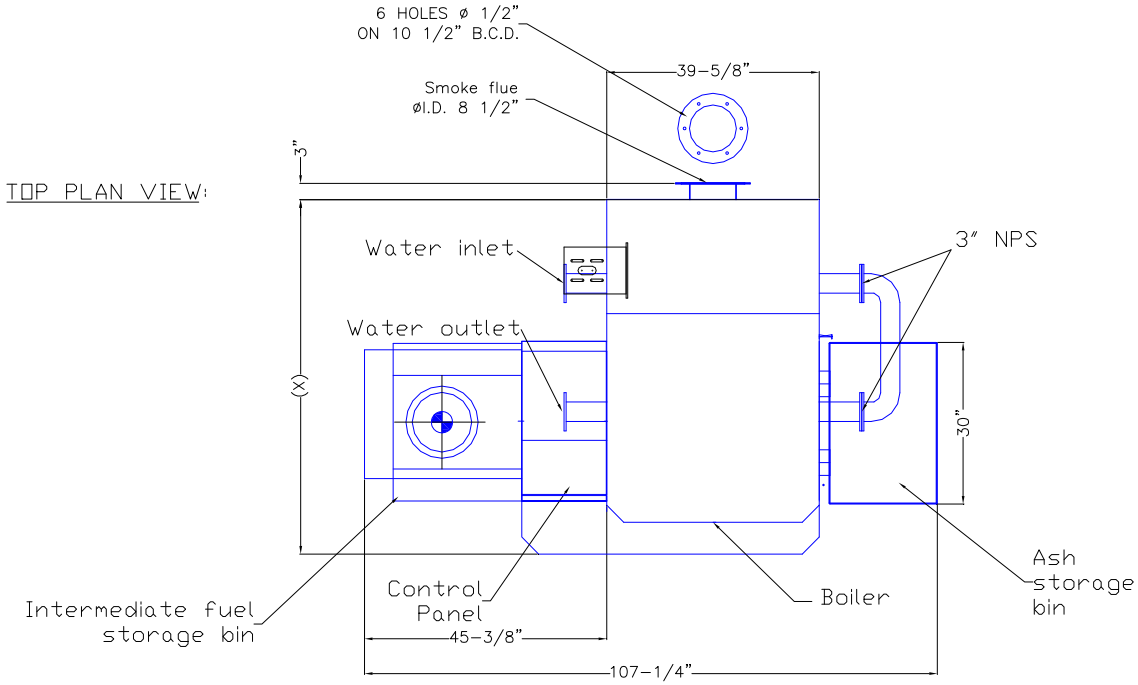
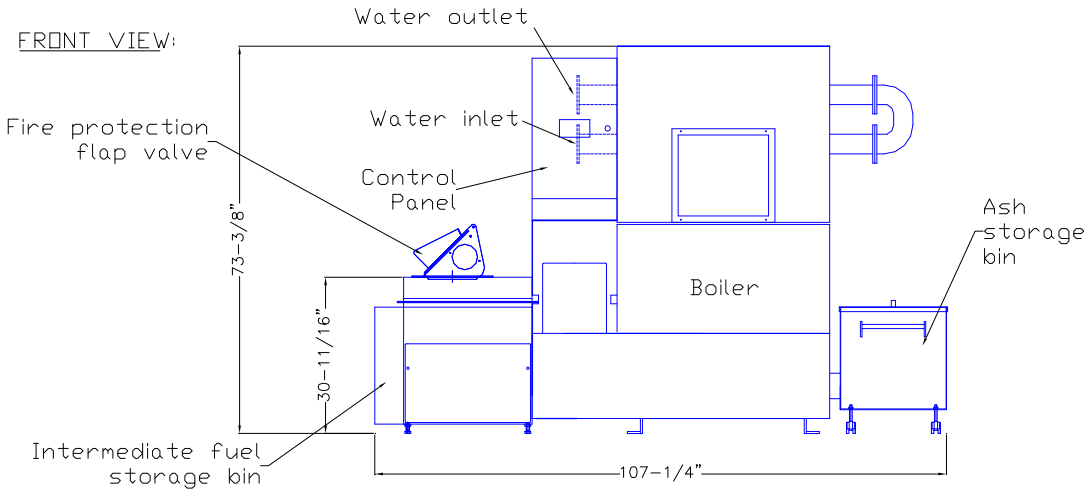
ACT Bioenergy™ Boiler Dimensions 0.5-0.85 Million Btu/h (150-250kW)

