	1	1	1	1	1	1
Steam Nozzle (300# ANSI Flange)	DD	4	4	4	4	6	6	6	6	8	8	8	8
Blowdown-Front & Rear	EE	1.25	1.5	1.5	1.5	1.5	1.5	1.5	2	2	2	2	2
Chemical Feed	FF	1	1	1	1	1	1	1	1	1	1	1	1
<b>VENT STACK</b>													
Vent Stack Diameter (Flanged)	AA	16	16	16	16	20	20	24	24	24	24	24	24
<b>MINIMUM CLEARANCES</b>													
Tube Removal - Front Only	X	84	89	92	115	120	126	125	133	136	142	150	150
<b>MINIMUM BOILER ROOM LENGTH ALLOWING FOR TUBE REMOVAL:</b>													
Thru Window or Door		208.5	220.5	223	246	274	280	280.5	300.5	303	309	329	329

**Table 3. CBEX Premium Steam Boiler Dimensions, 100-800 HP (Continued)**

Front of Boiler	252.5	262.5	268	314	330	342	343.5	359.5	365	377	393	393
<b>WEIGHTS IN LBS</b>												
Normal Water Weight	6,260	6,540	7,420	8,830	10,110	10,550	15,820	16,300	16,600	17,110	20,000	20,000
Approx. Shipping Weight - (150psig)	9,710	10,480	11,750	13,250	15,670	16,090	19,650	21,050	24,600	26,000	32,100	32,250

**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:

Figure 2. CBEX Premium Hot Water Boiler Dimensions, 100-800 HP

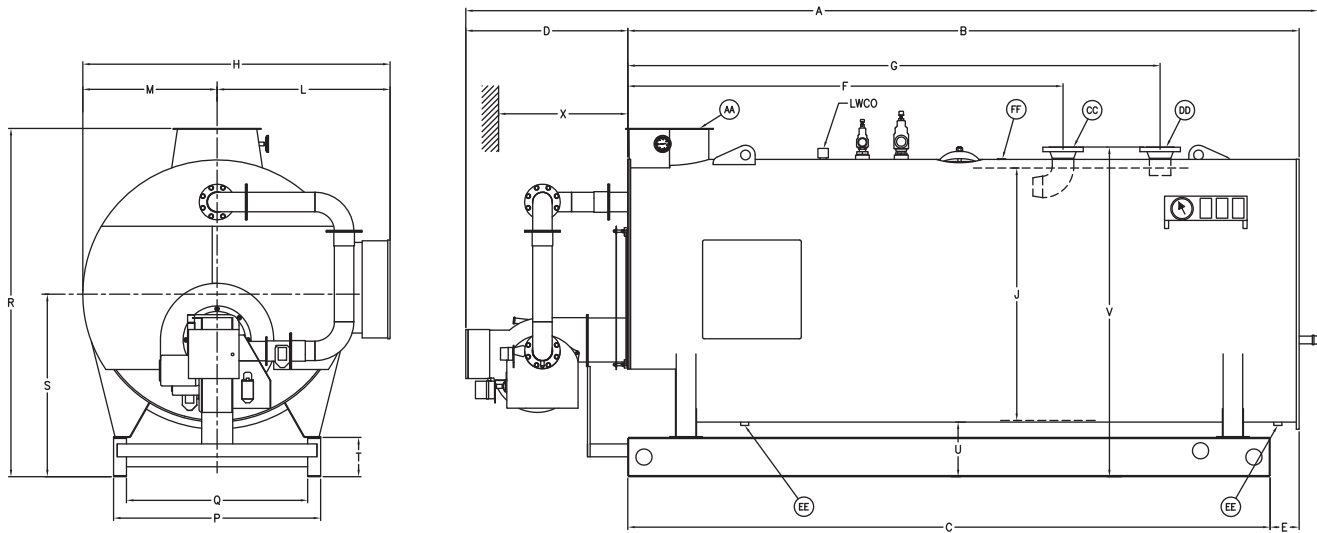


Table 4. CBEX Premium Hot Water Boiler Dimensions, 100-800 HP

BOILER H.P.	DIM	100	125	150	200	250	300	350	400	500	600	700	800
<b>LENGTHS</b>													
Overall Length	A	179.5	184.5	190	213	232	238	238.5	258.5	261	267	287	287
Shell	B	132.5	137.5	140	163	174	180	182.5	190.5	193	199	207	207
Base Frame	C	125.5	130.5	131	154	164	170	173.5	181.5	183.5	189.5	197.5	197.5
Burner Extension	D	41	41	44	44	52	52	50	62	62	62	74	74
Rear Ring Flange to Base	E	7	7	9	9	10	10	9	9	9.5	9.5	9.5	9.5
Shell Flange to Water Return	F	88.5	93.5	96	119	128.5	134.5	137	145	137.5	143.5	151.5	151.5
Shell Flange to Water Outlet	G	113.5	118.5	121	144	154.5	160.5	163	171	173.5	179.5	187.5	187.5
<b>WIDTHS</b>													
Overall Width	H	75	75	80	80	87	87	98	98	105	105	112	112
I.D. Boiler	J	55	55	60	60	67	67	78	78	85	85	92	92
Center to Panel	L	44.5	44.5	47	47	50.5	50.5	56	56	59.5	59.5	63	63
Center to Lagging	M	30.5	30.5	33	33	36.5	36.5	42	42	45.5	45.5	49	49
Base Outside	P	47.5	47.5	52.5	52.5	51	51	64	64	60	60	68	68
Base Inside	Q	39.5	39.5	44.5	44.5	43	43	56	56	47	47	55	55
<b>HEIGHTS</b>													
Base to Vent Outlet	R	81	81	87	87	94.5	94.5	108	108	114.5	114.5	122.5	122.5
Base to Boiler Centerline	S	41	41	46	46	50	50	56.5	56.5	61	61	65.5	65.5
Height of Base Frame	T	12	12	12	12	12	12	12	12	12	12	12	12
Base to Bottom of Boiler	U	13	13	15.5	15.5	16	16	17	17	18	18	19	19
Base to Water Return & Outlet	V	78.5	78.5	82.5	82.5	90	90	102	102	110	110	118	118
<b>BOILER CONNECTIONS</b>													
Water Fill (Both Sides)	BB	1.25	1.5	1.5	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5
Water Return (150# ANSI Flange)	CC	4	6	6	6	8	8	8	10	10	12	12	12
Water Outlet (150# ANSI Flange)	DD	4	6	6	6	8	8	8	10	10	12	12	12
Drain-Front & Rear	EE	1.5	1.5	1.5	2	2	2	2	2	2	2	2	2
Air Vent	FF	1.5	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)	AA	16	16	16	16	20	20	24	24	24	24	24	24
<b>MINIMUM CLEARANCES</b>													
Tube Removal - Front Only	X	84	89	92	115	120	126	125	133	136	142	150	150
<b>MINIMUM BOILER ROOM LENGTH ALLOWING FOR TUBE REMOVAL:</b>													
Thru Window or Door		208.5	220.5	223	246	274	280	280.5	300.5	303	309	329	329
Front of Boiler		252.5	262.5	268	314	330	342	343.5	359.5	365	377	393	393
<b>WEIGHTS IN LBS</b>													
Normal Water Weight		6,960	7,250	8,540	10,140	12,540	13,040	18,870	19,480	21,650	22,300	26,650	26,650



**Table 4. CBEX Premium Hot Water Boiler Dimensions, 100-800 HP (Continued)**

Approx. Shipping Weight - (30 psig)	8,190	8,430	9,570	10,830	13,100	13,450	16,240	17,640	20,680	21,480	26,500	26,500
Approx. Shipping Weight - (125 psig)	9,050	9,300	11,250	13,000	15,800	16,500	20,650	21,050	25,950	26,900	33,100	33,250

**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:

**PERFORMANCE DATA**

**Efficiency**

Tables 5 and 6 show predicted fuel-to-steam efficiencies (including radiation and convection losses) for Cleaver-Brooks CBEX firetube boilers. For specific efficiencies on firetube 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 CBEX Firetube 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

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%.

