

EXAMINATION BOARD OF BOILERS**(MAHARASHTRA STATE)**

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

Boiler Technology - I

28th September 2013

(TIME : 10-00 A.M. to 1-00 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 a neat sketches wherever necessary.

Marks

1. (a) Choose the correct options and complete the following statements :— 10
- (i) A bimetallic strip is used in which of the following traps
 (a) Inverted bucket (b) Thermostatic
 (c) Float trap (d) Thermodynamic.
- (ii) Main advantage of waste heat recovery in industry is
 (a) Reduction in pollution (b) Increase in efficiency
 (c) Both a and b (d) None of the above.
- (iii) The presence of calcium and magnesium bicarbonates in water to steam boiler would form
 (a) Neutral solution (b) Acidic solution
 (c) Alkaline solution (d) None of the above.
- (iv) How many kg. of CO_2 are produced in complete combustion of 16 kg. of methane
 (a) 42 (b) 44
 (c) 16 (d) None of the above.
- (v) The difference between mean solid velocity and gas velocity in FBC boiler is called
 (a) Settling velocity (b) Fluidisation
 (c) Slip velocity (d) None of the above.
- (vi) For complete combustion of every kg. of FO firing, the approx. Theoretical quantity of air required is
 (a) 18 (b) 14
 (c) 10 (d) 20.
- (vii) Increase of steam pressure has the following effects on steam
 (a) Steam temp. goes up and enthalpy of evaporation goes down
 (b) Specific volume goes down and enthalpy of evaporation goes up
 (c) Steam temp. goes up and enthalpy of evaporation goes up
 (d) Steam temp. and enthalpy of evaporation go down.
- (viii) Which of the refractories has the highest melting point temperature?
 (a) Lime (b) Titania
 (c) Alumina (d) Silica.

[Turn over

- (ix) Steam at $6 \text{ kg./cm.}^2(\text{ab})$ has a sensible heat of 159 kCal/kg. and latent heat of 498.5 KCal/kg. if steam is 95% dry than the total enthalpy is—
- (a) 625 kCal/kg. (b) 650 kCal/kg.
 (c) 553 kCal/kg. (d) 633 kCal/kg.
- (x) The unit of specific heat is—
- (a) kCal/kg. (b) $\text{kCal/kg.}^\circ\text{C}$
 (c) kCal/m^3 (d) $\text{kCal/m}^2^\circ\text{C.}$
- (b) Explain the terms :— 10
- (i) Blow down of safety valve
 (ii) Boiler feed water TDS
 (iii) Turndown ratio for oil fired burner
 (iv) pH and conductivity of DM water
 (v) Grindability index of coal.
2. (a) What do you understand by the term 'steam trap' List the items which are normally fitted before and after steam trap in a installation? 4
- (b) What do you understand by the term ' supercritical boiler' and What are the sailent features of supercritical boiler? 5
- (c) What are the important guidelines for proper drainage and layout of steam lines ? 5
- (d) A vertical oil tank of cylindrical shape has radius 0.5 m and height 0.9m . Find the capacity of the cylindrical tank in litres. If tank is having 6mm thick, calculate outer surface area of tank. Assume top of tank is open to atmosphere and bottom is closed. 6
3. (a) Explain advantages and disadvantages of boiler effeciency calculations by direct method. 4
- (b) What is needed for combustion ? What are the various types of combustion ? 5
- (c) What do you understand by term 'Cogeneration' list out important technical parameters to be considered in a congeneration system? 5
- (d) Steam with a dryness fraction of 0.9 at $8 \text{ kg./cm.}^2(\text{ab})$ passes through a reducing valve to a pressure of $3\text{kg./cm.}^2(\text{ab})$. What is the dryness fraction of the steam at downstream of the valve ? 6
4. (a) Draw a neat sketch of balanced draught system. Write limitations of natural draught. 5
- (b) What are the different methods to control superheat temperature of steam ? 5
- (c) What are the principle heat losses that occur in a boiler and list out the data required for calculation of boiler efficiency using indirect method ? 6
- (d) A boiler drum of total weight 23500 kg. is supported by four ropes. Find the diameter of ropes if allowable stress for rope meterial is 800 kg./cm.^2 . 4

