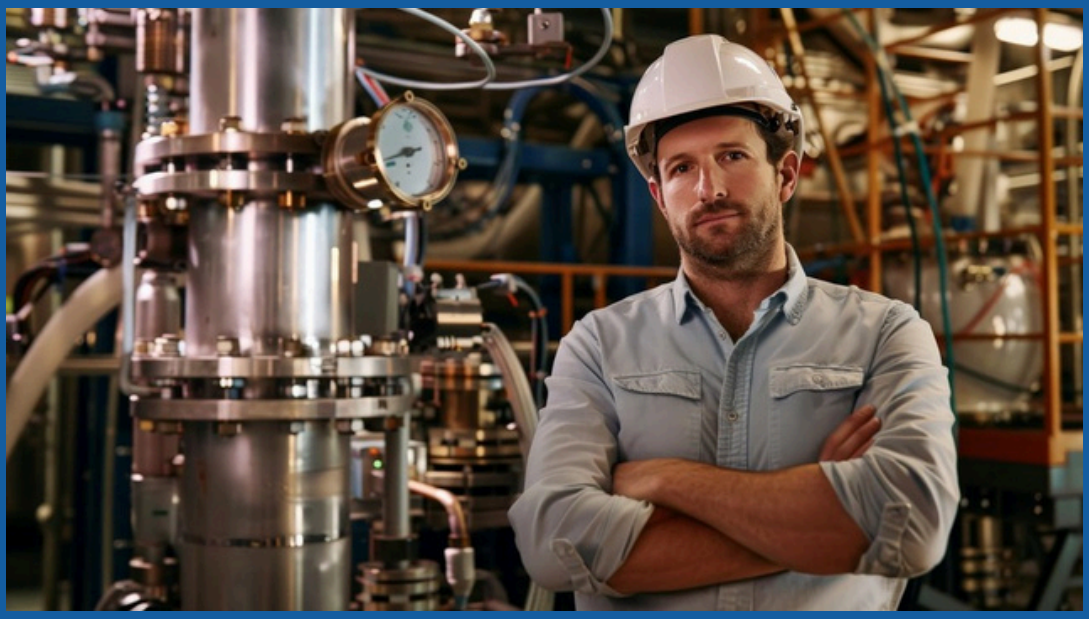
Study Material For Boiler Operation Engineer (BOE) Exams



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

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GUJARAT BOILER EXAMINATION BOARD
BOILER OPERATION ENGINEER EXAM – 2017
PAPER -1
Section B

Date: 07/10/2017 Time: 10:30 AM to 01:00 PM

Day: Saturday Marks: 70

Instruction:

1) Attempt all questions.
2) Wherever necessary draw neat sketch
3) Write new question on new page.

Q – 2 Attempt any One.....Marks (20)

1. **Calculate the efficiency of the Atmospheric Fluidised Bed Combustion Boiler by indirect method using the following data:**

Analysis of blended coal (% by mass)

Carbon	:	**53.9 %**
Hydrogen	:	**3.1 %**
Nitrogen	:	**1.1 %**
Sulphur	:	**0.3 %**
Ash	:	**23.8 %**
Oxygen	:	**10.5 %**
Moisture	:	**7.3 %**
GCV	:	**5060 kCal / kg**

The boiler operating parameters are given below.

Steam pressure	:	**62.0 kg / cm2g**
Steam temperature	:	**470 deg.C**
Actual air supplied	:	**8.91 kg/kg of coal**
Mass of dry flue gas	:	**9.31 kg/kg of coal**
Specific heat of flue gas	:	**0.23 kCal/kg deg.C**
Flue gas temperature	:	**160 deg.C**
CO2 in flue gas	:	**14.7 %**

CO in flue gas	:	325 ppm
GCV of bottom ash	:	800 kCal/kg
GCV of fly ash	:	452.5 kCal/kg
Ratio of bottom ash to fly ash	:	15 : 85
Ambient temperature	:	32.4 deg.C
Loss due to hydrogen in fuel	:	3.54 %
Loss due to moisture in fuel	:	0.93 %
Loss due to moisture in air	:	0.2 %
Surface heat losses (as assessed)	:	2 %

2. A chimney 30 meter high deals with flue gases at 288 ^{o}C, when the outside air temperature is 21° C. The air supplied for combustion is 18 kg/kg of coal burnt.

Calculate:

a) The draught in mm of water column produced by the chimney.
b) The draught produced in terms of height of column of hot gases in meters,
c) The velocity of flue gases in the chimney, if 50% of the draught is lost in friction at the grate an passages and
d) The draught produced in mm of water and the temperature of flue gases under the condition of maximum discharge.

Q – 3 Attempt any Five.....Marks (25)

1. For combustion of 500 lit/hr of furnace oil, estimate combustion air quantity per hour with 20% excess air. Specific gravity of furnace oil is 0.95 kg/litre
(Fuel analysis: C - 84%, H2 -12%, S - 3% O2 - 1%)

2. Feed water is provided to a boiler from the feed water tank at 60 deg.C, temperature of condensate water returning to the tank is 80 deg.C, and temperature of makeup water is 27 deg.C. What is the amount of condensate recovered?

3. A steam pipe of 100mm diameter is insulated with mineral wool. As a part of energy saving measure, the insulation is upgraded with efficient Calcium silicate insulation. Calculate the percentage reduction in heat loss due to above measure with the following data,

Boiler efficiency : 80%
Surface temperature with mineral wool : 95°C
Surface temperature with calcium silicate : 55°C
Ambient temperature : 25°C

4. Calculate the blow down rate for a boiler with an evaporation rate of 5 tons/hr, if the maximum permissible TDS in boiler water is 3000 ppm and with 18 % make up water addition. The feed water TDS is around 400 ppm.

5. A cogeneration plant has an electrical output of 5 MW with a back pressure turbine which has a input steam conditions to the turbine as 32 TPH with Enthalpy of 3418 KJ/kg @ 64 ata and 500 deg C and the exit conditions of steam at the end of the back pressure turbine is 186deg C, with enthalpy of 2835.8 KJ/kg. After the process heating, all the condensate @ 73 deg C returns to the boiler. Calculate the Heat to power Ratio and Energy Utilization factor of the process. Fuel consumption of the boiler is 8.2 TPH Coal at 4800 Kcal /Kg GCV.

6. For a boiler which produces 15000 kg of steam per hour at 20 bar from feed water at 40°C and the fuel consumption is 1650 kg/hr. Determine the condition of steam produced.

7. A vacuum of 722 mm of Mercury was obtained with a barometer reading 756 mm of Mercury. Correct the vacuum to a standard barometer of 760 mm of Mercury

8. One kilogram of steam at a pressure of 7 bar and 0.7 dry is heated at constant pressure until it becomes dry saturated. How much heat is added? What is the change in internal energy? If the process is continued until the final temperature is 200°C, how many kJ are required to be added? Take Kp for superheated steam as 2.1 kJ/KgK.

Q – 4 Attempt any One.....Marks (5)

1. A pump is delivering 40 m3/hr of water with a discharge pressure of 29 meter. The water is drawn from a sump where water level is 6 meter below the pump centerline. The power drawn by the motor is 7.5 kW at 89% motor efficiency. Find out the pump efficiency.

2. Find out the pressure drop occurred in 500 meters length of steam pipelines. The bore of the pipe is 250 mm in horizontal piping. Saturated steam velocity is 20 m/s and friction factor is 0.005. How much pressure drop will be reduced if pipe dia has increased from 250 mm to 350 mm.

Q - 5 The following data was obtained during trial of water tube boiler, steam pressure 15 Bar, degree of superheat 71.1^{o}C, temperature of feed water 96 ^{o}C, water evaporate 3223kg/hr, Coal fired 417.3 kg/hr, ash 43.3 kg/hr, percentage of combustible in ash 9.68, moisture in coal 4.42%, heat value of one kg of dry coal 30800 KJ/kg (Marks : 20)

Determine: a) the efficiency of boiler plant including super heater, and

b) the efficiency of boiler and furnace combined. Take kp of superheated steam 2.1 KJ/kg K.

GUJARAT BOILER EXAMINATION BOARD

Boiler Operation Engineer Exam -2017

Paper –II

Date: - 07/10/2017

Day: - Saturday

Time: - 02.30PM to 05.30PM

Time Duration: - 2hrs.30Min.

