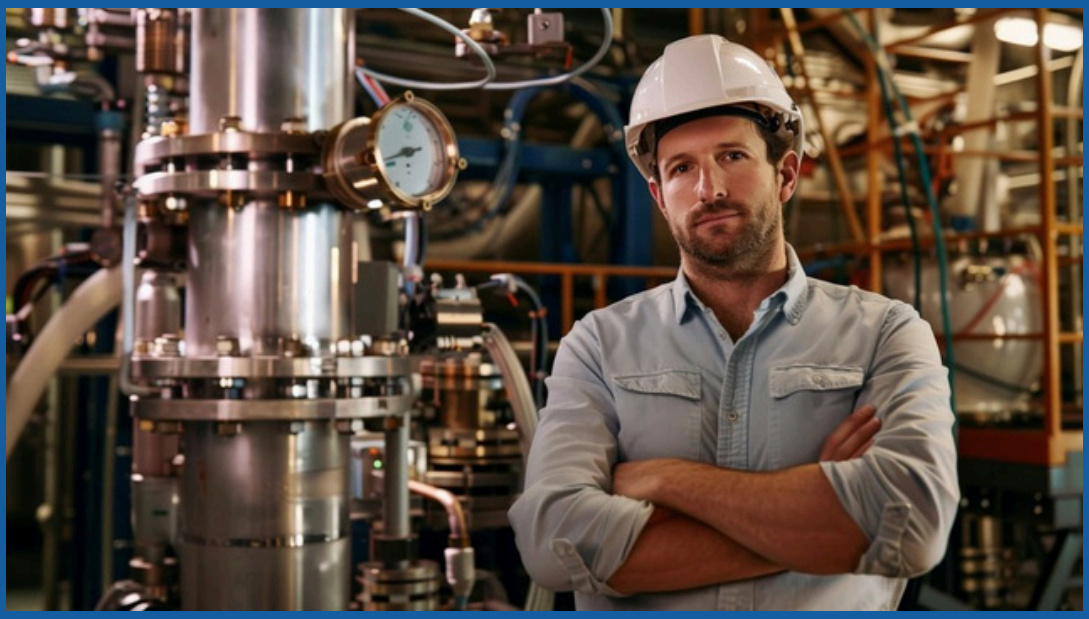
Study Material For Boiler Operation Engineer (BOE) Exams



Theory, Numerical Problems, MCQs and Boiler Drawing Problems from BOE Exams

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CON 1072

EXAMINATION BOARD OF BOILERS

(MAHARASHTRA STATE)

(Under The Boiler Operation Engineer's Rule, 2011)

Boiler Technology - I

23rd February 2019

[TIME : 10-00 A.M. TO 1-00 P.M.]

(MAX. MARKS — 100)

Notes.—(1) Question paper is divided into *two* sections.

(2) Section-I is *compulsory.*

(3) Answer any *four* questions from section-II.

(4) Answer should be brief and to the point.

(5) All Answers of one question should be at one place only.

Section I **Marks**

1. (*a*) Choose right answer :— 10

(*i*) Following part is not included in Boiler accessories ..... .

(*a*) ESP

(*b*) Economiser

(*c*) Chimney

(*d*) Air pre-heater.

(*ii*) The following are the water tube boilers except ..... .

(*a*) Stirling

(*b*) Lancashire

(*c*) Yarrow

(*d*) Babcock and Wilcox.

(*iii*) ..... is generally placed after the economizer.

(*a*) Air pre-heater

(*b*) Superheater

(*c*) Evaporator

(*d*) None of the above.

(*iv*) An economiser in a boiler ..... .

(*a*) Increases steam pressure

(*b*) Increases steam temp

(*c*) Decreases fuel consumption

(*d*) Decreases steam pressure.

Marks

(*v*) Size of boiler tubes is specified by ..... .

(*a*) Mean diameter and thickness

(*b*) Inside diameter and thickness

(*c*) Outside diameter and thickness

(*d*) Outside diameter and inside diameter.

(*vi*) The number of fire tubes in Lancashire boiler is ..... .

(*a*) Zero

(*b*) One

(*c*) Two

(*d*) Four.

(*vii*) The biggest loss in the boiler is ..... .

(*a*) Moisture in fuel

(*b*) Dry flue gases

(*c*) Steam formation

(*d*) Unburnt carbon.

(*viii*) Which of the following can be measured by 'Bolometer' ?

(*a*) Thermal radiations

(*b*) Electrical signals

(*c*) Optical inputs

(*d*) Temperature inputs.

(*ix*) 'M' Alkalinity represents ..... .

(*a*) Total alkalinity

(*b*) Partial alkalinity

(*c*) Total hardness

(*d*) None of the above.

(*x*) Which loss is not considered while evaluating boiler efficiency by "Indirect Method" ?

(*a*) Blow down Loss

(*b*) Un-burnt loss

(*c*) Air infiltration loss

(*d*) Stack Temp loss.

Marks

(*b*) Explain following terms :— 10

(*i*) Difference between three element and single element FW control system.

(*ii*) Difference between Safety valve and Relief valve.

(*iii*) Difference between RAV (Rotary air lock valve) and PKGV (Pneumatic knife gate valve).

(*iv*) Difference between Feed Water heater and Economiser.

(*v*) Explain Soot Blowers with list out its type.

Section II

2. (*a*) What is calorifiers and list out industries where it is mostly used ? 5

(*b*) What is LMTD? What is the importance of LMTD in heat exchanger ? What is unit of LMTD? 5

(*c*) What is difference between granulator and impact type coal crusher ? 5

(*d*) Feed water is provided to a boiler at 70° C from the feed water tank. The temperature of Condensate water returning to the tank is 86° C, temperature of makeup water is 27° C. Determine the amount of condensate water that can be recovered. What precaution to be taken before taking the condensate to Boiler ? 5

3. (*a*) What is Stiochometric Air fuel ratio? Calculate Stiochometric Air fuel ratio of Ethylene (C_2H_4). 4

(*b*) What is dearator and write down type of dearator ? Sketch direct contact dearator and write down function of each parts. 5

(*c*) What is meant by priming and foaming ? 5

(*d*) Work out cost benefit analysis for Coal V/s Natural gas. 6

Boiler operating Pressure (Sat) is 25kg/cm2 and FW temp is 105°C

Coal Fired Boiler Details :

Efficiency of Coal Fired Boiler =75%

S/F ratio = 5.6

Landed Cost of Coal = Rs. 4500/MT

Power consumption for Coal Preparation = 2.85 kWh/MT

Auxiliary power consumption = 15kWh/MT

Chemical cost = Rs 3.2/MT

Efficiency of Natural Gas (NG) Fired Boiler =90%

Cost of NG = Rs 900/Mmbtu

GCV of NG = 9500 Kcal/SCM

1 Mmbtu = 25.2 SCM

Auxiliary Power consumption =4kWh/MT

Chemical cost = Rs 3.2/MT

Marks

4. (*a*) Describe chemical cleaning of boiler. 5

(*b*) What is soot blowing ? Write down its type. Why it is needed in Boiler ? 5

(*c*) What is mechanism of corrosion embrittlement ? 5

(*d*) A boiler plant has ESP of 99% Efficiency and flue gas scrubber for removal of sulphur dioxide with 80 % Efficiency. It operates at efficiency of 85 % at full load. In which bottom ash share is 20%, calculate the sulphur dioxide and particulate emission through the stack per day ? 5

CV of coal = 4000 Kcal/kg

Steam consumption = 480Kg/Min

Working pressure = 45Kg/Cm2

FW Temp =105°C.