5. (a) What are the various methods available to control the excess air in a boiler? 4
- (b) What are the factors involved in selecting a lagging materials? 4
- (c) List out the main components of thermal deaerators and explain the importance of U seal connected to thermal deaerator. 4
- (d) Calculate quantity of heat available without economiser and fuel oil savings by providing an economiser for a boiler. The performance data of the boiler are given as below :— 8
- Avg. quantity of steam generated : 5 T/hr.
 - Avg. flue gas temp. : 315°C (without economiser)
 - Avg. steam generation/kg. of fuel oil : 14 kg.
 - Ambient temperature : 40°C
 - Fuel oil supply quantity : 314 kg./hr.
 - Fuel gas quantity : 17.4 kg/kg. of fuel
 - Sp. Heat of fuel : 0.23 kCal/kg.°C
 - GCV of fuel oil : 10000 kg./hr.
 - Rise in feed water temp. by providing economiser. : 26°C
 - Annual operating hrs. : 8600
6. Write short notes on (any four) :—
- (a) Energy conservation opportunities in steam system 5
 - (b) Methods to improve bagasse fired water tube boiler efficiency 5
 - (c) Sources and effects of air leakage into a steam condenser 5
 - (d) Boiler Do's and Don'ts 5
 - (e) Basic factors consideration in selection of boilers. 5

EXAMINATION BOARD OF BOILERS
(MAHARASHTRA STATE)

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

Boiler Technology - 2

28th September 2013

(TIME : 2-00 P.M. to 5-00 P.M.)

(MAX. MARKS : 100)

Notes.—(1) Attempt any *Five* questions.

(2) Question No. 1 is *compulsory*.

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

(4) Draw a neat sketches wherever necessary.

Marks

1. (A) State whether the following statements are *True* or *False*. :— 10
- (a) The percentage radiation loss from a boiler will decrease with increased loading.
 - (b) Pitot tube instrument used for the measurement of specific gravity of liquid fuels.
 - (c) % requirement of excess air for efficient combustion coal is less than that of natural gas.
 - (d) The problem of water hammer can be eliminated by positioning the pipe so that there is a continuous slope in the direction of flow.
 - (e) Latent heat at the critical point of steam phase diagram is 540 kCal/kg.
 - (f) In an oil fired burner, the excess air level increases towards the highest turndown ratio for efficient combustion.
 - (g) Excess air can be derived by measuring % of N_2 in the flue gas.
 - (h) Maximum continuous rating (MCR) of a boiler is the maximum evaporation rate that can be sustained for 16 hrs.
 - (i) 1 kg of carbon requires 2.67 kg. of oxygen and produces 3.67 kg. CO_2 .
 - (j) The injector is a simple appliance used to deliver feed water into the boiler using combustion air from FD fan.
- (B) Write long form of the following :— 5
- (a) MEDA (b) LDO
 - (c) PCRA (d) ASTM
 - (e) MSDS.
- (C) Write your comments, if following conditions were observed in flue gases than normal limits :— 5
- (a) CO_2 % increase
 - (b) O_2 % increase
 - (c) CO ppm increase
 - (d) CO_2 % increase.

[Turn over

2. (A) Explain the restrictions for the use of a boiler as per Indian Boiler Act, 1923 and its latest amendments. 4
- (B) What are the importance of steam test, open inspection and hydraulic test of boiler. 6
- (C) List out various benefits of condensate recovery systems. 4
- (D) Estimate SO_2 emission through chimney in Tons/annum. Data as follows :— 6
- Days considered : 340
- Fuel used : Furnace Oil
- Sp. Gravity : 0.94
- Sulphur content : 3.8 %
- Qty. of FO consumption : 3.5 KL/hr
- and If measured O_2 in flue gas is 2.5 %, Find % excess air level.
3. (A) Define boiler and steam pipe as per Indian Boiler Act, 1923. 4
- (B) What are the major changes are required to convert an existing oil fired boiler to FBC system. 6
- (C) State merits and demerits of stoker firing over pulverised fuel firing system. 4
- (D) During an air pollution monitoring study, the inlet gas stream to a bag filter was $150000 \text{ m}^3/\text{hr}$. The outlet stream from the bag filter was a little bit higher at $160000 \text{ m}^3/\text{hr}$. Dust load at the inlet was $7 \text{ gm}/\text{m}^3$ and at the outlet $0.2 \text{ gm}/\text{m}^3$. How much dust in kg/hr. was collected in the bag filter bin. 6
4. (A) What are the advantages and disadvantages of electrostatic precipitator. 4
- (B) State comparison between steam and sonic soot blowing system. 6
- (C) What actions is necessary when a tube suddenly leaks during boiler operation. 4
- (D) Calculate height of chimney to produce a draught of 16 mm. of water column when the temp. of the flue gases in the chimney is 317°C and boiler room temp. is 38°C and supply quantity of air is 18 kg. per kg. of fuel. 6
5. (A) Why boiler blow down is required and what are the advantages of automatic blow down system used for boilers. 4
- (B) Explain following terms :— 6
- (a) Priming (b) Foaming
- (c) Carryover.
- (C) Explaining periodical boiler cleaning schedule (fire and water side) w.r.t. bagasse or coal or oil. 4
- (D) Efficiency of a 110 TPH, $80 \text{ kg}/\text{cm}^2$ (ab), 520°C . boiler is 81 % Calculate quantity of coal required per hr., if feed water inlet temperature is 125°C . Make up water is almost nil. GCV of coal used is $3650 \text{ kCal}/\text{kg}$. Calculate evaporation ratio of the boiler. 6