Section –II

Marks: - 70

Instructions:-

1. **Attempt all questions.**
2. **Draw Sketch where ever required.**
3. **Marks for each question indicated on right side.**
4. **All answers of one question should be at one place.**

Q. 2 Answer the following questions. (Any Four) 20 Marks

1) Write stepwise procedure for starting erection of new boiler. What kind of loads to be considered for boiler civil foundations and what precautions to be taken during civil foundations of boilers, fan and BFP.
2) Explain method for monitoring and control of boiler water level, furnace draft, combustion control and air control by automation.
3) Describe primary, secondary and tertiary air used in boiler combustion.
4) List out various materials specification in boiler components and piping for medium and high pressure and temperature boiler,
5) What is Smurt? What is the cause of its emission? How Smurt emission could be prevented?

Q.3 Answer the following Questions (Any Four) 20 Marks

1) What is volatile matter in coal and How it is determined? How much % of volatile matter available in coal and its effect in combustion.
2) What are the causes of silica slippage from a mixed bed?
3) What steps to be taken by you in case of abnormal condition of Heavy noise noticed from furnance?
4) What steps to be taken by you in case of abnormal condition of Boiler back fire?
5) What is positive circulation? What do you mean by circulation ratio and list out advantage of positive circulation?

Q.4 Answer the following Questions. (Any Four) 20 Marks

1) Discuss the effect of flue gas recirculation
2) Super heater
3) PRDS
4) What is stream trap? List out various types of steam trap and explain inverted bucket steam trap with neat sketch
5) What are the advantaged of thermal spray coating?

Q.5 Answer the following Questions. (Any Two) 10 Marks

1) Air pre-heater and re-heater.
2) Difference between deaeration and deoxygenation
3) What is vanadium corrosion? Where it can attack and how it can be reduce?

----------END OF SECTION TWO----------

Candidate Exam. Seat No._____

GUJARAT BOILER EXAMINATION BOARD
BOILER OPERATION ENGINEER EXAMINATION-2017
Paper-3 (Drawing) Section-B Date: 08-10-2017 Time: 10.30 AM to 2.00 P.M

Instructions: 1. Attempt all questions.
2. Figures to the right indicate full marks.
3. Make suitable assumptions if needed and justify.
4. Dimensions are in mm or otherwise specify.

Q.2 (a) Draw sectional view for the 2:1 elliptical dished end with following dimensions. Take scale of 1:20. **[15]**

OD: 4000 mm, Straight Face (SF) : 100 mm, Thickness: 40 mm, Outside height without SF: 1000 mm.

(b) Draw the torrispherical dished end for following dimensions. **[15]**

Use scale of 1:1.

OD: 200 mm, Thickness: 20 mm, Knuckle Radius: 30 mm,

Crown Radius: 160 mm and SF: 20 mm



[50]

Q.3 Write **Any Five** of the followings.

(a) Draw elevation and side view with standard dimensions the slip-on flange (as per Table-H) for carbon steel pipe of Nominal bore 50 mm and following details. Use scale of 1:1.

PCD = 125 mm Bolt hole dia. = 16 mm, Flange O.D.= 162 mm,

Flange thickness= 20 mm.

(b) Draw dimensionally proportionate sectional side view of the high pressure boiler drum internal assembly showing major components like feed pipes, down comer inlet, manifold baffle plates, primary cyclone separators, scrubber elements etc.

(c) Draw the standard steel butt welding Equal Tee for following dimensions as per IBR. Take scale of 1:1.

Nominal Diameter : 50 mm, External Diameter: 60.3 mm. Distance of centre to end run: 64 mm.

(d) Draw the dimensionally proportionate Hexagonal headed bolt for M20×1.5×48 with half length threaded.

(e) Draw the swaged end tube with following dimensions.
Total length of pipe: 700 mm, Tube size:53.5 mm ID×5 mm thk,
Swaged size : 48 mm ID×4.5 mm thk×150 mm long.

(f) Draw the line diagram in sectional elevation of the deaerator with different connections and mountings and internal components.

(g) Draw the sketch of mixed bed ion exchange unit with internal arrangements and necessary connections.

(h) Draw the line diagram of typical PRV station with all necessary components and flow directions. Take inlet pipe size of 100 mm, inlet and outlet pressure of 14 bar and 3.5 bar respectively. Also state the approximate dimensions/sizes of various components.

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