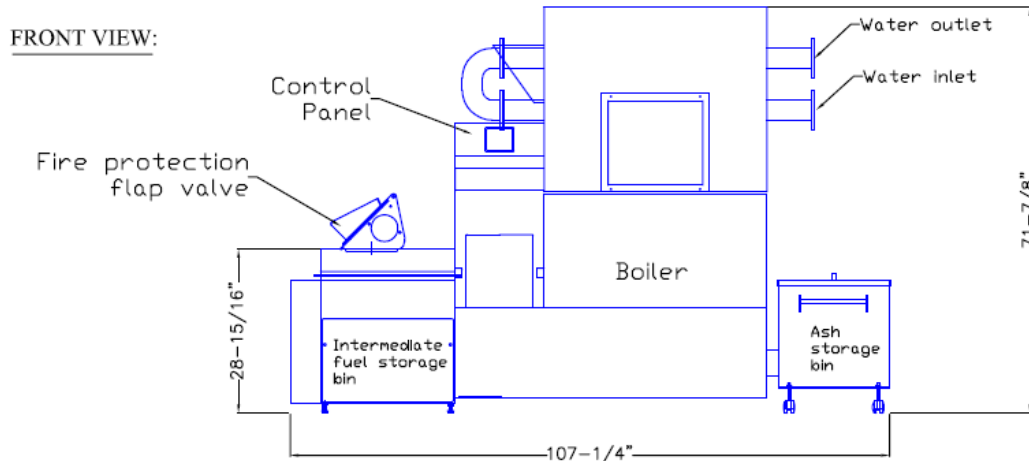
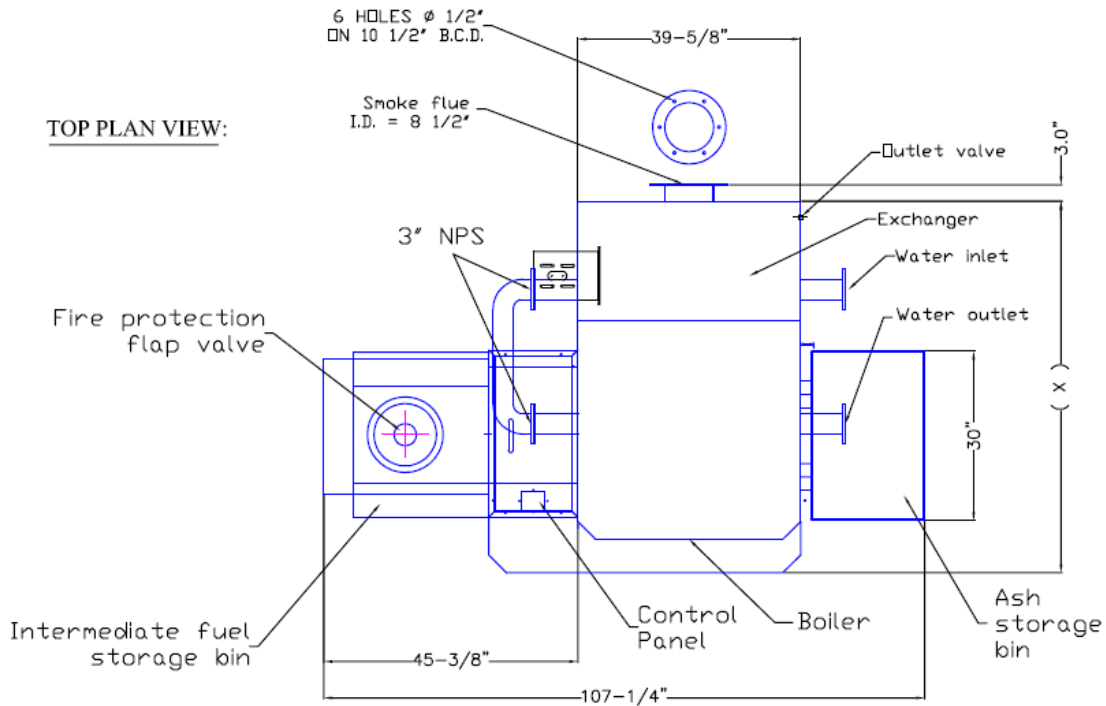


