

Model CBEX ELITE 900-1200 HP

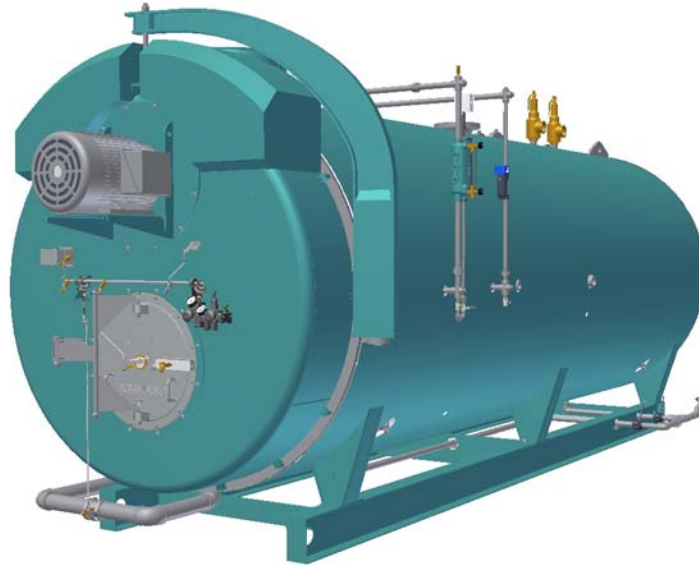


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FEATURES AND BENEFITS

The CBEX Elite 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 Elite.

Two Pass Design:

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

Front and Rear Access:

- Davited front doors, all sizes.
- Provides access to front tube sheet and tubes.
- Large rear access plug for turnaround, tubes, 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

Cleaver-Brooks CBEX Elite Boilers are available in 150-250 psig steam designs. Burners are available to fire natural gas, No. 2 oil, or a combination of oil and gas. Standard product offering is:

- 900-1200 hp.
- Two pass wetback design.
- Full modulation, all sizes.

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

- Boiler Options:
 - Additional screwed or flanged tappings.
 - Blowdown valves.
 - Non-return valves.
 - Feedwater valves and regulators.
 - Surface blowdown systems.
 - Surge load baffles.
 - Seismic design.
- Burner/Control Options:
 - Flame safeguard controllers.
 - Lead/lag system.
 - Special insurance and code requirements (e.g., FM, NFPA-85).
 - Alarm bell/silence switch.
 - Special motor requirements (TEFC, high efficiency).
 - Special indicating lights.
 - Main disconnect.
 - Elapsed time meter.

NEMA enclosures.
Remote emergency shut-off (115V).
Circuit breakers.
Day/night controls.
Special power requirements.
Low NOx Equipment.

- 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. The information is subject to change without notice.

- Table 1. CBEX Elite Steam Boiler Ratings
- Table 2. CBEX Elite Steam Boiler Dimensions 900-1200 HP

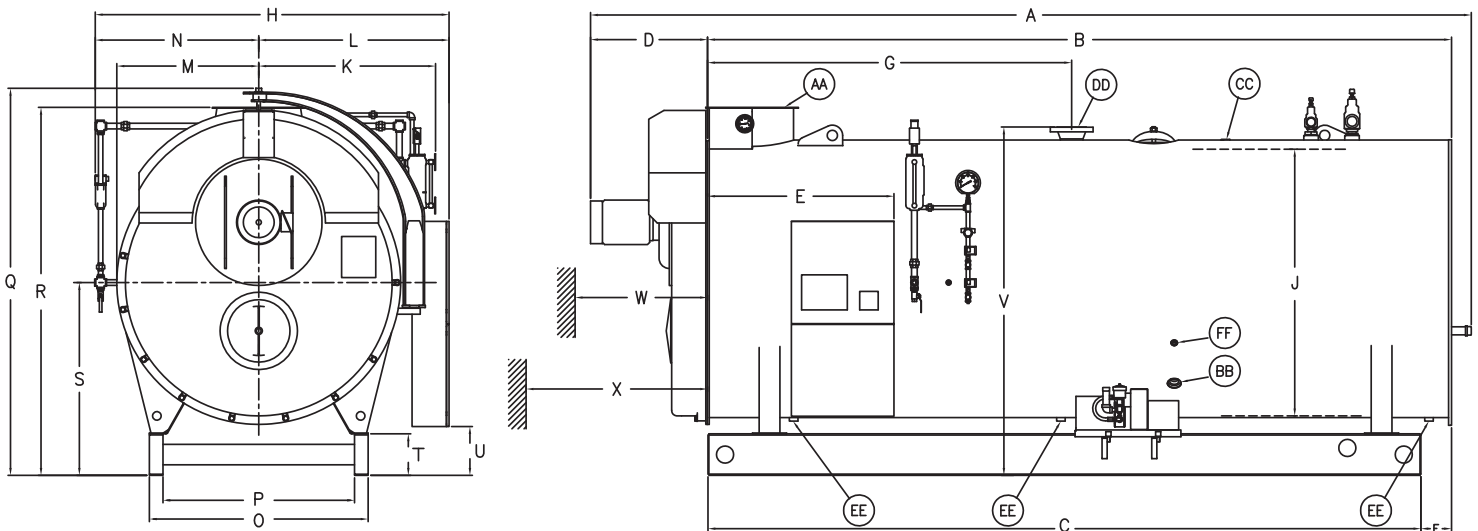
Table 1. Steam Boiler Ratings

BOILER H.P.	900	1000	1100	1200
RATINGS - SEA LEVEL TO 700 FT.				
Rated Capacity (lbs-steam/hr from and at 212 OF)	31050	34500	37950	41400
Btu Output (1000 Btu/hr)	30128	33475	36823	40170
APPROXIMATE FUEL CONSUMPTION AT RATED CAPACITY BASED ON NOMINAL 82% EFFICIENCY				
Light Oil gph (140,000 Btu/gal)	262.4	291.6	320.8	349.9
Gas CFH (1000 Btu)	36741	40823	44905	48988
Gas (Therm/hr)	367.4	408.2	449.1	489.9
POWER REQUIREMENTS - SEA LEVEL TO 700 FT. (60 HZ)				
Blower Motor hp (30 ppm) ^A	100	100	100	125
Blower Motor hp (9 ppm/5 ppm) ^A	75	100	100	125
Oil Pump Motor, No. 2 Oil	1-1/2	1-1/2	1-1/2	1-1/2
Air Compressor Motor hp (No. 2 Oil firing Only)	15	15	15	15
BOILER DATA				
Heating Surface sq-ft. (Fireside)	3219	3594	3609	3751

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.

Table 2. Dimensions CBEX Elite 900-1200 HP



Dimensions in inches

BOILER H.P.	DIM	900	1000	1100	1200
LENGTHS					
Overall Length (60 ppm system)	A	N/A	N/A	N/A	N/A
Overall Length (30 ppm system)	A	330.5	335.5	369.5	385
Overall Length (9 ppm system)	A	330.5	335.5	375	385
Shell	B	260.5	264.5	299	309
Base Frame	C	251	255.5	289.5	299.5
Front Head Extension (60 ppm system)	D	N/A	N/A	N/A	N/A
Front Head Extension (30 ppm system)	D	54	54	54	59.5
Front Head Extension (9 ppm/5 ppm) system)	D	54	54	59.5	59.5
Front Ring Flange to Panel	E	57.5	57.5	57.5	57.5
Rear Ring Flange to Base	F	10.25	10.25	10.25	10.25
Shell Flange to Steam Nozzle	G	134	130	140	150
WIDTHS					
Overall Width	H	133	133	133	133
I.D. Boiler	J	106	106	106	106
Center to Water Column	K	64	64	64	64
Center to Panel	L	69.5	69.5	69.5	69.5
Center to Lagging	M	55.5	55.5	55.5	55.5
Center to Auxiliary LWCO	N	63.5	63.5	63.5	63.5
Base Outside	O	74.75	74.75	74.75	74.75
Base Inside	P	61.75	61.75	61.75	61.75
HEIGHTS					
Overall Height	Q	147.5	147.5	147.5	147.5
Base to Vent Outlet	R	138	138	138	138
Base to Boiler Centerline	S	71	71	71	71

BOILER H.P.	DIM	900	1000	1100	1200
Height of Base Frame	T	12	12	12	12
Base to Bottom of Panel	U	18	18	18	18
Base to Steam Outlet	V	130.5	130.5	130.5	130.5
BOILER CONNECTIONS					
Feedwater Inlet (Both Sides)	BB	3	3	3	3
Surface Blowoff	CC	1	1	1	1
Steam Nozzle (300# ANSI Flange)	DD	8	10	10	10
Blowdown	EE	2	2	2	2
Chemical Feed	FF	1	1	1	1
VENT STACK					
Vent Stack Diameter (Flanged)	AA	32	32	32	32
MINIMUM CLEARANCES					
Front Door Swing	W	112	112	112	112
Tube Removal - Front Only	X	183	187	221	231
MINIMUM BOILER ROOM LENGTH ALLOWING FOR DOOR SWING AND TUBE REMOVAL:					
Thru Window or Door		414	419	453	463
Front of Boiler		485	494	562	582
WEIGHTS IN LBS					
Normal Water Capacity		35,800	36,000	37,200	38,650
Approx. Shipping Weight - (150psig)		51,900	54,200	57,300	58,850

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

Table 3 shows predicted fuel-to-steam efficiencies (including radiation and convection losses) for Cleaver-Brooks CBEX Elite 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 Elite 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, ten thousand dollars (\$10,000) 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.

- 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
- Efficiencies are based on ambient air temperature of 80 °F, relative humidity of 30%, and 15% excess air in the exhaust flue gas.
- 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 3. CBEX Elite Efficiencies 900-1200 HP

	Efficiency Natural Gas				Efficiency #2 Oil			
	25% f.r.	50%	75%	100%	25%	50%	75%	100%
900	82.7	82.2	81.5	80.7	86.0	85.5	84.8	84.1
1000	82.6	82.1	81.3	80.5	85.9	85.4	84.6	83.8
1100	82.7	82.2	81.5	80.8	86.0	85.5	84.8	84.1
1200	82.6	82.1	81.4	80.6	86.0	85.4	84.7	83.9

ENGINEERING DATA

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

Boiler Information

Table 4 lists quantity and outlet size for safety valves supplied on CBEX Elite steam boilers.

Table 5 gives steam volume and disengaging area for CBEX Elite Boilers.

Blowdown Water Requirements

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

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

Table 6 lists the approximate quantity of water represented by 4 inches of water at normal operating level for Cleaver-Brooks CBEX Elite Boilers.

Burner/Control Information

Burner Characteristics

Note that altitude correction and burner changes are required for higher altitudes which may alter dimensions, motor hp and gas pressures. Also 50 Hz applications and low NOx options should be reviewed by the Cleaver-Brooks authorized representative.

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.

Boiler Room Information

Table 16 shows typical boiler room length and width requirements.

Stack Support Capabilities

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

CBEX Elite boilers can be reinforced to support up to 3000 lbs.

Boiler Room Combustion Air

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

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

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

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

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

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

Notice

Consult local codes, which may supersede these requirements.

Stack/Breeching Size Criteria

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

Although constant pressure at the flue gas outlet of the CBEX Elite 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 4. CBEX Elite Steam Boiler Safety Valve Outlet Size

BOILER HP	150 PSIG STEAM		200 PSIG STEAM		250 PSIG STEAM	
	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)	NO. OF VALVES REQ'D	OUTLET SIZE (IN.)
900	3	2-1/2	3	(2) 2-1/2 (1) 1-1/2	2	2-1/2
1000	4	(3) 2-1/2 (1) 2	3	(2) 2-1/2 (1) 1-1/2	2	2-1/2
1100	4	(3) 2-1/2 (1) 2	3	(2) 2-1/2 (1) 2	3	(2) 2-1/2 (1) 1-1/2
1200	4	2-1/2	3	2-1/2	3	(2) 2-1/2 (1) 2

NOTE: Valve manufacturers are Kunkle, Consolidated or Conbraco, depending on availability.