5. (*a*) What is draught ? Describe type of draught system used in Boiler. Which draught system is less power consuming? 4

(*b*) What is steam condenser? Write the main type of Steam condenser. Describe Surface condenser. 5

(*c*) What is attemprator and draw a sketch of its flow diagram. Why its necessary in high pressure super heated Steam generating Boiler ? 5

(*d*) Following reading are taken during the test on a Boiler for One Hour : 6

Steam generated = 8000Kg

Coal burnt = 800 Kg

CV of coal = 5600 Kcal/Kg

Dryness fraction of steam entering the Super Heater = 0.92

Rated Pressure of Boiler = 25 Kg/CM2

Temp of Steam leaving SH = 310° C

Determine—

(*i*) Equivalent of evaporation per kg of fuel with and without Super heater.

(*ii*) Thermal efficiency of Boiler without Super heater and with Super heater.

(*iii*) Amount of heat supplied by Super heater per Hour.

6. Write short notes on following :—

(*a*) Volatile matter of coal 5

(*b*) Drum Internals 5

(*c*) Electric Boiler 5

(*d*) Safety interlocks of Coal Fired Boiler or Oil Fired Boiler. 5

CON 1073

EXAMINATION BOARD OF BOILERS

(MAHARASHTRA STATE)

(Under The Boiler Operation Engineer's Rule, 2011)

Boiler Technology-II

23rd February 2019

[TIME : 02-30 P.M. TO 05-30 P.M.]

(MAX. MARKS — 100)

Notes.— (1) Attempt *Five* questions.
(2) Question No.1 is *compulsory.*
(3) Answers in brief and to the point will attract more marks.
(4) Draw neat sketches wherever necessary.

Marks

1. (*a*) State whether the following statements are *True* or *False.*— 10

(*i*) The smallest size of the coal (less than 75 micron) is required in pressurized fluidized bed combustion boiler for firing.

(*ii*) The Major axis of elliptical manholes on the shell should be provided circumferentially.

(*iii*) Fusible plug for boilers is made of fusible metal containing tin, lead and copper.

(*iv*) Boiler stays are used to prevent flat surfaces from tearing apart.

(*v*) Vacuum efficiency of a condenser would be 100 % if the condenser is of surface type and temperature of condensate falls below saturation temperature.

(*vi*) A vessel having vacuum of 60 cm of Hg will have absolute pressure equal to 160 mm of Hg when barometer reads 750 mm of Hg.

(*vii*) Abrasiveness index gives idea about hardness of coal and caking index is a measure of binding property of coal.

(*viii*) Junker's calorimeter is used to determine calorific value of liquid fuel and also gaseous fuels.

(*ix*) 1 kg of CO needs 1.57 kg of O_2 and produces 2.57 CO_2.

(*x*) On the basis of boiler pressure, medium pressure boiler is operated in between 10.54 to 15.5 kg/cm^2.

Marks

(*b*) Define the following terms .— 5

(*i*) pH and conductivity of boiler feed water.

(*ii*) Boiler circulation ratio and mention its value for natural circulation.

(*iii*) 'Steam pipe' as per The Boiler Act, 1923.

(*iv*) Sp. Heat at constant volume.

(*v*) Volatile matter in coal.

(*c*) Fill in the gaps and complete the chemical equation connected to combustion. 5

(*i*) Hydrogen reacts with oxygen produces ..... and release heat ..... kCal / kg.

(*ii*) Carbon reacts with Oxygen produces ..... and release heat ..... kCal / kg.

(*iii*) Carbon monoxide reacts oxygen produces ..... and release heat ..... kCal / kg.

(*iv*) Sulphur reacts with oxygen produces ..... and release heat ..... kCal/kg.

(*v*) Methane reacts with oxygen produces ..... and release heat ..... kCal/kg.

2. (*a*) What are the basic elements of consideration in design of boiler drum ? 4

(*b*) What do you understand the term furnace explosion ? Describe reasons for furnace explosion and give the safety precautions needed to prevent furnace explosions. 5

(*c*) What are the reasons for abnormally high superheated steam temperature with constant load ? 5

(*d*) Estimate steam flow rate in Tons / hr and pressure in kg / cm^2 with following parameters— 6

- Diameter of steam pipe : 200 mm.
- Length of steam line : 150 m.
- Steam pressure 20 kg/cm^2(g) and temp. 380° C.
- Velocity is measured and found : 20 m /sec.
- Assume frictional factor 0.005.
- Pressure drop of 90° bend is 3.8 m / bend.
- No. of bends in line 2 Nos.