ACT Bioenergy™ Boiler Dimensions 0.5-0.85 Million Btus (150-250kW)

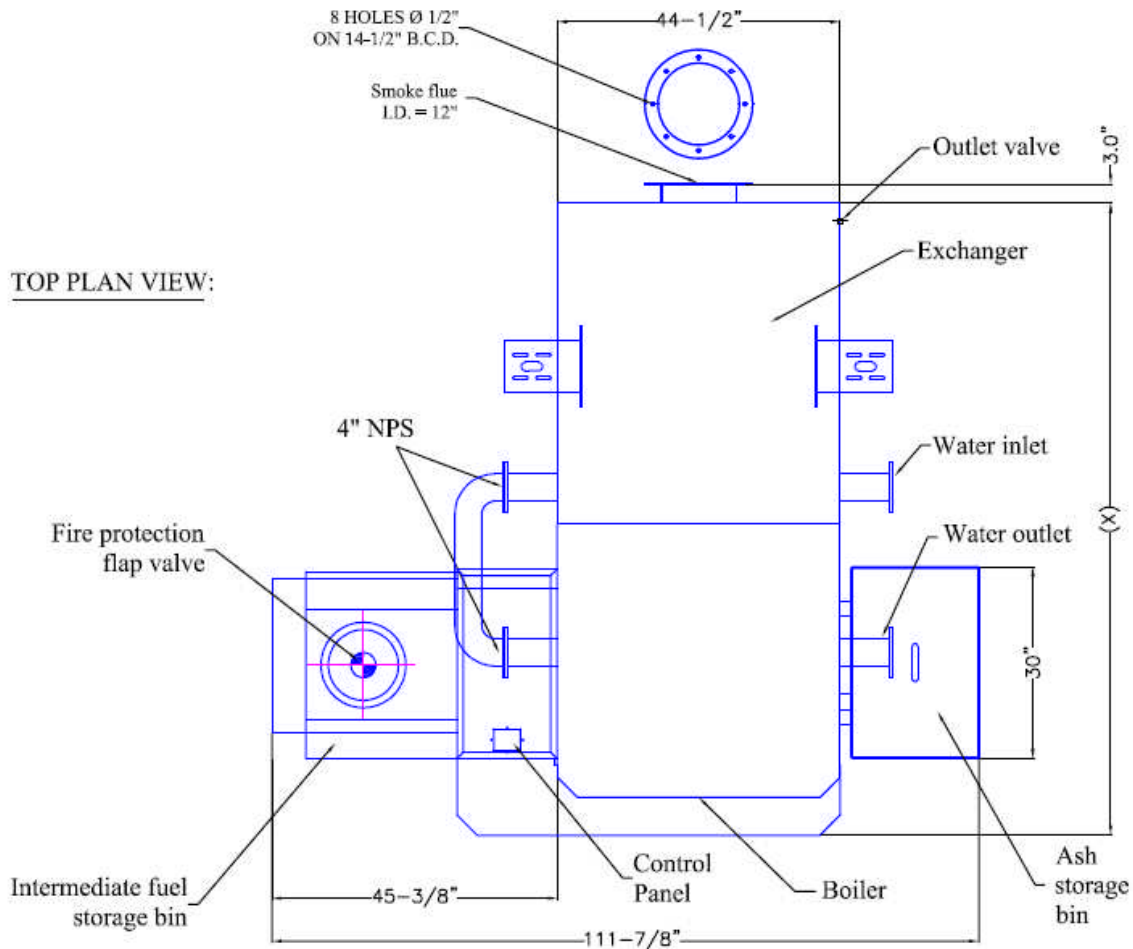
Boiler Model	CP500	CP600	CP750	CP850
Height ft (mm)	6' (1825)	6' (1825)	6' (1825)	6' (1825)
Length (X) ft (mm)	6'11" (2100)	7'4" (2220)	7'9" (2340)	8'1" (2460)
Width ft (mm)	8'10" (2700)	8'10" (2700)	8'10" (2700)	8'10" (2700)



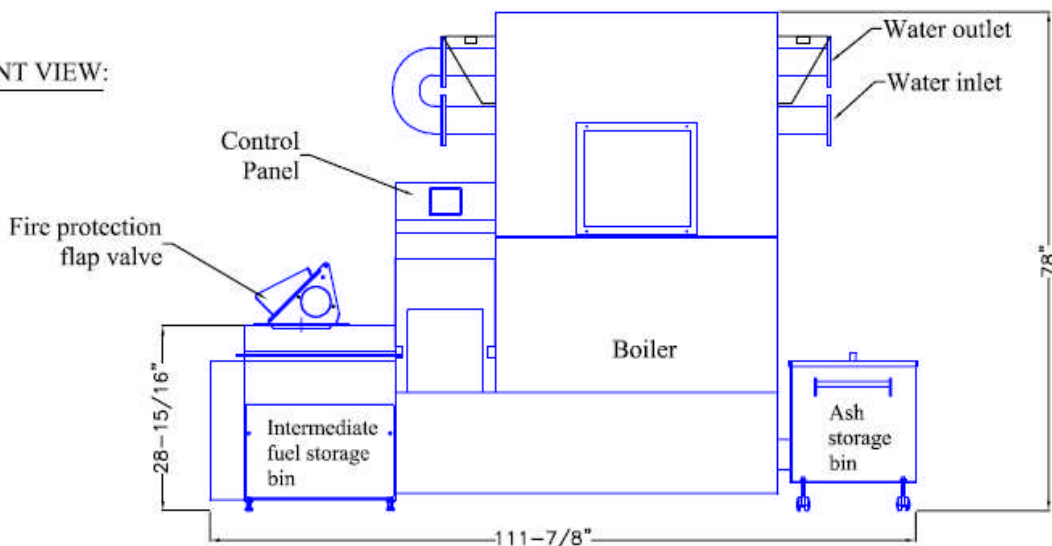
ACT Bioenergy™ Boiler Dimensions 1-1.7 Million Btu (300-500kW)

Boiler Model	CP1000	CP1200	CP1350	CP1500	CP1700
Height ft (mm)	6'6" (1985)	6'6" (1985)	6'6" (1985)	6'6" (1985)	6'6" (1985)
Length (X) ft (mm)	8'1" (2460)	8'6" (2580)	8'10" (2700)	9'3" (2820)	9'7" (2940)
Width ft (mm)	9'3" (2825)	9'3" (2825)	9'3" (2825)	9'3" (2825)	9'3" (2825)

TOP PLAN VIEW:



FRONT VIEW:



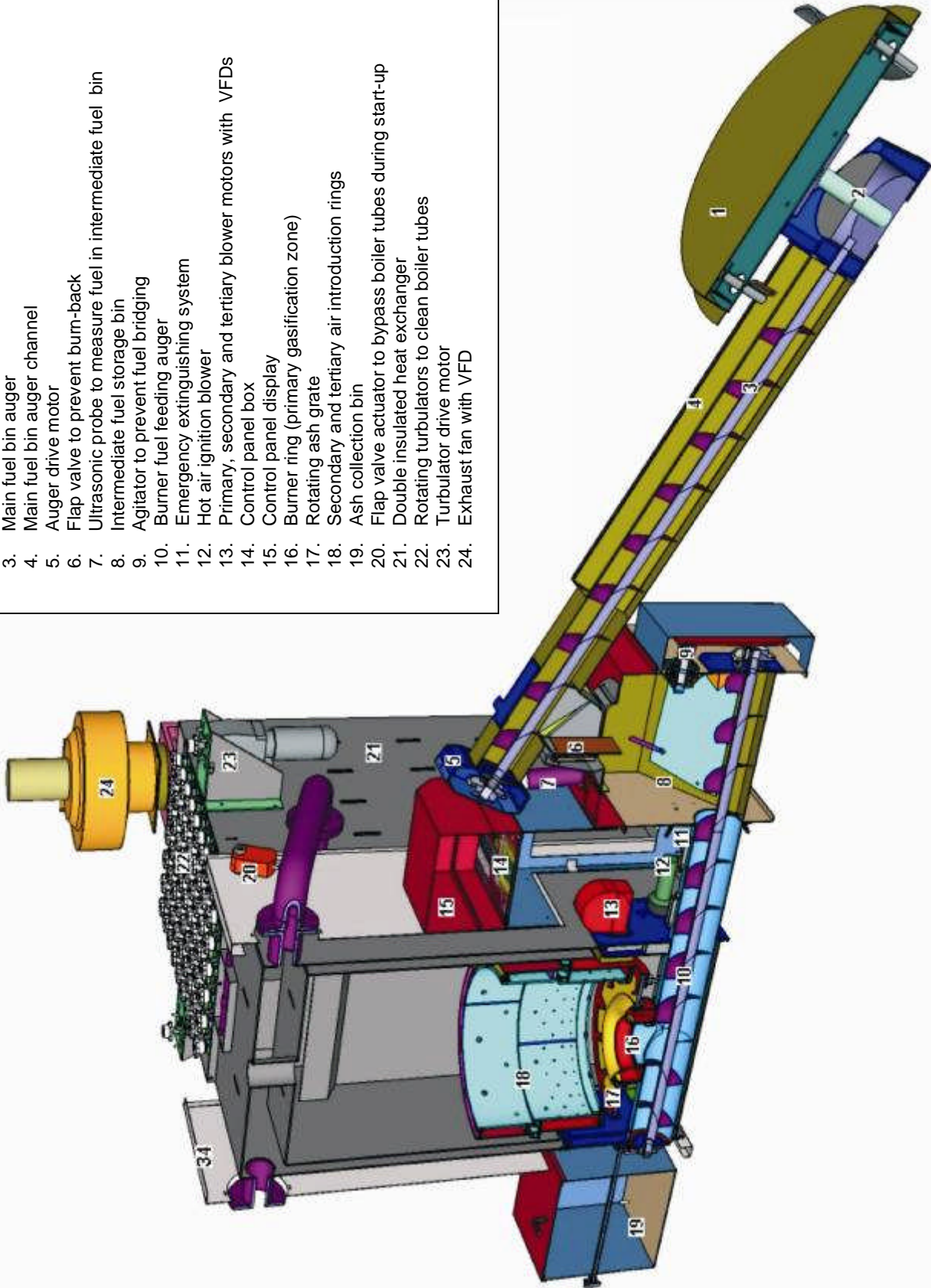
BOILER TECHNICAL DATA						
Marking		CP500	CP600	CP750	CP850	
Full load output	Btu	510,000	610,000	750,000	850,000	
Partial load output	Btu	137,000	154,000	188,000	222,000	
Boiler efficiency at full load	%	85-90	85-90	85-90	85-90	
Boiler class (ASME)		IV	IV	IV	IV	
Water						
Water volume	gal	100	110	122	132	
Water connection diameter	in	3	3	3	3	
Hydraulic-pressure drop of the boiler at 35 °F temperature differential	mbar	65	73	80	87	
Boiler operating temperature	°F	140-210	140-210	140-210	140-210	
Min. return water temperature	°F	135	135	135	135	
Max. operating pressure	psi	30	30	30	30	
Test pressure	psi	75	75	75	75	
Furnace						
Temperature of furnace	°F	1650 – 2000				
Pressure of furnace	in (H ₂ O)	- 0.016	- 0.016	- 0.016	- 0.016	
Required draft at cyclone output	in (H ₂ O)	0.08	0.08	0.08	0.08	
Exhaust ID fan requirement		Yes	Yes	Yes	Yes	
Exhaust temperature at full load	°F	430	430	430	430	
Exhaust temperature at partial load	°F	280	280	280	280	
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						
Max. woodchip size	in	1.25	1.25	1.25	1.25	
Max. fuel moisture	%	30	30	30	30	
Electrical installation						
Connector		208-230V, 60 Hz, 3-phase, Wye Connection				

BOILER TECHNICAL DATA							
Marking		CP1000	CP1200	CP1350	CP1500	CP1700	
Full load output	Btu	1,000,000	1,200,000	1,350,000	1,500,000	1,700,000	
Partial load output	Btu	256,000	310,000	340,000	400,000	480,000	
Boiler efficiency at full load	%	85-90	85-90	85-90	85-90	85-90	
Boiler class (ASME)	%	IV	IV	IV	IV	IV	
Water							
Water volume	gal	182	195	210	225	240	
Diameter of the water connection	in	4	4	4	4	4	
Hydraulic-pressure drop of the boiler at 35 °F temperature differential	mbar	95	102	110	122	130	
Boiler operating temperature	°F	140-210	140-210	140-210	140-210	140-210	
Minimum return water temperature	°F	135	135	135	135	135	
Maximum operational pressure	psi	30	30	30	30	30	
Test pressure	psi	75	75	75	75	75	
Temperature of furnace	°F	1650 – 2000					
Pressure of furnace	in (H ₂ O)	- 0.016	- 0.016	- 0.016	- 0.016	- 0.016	
Required draft at cyclone output	in (H ₂ O)	0.08	0.08	0.08	0.08	0.08	
Exhaust ID fan requirement		Yes	Yes	Yes	Yes	Yes	
Exhaust temperature at full load	°F	390	430	430	430	430	
Exhaust temperature at partial load	°F	250	280	280	280	280	
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							
Max. woodchip size	in	1.25	1.25	1.25	1.25	1.25	
Max. fuel moisture	%	30	30	30	30	30	
Electrical installation							
Power connection		208-230V, 60 Hz, 3-phase, Wye Connection					

Specifications are subject to change without notice

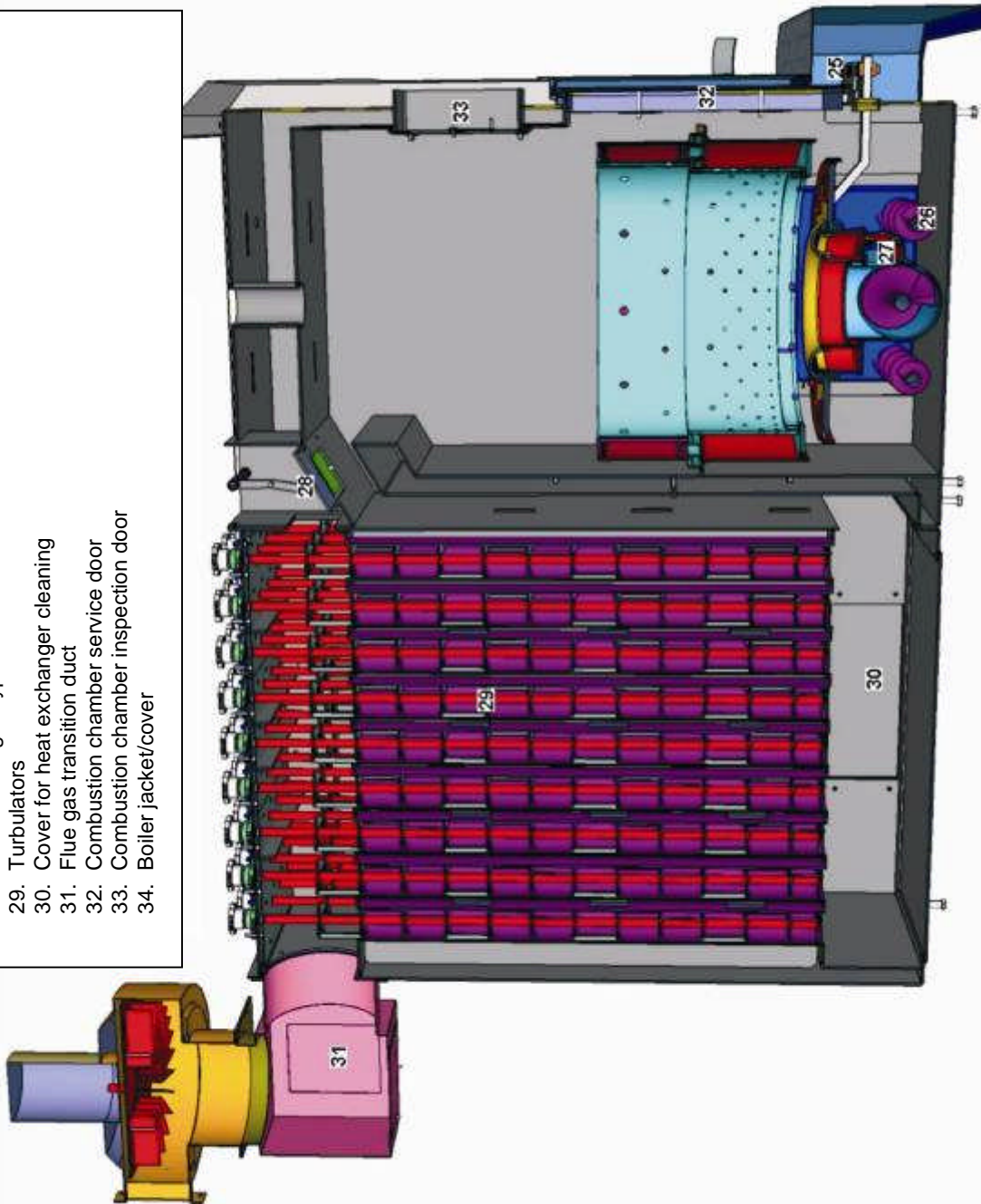
ACT Bioenergy™ Boiler with fuel auger

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 transition duct
- 32. Combustion chamber service door
- 33. Combustion chamber inspection door
- 34. Boiler jacket/cover



Boiler Function

The boiler consists of the following main components:

- I. boiler combustion chamber
- II. heat exchanger
- III. control panel
- IV. fuel storage and delivery system

The combustion chamber is located at the front of the boiler. It consists of the round burner ring (16), two-part collar for secondary and tertiary air (18) and rotating ash grate (17). 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 closes when the flue gases are hot enough so that moisture in the flue gases won't condense on the heat exchanger tubes 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 for servicing.

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. 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.

The control panel contains the primary, secondary and tertiary combustion air fans (13), and the combustion chamber pressure sensor, which measures the negative pressure in the combustion chamber. A variable frequency drive automatically adjusts the speed of the exhaust fan to maintain a constant negative 30 pascals (-0.08" H₂O) in the combustion chamber. This draft helps ensure optimal combustion 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 200°F (90°C). The boiler control panel and control panel display (14, 15) manage the boiler operations and allow the operator to adjust boiler control parameters. The control system constantly monitors the oxygen level in the exhaust gases and adjusts the fan speed to achieve optimal combustion.

The fuel storage and delivery system. conveys fuel from the main fuel storage bin to the boiler. The storage bin auger/stirrer system consists of a rotating arm (1) with the conveying auger (3) inside the auger channel (4) and an auger motor (5). The rotating stirrer has leaf spring arms with the spindle covered by a turntable. At the output end of the auger channel close to the boiler there is a burn back prevention flap valve controlled (6) by an actuator. 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 predetermined level, the flap valve (6) is opened and the auger fills the intermediate fuel bin (8). Once the intermediate bin is filled, the auger stops and the flap valve closes. The sealed burn-back prevention flap valve (6) is automatically shut in the event of power failure. The fuel is delivered from the intermediate bin by the burner (stoker) auger (10) to the burner ring grate (16). Below the intermediate fuel bin are the burner (stoker) motor linked with intermediate fuel bin agitator arms (9) to prevent fuel bridging and the ash removal motor.