Table 5. CBEX Elite Steam Volume and Disengaging Area

BOILER HP	STEAM VOLUME CU-FT	STEAM RELIEVING AREA SQ-IN
900	157.2	19498
1000	146.3	19411
1100	183.3	22723
1200	190.0	23558

NOTES:

1. Based on normal water level.
2. Based on 150 psig design pressure.

Table 6. CBEX Elite Blowdown Tank Sizing

BOILER HP	WATER (GAL)
900	349
1000	349
1100	408
1200	422

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

Table 7. CBEX Elite Recommended Steam Nozzle Size

OPERATING PRESSURE PSIG	BOILER HP			
	900	1000	1100	1200
50	12	12	14	14
75	10	12	12	12
100	10	10	10	10
125	10	10	10	10
150	10	10	10	10
200	8	8	8	8
250	8	8	8	8

NOTES:

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

Table 8. CBEX Elite Recommended Non-Return Valve Size

BOILER HP	BOILER CAPACITY (LBS/HR)	OPERATING PRESSURE (PSIG)							
		50	75	100	125	150	175	200	250
900	31050	8	6	6	6	6	6	6	5
1000	34500	8	6*	6	6	6	6	6	5
1100	37950	8	8	6	6	6	6	6	6
1200	41400	8	8	8	6	6	6	6	6

NOTE: Valve sizes (300 psig flanges) given in inches.

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

Table 9. 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.

Table 10. CBEX Elite Natural Gas Estimated Emission Levels

POLLUTANT	UNITS	30 PPM SYSTEM	9 PPM SYSTEM	7 PPM SYSTEM	5 PPM SYSTEM
CO	ppm ^A	10/50 ^B	25	50	50
	lb/MMBTU	0.0075/0.0375 ^B	0.018	0.037	0.037
NOx	ppm ^A	30	9	7	5
	lb/MMBTU	0.035	0.0105	0.0082	.0058
SOx	ppm ^A	1	1	1	
	lb/MMBTU	0.001	0.001	0.001	
HC/VOCs	ppm ^A	8	4	4	
	lb/MMBTU	0.0032	0.0016	0.0016	
PM	ppm ^A	-	-	-	
	lb/MMBTU	0.01	0.01	0.01	

A. ppm levels are given on a dry volume basis and corrected to 3% oxygen (15% excess air).
 B. Below 50% firing rate.

Table 11. CBEX Elite #2 Oil Estimated Emission Levels

POLLUTANT	UNITS	30 PPM SYSTEM	9 PPM SYSTEM	7 PPM SYSTEM	5 PPM SYSTEM
CO	ppm ^A	10	10	10	10
	lb/MMBTU	0.008	0.008	0.008	0.008
NOx	ppm ^A	90	70	70	70
	lb/MMBTU	0.12	0.093	0.093	0.093
SOx	ppm ^A	55	55	55	55
	lb/MMBTU	0.1	0.1	0.1	0.1
HC/VOCs	ppm ^A	4	4	4	4
	lb/MMBTU	0.002	0.002	0.002	0.002
PM	ppm ^A	-	-	-	-
	lb/MMBTU	0.025	0.025	0.025	0.025

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% or less by weight

Sulfur content = 0.1% by weight

Ash content = 0.01% by weight

Table 12. Model CBEX Elite, Min. Required Gas Pressure at Entrance to C-B Supplied Regulator/Gas Valve

BOILER HP	Combination Regulator and Gas Valve Size (in)	PRESSURE REQUIRED ("WC)
900	3	125
1000	3	155
1100	3	175
1200	3	200

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

Table 13. Predicted Sound Levels (30 ppm NOx systems) at High Fire

BHP	Sound Level-dbA
900	90
1000	91
1100	91
1200	91.5

Table 14. Lifting Lug Location

BOILER HP	ALL DIMENSIONS IN INCHES				
	A	B	C	D	E
900	127.9	48	193.25	12	3
1000	127.9	48	198	12	3
1100	127.9	48	232	12	3
1200	127.9	48 <td 242	12	3	

