

# Industrial Boiler and Its Functioning

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## Abstract:

Boilers are the container that converts water into hot fumes or so-called steam into a desired temperature, flow and pressure. Boilers mainly work on the principle of Rankin cycle. Boilers are classified into two categories Water tube boiler and smoke tube boilers (fire tube). Water tube boiler has more advantages than smoke tube boiler, as smoke tube boilers need shell for holding water in generation of steam. There are the chances to choke the tubes in smoke tube boiler as the solid residue of combustion present in the hot gases will settle inside the tubes thereby reducing the heat transfer in case of water tube boiler one can easily design the large capacity and high-pressure boiler, but this can't be done in fire tube boiler. For fuel of boiler generally biomass briquettes are being used, they have various advantages as compared to other fuels traditionally used. They do not have any sulphur content, Moisture content is also less than 10%, Easy to store and clean to handle. The main reason is that the heat output of a single piece of briquettes is equivalent to eight cubic metre of seasoned logs (a saving of approximately 40% on fuel cost annually) and also low ash content 2 to 10% as compared to 20 to 40% that is in coal

**Keywords**—biomass, sulphur, coal, tube boiler, smoke, Moisture, Rankin cycle, temperature, pressure

## Introduction:

IBR stands for “Indian Boiler Regulations” BOILERS can be classified on various basis.  
Fired boiler - AFBC, CFBC, FBC

- (ii) Non-fired boiler - WHRB, HRSG
- On the Basis of heat source :
  - Fuel fired boiler -
  - Waste heat boiler
- On the Basis of Pressure :
- Low pressure Boiler  $< 1 \text{ Kg/cm}^2$
- Medium pressure Boiler  $> 1.021 \text{ atm} < 7 \text{ Kg/cm}^2$
- High Pressure Boiler  $> 7 \text{ Kg/cm}^2$

### On the Basis of Nature of fuel :

- (i) Coal fired (PF, Stoker, hand fired)
- (ii) Gas fired
- (iii) Oil fired
- (iv) Wood fired/Biomass fired
- (v) Bagasse fired

### On the Basis of Boiler water Circulation :

Natural circulation Boiler

Forced circulation boiler

Every other type of boiler often utilized in business house heating applications is cast iron sectional boilers .. Tubes aren't used in these Boilers. They're made up of solid iron parts with

water and combustion fuel channels instead. Similar to an old steam radiator, the iron castings are welded together. Gaskets are used to seal the parts together. They are present in capacities from 35,000 to 14,000,000 BTU input and may produce steam or warm water.

## TYPES OF BOILERS

### Water Tube Boilers-

Feed water from a lower drum is circulated through a bundle of tubes called tube bank.

The hot products of combustion from the furnace pass over this tube bank and heat is transferred to water through tube material.

### Smoke Tube Boilers-

- The boiler contains have a shell containing water.
- The hot combustion products from the furnace are directed through the tubes within the shell and immersed in water.
- The water in the shell cools the hot gases passing through the tubes. The gases coming out of the tubes are collected in a smoke box and let out into the chimney

**Advantages of Water tube boiler over smoke tube boiler-**

- Smoke tube boilers need a shell to hold the water for steam generation, the size of which needs to be increased with increase in steaming capacity.
- In smoke tube boiler, the solid residue of combustion present in the hot gases will settle inside the tubes, thereby reducing the heat transfer as well chokes the tubes.
- With water tube design, boiler of very large capacities and high pressure can be designed

**Important Boiler parts-**

Boiler basically consist of following parts:

- Boiler Pressure Parts
- Fans
- Furnace
- Dust collectors
- Deaerator

Pressure Parts

**Commonly employed pressure parts:**

- Economizer
- Boiler Drum
- Water wall systems

**Types of Economizers:**

Steaming Economizer and Non Steaming Economizer.

Advantages:

The feature of fusible plug is to defend the boiler from injury due to overheating of boiler tubes via low water level. it is actually a hole gun metallic plug screwed into the hearth field crown. This hole gun steel plug is separated from the most important steel plug through an annulus fusible material.

Pressure part: Drum and Drum internals

*Drum: Steam separation*

- Steam Separation using baffles
- Steam Separation using Centrifugal separator

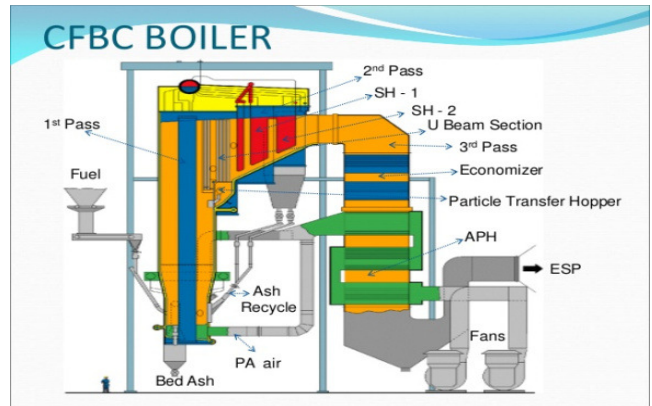
**WHRB** :- Waste Heat Recovery Boiler.

**HRSG** :- Heat Recovery Steam Generation Boiler

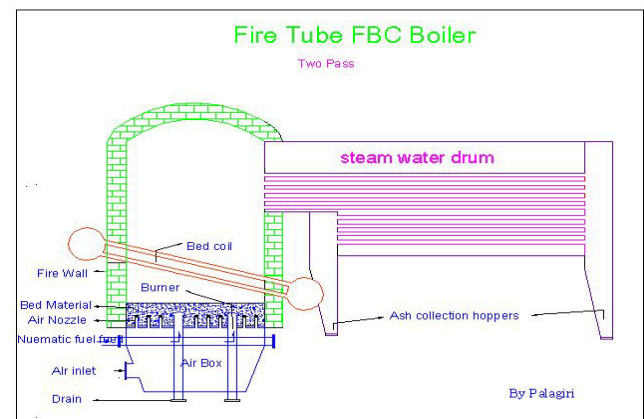
**AFBC boiler-**



**CFBC boiler-**



**FBC boiler-**



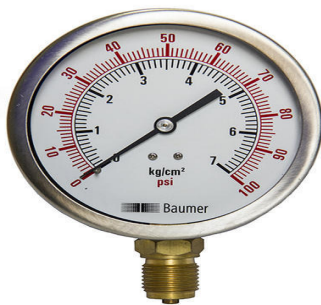
**Boiler Mountings :**

'Boiler Mounting' are the components mounted on the surface of the boiler to have safety during operations.

Different kind of mountings are as under:

- Safety Valve
- Steam stop
- Water level controller(Mobrey)
- Steam High Pressure Switch
- Feed check valve
- Manhole & mud box

#### A. Pressure gauge



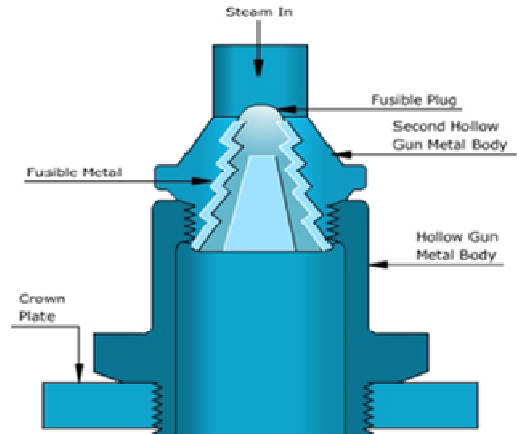
Function:

1. To file the steam stress at which the steam is generated in the boiler.
2. A Bordon strain gauge in its easiest shape consists of an elliptical elastic tube bent into an arc of a circle
3. This bent-up tube is referred to as BOURDON'S tube.
4. One gives up of the tube gauge is constant and related to the steam area in the boiler.
5. The different give up is related to a zone thru a link.

#### B. Water Level Indicator

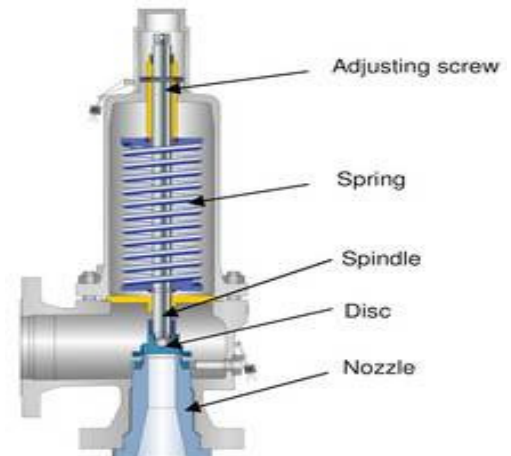


#### C. Fusible plug



- The purpose of a fusible plug is to prevent the boiler from damage caused by low water levels overheating the boiler tubes. It's just a hollow gun metal plug placed into the top of the firebox. An annular fusible material separates this hollow gun metal plug from the main metal plug.

