

Mechanical Engineering Fundamentals

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Mechanical Engineering Fundamentals

(MEC103)

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Assessment Component

Component	Weightage
Attendance	5%
AT - 1	10%
AT - 2	10%
MSE	25%
ESE	50%

Content

- 1) Fundamental Concepts of Thermodynamics
- 2) Laws of Thermodynamics
- 3) Pressure and its Measurement
- 4) Heat Transfer
- 5) Power Absorbing Devices
- 6) **Power Producing Devices**
- 7) Principles of Design
- 8) Power Transmission Devices and Machine Elements

Lecture No. - 2

- Steam boiler
- Application
- Classification of boilers
- Types of boilers (Brief Description)
- Essentials of a good boiler
- Advantages of superheating the steam
- Comparison between Water tube and Fire tube boilers
- Function of boiler Mountings and Accessories

Boiler

A boiler or steam generator is a device used to generate steam or vapour or superheated steam at required pressure by applying heat energy to water.

Applications of Boiler

A boiler or steam generator is used wherever a source of steam is required. The steam can be used in power steam engines or other industrial applications. Steam is a key source because of its availability, advantageous properties and nontoxic nature.

Working Principle of Boiler

The boiler is essentially a closed vessel inside which water is stored. Fuel (generally coal) is burnt in a furnace and hot gases are produced. These hot gases come in contact with water vessel where the heat of these hot gases transfer to the water and consequently steam is produced in the boiler. Then this steam is piped to the point of application.

Classification of Boilers

Boilers are classified as:

Depending upon to the position of water and flue gases

Smoke tube or Fire tube boilers

The fire tube boilers are classified as **single tube and multi-tube boilers**, depending upon whether the fire tube is one or more than one.

Water tube boilers

Babcock and Wilcox, Stirling, Yarrow boiler etc.

Depending upon to the position furnace

Internally fired boilers: In case of internally fired boilers, the furnace is located inside the body of the boiler shell. Examples: Lancashire, Locomotive, Cochran boiler etc.

Externally fired boilers: In case of externally fired boilers, the fire is outside the shell. Examples: Babcock and Wilcox boiler, Stirling boiler etc.

Depending upon the position of axis of the boiler

Vertical boilers: If the axis is vertical, it is called vertical boiler. The vertical boiler occupies less floor area.

Horizontal boilers: If the axis of the boiler is horizontal, the boiler is called horizontal boiler. The parts of horizontal boiler is can be inspected and repaired easily but it occupies more space.

Inclined boilers: If the axis is inclined it is called as inclined boiler.

Depending upon the steam pressure

Low pressure boilers: The boilers which produce steam at pressure below 20 bar are called low pressure boilers. Examples: Cochran, Cornish, Lancashire and Locomotive boiler etc.

High pressure boilers: The boilers which produce steam above 20 bar are called high pressure boilers. Examples: Babcock and Wilcox, Benson Boiler etc.

Depending upon the use

Stationary boilers: Stationary boilers are used in power plant for electricity generation.

Portable boilers: Mobile boilers or portable boilers include locomotive type, and other small units for temporary use at sites.

Depending upon the method of circulation of water and steam

Natural circulation: In natural circulation type of boilers, circulation of water in the boiler takes place due to natural convection currents produced by the application of heat. Examples: Lancashire, Babcock and Wilcox boiler etc.

Forced circulation: In forced circulation boiler, the water is circulated with the help of prime mover by external source of power such a method of water circulation is usually employed in high pressure boilers. Examples: Velox, Lamomt, Benson Boiler etc.

Depending upon the type of fuel used

- Coal fired boilers
- Oil fired boilers
- Gas fired boilers
- Multi-fuel fired boilers
- Industrial waste fired boilers
- Biomass fired boilers

Depending on type of firing adopted in boilers they can be classified as

- Stoker fired
- Pulverized coal fired
- Down shot fired
- Fluidized bed boilers
- Cyclone fired
- Chemical recovery boilers
- Incinerators

Essentials of Good Boiler

- The boiler should be able to produce the required amount of steam per hour.
- The maintenance of the boiler should be easy and cheap.
- Boiler should be able to produce maximum amount of steam with given amount of fuel.
- Boiler should rapidly meet fluctuation of load.

Essentials of Good Boiler

- Boiler should be light in weight, occupy less space.
- Boiler should be as per the safety regulations according to Indian Boiler Act 1923.
- Low emission of carbon monoxide, NO_x and SO_x in flue gases.
- The mud & other deposits should not collect on the heating surface.

Different between Fire Tube Boiler and Water Tube Boiler

S. No.	Parameter	Fire Tube Boiler	Water Tube Boiler
1	Position of hot gases	Hot gases inside the tubes.	Hot gases outside the tubes.
2	Position of Water	Water outside the tubes.	Water inside the tubes.
3	Mode of Firing	Generally Internally Fired	Externally Fired
4	Rate of Steam Production	Lower	Higher
5	Operating Pressure	Operating Pressure limited to 16 bar	Can work under high pressure up to 100bar
6	Risk on Bursting	Lesser risk on bursting	Higher risk on bursting
7	Accessible for cleaning, inspection or repair	Not simply accessible	Simply accessible
8	Examples	Lancashire boiler, Locomotive boiler	Babcock Wilcox boiler, Striling boiler

Question

Learning Outcome

- Boilers

THANK YOU