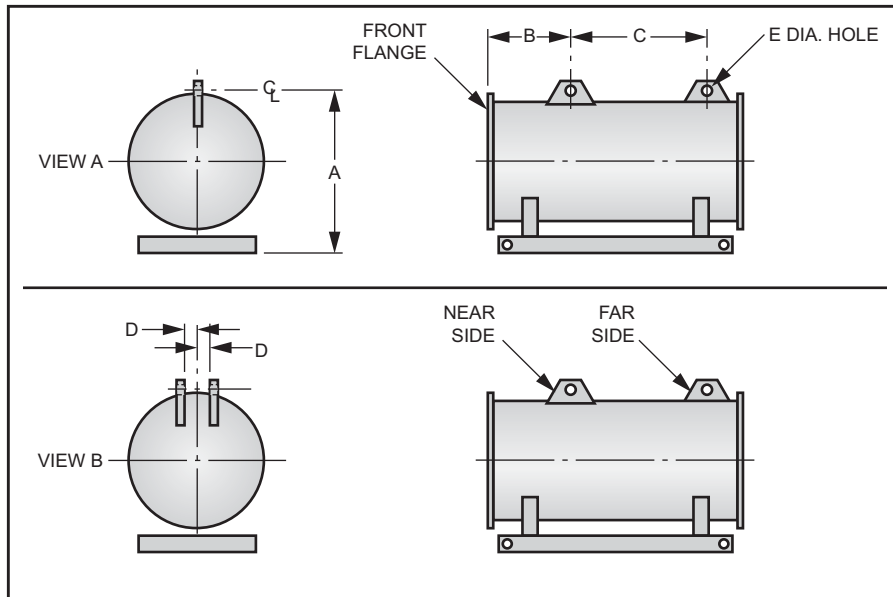


Table 15. Mounting Piers

BOILER HP	ALL DIMENSIONS IN INCHES								
	A	B	C	D	E	F	G	X1	X2
900	6	12	251	56.25	80.25	6.5	61.75	27.75	13.75
1000	6	12	255.5	56.25	80.25	6.5	61.75	27.75	13.75
1100	6	12	289.5	56.25	80.25	6.5	61.75	27.75	13.75
1200	6	12	299.5	56.25	80.25	6.5	61.75	27.75 <td 13.75	

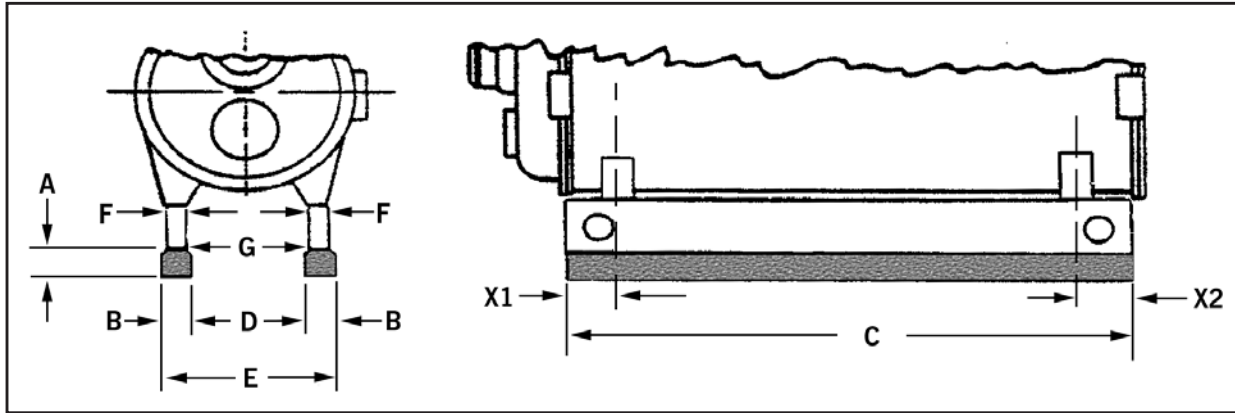


Table 16. Boiler Room Size

BOILER HP	900-1000	1100-1200
Dimension "A" (Inches) ¹	108	108
Dimension "B" (Inches) ²	189	189

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 60". If space permits, this aisle should be widened.