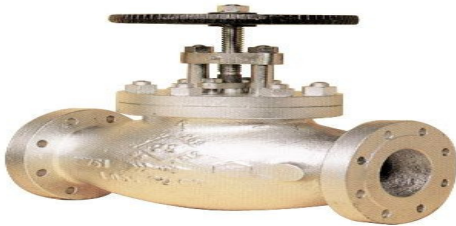
#### D. Safety Valve



- The security valve is one of the most vital mechanical security in a steam system. The primary characteristic of a protection valve is to relieve extra stress in vessel. It is positioned on the boiler steam drum, and will mechanically open when the strain of the inlet facet of the valve will increase previous the preset pressure



**E. Steam stop valve**

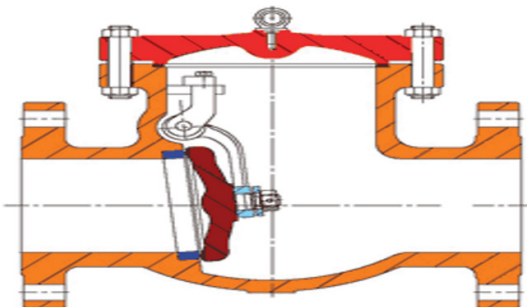


**F. Water Level Controller (Mobrey)—**



The main purpose of the water level controller is to bring the drum up to level at boiler start-up and maintain the water level at all time. A sudden decrease in this level may uncover boiler tubes, causing them to become overheated and damaged

**G. Feed check valve—**



**H. Steam High Pressure Switch—**

The main purpose of the Steam High Pressure switch is to cut off the burning of fuel in boiler furnace so the steam pressure will not exceed above the normal working pressure.

**I. Manhole & mud box**

**Boiler Accessories**

“The device which are used in a boiler as an integral part and help to run the boiler efficiently is called as boiler accessories.”

**Examples:**

1. Economizer
2. Air pre heater
3. Feed pump
4. ID Fan / PA Fan / FD fan
5. De-super heater/Attemporator
6. Soot blower Super heater
7. Ash removal system

Sl no	ACTIVITIES	HEATER	BOILER
1	Check and ensure the readiness of softener/RO	Yes	No
2	Check and ensure the soft water tank is full and free from dirt and other foreign particle	Yes	No
3	Ensure to check the feed water parameters as per recommendations given in P&I	Yes	No
4	Inlet pipes and filters to be flushed and cleaned properly to ensure readiness of feed water availability up to feed pump suction.	Yes	No
5	Now the feed water pump is again ready for operation	Yes	No
6	Check and ensure fuel is stored at proper place and ready to be fed up to fuel feeder	Yes	Yes
7	Ensure the readiness of fuel conveyer with respect to bucket ,belt, motor, gear box , any external noise condition	Yes	Yes
8	Ensure screw/ rotary feeder casing should be properly cleaned and ready to be operated in fresh condition. Do not forget to check gearbox oil condition/level	Yes	Yes
9	Panel should be cleaned externally and internally with the help of blower to remove external/internal dust accumulation and ingress	Yes	yes
10	Also recommended to use hot air with help of hand blower to remove moister because of long storage	Yes	Yes
11	Ensure power and instrument earthing termination condition	Yes	Yes
12	Care to be taken while restart up of VFD and kindly follow the OEM manual	Yes	Yes
13	Before startup of boiler donot forget to ensure phase voltage ,line voltage and voltage between earth and neutral.	Yes	Yes
14	Ensure wiring are properly connected / intact.	Yes	Yes
15	If the voltage ranges are ok, panel is ready for start up	Yes	Yes
16	Restart the panel power and control and ensure to check rotation and direction of rotary equipment with closing tamper condition.	Yes	Yes
17	Ensure all the blow down, drain valves are kept closed.	Yes	No
18	Ensure and check main steam stop valves should be closed.	Yes	No
19	Ensure and check air vent valve should be opened.	Yes	No



## **Conclusion**

Industrial Boilers are of two type water tube boiler and fire tube boiler. Both of their function is same to generate steam for the various purposes. The pressure of steam is controlled by temperature change by adding or decreasing fuel. Mostly Coal is used as the fuel of Boiler but due to environmental pollution and health issues now a days Briquette is being used as the boilers fuel it has calorific value less than Coal. As in food and beverages plant Steam is used for lubrication on the conveyer belts, CIP (Clean in Place) after the flavour and batch change it is required to clean the channels and pipelines of the beverage flow lines. And the high pressure of steam is used to run certain machines that is an efficient way to reduce power requirement. Each component of boiler is tested before firing as it is designed to bear high pressure and due to any small error it can lead to heavy losses and can explode too. Water used in boilers are filtered beforehand so that their must not be any sort of impurities present in it, after every use the steam is cooled and then the steam is condensed, and water is been recovered. This process is repeated every time as the requirement of plant.

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