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

- (a) Classification of boiler tube failures
 - (b) Types of deaerator
 - (c) Drum internals
 - (d) Care of chimney
 - (e) Off season maintenance of bagasse fired boiler in suger mill.
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EXAMINATION BOARD OF BOILERS**(MAHARASHTRA STATE)****(Under The Boiler Operation Engineer's Rule, 2011)****Engineering Drawing**

29th September 2013

(TIME : 10-00 A.M. to 1-00 P.M.)

(MAX. MARKS : 100)

Notes.—(1) Attempt any *Five* questions.(2) Figures to the right indicates *full* marks

- | | Marks |
|--|-------------------------|
| 1. (a) Draw proportionate free hand sketches of the following (any two) :— | 10 |
| (i) Hexagonal headed bolt : Diameter = 10 mm. L = 50 mm | |
| (ii) Single riveted lap joint | |
| (iii) Flanged Coupling. | |
| (b) Draw a symbol of the following :— | 10 |
| (i) Spot weld | (ii) Square butt weld |
| (iii) Fillet weld | (iv) Single V butt weld |
| (v) First angle projection method. | |
| 2. Shown in Fig. No. 1 — | |
| Draw a following views by first angle method of projection :— | |
| (a) Sectional elevation alongwith the direction of arrow X and section along AA. | 8 |
| (b) Plan. | 5 |
| (c) Side view along the direction of arrow Y. | 5 |
| (d) Give all dimensions. | 2 |
| 3. Draw a neat sketch of main stop valve (Junction valve) and identify the different components and write in tabulated form. | 20 |
| 4. Draw a neat proportional sketches and name all parts of following (any two) :— | 20 |
| (a) Lift type non return valve | |
| (b) Steam pressure reducing station | |
| (c) Inverted bucket traps | |
| 5. Fig. No. 2 shows Front View and Side View of an object. | 15 |
| Draw an isometric projection taking origin at 'O' and give all dimensions. | 5 |
| 6. Draw a flow diagram of Coal based Power plant showing all equipments incorporated in between. | 20 |

OR

Draw a flow diagram of Bagasse handling from Bagasse storage to boiler and flue gas path showing all equipments incorporated in between.

OR

Draw a flow diagram of Fuel oil (Furnace oil or LSHS) handling from Fuel oil tanker unloading station to boiler burner tip showing all equipments incorporated in between.

[Turn over

Fig. No.1:

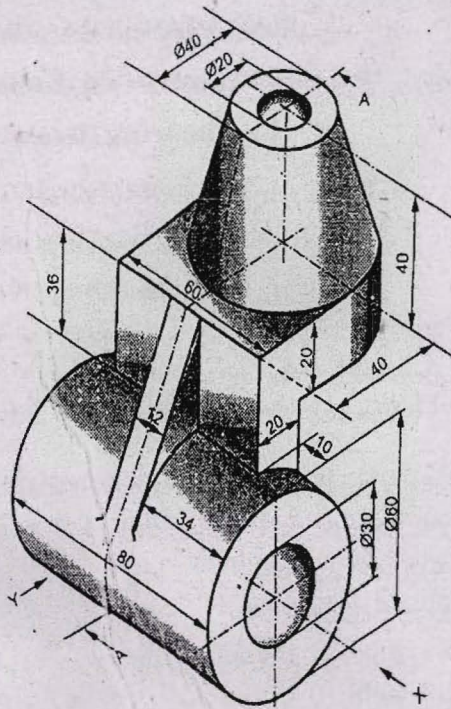


Fig No.2:

