CBEX PREMIUM

100-800 HP

Boiler Book
01/2020

CONTENTS

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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 waterback 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 ^{0}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)[A]	2	3	5	7 1/2	5	7 1/2	10	15	15	15	20	25
Blower Motor hp (30 ppm)[A]	3	5	5	7 1/2	7 1/2	7 1/2	10	15	20	25	30	40
Circulating Oil Pump Motor hp[B]	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[B]	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[B]	**	**	**	**	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[A]	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[A]	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[A]	**	**	**	**	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

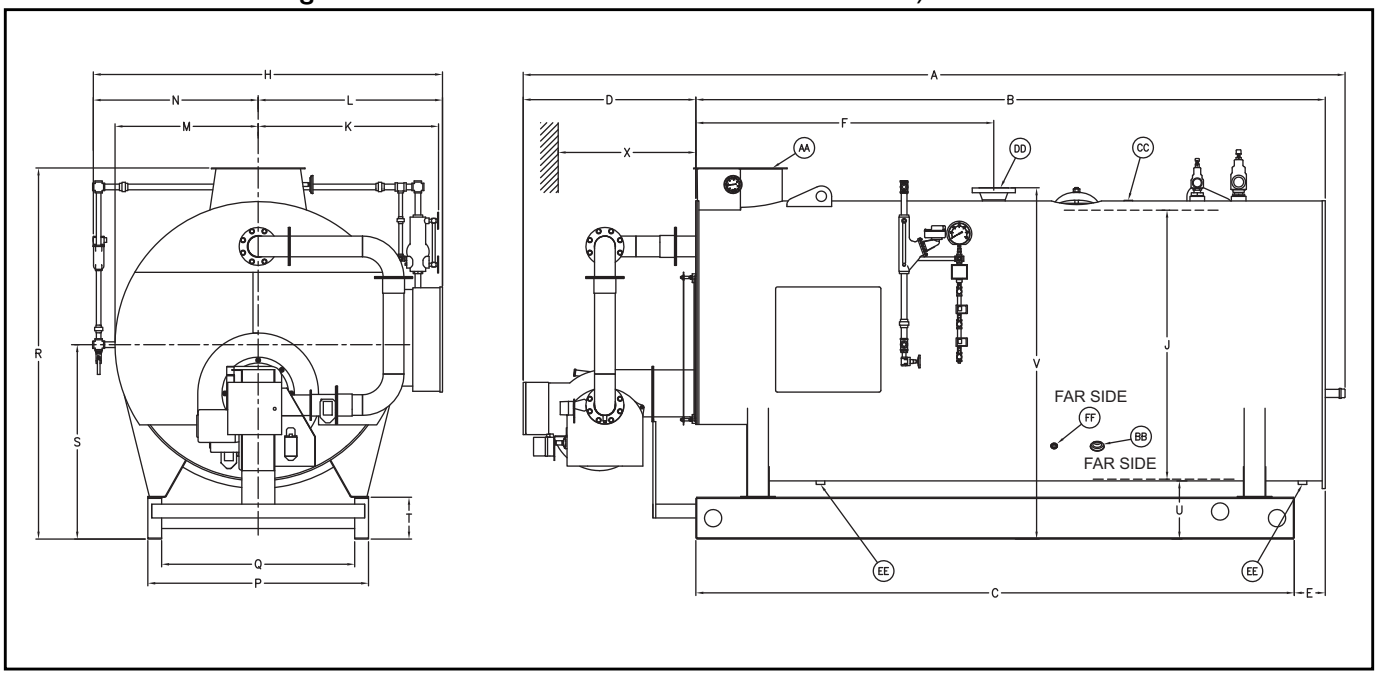


Table 3: Premium Steam Boiler Dimensions, 100-800 HP

BOILER H.P.	DIM	100	125	150	200	250	300	350	400	500	600	700	800
LENGTHS													
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	113.5	104.5	104.5
WIDTHS													
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 Auxiliary 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
HEIGHTS													
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
BOILER CONNECTIONS													
Feedwater Inlet	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
VENT STACK													
Vent Stack Diameter (Flanged)	AA	16	16	16	16	20	20	24	24	24	24	24	24
MINIMUM CLEARANCES													
Tube Removal - Front Only	X	84	89	92	115	120	126	125	133	136	142	150	150

Table 3: Premium Steam Boiler Dimensions, 100-800 HP (Continued)

MINIMUM BOILER ROOM LENGTH ALLOWING FOR TUBE REMOVAL:												
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
WEIGHTS IN LBS												
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

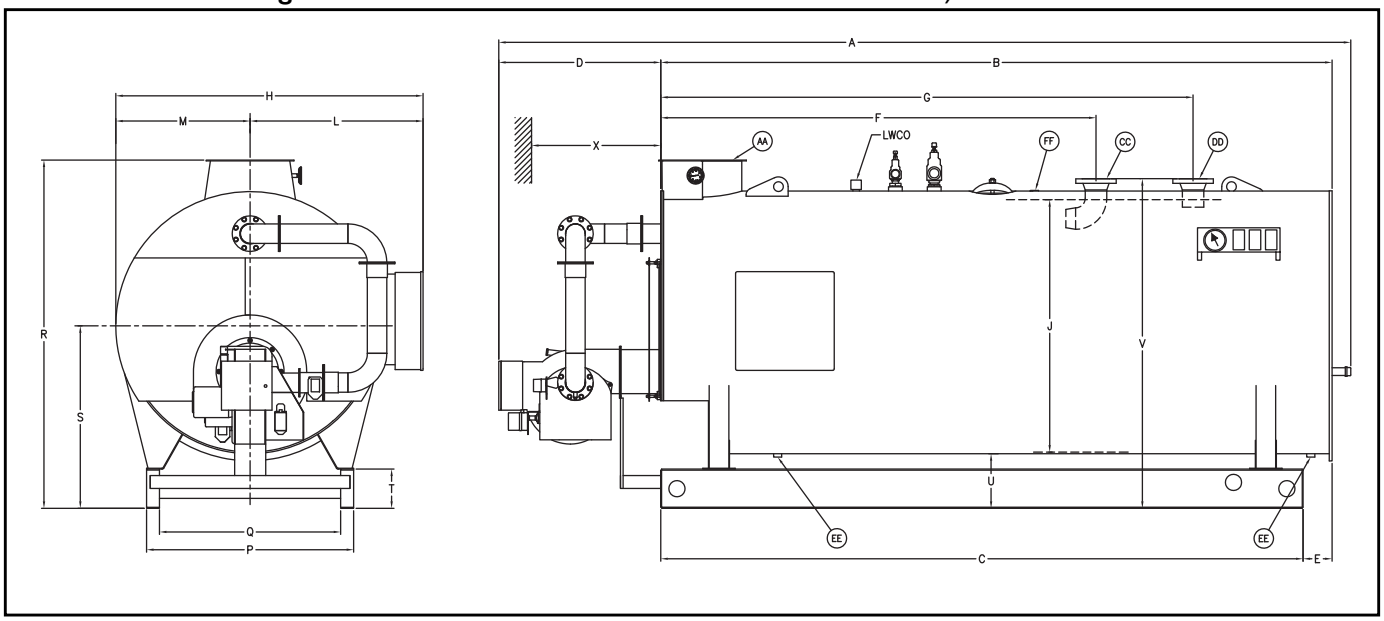


Table 4: ***CBEX Premium Hot Water Boiler Dimensions, 100-800 HP***

BOILER H.P.	DIM	100	125	150	200	250	300	350	400	500	600	700	800
LENGTHS													
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
WIDTHS													
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
HEIGHTS													
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
BOILER CONNECTIONS													
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
VENT STACK													
Vent Stack Diameter (Flanged)	AA	16	16	16	16	20	20	24	24	24	24	24	24
MINIMUM CLEARANCES													
Tube Removal - Front Only	X	84	89	92	115	120	126	125	133	136	142	150	150
MINIMUM BOILER ROOM LENGTH ALLOWING FOR TUBE REMOVAL:													
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

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

WEIGHTS IN LBS												
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
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

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

Table 6: CBEX fuel-to-steam efficiencies #2 oil

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

Table 7: CBEX natural gas estimated emission levels

POLLUTANT	UNITS	UNCONTROLLED	30 PPM SYSTEM
CO	ppm[A]	50	50
	lb/MMBtu	0.037	0.037
NOx	ppm[A]	120	30
	lb/MMBtu	0.1214	0.0364
SOx	ppm[A]	-	-
	lb/MMBtu	0.001	0.001
HC/VOC5	ppm[A]	-	-
	lb/MMBtu	0.0055	0.0055
PM	ppm[A]	-	-
	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[A]	50	50
	lb/MMBtu	0.039	0.039
NOx	ppm[A]	160	90
	lb/MMBtu	0.2047	0.12
SOx	ppm[A]	55	55
	lb/MMBtu	0.1	0.1
HC/VOC5	ppm[A]	-	-
	lb/MMBtu	0.0021	0.0021
PM	ppm[A]	-	-
	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	
BOILER HP	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) 1-1/2 (1) 1-1/4	2	(1) 1-1/2 (1) 1-1/4
300	2	(1) 2 (1) 1-1/2	2	1-1/2	2	(1) 1-1/2 (1) 1-1/4
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) 2 (1) 1-1/2
500	2	(1) 2-1/2 (1) 2	2	(1) 2 (1) 2-1/2	2	(1) 2 (1) 1-1/2
600	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	
BOILER HP	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)
100	1	2	1	1
125	1	2-1/2	1	1-1/4
150	1	2-1/2	1	1-1/4
200	2	2	1	2
250	2	(1) 1-1/2 (1) 2-1/2	1	2
300	2	(1) 2 (1) 2-1/2	1	2
350	2	2-1/2	1	2-1/2
400	3	(2) 2 (1) 2-1/2	1	2-1/2
500	3	(1) 2 (2) 2-1/2	1	2-1/2
600	3	2-1/2	2	(1) 1 (1) 2-1/2
700	4	(1) 2 (3) 2-1/2	2	(1) 1 (1) 2-1/2
800	4	2-1/2	2	(1) 2 (1) 2-1/2

NOTE: Relief valve is Kunkle #537 for 30# & 125# (Section IV) 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.

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 17 shows typical boiler room width requirements.

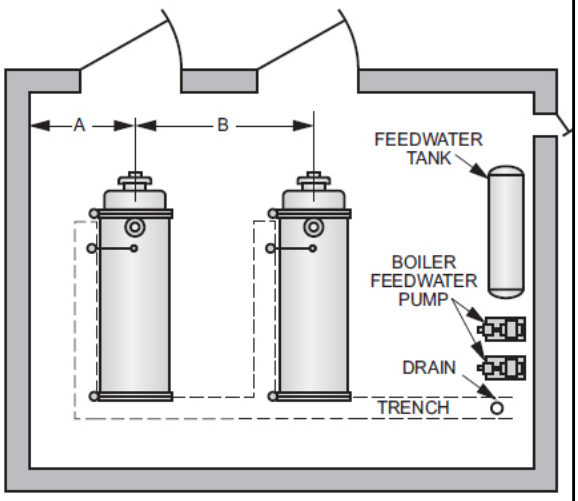
Table 17: *Boiler room width*

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:

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

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.

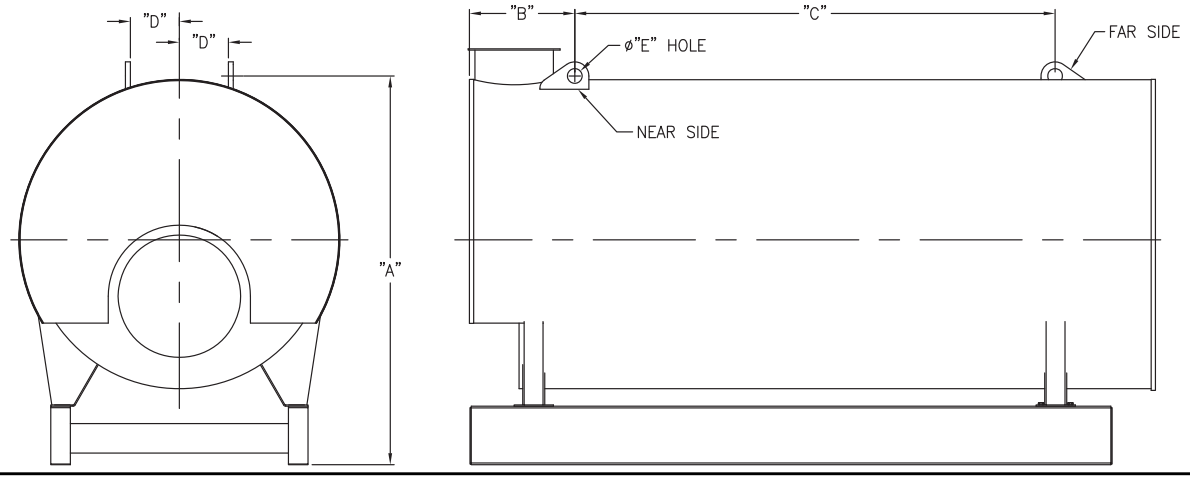
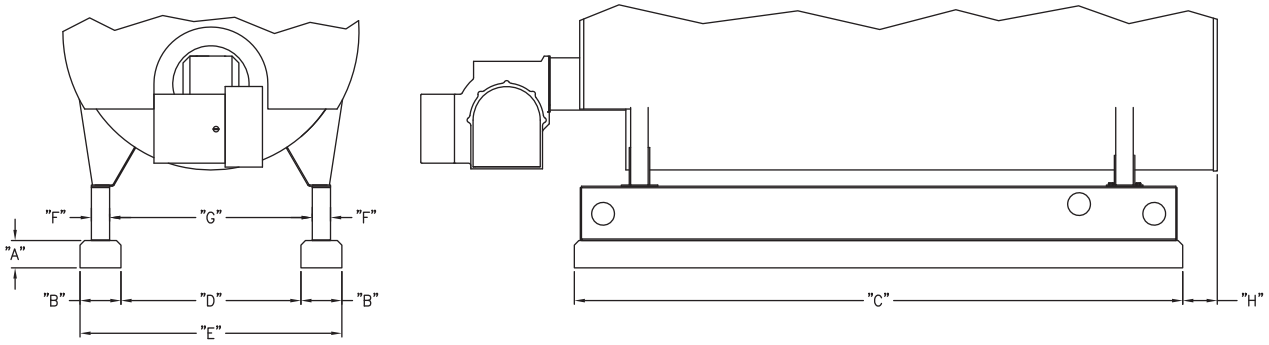


Table 19: CBEX Premium boiler mounting piers

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	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.



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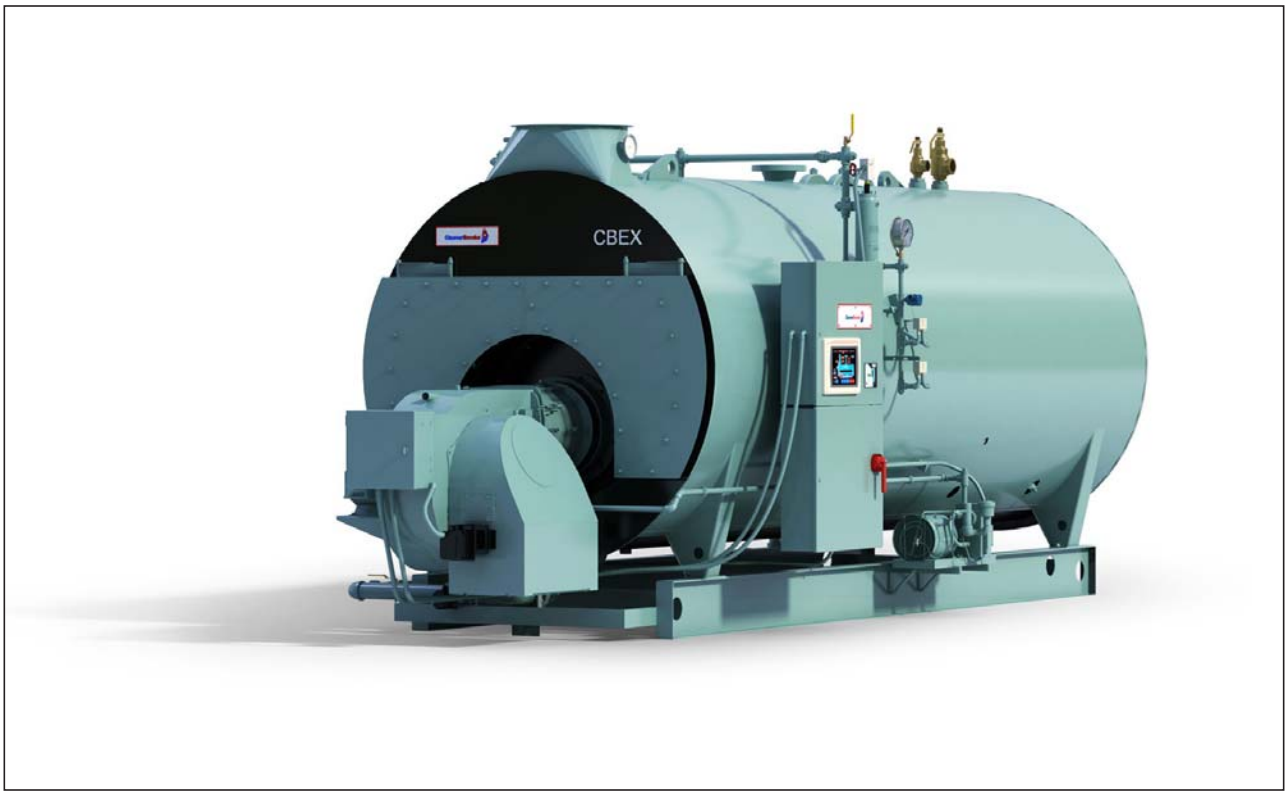
MODEL CBEX PREMIUM BOILERS
100 - 800 HP



Dimensions and Ratings

Table 1. CBEX Premium Steam 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 0F)	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)[A]	2	3	5	7 1/2	5	7 1/2	10	15	15	15	20	25
Blower Motor hp (30 ppm)[A]	3	5	5	7 1/2	7 1/2	7 1/2	10	15	20	25	30	40
Circulating Oil Pump Motor hp[B]	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[B]	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[B]	**	**	**	**	3	3	5	5	5	7 1/2	7 1/2	7 1/2

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[A]	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[A]	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[A]	**	**	**	**	3	3	5	5	5	7 1/2	7 1/2	7 1/2

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. Model CBEX Premium Steam Boiler Dimensions 100 - 800 HP

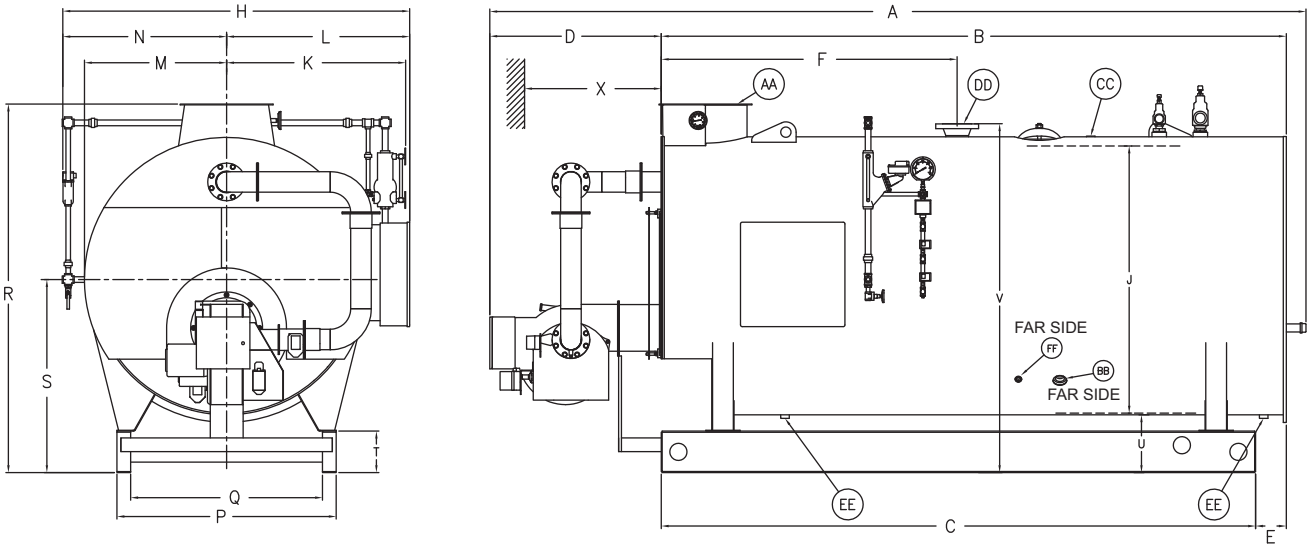


Table 3. **Model CBEX Premium Steam Boiler Dimensions 100 - 800 HP**

BOILER H.P.	DIM	100	125	150	200	250	300	350	400	500	600	700	800
LENGTHS													
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	113.5	104.5	104.5
WIDTHS													
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 Auxiliary 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
HEIGHTS													
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
BOILER CONNECTIONS													
Feedwater Inlet	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
VENT STACK													
Vent Stack Diameter (Flanged)	AA	16	16	16	16	20	20	24	24	24	24	24	24

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

BOILER H.P.	DIM	100	125	150	200	250	300	350	400	500	600	700	800
MINIMUM CLEARANCES													
Tube Removal - Front Only	X	84	89	92	115	120	126	125	133	136	142	150	150
MINIMUM BOILER ROOM LENGTH ALLOWING FOR TUBE REMOVAL:													
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
WEIGHTS IN LBS													
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. Model CBEX Premium Hot Water Boiler Dimensions 100 - 800 HP

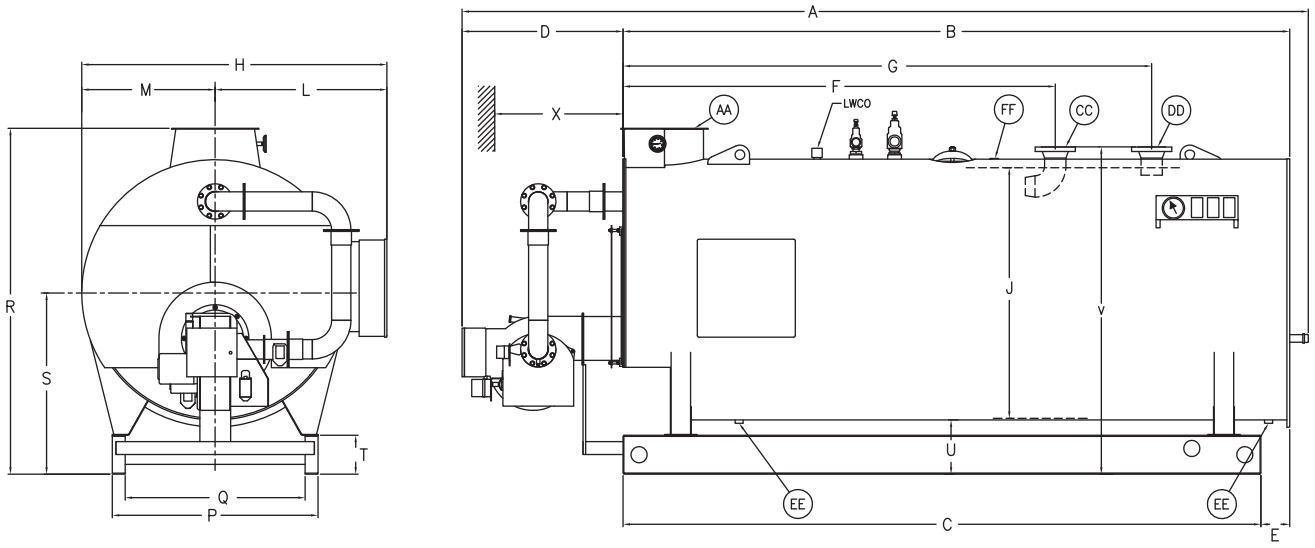


Table 4. **Model CBEX Premium Hot Water Boiler Dimensions 100 - 800 HP**

BOILER H.P.	DIM	100	125	150	200	250	300	350	400	500	600	700	800
LENGTHS													
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
WIDTHS													
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
HEIGHTS													
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
BOILER CONNECTIONS													
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
VENT STACK													
Vent Stack Diameter (Flanged)	AA	16	16	16	16	20	20	24	24	24	24	24	24

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

BOILER H.P.	DIM	100	125	150	200	250	300	350	400	500	600	700	800
MINIMUM CLEARANCES													
Tube Removal - Front Only	X	84	89	92	115	120	126	125	133	136	142	150	150
MINIMUM BOILER ROOM LENGTH ALLOWING FOR TUBE REMOVAL:													
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
WEIGHTS IN LBS													
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
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:

e-mail: info@cleaverbrooks.com
Web address: http://www.cleaverbrooks.com

STANDARD ECONOMIZER PRODUCT GUIDE

CONTENTS

Overview

An Economizer recovers heat from flue gases and uses it to increase boiler feedwater temperatures, prior to entering the boiler. Cleaver-Brooks offers two types of Standard Economizers - CCE (Cylindrical) and CRE (Rectangular) units.

Reduces Fuel Use and Cost:

- Recovers heat from flue gases that would otherwise be wasted
- Heat is used to raise boiler feedwater temperature prior to entering the boiler

Load Changes:

- Rapid changes in load demands can be met faster due to higher feedwater temperature

Emissions:

- Reduced fuel-firing rates for any given steam output means reduced NOx emissions

ASME Construction:

- Ensures high quality design and manufacturing standards
- Provides safety and reliability

High Efficiency Heat Exchanger:

- Provides uniform fin-to-tube contact for maximum heat transfer
- Fin tubing offers up to 12 times the heat exchange surface of bare tubing of the same diameter

Self-Draining Design:

- Suitable for outdoor installation.

Low Pressure Drop:

- Provides low gas side pressure drops.
- Permits use of smaller forced draft fans.
- Permits use of existing fans in almost all installations.

Gas Tight Combustion Stack:

- Stainless Steel casing.
- Compact dimensions provide for easy installation.

Applications

Note:

- Must always have continuous water flow through the economizer when flue gas is travelling through the economizer.
  - Not Recommend
    - Running the economizer dry.

Boiler Feedwater

- Running Feedwater directly through the economizer (direct feedwater heating) – continuous run pump and modulating feedwater control is required.

On/Off Feedwater Control

- Convert to modulating control OR
- Supply Circulating Pump and Tank System must be proposed
  - Circulating pump and tank systems are only available up to 150 lb boiler design pressure.
    - Storage Tank Selection
      - Based on MBH of Economizer Recovery
  - General rule of thumb is to pick 20-30 GPM for the circulating pump flowrate.
  - Minimum water flow rate through the economizer should be the maximum evaporation rate of the boiler.
  - Add liquid temperature control assembly
    - ByPass Damper Open reduces the heat recovery by up to 50%
    - May need additional means of removing the excess heat within the system.

Make-up Water Heating

- Must have Minimum of 50% makeup to ensure a sufficient heat sink
- Even with this guideline, flow may still be interrupted, which can cause steaming in the economizer.
  - Add a tank and pump upstream of the feedwater tank.
  - Then flow is not interrupted.
- Recommend SS Headers (All SS Liquid Side)
  - Untreated Condensate – Carbonic Acid
  - MU Water – O_2 Corrosion
- If water is less than 150°F, may recommend a C1X – Single Stage Condensing Economizer

Hot water boilers

- Supply Circulating Pump to draw water from, and return it to, the system hot water return.
- Use approximately 2-3 gpm per economizer tube as the minimum water flow rate.
- Note:
  - Saturated Steam Temp versus Feedwater Temperature
    - High Fire use lowest flow possible to keep a Temperature difference of 15 or 20°F below the sat. temp of the boiler
- Supply Temperature + Boiler Delta T (LPS/HW) = Flue Gas Temp

Potable Water

- Depends on local code if you can run direct through economizer or need a secondary heat exchanger
- Quote a circulating pump kit
- Select a second identical pump
- Second pump not with the kit
- Controller with kit is set up to only control one pump
- Would have to provide own means of switching over to the backup pump

Guide:

Special Applications (Contact Milwaukee Sales):

- Low Pressure Steam
- Hot Water Boiler
- Operating Pressure Less Than 35 psi
- Heavy Oil Fuel
- On/Off Feedwater Control
- Maximum Feedwater Temperature is greater than what is allowed within the program
- Multiple Boilers into 1 Economizer
  - Not Recommended
  - Size for maximum capacity
    - Must include a SCCA

Tab 1: Application Data

Model Selection

- Select the correct Cleaver Brooks boiler model.
  - For non Cleaver Brooks models select “Other”

Load Points

- Firetube Models will provide 4 Load Points
- Model 4/ Model 5 will provide 1 Load Point at 100% Load
- Model FLX will Provide 2 Load Points

Fuel Series Consideration

- **Natural Gas Only:**
  - Condense Temperature ~140°F
  - Stack Temperature (Economizer leaving temp)
    - 290 – 300°F target
      - Stack corrosion control assembly not required.
    - 290°F (85% efficiency requires 265 - 275°F stack temp)
      - May require the Stack Corrosion Control Assembly if temperature falls below @ 230°F at low fire.
      - SCCA also recommended for tall or un-insulated stacks to prevent condensation.
  - Feedwater Temperature
    - 40°F minimum.
    - Inlet water temperature below 100°F requires all stainless steel liquid side surfaces.
  - Construction
    - Standard Al-Fuse stainless tube/aluminum fin construction.
  - Fin Spacing:
    - Maximum 6 Fins/inch.

- **Natural Gas and/or #2 Oil:**
  - Natural Gas Condense Temp ~140°F
  - #2 oil Condense Temperature: ~180°F
  - Stack Temperature (Economizer leaving temp)
    - 300 – 325°F target,
      - Stack corrosion control assembly not required.
    - Below 290°F (85% efficiency requires 265 - 275°F stack temp)
      - Stack Corrosion Control Assembly is required.
  - Feedwater Temperature
    - 120°F minimum.
  - Construction
    - Standard Al-Fuse stainless tube/aluminum fin construction.

- Fin Spacing
  - Maximum 6.0 Fins/inch.

- **#6 Oil:**
  - Forward all #6 oil selection to Cleaver Brooks.
    - Stack Temperature (Economizer leaving temp)
      - 325 – 350°F target
      - Stack corrosion control assembly required for all applications.
      - Automatic sootblower required
    - Feedwater Temperature
      - 220˚F minimum required.
      - Feedwater must be from DA or otherwise preheated
    - Maximum fuel sulfur content
      - 3%
    - Construction
      - Stainless Steel tube/ Carbon Steel fin for low sulfur
      - Stainless Steel tube/ Stainless fin for 2% or greater sulfur content.
    - Fin Spacing
      - 4 – 5 fins/inch.

Pressure Drop:

- Majority of Cleaver Brooks Boilers
  - 0.25" w.c. maximum Gas Side pressure drop
- Some Cleaver Brooks Boilers
  - 0.50" w.c. maximum Gas Side pressure drop.
- Industrial watertube boilers
  - 0.8" w.c. maximum pressure drop.

Feedwater Temperature

- Maximum Temperature
  - Calculated and set at a temperature to assure at least a 25°F Differential between the Boiler Operating Temperature and the Economizer Outlet Feedwater Temperature

Flue Gas Temperatures

- Predicted Values are Calculated
- Can override the Defaulted Value

Hours of Operation

- Can override the Defaulted Value: 2190

Tab 2: Economizer Selection

Boiler Performance Baseline

- Display field in the upper left corner
- Shows the Boiler Information formed from Tab 1 Selections

Stack Temperature Loss

- Display field in the upper right corner
- Shows the minimum recommended exit temperature from the economizer to avoid condensation.
- Uses Stack Height, Feet and Stack Construction for calculation

Economizer Type

- CCE
  - Cylindrical Model
  - Horsepower is less than or equal to 250HP
  - Base price includes economizer and stack transitions with flanges, Qty. (2) mating flanges, and Qty. (2) mating flange gaskets.
  - Standard Design Pressure
    - 300psig
  - Standard Test Pressure
    - 375 psig
  - 150psi – 250psi Boiler Design
    - Switch Design Press/Test to 400/600
    - Change Relief Valve to 400psig
  - Above 550°F
    - Special Request
    - Other materials required
  - Features
    - Does not have a field replaceable tube core
  - The Unit can be rebuilt at the factory if needed.
    - Header manifold for high liquid flow rates
    - UM Stamp Standard

- Hinged stainless steel access door panels
- Quick release tension for doors
- Manual bypass control lever
- Stainless steel internal bypass assembly
- Vertical Flow Only
- Internal thermal expansion design
- Built in by-pass damper
  - Allow manual stack temperature control and heat adjustment
- Mounting flanges for bolting to mating flanges or adapters
- Single Row Construction
  - Have much higher water side pressure drops.
  - Water side pressure drop limit is 10 psig, unless the rep can accept a higher drop.
- 2 Row Construction (CRE-M2D, L2H, etc.)
  - More likely to achieve higher efficiency
  - Will have much higher gas side pressure drops.

- CRE
  - Rectangular Model
  - Boiler HP 150 HP up to 2200 HP
  - Standard Design Pressure
    - 300psig
  - Standard Test Pressure
    - 450 psig
  - 150psi – 250psi Boiler Design
    - Switch Design Press/Test to 400/600
    - Change Relief Valve to 400psig
  - Above 550°F
    - Special Request
    - Other materials required
  - Features
    - Removable tubes with unions and Compression fittings
    - Tube replacement without welding or cutting
    - Hinged access door
    - Water Side Pressure drop is not a concern with rectangular CRE units.

- UM stamp standard
- Stainless steel interior shell
- Built in by-pass damper
  - Allow manual stack temperature control and heat adjustment
- Removable panels allow for complete cleaning
- Vertical or Horizontal Flow
- Built-stainless steel condensate pan and drain
- Mounting flanges for bolting to mating flanges or adapters
- Square pieces for transitions are 2x2 angle flanges

Exhaust Flow Direction

- CRE
  - Vertical or Horizontal
- CCE
  - Vertical Only

Target Stack Temperature

- Default: 310 – 330 Deg. F (84 - 84.5)
  - Selects Economizers that would produce an outlet flue gas temperature between 310 to 400
- 290 – 310 Deg. F (84.5 - 85)
  - Selects Economizers that would produce an outlet flue gas temperature between 290 to 310
- 275 – 290 Deg. F (85 plus)
  - Selects Economizers that would produce an outlet flue gas temperature between 275 to 290

Tube Construction

- 316L SS Tube w/Al-Fuse Fin
  - Standard Offering
  - Most efficient for the price
  - Higher Allowed Maximum Temperature than Duplex SS
- CS Tube / CS Fin, Nickel Brazed
- Duplex SS Tube w/ Al-Fuse Fin

Selection Criteria

- Used to narrow down the Economizer Selections
- Best Payback
  - Best Heat Transfer Recovered versus Cost
- Lowest Price
  - Lowest Dollar Amount in selection range

Economizer Model

- Select economizer model
- Clarification Example: CCE-16A6AL
  - CCE – Model Type (CCE – Cylindrical; CRE – Rectangular)
  - 16 – Core Size (Ex.: 16, 18, 20, etc.)
    - CCE – Diameter; CRE – Length x Width
  - A – Number of Rows (Ex.: 6 = 6 Rows; 8 = 8 Rows; A = 10 rows, etc.
    - Determines Economizer Height
  - 6 – Fin Spacing (per inch)
  - AL – Fin and Tube Construction
    - AL = 316L SS Tube w/ Al-Fuse Fin
    - DS = Duplex SS Tube w/ Al-Fuse Fin
    - CS = CS Tube / CS Fin, Nickel Brazed
- Total Height of Economizer with Transition Pieces
  - If (core size – vent size) >= 12
    - (Model Size – Vent Size) + 10 + Height of Economizer
  - If (core size – vent size) < 12
    - 5 x 2 = 10 + Height of Economizer

Economizer Model Displays

- Displays all of the information once an Economizer model is selected
- Economizer Weights and Dimensions
  - Links
    - CCE_Dims and Weights.pdf
    - CRE_Dims and Weights.pdf
- Sales Brochure Link
  - Links
    - CB-8089_Stack_Economizer_NL.pdf
- Dimensions – Charted DD's

- Links
  - DD_CCE_06-08.pdf
  - DD_CCE_10-14.pdf
  - DD_CCE_16-20.pdf
  - DD_CCE_H2-J2.pdf
  - DD_CCE_L2-M2.pdf
  - DD_CRE_16-30_Flat Tran.pdf
  - DD_CRE_36-42_Angle Tran.pdf
  - DD_CRE_36-42_Flat Tran.pdf
  - DD_CRE_48_Angle Tran.pdf
  - DD_CRE_54-60_Angle Tran.pdf
  - DD_CRE_66-72_Angle Tran.pdf
- Estimated Performance (Based on Fuel Series Selection)

Tab 3: Economizer Options

Standard Equipment

- Designed and fabricated in accordance with the ASME Boiler and Pressure Vessel Code, 'UM' Stamp
- Incorporates self-draining design.

Boiler Vent Mating Flanges and Gaskets

- Standard on CCE Model (Qty. 2)
- CRE Models Option

Flange Size (CB Mating Flange)	Mating Flange Gasket
6" I.D.	6" I.D.
8" I.D.	8" I.D.
10" I.D.	10" I.D.
12" I.D.	12" I.D.
16" I.D.	16" I.D.
18" I.D.	18" I.D.
20" I.D.	20" I.D.
24" I.D.	24" I.D.
32" I.D.	32" I.D.
36" I.D.	36" I.D.
42" I.D.	42" I.D.

Relief Valves

Cannot be sized any higher than the Design Pressure of the Economizer

- ¾" NPT ASME Relief Valve: 300 PSI
- ¾" NPT ASME Relief Valve: 400 PSI
- PRV Sized For
  - ¾" 300psi
    - Relieves 106 gpm
    - 880 lbs/min
  - 1" 300psi
    - Relieves 165 gpm
    - 1370 lbs/min
  - Criteria
    - Only way to build up pressure is if close off the valves and continue to run
    - Example: 227°F (5psi) ¾" 300psi relief
      - Raise to 300psi or 421°F

- Delta T = 196
- = 196 x 500 x 106gpm
- Relieves Over 10million btu/hr

Outdoor Coat – Paint

Required for outdoor insulations

Flue Gas Thermometer

- Recommend: (2) Two
- Gauge Mounting
  - Inlet – 2 pipe diameters away from inlet
  - Outlet – 2 pipe diameters away from outlet
    - Allows for mixing of the gas moving through the bypass damper and gas moving around the bypass damper to mix adequately for an accurate reading.

Flue Gas Thermometer
3" Dial; 150-750°F
3" Dial; 200-1000°F
3" Dial, Adjust.< 150-750°F
3" Dial, Adjust. <200-1000°F
5" Dial; 150-750°F
5" Dial 200-1000°F
5" Dial, Adjust. < 150-750°F
5" Dial, Adjust. <200-1000°F

Liquid Thermometer

- Recommend: (2) Two
- Gauge Mounting
  - Water (inlet and outlet)
    - Before and after the headers

Liquid Thermometer
3" Dial, bimetal 150-750 w/well
3" Dial, bimetal 50-300 w/well
3" Dial, bimetal 50-500 w/well

Timed Automatic Sootblower

The Timed Automatic Sootblower has a ring nozzle assembly that travels the length of the economizer while jetting steam at the finned tubes. The traveling action of the sootblower, along with the single row arrangement of the finned tubes, ensures coverage of the finned tubes by the steam jets. Maximum steam pressure to the sootblower is 100 psig, pressure reducing valve, if required, is to be supplied by others.

Select by Model and Core Size

- Ex: **CCE**-1**08**A
  - Select if Model is CCE and Core Size is 08

Sizes

Timed Automatic Sootblower	Timed Automatic Sootblower
CCE-108A	CRE-114
CCE-110A	CRE-116A
CCE-114C	CRE-118B
CCE-116C	CRE-120B
CCE-118D	CRE-124C
CCE-120D	CRE-130E
CCE-124D	CRE-136H
CCE-130D	CRE-142G
CCE-136E	CRE-148H
	CRE-154H
	CRE-160L
	CRE-166N
	CRE-172T

Options

- NEMA 4 panel in lieu of NEMA 12
  - Only (1) Adder Required if a SCCA and a Sootblower is selected

Stack Corrosion Control Assembly

The Stack Corrosion Control Assembly (SCCA) automatically modulates the internal exhaust gas bypass to control the temperature of the cooled exhaust gas leaving the economizer. A desired minimum temperature is entered on the digital indicating controller. The controller has a continuous temperature display.

Includes

- Damper Actuator Factory Mounted
- One controller (Pre-Programmed)
- Thermocouple
- Thermocouple wire shipped loose.

Sizes

- Core Size 42 and Lower
- Core Size Larger than 42
  - SCCA 600"lbs Torque/120V./10S

Options

- NEMA 4 panel in lieu of NEMA 12
  - Only (1) Adder Required if a SCCA and a Sootblower is selected

Circulating Pump and Tank Systems:

- Only applicable to boilers with design pressures of 150 psig or less
  - Circulating pumps with higher pressure ratings
    - Not readily available to support higher design pressures
- Tanks are only rated to 200 psig.
  - Storage tank selections based on MBH of Economizer Recovery
- Circulating pump and tank systems consist:
  - (1) Pump kit assembly
  - (1) BTU Storage tank.
- The pump kit includes:
  - (1) circulating pump
  - (1) flow control valve
  - (1) check valve
  - (1) relief valve (for the storage tank, economizer relief valve is still required)
  - (1) pump controller
  - (2) Gas side thermometers.
  - Do not include Gas Side Thermometers Separately
    - Included in pump kit

Vent Extension

- Only Required for CBLE, 4WI, and CBR boilers.
- 2000lb. 12" Vent Stub Extension
- Available for 70 HP to 800 HP
- Additional support is needed to completely secure an Economizer

12" 2000lb. Vent Extension (Equivalent Horsepower)
70 HP to 100 HP
125 HP to 225 HP
250 HP to 350 HP
400 HP to 800 HP

Economizer Supports

- Option available within the Firetube Program (Tab: Pressure Vessel)

ASME Stamp / CRN

- ASME National Board "UM"
  - Standard
- ASME National Board Stamp – Sec. VIII; Div. I ('U')
- Optional
- Required (Water Volume is larger at the specified Design Pressure)
  - 1-1/2 ft^3 @ 600psi (Design Pressure)
  - 3 ft^3 @ 350psi (Design Pressure)
  - 5 ft# @ 250psi (Design Pressure
- ASME National Board Stamp – Sec. I ('S')
  - Optional
- CRN (Must Specify CRN Province)
  - Optional

International Orders

- Ship to Thomasville
- Export Packaging

Other offerings

- C1X
  - Single Stage Condensing Economizer
  - Process or Make-Up Water
  - Hot Water of Low Pressure Steam Application
- C2X
  - Two Stage Condensing Economizer
  - 1st Stage
  - Boiler Feedwater

BOILER EXHAUST ECONOMIZER SPECIFICATIONS

CRE Section VIII

1.0 GENERAL DESIGN

1.1 Furnish and install an exhaust gas economizer in the vertical exhaust duct of the boiler in accordance with the following specifications as designed and manufactured by Cain Industries, Inc.

1.2 The economizer shall be a light weight design for easier installation, rectangular, and manufactured and tested in accordance with the requirements of Section VIII, Division I of the ASME Boiler and Pressure Vessel Code.

1.3 The economizer shall be designed to include as standard, an internal, high temperature heat resistant design Flue Gas By-pass Diverter to provide for: emergency by-pass, requiring no additional duct work for controlling either:
A. Stack Corrosion B. Turn Down Performance C. Excessive flue gas back pressure due to fouling

1.4 The Economizer shall have a hinged, full face, gas tight, inspection door, providing access to the heating surface for inspection and/or cleaning.

1.5 The Economizer must be completely drainable when mounted in the vertical position or horizontal position.

1.6 Header manifolds for low liquid flow pressure drop shall be provided. The liquid header manifolds shall also contain 3/4" NPT connections for venting, draining, and/or safety relief valves as required.

1.7 Compression fitted Al-Fuse fin tubes shall be connected to header manifolds for ease of tube replacement requiring no welding.

2.0 CONSTRUCTION

2.1 Design Pressure: 300 psig @650°F.; Test Pressure: 450 psig; Max. Flue Gas Inlet Temperature: 750°F.

2.2 Fins: pitch 6 Fins/In. Max.; Material: Aluminum; Thickness: .020"; Height: .50"; Alfuse metallurgically bonded to the tube.

2.3 Tube: outside diameter: 1.0"; Wall Thickness: .065"; Material: TP316 Stainless steel ERW

2.4 Headers: material: SA106 Gr.B/ SA 53 Gr. B

2.5 2" thks. 1000°F thermofiber factory installed, high temperature insulation shall cover the shell less the header assemblies and stack adapters.

2.6 Exterior surfaces shall be 10ga. carbon steel and shall be primed and painted with a high temperature metallic paint rated for 1000°F. The inner shell shall be 304 stainless steel.

3.0 OPTIONAL EQUIPMENT

3.1 (2) 50-500°F, bimetal, 3" adjustable dial, water temperature thermometers with wells

3.2 (2) 150-750°F Bi-metallic flue gas temperature thermometers, 5" dial.

3.3 (1) 300 psig safety relief valve.

CRE Section I

1.0 GENERAL DESIGN

1.1 Furnish and install an exhaust gas economizer in the vertical exhaust duct of the boiler in accordance with the following specifications as designed and manufactured by Cain Industries, Inc.

1.2 The economizer shall be a light weight design for easier installation, rectangular, and manufactured and tested in accordance with the requirements of Section I of the ASME Boiler and Pressure Vessel Code.

1.3 The economizer shall be designed to include as standard, an internal, high temperature heat resistant design Flue Gas By-pass Diverter to provide for: emergency by-pass, requiring no additional duct work for controlling either:
A. Stack Corrosion B. Turn Down Performance C. Excessive flue gas back pressure due to fouling

1.4 The Economizer shall have a hinged, full face, gas tight, inspection door, providing access to the heating surface for inspection and/or cleaning.

1.5 The Economizer must be completely drainable when mounted in the vertical position or horizontal position.

1.6 Header manifolds for low liquid flow pressure drop shall be provided. The liquid header manifolds shall also contain 3/4" NPT connections for venting, draining, and/or safety relief valves as required.

1.7 Tubes are welded to the header manifolds.

2.0 CONSTRUCTION

2.1 Design Pressure: 300 psig @650°F.; Test Pressure: 450 psig; Max. Flue Gas Inlet Temperature: 750°F.

2.2 Fins: pitch 6 Fins/In. Max.; Material: Carbon Steel; Thickness: .030"; Height: .50"; Nickel brazed/welded to the tube.

2.3 Tube: outside diameter: 1.0"; Wall Thickness: .083"; Material: SA178 Gr.A

2.4 Headers: material: SA106 Gr.B/ SA 53 Gr. B

2.5 2" thks. 1000°F thermofiber factory installed, high temperature insulation shall cover the shell less the header assemblies and stack adapters.

2.6 Exterior surfaces shall be 10ga. carbon steel and shall be primed and painted with a high temperature metallic paint rated for 1000°F. The inner shell shall be 304 stainless steel.

3.0 OPTIONAL EQUIPMENT

3.1 (2) 50-500°F, bimetal, 3" adjustable dial, water temperature thermometers with wells

3.2 (2) 150-750°F Bi-metallic flue gas temperature thermometers, 5" dial.

3.3 (1) 300 psig safety relief valve.

Notes

Height information is for the economizer only and does not include any transition pieces.

Model	Length (in.)	Width (in.)	Height (in.)	Dry Weight (lbs)
CRE-168	34	27	25	501
CRE-16A	34	27	29.2	555
CRE-16B	34	27	33.3	605
CRE-16C	34	27	37.4	655
CRE-18A	36	29	29.2	595
CRE-18B	36	29	33.3	645
CRE-18C	36	29	37.4	695
CRE-18D	36	29	41.5	745
CRE-20C	40	32	37.4	725
CRE-20D	40	32	41.5	775
CRE-20E	40	32	45.7	825
CRE-20F	40	32	49.8	875
CRE-24B	44	36	33.3	915
CRE-24C	44	36	37.4	1001
CRE-24D	44	36	41.5	1095
CRE-24E	44	36	45.7	1185
CRE-24F	44	36	49.8	1275
CRE-24G	44	36	54.2	1365
CRE-24H	44	36	58.3	1455
CRE-24I	44	36	62.7	1545
CRE-24J	44	36	66.8	1635
CRE-24K	44	36	70.9	1725
CRE-30C	52	43	37.4	1201
CRE-30D	52	43	41.5	1305
CRE-30E	52	43	45.7	1405
CRE-30F	52	43	49.8	1505
CRE-30G	52	43	54.2	1605
CRE-30H	52	43	58.3	1705
CRE-30I	52	43	62.7	1805
CRE-30J	52	43	66.9	1905
CRE-30K	52	43	70.9	2005
CRE-36D	60	50	41.5	1401
CRE-36E	60	50	45.7	1501
CRE-36F	60	50	49.8	1601
CRE-36G	60	50	54.2	1705
CRE-36H	60	50	58.3	1801
CRE-36I	60	50	62.7	1905
CRE-36J	60	50	66.8	2005
CRE-36K	60	50	70.9	2105
CRE-42D	70	58	41.5	1601
CRE-42E	70	58	45.7	1701
CRE-42F	70	58	49.8	1805
CRE-42G	70	58	54.2	1925
CRE-42H	70	58	58.3	2045
CRE-42I	70	58	62.7	2165
CRE-42J	70	58	66.8	2285
CRE-42K	70	58	70.9	2401
CRE-48D	80	63	41.5	1885
CRE-48E	80	63	45.7	2001
CRE-48F	80	63	49.8	2101

Model	Length (in.)	Width (in.)	Height (in.)	Dry Weight (lbs)
CRE-48G	80	63	54.2	2201
CRE-48H	80	63	58.3	2321
CRE-48I	80	63	62.7	2475
CRE-48J	80	63	66.8	2621
CRE-48K	80	63	70.9	2801
CRE-54E	88	73	45.7	2201
CRE-54F	88	73	49.8	2355
CRE-54G	88	73	54.2	2501
CRE-54H	88	73	58.3	2655
CRE-54I	88	73	62.7	2855
CRE-54J	88	73	66.8	3055
CRE-54K	88	73	70.9	3205
CRE-54L	88	73	75	3355
CRE-54M	88	73	79.2	3501
CRE-54N	88	73	83.4	3655
CRE-60F	98	82	49.8	4105
CRE-60G	98	82	54.2	4205
CRE-60H	98	82	58.3	4301
CRE-60I	98	82	62.7	4405
CRE-60J	98	82	66.8	4505
CRE-60K	98	82	70.9	4605
CRE-60L	98	82	75	4705
CRE-60M	98	82	79.2	4805
CRE-60N	98	82	83.4	4905
CRE-60O	98	82	87.6	5005
CRE-60P	98	82	91.8	5105
CRE-66I	106	90	62.7	4505
CRE-66J	106	90	66.9	4655
CRE-66K	106	90	70.9	4801
CRE-66L	106	90	75	4955
CRE-66M	106	90	79.2	5105
CRE-66N	106	90	83.4	5255
CRE-66O	106	90	87.6	5405
CRE-66P	106	90	91.8	5555
CRE-72I	114	96	62.7	4805
CRE-72J	114	96	66.8	4955
CRE-72K	114	96	70.9	5105
CRE-72L	114	96	75	5255
CRE-72M	114	96	79.2	5405
CRE-72N	114	96	83.4	5555
CRE-72O	114	96	87.6	5705
CRE-72P	114	96	91.8	5855
CRE-72Q	114	96	95.9	6005
CRE-72R	114	96	100.1	6155
CRE-72S	114	96	104.3	6305
CRE-72T	114	96	108.5	6455

SPRAYMASTER
SPRAYMASTER COMBO

Deaerators

Boiler Book
05/2018

The Cleaver-Brooks designed deaerator assures high purity effluent by removing oxygen and other dissolved gases in boiler feed. Thus, it is the answer to long- lasting boiler equipment for industrial and commercial boiler users. Built of corrosion-resistant alloys for lifetime service, the deaerator employs those basic principles of gas removal proven most effective and economical to every boiler owner. Contact your local Cleaver-Brooks authorized representative for component sizing information.

FEATURES AND BENEFITS

Low Profile desgn:
- Low head allows installation in space restricted areas.

Two-Stage Deaeration in a Common Vessel:
- Recycle pumps are not required.
- Packaged for easy maintenance.

ASME Code Design (Section VIII):
- Assures deaerator vessel quality in materials and fabrication to meet safety requirements.

Internal Stainless Steel Vent Condenser:
- Protects deaerator vessel against corrosive gases while providing a means for removal of corrosive gases from boiler feedwater.

Self-Cleaning Water Spray Valve:
- Maintains deposit-free surface.
- Reduces maintenance requirements.

Internal Automatic-Check Valve Prevents Steam Back-Flow:
- The water spray valve is normally closed at no flow.
- Prevents steam back flow through the water spray valve at no flow conditions.

Removable Water Spray Inlet Assembly:
- Flanged assembly allows easy access for maintenance and/or inspections.

Stainless Steel Deaeration Assembly:
- Ensures a longer life of wetted materials in intimate contact with corrosive liquids and released corrosive gases.

Pressurized Tank Reduces Flashing and Minimal Venting:
- Recovery of exhaust and turbine steam.
- Saves BTU that would normally be exhausted to atmosphere.
- Improves plant efficiency.

Auto Vent Valve Eliminates Gases at Start-Up:
- Atmospheric contamination virtually eliminated for incoming water.

O2 levels to 0.005 cc/l; CO2 levels near zero:

- Cleaver-Brooks deaerator is guaranteed to remove oxygen concentrations to 0.005 cc/liter while operating between 5 and 100% capacity.

Carbon dioxide concentration is practically reduced to zero.

Capacity Not Affected by Mixed Inlet Temperature:

- Consistent performance under variable conditions.

Integral Level Control

- Automatically introduces cold water make-up to supplement condensate only when necessary to meet boiler demand:
- Saves BTU by accepting condensate before cold make-up water. Maintains a minimal water level within the deaerator vessel to prevent damage to the boiler feed pumps, and to maintain system operation.

Variety of Tank Sizes to Handle Volume-Swings in Condensate Return:

- Provides flexibility for selecting a tank for specific applications to limit the loss of hot condensate to drain.

Packaged Units for Cost Effective Installation:

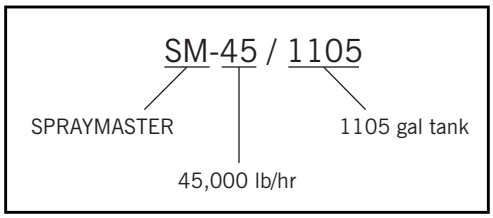
- Complete packages are prefabricated in the Cleaver- Brooks manufacturing facility to ensure piping alignment and control wiring function. The unit is partially disassembled, match marked for efficient field re-assembly.

Internal Pump Suction Vortex Breakers:

- Eliminates the problems of loss in NPSHA and cavitation associated with the creation of vortices within pump suction piping.

PRODUCT OFFERING

Spraymaster Deaerators are designated by spray head and tank size. Example:



The table below lists storage capacity for standard tank sizes.

Minutes of storage from the overflow level to the bottom of the tank at rated capacity

Industry standard sizing is for 10 minutes of storage

Model number		SM-7	SM-15	SM-30	SM-45	SM-70	SM-100	SM-140	SM-200	SM-280
Spray capacity (LBS/HOUR)		7000	15,000	30,000	45,000	70,000	100,000	140,000	200,000	280,000
Spray Capacity (GPM)		14	30	60	90	140	200	280	400	560
Total Boiler HP		203	435	870	1304	2029	2899	4058	5797	8116
Tank size	260	18.6	8.7							
	300	21.4	10.0	5.0						
	415		13.8	6.9						
	610		20.3	10.2	6.8					
	840			14.0	9.3	6.0				
	1105			18.4	12.3	7.9	5.5			
	1400				15.6	10.0	7.0	5.0		
	2200					15.7	11.0	7.9		
	2485					17.8	12.4	8.9		
	3200						16.0	11.4	8.0	5.7
	4500						22.5	16.1	11.3	8.0
	6200							22.1	15.5	11.1

The Spraymaster Deaerator is a pressurized low-headroom system designed to remove dissolved oxygen in boiler feedwater to 0.005 cc per liter, or less, and eliminate carbon dioxide. A typical deaerator package includes the deaerator tank mounted on a stand of appropriate height along with all operating controls, feed pumps assembled and piped (typically knocked down for shipment and field assembly). The tank conforms to section VIII of the ASME code.

The main deaerating portion is located internally and consists of a water collector and steam atomizing valve. Built into a flange on top of the tank is a spring loaded water spray nozzle which includes an automatic and manual vent valve.

Packaged Spraymaster systems offer substantial advantages through lower-cost installation and simplified operation and maintenance. Spraymaster Deaerators arrive on site ready for hookup to your water, steam, and electric power connections.

The deaerator stand comes with feed pump/motor set mounted on a solid base. The base is specially reinforced to prevent vibration wear on vital system components. Rugged square structural tubing combines lasting strength with generous working space for inspection or routine servicing.

Control Panel

The control panel, complete with starters, fuse protection, switches, lights and pre- wired terminal blocks is mounted on the stand assembly. Wiring to feed pump motor and all controls is standard.

Deaerator Tank

ASME construction - certified to 50 psig. All tanks provided with manhole, individual pump suction tappings and other openings as required. Saddles or legs standard on all sizes. Select from sizes for 5 to 30 minutes of storage to overflow.

Piping

Pump and motor sets are mounted on individual bases before mounting on stand base. Individual suction piping (including strainer and shutoff valve) are provided for all feed pumps.

Standard Equipment

- Spraymaster deaerator.
- Deaerator storage tank.
- Deaerator water inlet atomizing valve.
- Deaerator steam inlet atomizing valve.
- Gauge glass.
- Steam pressure gauge.
- Feedwater thermometer.
- Required tappings.

Optional Equipment

- Steam pressure reducing valve
- Three valve bypass and strainer (MUV)
- Steam relief valves
- High water alarm
- Low water alarm
- Low water pump cut off
- High-temperature condensate diffuser tube (over 227 °F)
- Boiler feed pump and motor sets
- Recirculation orifice or relief valve
- Suction shutoff valve
- Suction strainer
- Discharge check valve
- Discharge shutoff valve
- Discharge pressure gauge
- Discharge manifold
- Overflow drainer
- Control panel
- Chemical feed quill
- Vacuum breaker
- Insulation and lagging
- Sentinel relief valve
- Tank drain valve
- Back pressure relief valve
- Magnesium anode
- Stand
- Seismic construction

Packaging

- Fully packaged, factory piped and wired.
- Half packaged, suitable for field erection with interconnecting piping and wiring by others

COMBO UNITS

The Spraymaster Combo combines a Spraymaster deaerator and a surge tank in a single vessel. Deaerator options and storage capacity are as listed above.

In addition to providing all the benefits of an independent deaerator and surge, the SM Combo offers the following features:

Double Inner Head Separates the Deaerator Pressure Vessel From Surge Tank:

Ensures the deaerator and surge tank are two separate vessels while structurally attached for space considerations. This also limits heat transfer from the deaerator pressure vessel to the surge atmospheric vessel, preventing energy loss due to surge tank water boiling.

Vented and Insulated Gap Between the Deaerator and Surge Tank:

Insulation is placed between the double inner head to further limit heat transfer from the deaerator pressure vessel to the surge atmospheric vessel. A vent is placed between the double inner head to allow moisture evaporation eliminating corrosion potential.

Low Profile Design:

Low head room allows for installation in space restricted areas.

Two-Stage Deaeration in a Common Vessel:

- Recycle pumps are not required.
- Packaged for easy maintenance.

Packaged Units for Cost Effective Installation:

Complete packages are pre-fabricated in the Cleaver-Brooks manufacturing facility to ensure piping alignment and control wiring function. The unit is disassembled and match marked for efficient field re-assembly.

Spraymaster Combo Models

Available Models	DA Tank Gallons	Surge Tank Gallons
SD-(7-45)-260-260	260	260
SD-(7-45)-300-300	300	300
SD-(7-140)-415-450	415	450
SD-(7-140)-610-600	610	600
SD-(7-140)-840-900	840	900
SD-(7-140)-1105-1200	1105	1200
SD-(7-140)-1400-1800	1400	1800
SD-(7-280)-2200-2200	2200	2200
SD-(7-280)-2485-2500	2485	2500

RETURN ON INVESTMENT

The advantages of a pressurized deaerator over an atmospheric boiler feed system can be readily seen in the following areas:

- Flash steam
- Exhaust steam
- Blowdown
- Makeup water
- Chemical treatment
- Intangibles

Flash Steam
A percentage of the high-pressure condensate returns will flash to steam and be lost in an atmospheric vessel application. This flash steam loss equates to lost energy and higher fuel costs.

Exhaust Steam
Exhaust steam cannot be recovered in an atmospheric vessel application. An example would be steam turbine exhaust.

Surface Blowdown
Flash and exhaust steam losses require increased makeup water. This increase in makeup water in turn requires an increase of surface blowdown, again resulting in lost energy and associated higher fuel costs. The additional surface blowdown may also result in an increase in capital expenditure for a larger blowdown heat recovery system.

Makeup Water
The additional makeup water necessitated by flash steam, exhaust steam, and surface blowdown losses itself has an associated cost. This can include increased utility/sewer charges as well as pretreatment equipment costs.

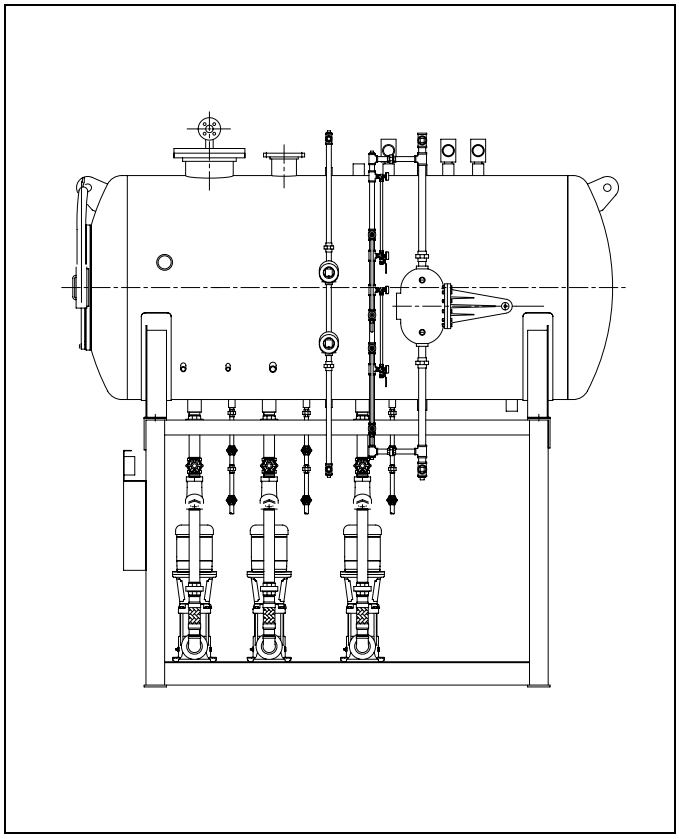
Chemical Treatment
Dissolved oxygen content in an atmospheric boiler feedwater system is a function of water temperature. Lowering the dissolved oxygen content below what is naturally present, based on mixed water temperature at atmospheric pressure, requires the addition of a chemical treatment program. The most common oxygen scavenger used is sodium sulfite. Sodium sulfite reacts with dissolved oxygen as follows:

Theoretically, it takes approximately 8 ppm of sodium sulfite as Na2SO3 to scavenge 1 ppm of dissolved O2:

$$2Na2SO3 + O2 \rightarrow 2Na2SO4$$

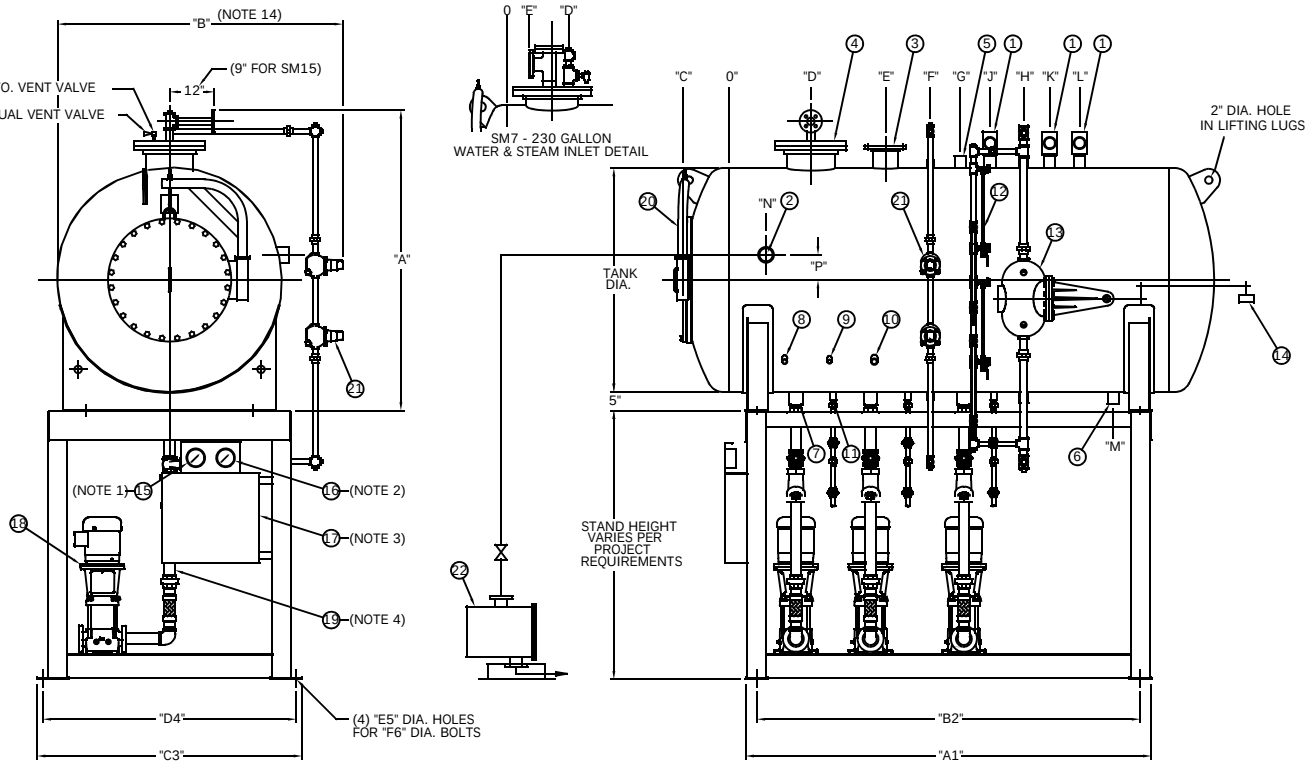
Intangibles
Some cost savings are difficult to calculate - in general, best practices in deaeration will prolong the life of boiler room equipment, reducing repair and maintenance costs.

SPRAYMASTER CLASSIC DEAERATORS (Single Tank)



Dimensions and Ratings

Figure 1a. Spraymaster Dimensions (sheet 1 of 2)



FRONT VIEW RIGHT SIDE

1. Mounted at dim. "H" (top of tank) on non-packaged units.
2. Tank mounted on non-packaged units.
3. Packaged units only. Mounted on front of stand.
4. Suction piping includes strainer, gate valve and flexible connector.
5. All couplings are 3000# F.S.
6. All flanges are 150# F.F. except as noted.
7. SM-200 is the same as SM-100 and SM-280 is the same as SM-140 except 2 water & steam inlets are used per vessel (dual inlet).
8. Customer to plug all fittings not being used.
9. Mount tank above pump at elevation necessary for static head including safe allowance for piping friction as approved by pump manufacturer.
10. Deaerator tank is built to ASME Code.
11. Accompanying dimensions, while sufficiently accurate for layout purposes, must be confirmed for construction by certified dimension prints.
12. Add Suffix "P" to Model No. for packaged units (SMP-45).
13. Optional tanks available for 5 minutes storage (except SM7 & SM15), other combinations of capacities as required - contact your local Cleaver-Brooks authorized representative.
14. Dimension "B" will change depending on controls required - contact your local Cleaver-Brooks authorized representative.
15. No interconnecting piping or wiring furnished on non-packaged units unless specified, contact your local Cleaver-Brooks representative for specific piping or wiring furnished on packaged assemblies.
16. Weights shown are without controls or packaging - contact your local Cleaver-Brooks representative for additions.
17. Capacities other than shown as standard available by proper selection of controls - contact your local Cleaver-Brooks authorized representative.
18. Optional tank sizes and ratings available - contact your local Cleaver-Brooks authorized representatives.
19. Lifting lugs are for lifting empty tank only.

RATINGS		SM TANK											
Capacity (Gal. to Overflow)		230	300	450	600	700	900	1000	1400	2000	2800	4000	5600
Tank Weight (Dry) (lb)													
Tank Weight (Flooded) (lb)		3600	7850	10700	11750	13450	15500	17000	25450	33650	41550	52500	73600
Tank Size (Dia x Length)		36 x 71	48 x 96	48 x 134	54 x 118	54 x 136	60 x 129.5	60 x 142.5	66 x 177	72 x 200	84 x 184	96 x 179	108 x 199
TANK DIMENSIONS													
A	Overall Height	58	70	70	76	76	82	82	88	94	108	120	132
B	Overall Width	51	63	63	69	69	75	75	81	87	99	111	123
C	Front Head	8	10	10	11	11	12	12	14	15	17.5	20	21.5
D	Water Inlet - SM 7	17.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Water Inlet - SM 15 thru 100	N/A	20	22	22	22	22	22	22	22	22	22	22
	Water Inlet - SM140	N/A	N/A	N/A	N/A	N/A	N/A	N/A	18	18	18	18	18
E	Steam Inlet	6.5	40	42	42	42	42	42	42	42	42	42	42
F	Level Alarm	32	50	54	54	54	54	54	56	56	56	56	56
G	High Temperature Return	27	55	62	62	62	62	62	63	63	63	63	63

Figure 1b. Spraymaster Dimensions (sheet 2 of 2)

H	Level Control	44.5	60	79	79	79	79	79	90	90	90	90	90
J	Relief Valve	38.5	66 *	70	70	70	70	70	100	100	100	100	100
K	Relief Valve	50	66 *	86	86	86	86	86	111	111	111	111	111
L	Relief Valve	N/A	N/A	N/A	N/A	N/A	N/A	N/A	122	122	122	122	122
M	Drain	10	30	98	84	98	93	103	135	153	135	127	144
N	Overflow	5	10	10	10	10	10	10	14	14	14	14	14
P	Overflow	10	0	0	3.75	3.75	6.75	6.75	6.5	8	14.5	26.5	27.5
	Sprayhead	SM15		SM30		SM45		SM70		SM100/200		SM140/280	
R	Manual Vent Valve Size	0.75		0.75		0.75		1		1.5		2	
STAND DIMENSIONS													
Capacity (Gal. to Overflow)		230	300	450	600	700	900	1000	1400	2000	2800	4000	5600
A1	Overall Length	52.5	74	108.5	92.5	108.5	101	108.5	144	162	149	134	151
B2	C/L to C/L Bolt Holes	47.5	69	102.5	87.5	102.5	95	102.5	138	155	146	127	144
C3	Overall Width	49	62	66	64	66	71	71	76	83	86.5	102	113
D4	C/L to C/L Bolt Holes	46	59	63	61	63	68	68	73	80	79.5	99	110
E5	Hole Size	0.75	1	1	0.75	1	1.125	1.125	1.25	1.125	1.125	1.125	1.25
F6	Anchor Bolt Size	0.625	0.875	0.875	0.625	0.875	1	1	1.125	1	1	1	1.125
CONNECTIONS AND TRIM													
1	Relief Valve Size	Contact Your Local Cleaver-Brooks Authorized Representative											
2	Overflow Size	1.5" NPT	3" NPT	3" NPT	3" NPT	3" NPT	3" NPT	3" NPT	4"-150# FF	4"-150# FF	4"-150# FF	6"-150#	6"-150# FF
3	Steam Inlet Size	See Table Below											
4	Water Inlet Size	See Table Below											
5	High Temperature Return Size	1.5" NPT	1.5" NPT	2" NPT	2" NPT	2" NPT	2" NPT	2" NPT	3" NPT	3" NPT	3" NPT	3" NPT	3" NPT
6	Drain Size	1.5" NPT	2" NPT	2" NPT	2" NPT	2" NPT	2" NPT	2" NPT	2" NPT	2" NPT	2" NPT	2" NPT	2" NPT
7	Suction Size	2.5" NPT	2.5" NPT	2.5" NPT	2.5" NPT	2.5" NPT	2.5" NPT	2.5" NPT	4"-150# FF	4"-150# FF	4"-150# FF	4"-150#	4"-150# FF
8	Thermometer (3/4" NPT)												
9	Sample (1/2" NPT)												
10	Chemical Feed (1" NPT)												
11	Recirculation (1" NPT)												
12	Gauge Glass Assembly												
13	Level Controller (1.5" NPT)												
14	Make-Up Valve												
15	Pressure Gauge												
16	Thermometer												
17	Control Panel (Optional)												
18	Feed Pump/Motor (Optional)												
19	Suction Piping (Optional)												
20	Manway Size - SM 7	20"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Manway Size - SM 15 thru 70	N/A	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"
	Manway Size - SM100, 200	N/A	32"	32"	32"	32"	32"	32"	32"	32"	32"	32"	32"
	Manway Size - SM140, 280	N/A	N/A	N/A	N/A	N/A	N/A	N/A	36"	36"	36"	36"	36"
21	Level Alarms (Optional) (1" NPT)												
22	Overflow Drainer (Optional)												
	RATINGS for												
	SPRAYMASTER MODEL	TANK SIZES		RATING (lb/hr)		Conn 3 Steam Inlet		Conn 4 Water Inlet					
	SM-7	230		7000		3"-150# FF Flg		1" NPT					
	SM-15	300 thru 700		15000		6"-150# FF Flg		1.5"-150# RF Flg					
	SM-30	300 thru 5600		30000		6"-150# FF Flg		2"-150# RF Flg					
	SM-45	300 thru 5600		45000		6"-150# FF Flg		2"-150# RF Flg					
	SM-70	300 thru 5600		70000		6"-150# FF Flg		2.5"-150# RF Flg					
	SM-100	300 thru 5600		100000		6"-150# FF Flg		3"-150# RF Flg					
	SM-140	2000 thru 5600		140000		8"-150# FF Flg		4"-150# RF Flg (2)					
	SM-200 (NOTE 7)	2000 thru 5600		200000		6"-150# FF Flg		3"-150# RF Flg					
	SM-280 (NOTE 7)	2000 thru 5600		280000		8"-150# FF Flg		4"-150# RF Flg (2)					

* 2 relief valve tappings for SM 300 located at 66" are offset 6" on either side of top centerline.

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BLOWDOWN SEPARATORS

CONTENTS

ILLUSTRATIONS

TABLES

This section contains information on blowdown separators, which are used to provide safe and economical flash purification to enhance blowdown effectiveness.

FEATURES AND BENEFITS

- Fast, safe, low-cost way to separate steam and water and remove harmful dissolved solids
- Protects boiler surfaces from severe scaling or corrosion problems.
- Economical flash purification process for enhancing blowdown effectiveness
- Reduce drain water temperature to meet state and local requirements.
- Quiet design, with noise levels below 90 dBA, so no exhaust head is required
- CB blowdown separators are compact, and can be quickly installed with few connections
- Stainles steel striking plate greatly extends separator life.
- Momentum of water is speeded by spiral baffle centerwise to drain. Drain is completely filled - no center void.
- Tangential inlet and small diameter prompt high velocity spinning for release of steam.
- All interior surfaces slant toward drain, making unit self-draining, self-drying for longer life.
- Proven performance
- Demonstrated durability
- Universal adaptability

PRODUCT OFFERING

Boilers that supply steam for power, process or heating applications require periodic and more often, frequent, blowdowns to prevent buildup of harmful solids. Blowdown protects boiler surfaces from severe scaling or corrosion problems that would otherwise result.

Cleaver-Brooks blowdown separators use a safe, economical flash purification process for enhancing blowdown effectiveness. Steam is rapidly separated from blowdown water and vented out the top of the blowdown separator in a cyclonic spinning action. Water and dissolved solids are flushed out the bottom drain.

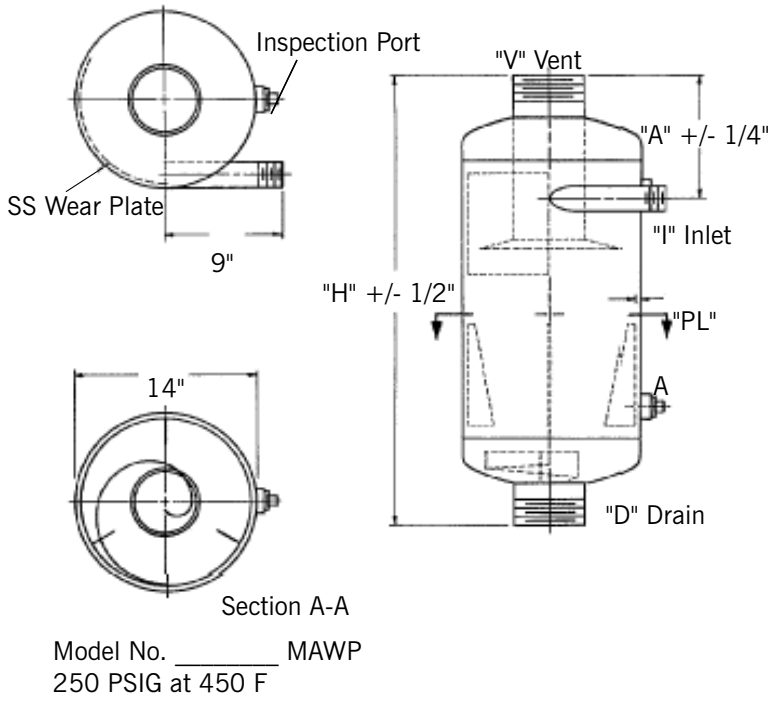
The design is quiet, with noise levels held below 90 dBA, so no exhaust head is required. Internal pressures do not exceed 5 psig. Blowdown water is cooled to 120 °F by a drain tempering device, designed to meet state and local codes.

Cleaver-Brooks blowdown separators are compact, and can be quickly installed with few connections. Accessories include leg or wall brackets, drain tempering fitting, strainer, temperature regulating valve, thermometer, pressure gauge and flanges.

- Pressure ranges:

  0 to 300 psig, standard.

  301 to 1600 psig, special.
- Available with ASME “U” stamp.



MODEL NO.	A20B	A34B	A56B
"H" Dimension	22"	34"	56"
"A" Dimension	10"	10-1/4"	11"

"I" Inlet size – Determined by blowdown valve size.
:V" Vent size – Select from Table 1.
"D" Drain size – Select from Table 1.
"PL" Plate size – 5/16" or 3/8". May be determined by codes.

HEADS	SA 516-70
SHELL	SA 53B
COUPLINGS	SA 105
WEAR PLATE	SA 240-304
BAFFLES	SA 240-304
NOZZLES	SA 53B, SA 106-B
FINISH	RED OXIDE PRIMER

Figure 1. Blowdown Separator Dimensions

Table 1. Boiler Blowdown Separator Sizing

BDV	PRESS.	TANK SIZE	INLET	DRAIN	VENT	CWI	BDV FLOW	COND GPM	COLD WATER	TOTAL DRAIN	FLASH
1"	50	14"X 20"	1"	2"	2 1/2"	1/2"	6444	12.17	12.52	24.69	360
1"	100	14"X 20"	1"	3"	2 1/2"	1/2"	11844	21.18	21.80	42.98	1252
1"	125	14"X 34"	1"	3"	3"	1/2"	13,604	23.56	24.25	47.81	1823
1"	150	14"X 34"	1"	3"	3"	1/2"	15394	26.48	27.25	53.72	2155
1"	200	14"X 34"	1"	3"	4"	3/4"	19690	32.84	33.80	66.64	3268
1"	250	14"X 34"	1"	4"	4"	1"	21838	35.25	36.27	71.52	4214
1"	300	14"X 56"	1"	4"	4"	1"	25060	39.70	40.85	80.54	5212
1 1/4"	50	14"X 20"	1 1/4"	3"	4"	1/2"	13472	25.44	26.17	51.61	754
1 1/4"	100	14"X 34"	1 1/4"	4"	4"	3/4"	22284	39.67	40.82	80.49	2448
1 1/4"	125	14"X34"	1 1/4"	4"	4"	1"	25379	43.96	45.23	89.19	3400
1 1/4"	150	14"X 34"	1 1/4"	4"	4"	1"	30792	52.96	54.50	107.46	4310
1 1/4"	200	14"X 34"	1 1/4"	4"	5"	1 1/4"	37848	63.13	64.96	128.09	6282
1 1/4"	250	14"X 56"	1 1/4"	4"	5"	1 1/2"	42339	68.34	70.32	138.65	8171
1 1/4"	300	14"X 56"	1 1/4"	4"	5"	1 1/2"	48754	77.23	79.47	156.70	10140
1 1/2"	50	14"X 34"	1 1/2"	3"	4"	3/4"	19437	36.70	37.76	74.46	1088
1 1/2"	100	14"X 34"	1 1/2"	4"	4"	1"	33573	60.03	61.77	121.80	3558
1 1/2"	125	14"x34"	1 1/2"	4"	4"	1 1/4"	38874	67.33	69.28	136.61	5209
1 1/2"	150	14"X 34"	1 1/2"	4"	5"	1 1/4"	44625	76.88	79.11	155.99	6184
1 1/2"	200	14"X 56"	1 1/2"	5"	5"	1 1/2"	53893	89.89	92.50	182.39	8946
1 1/2"	250	14"X 56"	1 1/2"	5"	6"	2"	60962	98.39	101.25	199.64	11765
1 1/2"	300	14"X 56"	1 1/2"	5"	6"	2"	69796	110.56	113.76	224.32	14517
2"	50	14"X 34"	2"	4"	5"	1 1/4"	37454	70.69	72.74	143.43	2108
2"	100	14"X 34"	2"	5"	5"	2"	60,536	108.24	111.38	219.62	6416
2"	125	14"x34"	2"	5"	5"	2"	70,893	122.79	126.36	249.15	9496
2"	150	14"X 56"	2"	5"	6"	2"	79721	137.12	141.09	278.21	11162
2"	200	14"X 56"	2"	6"	6"	2"	94496	157.62	162.19	319.81	15686
2"	250	14"X 56"	2"	6"	8"	2 1/2"	109261	176.35	181.46	357.81	21087
2"	300	14"X 56"	2"	6"	8"	2 1/2"	122550	194.12	199.75	393.87	25490

251-300 psig U. Symbol Construction and Stamping is required.

To use this chart:
1.Select separator size from this table by matching operating pressure and blow-down valve size.
2.Select Plate Thickness (PL) as local regulations require or as desired for maximum pressure stamped on Separator 3/16", 150 psig, 5/16", 225 psig, 3/8", 250 psig.
3.If local regulations require, indicate ASME or Standard. Separator size is now determined and discharge piping may follow these sizes with no calculation necessary. Separators are designed to exhaust at less than 5 psig.

Standard and Optional Equipment Selection

For dimensions and sizing of blowdown separators, refer to Figure 1 and Table 1.

For manual drain water tempering, use Aftercooler model 5D and specify drain diameter.

For automatic control of drain water temperature, use 18DF___ or 20AO___ Aftercooler. 20AO Aftercooler is required in some areas to automatically regulate the temperature of the water to the drain. Check local codes to ascertain if it is required in your area.

A temperature regulating valve should be used when the blowdown temperature going to the drain needs to be less than 212 °F. (See Table 2 to select cooling water line and valve size.)

Use a solenoid valve and thermostat when the cooling water pressure exceeds 80 psig.

1. Model 18DF Aftercooler (Figure 1) or Model 16DS (Figure 3). Nonclogging automatic drain tempering fitting with stainless steel mixing tongue (on 4" and larger) to provide thorough mixing of influent cold water with drain water. The middle flange (Model 18DF) permits rotation for various pipe fitting requirements and also serves as a dismantling flange. Two bulb-wells for mounting control valve and thermometer are furnished. When ordering, state cold water inlet size.

2. Model 20AO Jacket Type After Cooler (Figure 4). Required in some areas. Has mixing holes corresponding to the cold water inlet size. The lower portion is designed with wells to accommodate automatic control bulb and thermometer. When ordering state cold water inlet size.

3. Temperature Regulator Valves. Automatically control the flow of cold water by responding to temperature changes at the thermostatic bulb. The 6" capillary tube allows installation in the cold water line while the 11" bulb is mounted in the lower portion of the aftercooler. The valve size should correspond to the cold water inlet.

4. Thermometer. Bi-metal, drawn steel case, rust resistant and finished in oven baked enamel. Six inch brass stem with 1/4" NPT bushing provided for use with Model 18DF and Model 20AO Aftercoolers.

5. Solenoid Valve. Automatically controls cooling water to aftercooler. Non-magnetic stainless steel body; micro-finished, hardened pilot valve ball. Has two-wire control circuit (120/60). Well immersion hot water control provided for actuating solenoid valve.

6. The Model 5D Drain Tempering Fitting (Figure 5). Simple type of aftercooler for adding cooling water with manual control. It has cold water inlet for adding cooling water to drain for tempering to 120 °F. Inlet is sized for minimum influent water conditions of 60 °F water at 40 psig pressure with 100 sq-ft of supply. When ordering, state Model 5D (Drain Diameter); i.e. for 4" drain use Model 5D 4.

7. Armstrong Strainer. Cast iron with .045 stainless steel screen. Install in cold water line to protect temperature regulator valve or solenoid valve shown in adjacent column.

8. Separator Floor Stand (Figure 6). Provides and excellent means for supporting separators. Constructed of sturdy angle iron. They come attached to the separator to provide an easy and expedient means of installation. Standard height raises separator 18 inches from floor, or when aftercoolers are provided, additional height

is provided.

9.Separator Wall Brackets (Figure 7). For wall mounting where floor space is limited, or where desired installation is at a level higher than leg height of 18 inches.

A	B	C	CWI
2	20	3	1/2
2	20	3	3/4
2-1/2	20	3	3/4
3	20	3-1/2	3/4
3	20	3-1/2	1
4	20	3-1/2	1
4	20	3-1/2	1-1/4
5	20	3-1/2	1-1/4
5	20	3-1/2	1-1/2
6	20	4	1-1/2
6	20	4	2

NOTES:
1. Temperature regulator valve bulb is installed in lower section of the aftercooler so that the bulb senses mixed water temperature. Valve is modulating so that the right amount of cold water is added to cool the drain water to the desired temperature set on the valve. Valve range is 115 to 180 °F.

2. Regulator Valve has composition seat to ensure tight shut-off when not blowing down. Valve should be protected with C.1. Strainer with .045 mesh.

3. CWI = cold water inlet size.

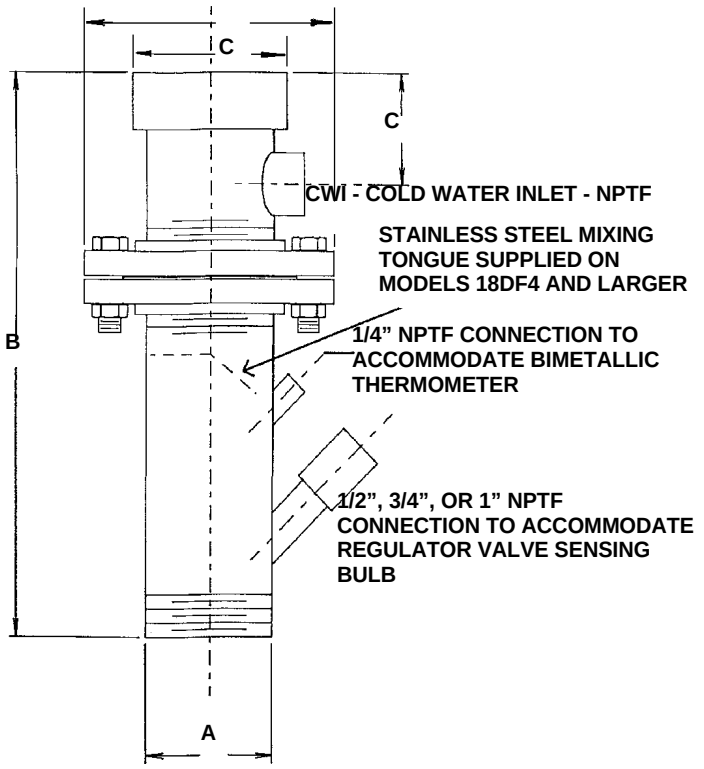


Figure 2. Automatic Drain Water Aftercooler (18DF) Dimensions

A	CWI	B
2	1/2	3
2	3/4	3
2-1/2	3/4	3
3	3/4	4-1/2
3	1	4-1/2
4	1	4-1/2
4	1-1/4	4-1/2
5	1-1/4	5
5	1-1/2	5
6	1-1/2	5
6	2	5

Temperature regulator valve sensing bulb is installed in lower section so that mixed water temperature is sensed by bulb. Valve modulates to add sufficient cold water to lower drain water temperature.

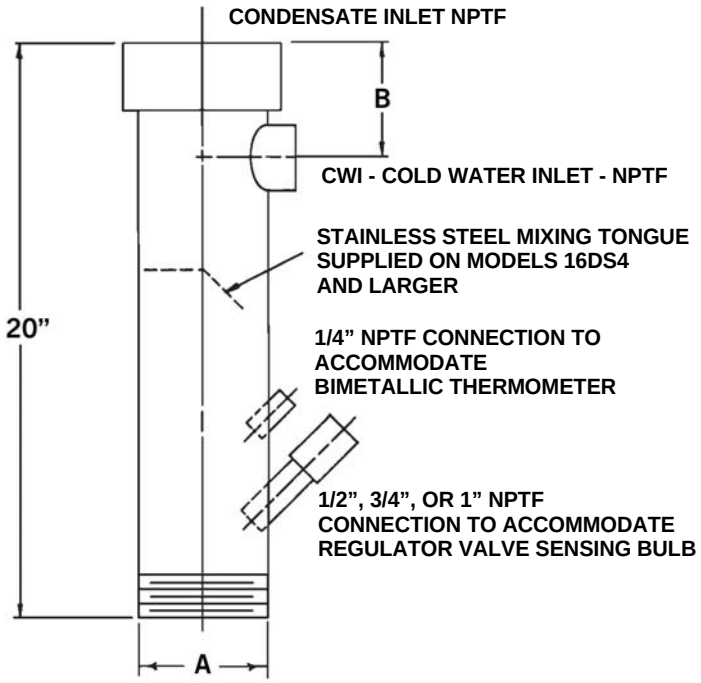


Figure 3. Automatic Drain Water Aftercooler (16DS) Dimensions

D_1	D_2	CWI
2	3	1/2
2	3	3/4
2-1/2	4	3/4
3	4	3/4
3	4	1
4	5	1
4	5	1-1/4
5	6	1-1/4
5	6	1-1/2
6	8	1-1/2
6	8	2

NOTES:
1. Temperature regulator valve bulb is installed in lower section of the aftercooler so that the bulb senses mixed water temperature. Valve is modulating so that the right amount of cold water is added to cool the drain water to the desired temperature set on the valve. Valve range is 115 to 180 °F.

2. Regulator Valve has composition seat to ensure tight shut-off when not blowing down. Valve should be protected with C.1. Strainer with .045 mesh.

3. CWI = cold water inlet size.

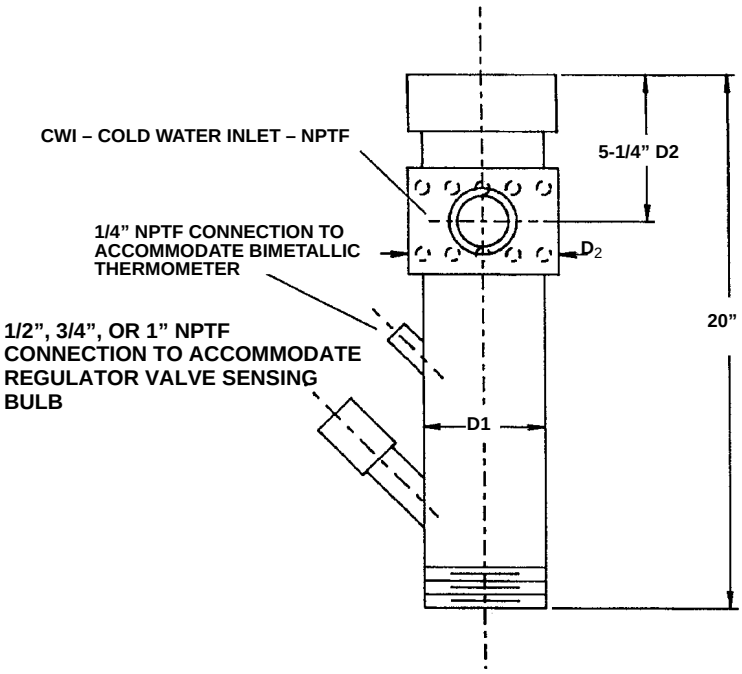


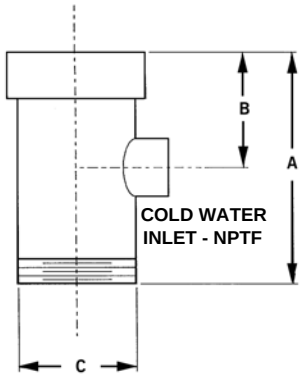
Figure 4. Automatic Drain Water Aftercooler (20AO) Dimensions

Table 2. Cooling Water Line and Valve Sizing

SEPARATOR INLET SIZE	1"			1-1/4"			1-1/2"			2"			2-1/2"		
COOLING WATER PRESS. (PSIG)	40	50	60	40	50	60	40	50	60	40	50	60	40	50	60
GENERATOR OPERATING PRESSURE (50 TO 70 °F COOLING WATER TEMPERATURE)															
0-50	1/2	1/2	1/2	1	1	1	1-1/4	1	1	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/2
51-100	1	3/4	3/4	1	1	1	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/4	2	2	2
101-125	1	3/4	3/4	1-1/4	1	1	1-1/4	1-1/4	1-1/4	2	2	1-1/2	2	2	2
126-175	1	1	1	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	2	2	2	2-1/2	2-1/2	2
176-225	1	1	1	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/4	2	2	2	2-1/2	2-1/2	2
226-250	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/4	2	2	2	2-1/2	2-1/2	2
251-300	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/4	2	2	2	2-1/2	2-1/2	2-1/2
GENERATOR OPERATING PRESSURE (71 TO 80 °F COOLING WATER TEMPERATURE)															
0-50	3/4	1/2	1/2	1	1	1	1-1/4	1	1	1-1/4	1-1/4	1-1/4	2	2	1-1/2
51-100	1	3/4	3/4	1-1/4	1	1	1-1/4	1-1/4	1-1/4	2	2	1-1/2	2	2	2
101-125	1	1	3/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	2	2	2	2-1/2	2-1/2	2
126-175	1	1	1	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/4	2	2	2	2-1/2	2-1/2	2
176-225	1	1	1	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/4	2	2	2	2-1/2	2-1/2	2-1/2
226-250	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/4	2-1/2	2-1/2	2	2-1/2	2-1/2	2-1/2
251-300	1-1/4	1-1/4	1-1/4	1-1/2	1-1/4	1-1/4	2	2	1-1/2	2-1/2	2-1/2	2	2-1/2	2-1/2	2-1/2

Use the chart as follows:
1. Depending upon the temperature of the cooling water used, locate the section of the chart which applies, 50-70 °F or 71 - 80 °F.
2. At the top of chart locate Separator inlet size and in left column under the section selected in step one, locate Boiler Operating pressure. You now have a selection of three valve sizes.
3. From the top of chart select the cooling water line pressure either 40, 50 or 60 and read the desired valve and line size.

A	B	C	CWI
6	3	2	3/4
6	3	2-1/2	3/4
7	3-1/2	3	1
7	3-1/2	4	1-1/4
7	3-1/2	5	1-1/2
8	4	6	2



NOTE:
1. Temperature regulator valve bulb is installed in lower section of the aftercooler so that the bulb senses mixed water temperature. Valve is modulating so that the right amount of cold water is added to cool the drain water to the desired temperature set on the valve. Valve range is 115 to 180 °F.

2. Regulator Valve has composition seat to ensure tight shut-off when not blowing down. Valve should be protected with C.1. Strainer with .045 mesh.

3. CWI = cold water inlet size.

4. 16DS Same as 18DF Without Flanges.

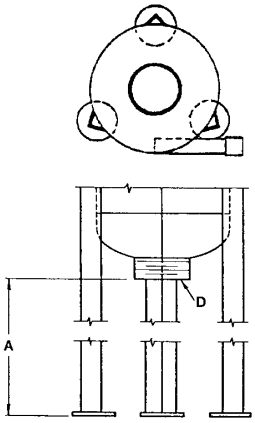
Figure 5. Model 5D Dimensions

For Screwed or Beveled Connections, Factory Fabricated 2" x 2" x 1/4" Angle Permissible Load 6000 lbs

If 18DF, 16DS, or 20AO Aftercooler is furnished with separator, see dimension chart for separator height “A”. “A” dimension is determined by separator drain size “D”. This provides adequate height for the aftercooler and elbow when required.

“A” dimension will always be 18" when separator is furnished without an aftercooler.

D	A
2	22
2-1/2	23
3	24
4	25
5	30
6	34



For Flanged Connections Factory Fabricated 2" x 2" x 1/4" Angle Permissible Load 6000 lbs.

If 18DF, 16DS, or 20AO Aftercooler is furnished with flanged connections on both ends, use dimension chart to determine separator height "A".

"A" dimension will always be 18" when separator is furnished without an aftercooler.

D	A
2	28
2-1/2	30
3	31
4	32
5	33
6	35

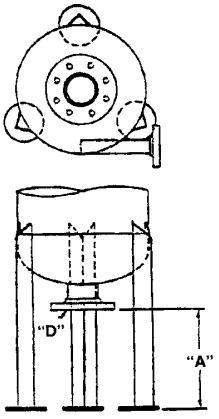
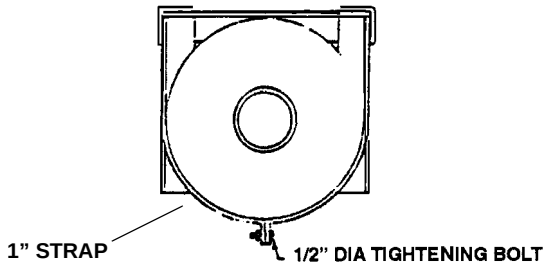
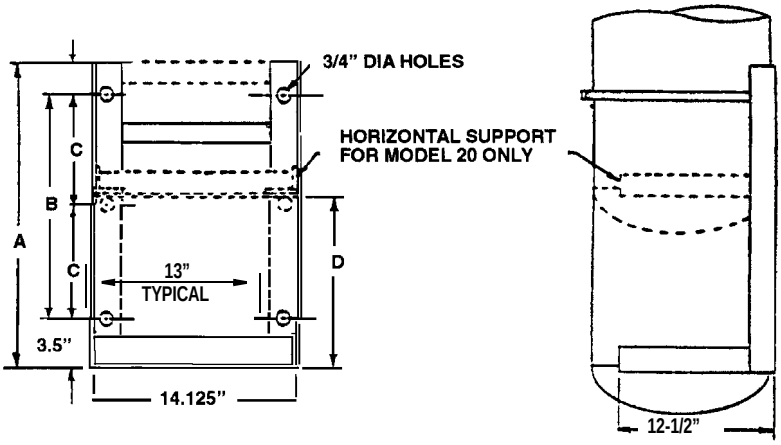


Figure 6. Separator Floor Stand





SEPARATOR WALL BRACKET 2 X 2 X 1/4" ANGLE

USE MODEL 20 W/20" SEPARATOR
USE MODEL 34 W/34" SEPARATOR
USE MODEL 56 W/56" SEPARATOR

MODEL	A	B	C	D
20	20	14	-	13
34	20	14	-	-
56	35	28	14	-

NOTE:
1. DIMENSION C IS FOR MODEL 56 ONLY.
2. DIMENSION D IS FOR MODEL 20 ONLY.

Figure 7. Separator Wall Bracket

Blowdown Separators
Sample Specifications

PART 1 GENERAL 1.1 GENERAL

The following sample specification is provided by Cleaver-Brooks to assist you in meeting your customer's requirements.

PART 2 PRODUCTS 2.1 EQUIPMENT

A. Blowdown Separaator

1. Furnish and install Cleaver-Brooks Model _____ blowdown separator with I=_____, D=_____, V=_____, and _____ plate thickness.
2. The separator shall be manufactured in accordance with ASME Code for 250 psig design and tested to 375 psig.
3. Provide separator with National Board stamping and "U" symbol. (Necessary in Michigan and Utah, optional elsewhere.)
4. The separator shall be furnished with _____ (screwed, weld bevel, 150# flanged or 300# flanged) connections.
5. The separator shall include a stainless steel striking plate at the point of inlet impingement and shall be furnished by Cleaver-Brooks.

B. Accessories

1. Provide a _____ solenoid valve to automatically control the flow of cold water by responding to temperature changes sensed at the thermostatic bulb in the aftercooler fitting.
2. Furnish a bi-metal thermometer with necessary adaptor bushing for use with _____ (18DF, 16DS, or 20AO) aftercooler.
3. Furnish a _____ cast iron strainer with .045 stainless steel screen ahead of the _____ (TRV or solenoid valve) to protect said valve against foreign matter.
4. Furnish and install an automatic drain water aftercooler, Model _____ (18DF, 16DS, or 20AO) with a _____ cold water connection for a _____ (TRV or solenoid valve and thermostat).
5. Provide a _____ temperature regulator valve to automatically control the flow of cold water by responding to temperature changes sensed at the thermostatic bulb in the aftercooler fitting.
6. Provide accessory separator floor stand or wall mounting bracket.

NOTES