**Table 5. CBEX fuel-to-steam efficiencies natural gas**

**Table 6. CBEX fuel-to-steam efficiencies #2 oil**

BHP	OPERATING PRESSURE = 125 psig			
	% OF LOAD			
	25%	50%	75%	100%
100	82.2	81.9	81.2	80.4
125	82.2	81.9	81.2	80.4
150	82.3	81.9	81.3	80.5
200	82.5	82.5	82.0	81.6
250	82.2	81.8	81.0	80.2
300	82.2	81.8	81.0	80.2
350	82.2	81.9	81.2	80.4
400	82.6	82.1	81.3	80.5
500	82.6	82.0	81.2	80.4
600	82.6	82.0	81.2	80.4
700	82.7	82.2	81.5	80.7
800	82.6	82.0	81.2	80.4

BHP	OPERATING PRESSURE = 125 psig			
	% OF LOAD			
	25%	50%	75%	100%
100	85.1	84.7	84.0	83.2
125	85.0	84.7	84.0	83.2
150	85.1	84.8	84.1	83.3
200	85.3	85.3	84.9	84.4
250	85.0	84.6	83.8	83.0
300	85.0	84.6	83.8	83.0
350	85.1	84.7	84.0	83.2
400	85.4	84.9	84.1	83.3
500	85.4	84.8	84.0	83.2
600	85.4	84.8	84.0	83.2
700	85.5	85.0	84.3	83.5
800	85.4	84.8	84.0	83.2

Emissions

**Table 7. CBEX natural gas estimated emission levels**

POLLUTANT	UNITS	UNCONTROLLED	30 PPM SYSTEM
CO	ppm <sup>A</sup>	50	50
	lb/MMBtu	0.037	0.037
NOx	ppm <sup>A</sup>	120	30
	lb/MMBtu	0.1214	0.0364
SOx	ppm <sup>A</sup>	-	-
	lb/MMBtu	0.001	0.001
HC/VOC5	ppm <sup>A</sup>	-	-
	lb/MMBtu	0.0055	0.0055
PM	ppm <sup>A</sup>	-	-
	lb/MMBtu	0.0076	0.0076

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

**Table 8. CBEX #2 oil estimated emission levels**

POLLUTANT	UNITS	UNCONTROLLED	30 PPM SYSTEM
CO	ppm <sup>A</sup>	50	50
	lb/MMBtu	0.039	0.039
NOx	ppm <sup>A</sup>	160	90
	lb/MMBtu	0.2047	0.12
SOx	ppm <sup>A</sup>	55	55
	lb/MMBtu	0.1	0.1
HC/VOC5	ppm <sup>A</sup>	-	-
	lb/MMBtu	0.0021	0.0021
PM	ppm <sup>A</sup>	-	-
	lb/MMBtu	0.0089	0.0089

A. ppm levels are given on a dry volume basis and corrected to 3% oxygen (15% excess air) BASED ON THE FOLLOWING CONSTITUENT LEVELS:

Fuel-bound Nitrogen content = 0.015% by weight.

Sulfur content = 0.1% by weight.

Ash content = 0.01% by weight.

## ENGINEERING DATA

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

### Boiler Information

Tables 9 and 10 list quantity and outlet size for safety/relief valves supplied on CBEX Premium boilers.

Table 11 shows steam volume and disengaging area.

Table 12 gives recommended steam nozzle sizes.

Table 13 shows recommended non-return valve sizes.

**Table 9. Safety valves steam**

VALVE SETTING	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.)
100	1	1-1/2	1	1-1/2	1	1-1/4
125	2	(1) 1-1/2 (1) 1-1/4	2	(1) 1-1/4 (1) 1	2	1
150	2	(1) 1-1/2 (1) 1-1/4	2	(1) 1-1/4 (1) 1	2	1
200	2	1-1/2	2	(1) 1-1/2 (1) 1-1/4	2	1-1/4
250	2	(1) 2 (1) 1-1/2	2	1-1/2	2	(1) 1-1/2 (1) 1-1/4
300	2	(1) 2 (1) 1-1/2	2	1-1/2	2	1-1/2
350	2	2	2	(1) 2 (1) 1-1/2	2	1-1/2
400	2	(1) 2-1/2 (1) 2	2	(1) 2 (1) 1-1/2	2	(1) 1-1/2 (1) 2
500	2	(1) 2-1/2 (1) 2	2	(1) 2-1/2 (1) 2	2	2
600	2	(2) 2-1/2	2	(1) 2-1/2 (1) 2	2	2
700, 800	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 10. Relief valves hot water**

VALVE SETTING	30 PSIG HW		125 PSIG HW	
	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)
100	1	2-1/2	1	1-1/4
125	1	2-1/2	1	1-1/4
150	1	2-1/2	1	2
200	2	(1) 2-1/2 (1) 1-1/4	1	2
250	2	(1) 2 (1) 2-1/2	1	2
300	2	2-1/2	1	2-1/2
350	3	(2) 2-1/2 (1) 1	1	2-1/2
400	3	(1) 2 (2) 2-1/2	1	2-1/2
500	4	(1) 1 (3) 2-1/2	2	(1) 1 (1) 2-1/2
600	4	(3) 2-1/2 (1) 2	2	(1) 1-1/4 (1) 2-1/2
700, 800	5	(1) 1 (4) 2-1/2	2	(1) 2-1/2 (1) 2