Marks

3. (*a*) Write down material of construction (MOC) of steam boiler components as below, suitable for max design pressure 17.5 kg / cm^2 (g) with oil fired or coal or gas fired boilers. 4

- Boiler steam drum
- Economiser coil
- Steam header
- Smoke tube and MPA tubes.

(*b*) What fundamental steps are involved in the electrostatic precipitation of particulate solids ? What factors affect dust removal by an ESP ? 5

(*c*) Describe between steam boiler and steam generator and also externally and internally fired boiler furnace ? 5

(*d*) Calculate SO_2 emission in Tons /annum of height of chimney 90 m which is suitable for coal fired and FO fired boilers. Data is given as follows— 6

- No. boilers connected to chimney : 2 Nos. (one No. boiler with coal another boiler with FO).
- Sulphur content in coal and FO : 1.2 and 3.5 % respectively
- Coal consumption : 40 Tons /day
- Furnace oil (FO) consumption : 10 Tons /day.
- Running hrs. of each boilers : 8160 hrs.

4. (*a*) What do you understand by the term ' Turn down ratio of oil burner ' ? On which factors the rate of combustion of liquid fuel droplet depend ? 4

(*b*) Explain with a neat sketch Pulverised coal firing unit system and state its advantages. 5

(*c*) Describe the procedure for replacing a fire tube or set of tubes in a boiler and list out tools used for removing and replacing the tubes. 5

(*d*) The safety valve of a boiler is set at 46 kg/cm^2. During testing , it is found valve lifts at 50 kg/cm^2 and reset at 43 kg /cm^2. 6

Calculate— (*i*) Over pressure in % (*ii*) % Blow down.

5. (*a*) What are the factors needs to be considered for suitable fabric for bag filters ? 4

(b) What are the types of stoker firing ? State merits and demerits of stoker firing. 5

(*c*) Explain with a neat sketch of La Mont high pressure boiler. 5

(*d*) Calculate fuel and money saved if 40 Tons of condensate at 95°C is recycled back to boiler deaerator instead of feeding cold feed water at 30°C. Boiler uses furnace oil as a fuel having net calorific value of 9650 kCal /kg and cost of Furnace oil is Rs.38 /kg. Boiler efficiency reported is 88 % on NCV basis. This calculated saving is based on heat recovery only. What will be additional saving available on the account of other points ? Assume sp. Heat of water : 1 kCal /kg°C. 6

Marks

6. Write short notes on (any *four*).—

(*a*) Different Method of superheater temperature control. 5

(*b*) Types of boiler furnaces used in Bagasse fired boilers in sugar industry. 5

(*c*) Coal benefication. 5

(*d*) Types of Thermostatic steam traps , its merits and limitations. 5

(*e*) Classification of gaseous fuel. 5

CON 1074

EXAMINATION BOARD OF BOILERS

(MAHARASHTRA STATE)

(Under The Boiler Operation Engineer's Rules, 2011)

Engineering Drawing

24th February 2019

[TIME : 10-00 A.M. TO 1-00 P.M.]

(MAX. MARKS — 100)

Notes.—(1) Attempt *five* questions.

(2) Answer each next main question on a new page.

(3) Answer in brief and to the point attract more marks.

(4) Assume suitable data, if necessary.

Marks

1. Draw Proportionate neat freehand sketches of following :—

   (*a*) Eye foundation bolt. 5

   (*b*) Hexagonal headed nut and bolt with washer having following dimension. 5

   Diameter - 24mm Length - 100mm

   (*c*) Draw Double riveted zigzag lap joint. 5

   (*d*) Draw freehand sketches of rolled steel sections of the following :— 5

   (*i*) Angle (*ii*) Tee (*iii*) Channel (*iv*) H section.

2. Draw the following (Any *two*) :—

   (*a*) Draw symbols for the following :— 10

   (*i*) Relief valve

   (*ii*) Steam trap

   (*iii*) Gate valve

   (*iv*) Flow orifice

   (*v*) Y type strainer.

   (*b*) Draw neat sketch of Mobrey Level control showing all its components. 10

   (*c*) Draw neat sketch of Swing check valve. 10

3. Draw the following (Any *two*) :—

   (*a*) Draw neat sketches of the following :— 10

   (*i*) With worth thread

   (*ii*) British association thread

   (*iii*) Square thread

   (*iv*) Knuckle thread.

   (*b*) Draw the symbols for the following weld joints :— 10

   (*i*) Single U butt (*ii*) Plug Weld

   (*iii*) Single bevel butt (*iv*) Fillet

   (*v*) Spot.

   (*c*) Draw neat sketches of Thermodynamic Steam Trap. 10

Marks

4. (*a*) Draw neat sketch of gauge glass, showing its internals. 10

   (*b*) Draw single volute and double volute casing for centrifugal pump. 10

5. Draw isometric view of the casting shown in fig. 1. 20

6. Draw sectional orthographic in first angle of the object shown in fig. 2. 20

   (*a*) Sectional front view (*b*) Top view (*c*) Left hand side view.

Fig 1

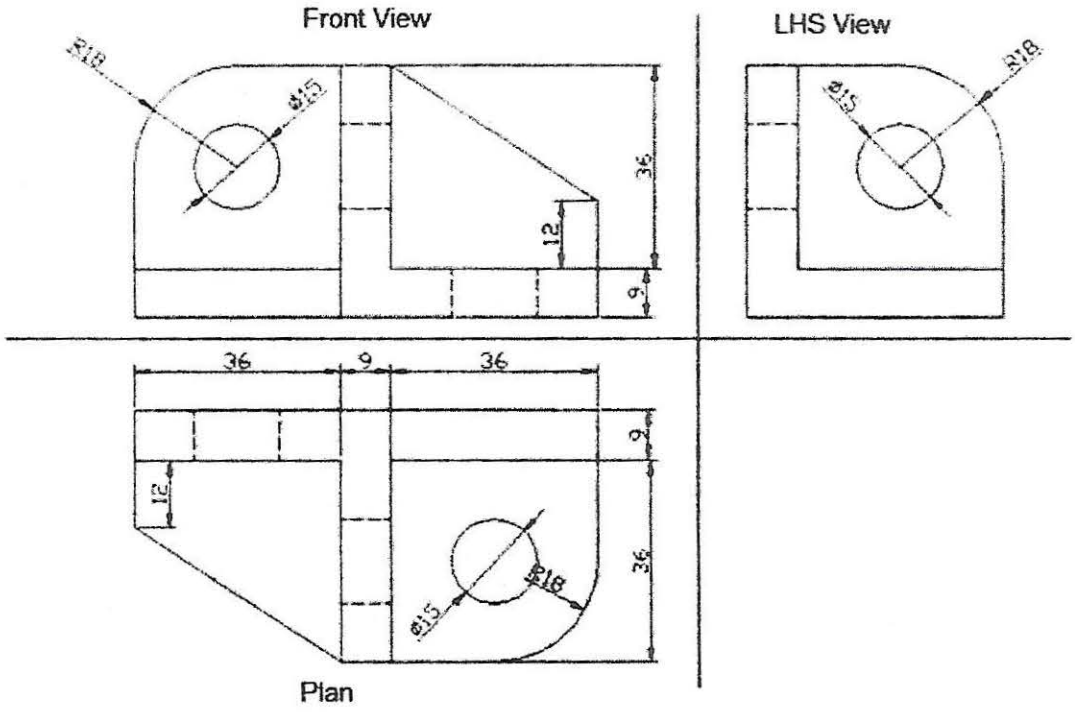

Fig 2