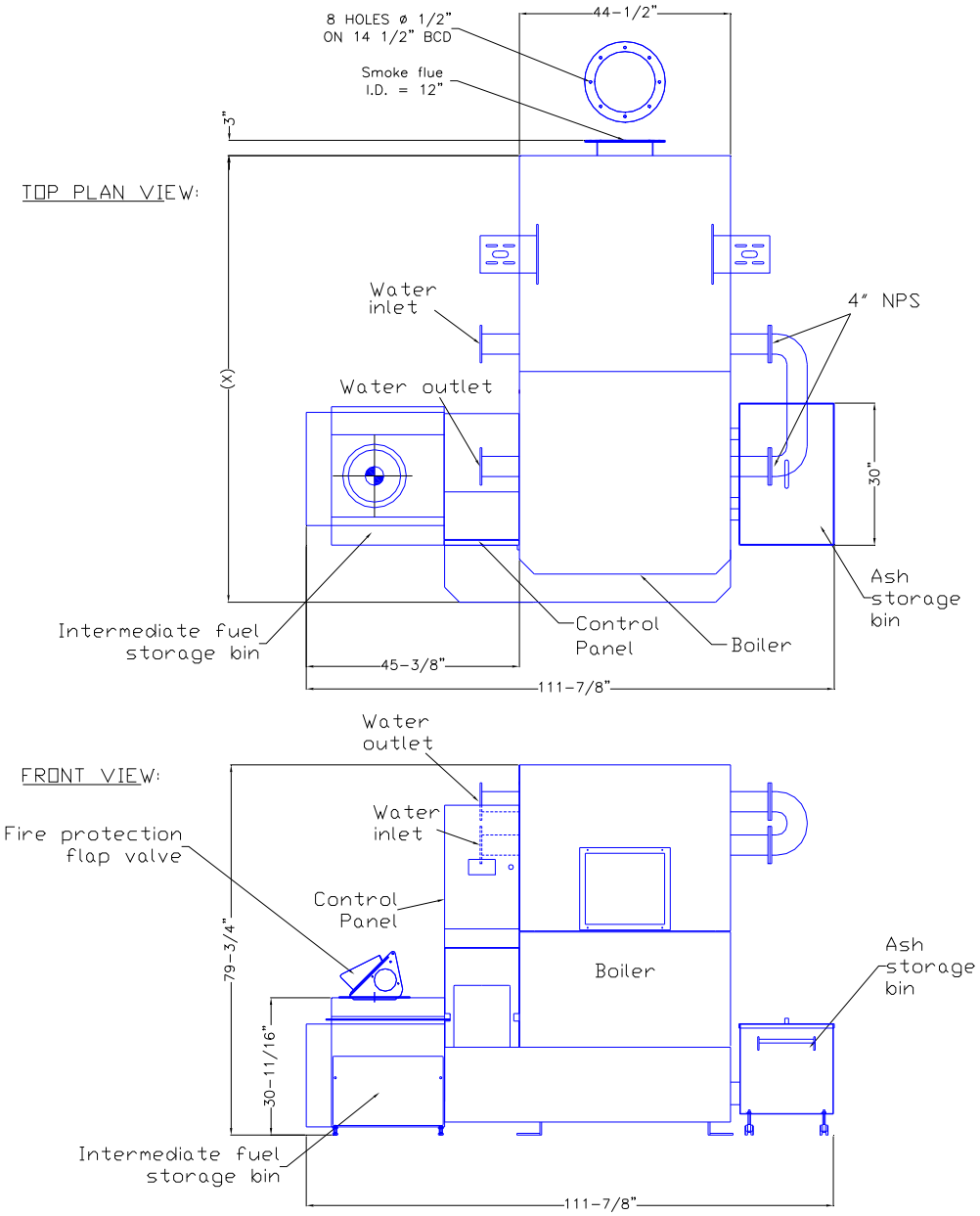
Model	CP500	CP600	CP750	CP850
Heat Output in MBtu/h (kW)	510 (150)	610 (180)	750 (220)	850 (250)
Height ft (mm)	6'1" (1855)	6'1" (1855)	6'1" (1855)	6'1" (1855)
Length (X) ft (mm)	5'7" (1700)	5'11" (1800)	6'4" (1930)	6'9" (2060)
Width ft (mm)	8'11" (2720)	8'11" (2720)	8'11" (2720)	8'11" (2720)





ACT Bioenergy™ Boiler Dimensions 1.0-1.7 Million Btu/h (300-500kW)

Model	CP1000	CP1200	CP1350	CP1500	CP1700
Heat Output in MBtu/h (kW)	1000 (300)	1200 (350)	1360 (400)	1500 (450)	1700 (500)
Height ft (mm)	6'8" (2030)	6'8" (2030)	6'8" (2030)	6'8" (2030)	6'8" (2030)
Length (X) ft (mm)	6'9" (2060)	7'1" (2160)	7'6" (2285)	7'11" (2410)	8'3" (2515)
Width ft (mm)	9'4" (2845)	9'4" (2845)	9'4" (2845)	9'4" (2845)	9'4" (2845)



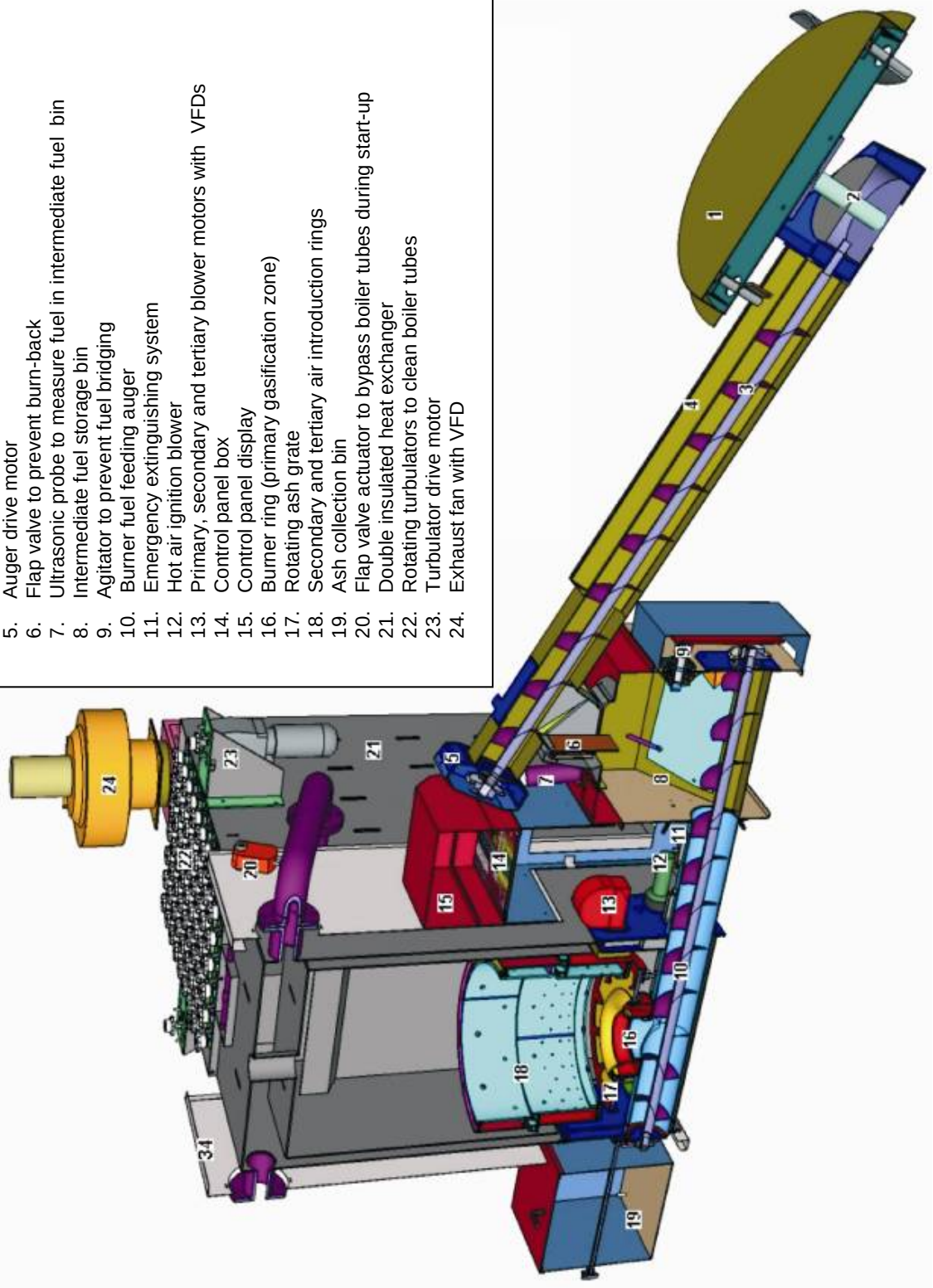
BOILER TECHNICAL DATA						
Boiler Model		**CP500**	**CP600**	**CP750**	**CP850**	
Full load output	Btu	510,000	610,000	750,000	850,000	
Partial load output	Btu	137,000	154,000	188,000	222,000	
Combustion efficiency at full load	%	80-85	80-85	80-85	80-85	
Boiler class (ASME)		IV	IV	IV	IV	
Water						
Water volume	gal	100	110	122	132	
Diameter of the water connection	in	3	3	3	3	
Hydraulic-pressure drop of the boiler at the temperature fall 35 °F	mbar	65	73	80	87	
Boiler operating temperature	°F	145-220	145-220	145-220	145-220	
Minimum return water temperature	°F	140	140	140	140	
Maximum operational pressure	psi	30	30	30	30	
Test pressure	psi	60	60	60	60	
Temperature of furnace	°F	1650 – 2000				
Pressure of furnace	in (H_2O)	- 0.12	- 0.12	- 0.12	- 0.12	
Required pressure in the chimney	in (H_2O)	- 0.08	- 0.08	- 0.08	- 0.08	
Requirement for the forced draught		Yes	Yes	Yes	Yes	
High stack temperature alarm	°F	446	446	446	446	
Exhaust temperature at full load	°F	280-300	280-300	280-300	280-300	
Flue gas output at full load	lbs/h	760	860	960	1040	
Flue gas output at partial load	lbs/h	200	230	260	280	
Flue diameter	in	9	9	9	9	
Chimney diameter	in	10	10	10	10	
Type of chimney		Moisture-resistant				
Fuel						
Maximum size	in	1.25	1.25	1.25	1.25	
Maximum moisture content	%	30	30	30	30	
Electrical installation						
Connection		208-230V, 60 Hz, 3-phase , Wye connection				

BOILER TECHNICAL DATA							
Boiler Model		**CP1000**	**CP1200**	**CP1350**	**CP1500**	**CP1700**	
Full load output	Btu	1,000,000	1,200,000	1,360,000	1,500,000	1,700,000	
Partial load output	Btu	256,000	310,000	340,000	400,000	480,000	
Combustion efficiency at full load	%	80-85	80-85	80-85	80-85	80-85	
Boiler class (ASME)	%	IV	IV	IV	IV	IV	
Water							
Water volume	gal	182	195	210	225	240	
Diameter of the water connection	„	4	4	4	4	4	
Hydraulic-pressure drop of the boiler at the temperature fall 35 °F	mbar	95	102	110	122	130	
Boiler operating temperature	°F	145-220	145-220	145-220	145-220	145-220	
Minimum return water temperature	°F	140	140	140	140	140	
Maximum operational pressure	psi	30	30	30	30	30	
Test pressure	psi	60	60	60	60	60	
Temperature of furnace	°F	1650 – 2000					
Pressure of furnace	in (H_2O)	- 0.12	- 0.12	- 0.12	- 0.12	- 0.12	
Required pressure in the chimney	in (H_2O)	- 0.08	- 0.08	- 0.08	- 0.08	- 0.08	
Requirement for the forced draught		Yes	Yes	Yes	Yes	Yes	
High stack temperature alarm	°F	446	446	446	446	446	
Exhaust temperature at full load	°F	280-300	280-300	280-300	280-300	280-300	
Flue gas output at full load	lbs/h	1150	1260	1370	1480	1590	
Flue gas output at partial load	lbs/h	310	330	360	400	420	
Flue diameter	in	12	12	12	12	12	
Chimney diameter	in	14	14	14	14	14	
Type of chimney		Moisture-resistant					
Fuel							
Maximum size	in	1.25	1.25	1.25	1.25	1.25	
Maximum moisture content	%	30	30	30	30	30	
Electrical installation							
Power connection		208-230V, 60 Hz, 3-phase, Wye connection					

Specifications are subject to change without notice.

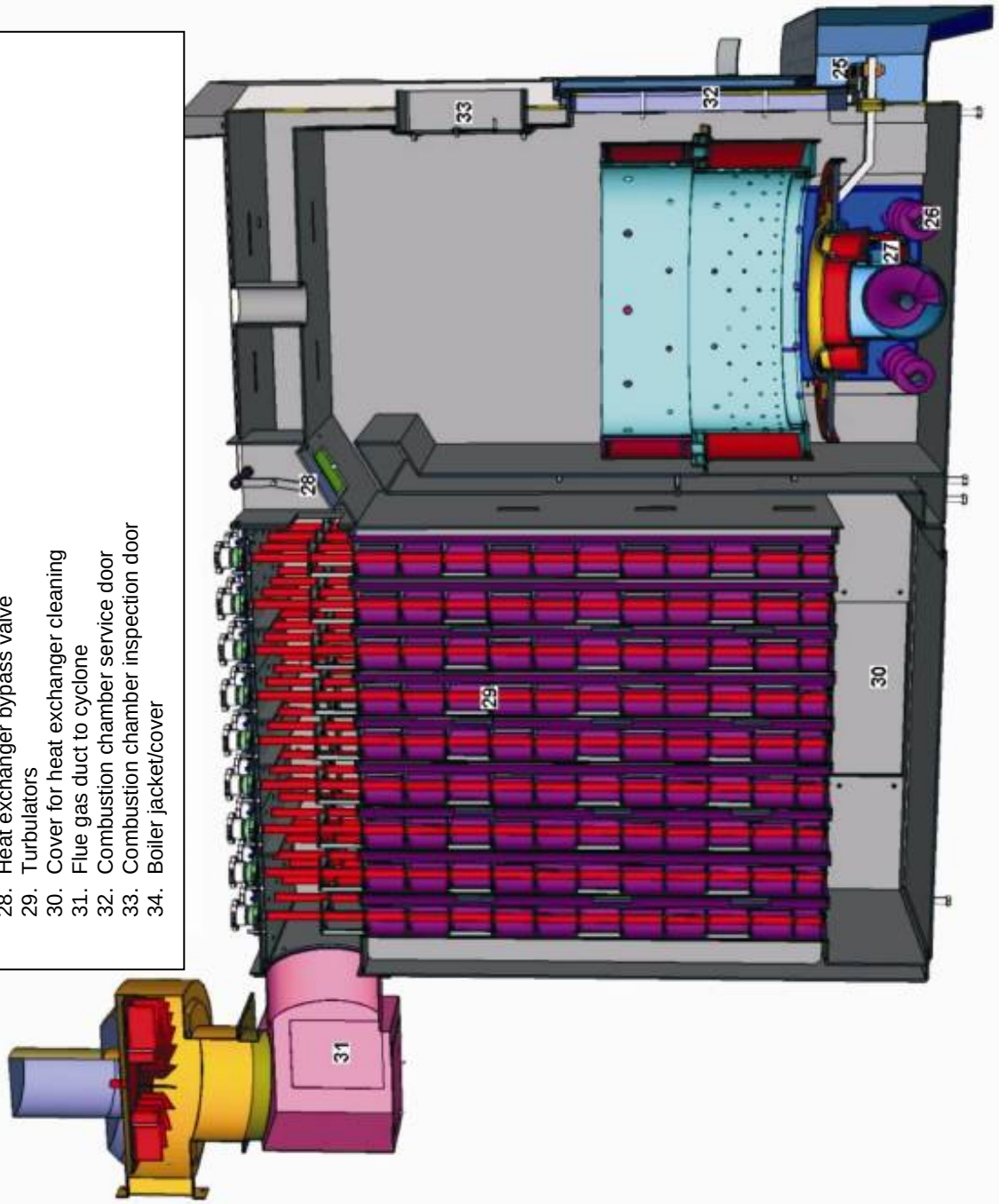
ACT Bioenergy™ Boiler with fuel auger

1. Rotating arm to feed fuel to auger
2. Auger drive shaft
3. Main fuel bin auger
4. Main fuel bin auger channel
5. Auger drive motor
6. Flap valve to prevent burn-back
7. Ultrasonic probe to measure fuel in intermediate fuel bin
8. Intermediate fuel storage bin
9. Agitator to prevent fuel bridging
10. Burner fuel feeding auger
11. Emergency extinguishing system
12. Hot air ignition blower
13. Primary, secondary and tertiary blower motors with VFDs
14. Control panel box
15. Control panel display
16. Burner ring (primary gasification zone)
17. Rotating ash grate
18. Secondary and tertiary air introduction rings
19. Ash collection bin
20. Flap valve actuator to bypass boiler tubes during start-up
21. Double insulated heat exchanger
22. Rotating turbulators to clean boiler tubes
23. Turbulator drive motor
24. Exhaust fan with VFD



ACT Bioenergy™ Boiler with fuel auger

25. Grate cleaning drive arm
26. Ash removal auger
27. Primary air channel
28. Heat exchanger bypass valve
29. Turbulators
30. Cover for heat exchanger cleaning
31. Flue gas duct to cyclone
32. Combustion chamber service door
33. Combustion chamber inspection door
34. Boiler jacket/cover



Boiler Function

The boiler consists of the following key components:

Fuel Storage and Delivery System
The fuel storage and delivery system conveys the fuel from the main fuel storage bin to the boiler. The ACT storage bin auger/stirrer system consists of the rotating arm (1) with the conveying auger (3) inside the auger channel (4) and the auger motor (5). A burn-back prevention flap valve controlled (6) by an actuator provides an airtight seal between the main fuel storage and the boiler system. This flap valve is only opened when fuel is feeding to the intermediate fuel storage bin. The rotating stirrer has leaf spring arms with the spindle covered by a turntable. The fuel auger delivers fuel to the intermediate storage bin (8). An ultrasonic probe (7) mounted on top of the intermediate storage bins measures the depth of fuel in the bin. When the level of fuel in the intermediate bin drops below a preset level, the flap valve (6) is opened and the auger refills the intermediate fuel bin (8). Once the intermediate bin is filled, the auger stops and the flap valve shuts. The fuel is delivered from the intermediate bin by the burner auger (10) to the burner ring (16). The sealed flap valve of burn-back protection (6) is automatically shut in the event of power failure. Below the intermediate fuel bin is the main drive motor, the motor for ash removal and the gear-drive for agitator to prevent bridging in the intermediate fuel bin (9). (Note: It is also possible to use other fuel delivery systems - such as a flex auger or pneumatic conveyor to supply fuel to the boiler to the boiler; but the compatibility of these systems must first be determined through consultation with ACT technical staff.)

Combustion Chamber
The combustion chamber is located at the front of the boiler. It consists of the round burner ring (16), rotating ash grate (17) and two-part collar for secondary and tertiary air (18). Due to high temperatures in the combustion chamber, all the parts are made of stainless steel. The fuel is fed from beneath and up through the center of the burner ring. The fuel is gasified at the burner ring where the primary air is supplied. The secondary and tertiary burner rings supply additional air to complete the combustion of the fuel. Next, the hot gases leave the combustion chamber through the heat exchanger bypass valve (28) which is at the top rear of the combustion chamber. The bypass valve is controlled by an actuator (20). On starting the boiler, the valve is open and the flue gases are sent directly to the stack. The bypass valve is closed once the flue gases are hot enough so that moisture in the flue gases won't condense within the heat exchanger portion of the boiler and cause corrosion. The ash from the combusted fuel falls from the edge of the rotating ash grate on two ash removal augers (26), which convey the ash into the ash collection bin (19). The combustion chamber service door (32) allow easy access to the combustion chamber if required for servicing.

Heat Exchanger
The rear "heat exchanger" portion of the boiler (21) is comprised of rows of vertical heat exchanger tubes. In the tubes there are turbulators (22, 29), which enhance heat transfer by creating turbulent air flows in the tubes. The turbulators are connected by a chain and motor drive (23). The turbulators rotate to scrape ash deposits from the inside of the heat exchanger tubes. Heat losses from the boiler are minimized by two layers of insulation covered by the steel boiler jacket (34). Hot gases exit the heat exchanger through the flue transition duct (31). The exhaust fan (24) is typically mounted on the top of a dust collection cyclone (not shown). There is a door (30) on either side of the heat exchanger for removal of ash from underneath the turbulators and access door(s) to remove ash from the flue.

Control Panel
The control panel modulates the primary, secondary and tertiary combustion air fans (13), and the combustion chamber pressure sensor, which senses the negative pressure in the combustion chamber. A consistent negative pressure is achieved by the variable frequency drive that adjusts the exhaust fan speed to maintain negative 30 Pascals to control draft and prevents fugitive exhaust emissions from the boiler. The hot-air ignition blower (12) enables automatic fuel ignition. The emergency fire extinguisher (11) measures the temperature for the fuel feeding auger channel and releases water into the auger channel if the temperature exceeds 200ºF (90ºC). The boiler control panel and control panel display (14, 15) manage the boiler operations and fuel feed rates and allow the operator to adjust boiler control parameters. The control system constantly monitors the temperature and oxygen levels of the exhaust gases and adjusts speed of the three fans to achieve optimal combustion.