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

**Table 11. CBEX Premium steam volume and disengaging area**

BOILER HP	STEAM VOLUME CU-FT HIGH PRESSURE (A)	STEAM RELIEVING AREA SQ-IN HIGH PRESSURE (A)
100	9.8	4115
125	10.2	4286
150	16.5	5181
200	19.5	6119
250	30.1	7544
300	31.2	7831
350	41.9	9126
400	43.9	9568
500	65.5	11254
600	67.7	11638
700	86.3	13299
800	86.3	17006

NOTES:

- 1. Based on normal water level.
- A. Based on 150 psig design pressure.
- B. Low Pressure steam is not offered for CBEX boilers.

**Table 12. CBEX Premium recommended steam nozzle size**

OPERATING PRESSURE PSIG	BOILER HP											
	100	125	150	200	250	300	350	400	500	600	700	800
50	4	6	6	6	6	8	8	8	8	10	10	12
75	4	4	4	6	6	6	8	8	8	8	10	10
100	4	4	4	6	6	6	6	6	8	8	8	10
125	4	4	4	4	6	6	6	6	8	8	8	8
150	2.5	3	3	4	4	6	6	6	6	6	8	8
200	2.5	2.5	3	4	4	4	4	6	6	6	6	6
250	2	2.5	2.5	3	4	4	4	4	6	6	6	6

NOTES:

- 1. Steam nozzle sizes given in inches.
- 2. Recommended steam nozzle sizes based on 4000 to 5000 fpm steam velocity.

**Table 13. CBEX Premium recommended non-return valve size**

BOILER HP	BOILER CAPACITY (LBS/HR)	OPERATING PRESSURE (PSIG)							
		50	75	100	125	150	175	200	250
100	3450	2-1/2	2-1/2	NA	NA	NA	NA	NA	NA
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.

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

**Table 14. Blowdown tank sizing**

BOILER HP	WATER (GAL)
100	80
125	84
150	98
200	116
250	141
300	146
350	169
400	177
500	205
600	212
700	241
800	241

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

**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.

***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. 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.

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

**Gas pressure requirements****Table 15. Minimum required gas pressure - standard, FM, & IRI gas trains**

BOILER HP	Combination Regulator and Gas Valve Size (in)	PRESSURE REQUIRED ("WC)
100	1.5	20
125	1.5	25
150	1.5	34
200	1.5	53.5
250	2	73
300	2	78.5
350	2	86.5
400	2.5	65
500	2.5	79
600	3	72.5
700	3	87
800	4	73.5

Note: For undersized or oversized gas trains or altitudes above 700 feet, contact your local Cleaver-Brooks representative.

**Table 16. CBEX altitude correction for gas**

ALTITUDE (FT)	CORRECTION FACTOR	ALTITUDE (FT)	CORRECTION FACTOR
1000	1.04	6000	1.25
2000	1.07	7000	1.3
3000	1.11	8000	1.35
4000	1.16	9000	1.4
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.



**Boiler Room Information**

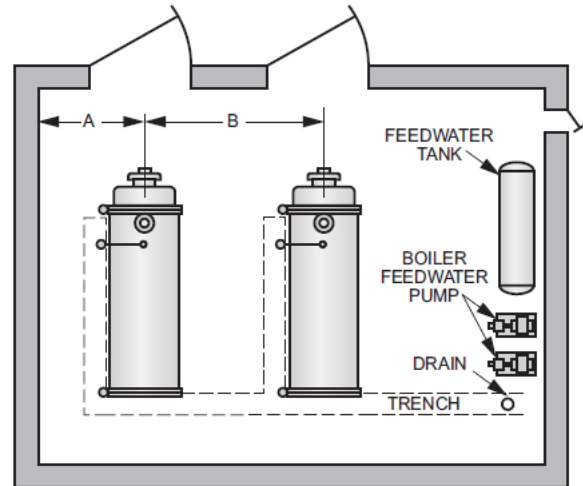
Table 18 shows typical boiler room width requirements.

**Table 17. Boiler room width**

BOILER HP	100-125	150-200	250-300	350-400	500-600	700-800
DIM. "A"	86	88	92	98	102	105
DIM. "B"	120	127	144	151	174	178

**NOTES:**

1. Recommended minimum distance between boiler and wall. Dimension "A" allows for a clear 42" aisle between the water column on the boiler and the wall. If space permits, this aisle should be widened.
2. Recommended minimum distance between boilers. Dimension "B" between boilers allows for a clear aisle of:
  - 42" - 100-200 HP
  - 48" - 250-400 HP
  - 60" - 500-800 HP
 If space permits, this aisle should be widened.



**Stack Support Capabilities**

CBEX boilers can support up to 2000 lbs. without additional support.

CBEX 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:  $\text{Area} = \text{cfm}/\text{fpm} = 10000/250 = 40$  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 CBEX 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.

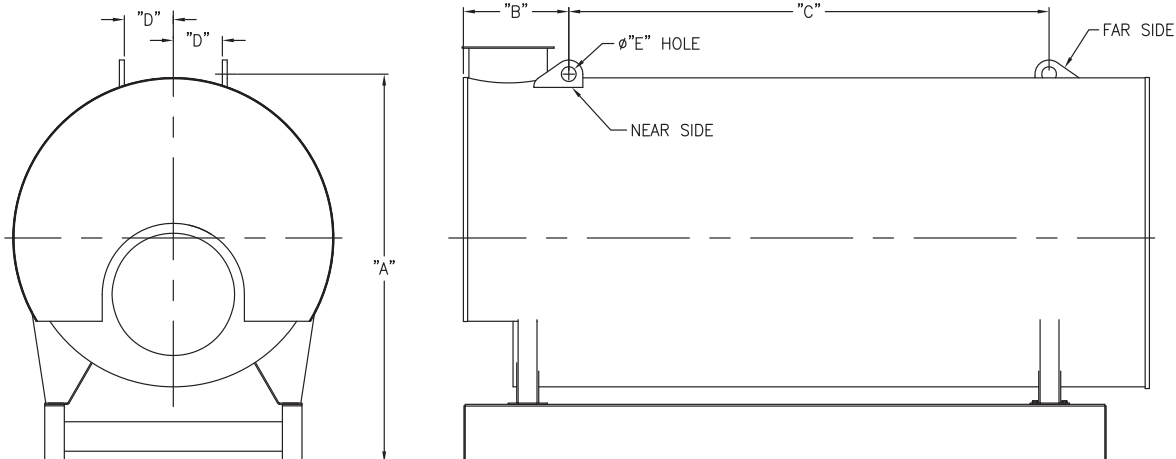
The low NOx option allowable pressure range is  $-0.25''$  W.C. to  $+0.25''$  W.C. The maximum pressure variation at any firing rate for the boiler is  $0.25''$  W.C.

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 18. CBEX lifting lugs**

BOILER HP	ALL DIMENSIONS IN INCHES				
	A	B	C	D	E
100	75.25	21.5	97.25	10	3
125	75.25	21.5	102.25	10	3
150	79.5	21.5	98	10	3
200	79.5	21.5	121	10	3
250	87.25	27.5	109	10	3
300	87.25	27.5	115	10	3
350	99.5	36.5	109	10	3
400	99.5	36.5	117	10	3
500	107.625	36.5	126	10	3
600	107.625	36.5	132	10	3
700	115.75	37.75	137.5	10	3
800	115.75	37.75	137.5	10	3

NOTE: Dimensions A, B, and C may vary by 1 inch.



**Table 19. CBEX Premium boiler mounting piers**

BOILER HP	ALL DIMENSIONS IN INCHES							
	A	B	C	D	E	F	G	H
100	6	9	135.5	34.5	52.5	4	39.5	5.5
125	6	9	140.5	34.5	52.5	4	39.5	5.5
150	6	9	143	39.5	57.5	4	44.5	7.5
200	6	9	166	39.5	57.5	4	44.5	7.5
250	6	9	177	38	56	4	43	8.5
300	6	9	183	38	56 </td <td>4</td> <td>43</td> <td>8.5</td>	4	43	8.5
350	6	12	185.5	48	72	4	56	7.5
400	6	12	193.5	48	72	4	56	7.5
500	6	12	196	41.5	65.5	6.5	47	8
600	6	12	202	41.5	65.5	6.5	47	8
700	6	12	210	49.5	73.5	6.5	55	8
800	6	12	210	49.5	73.5	6.5	55	8

**NOTE:**

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

