EXAMINATION BOARD OF BOILERS

(MAHARASHTRA STATE)

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

Boiler Technology – I

5th July 2014

[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 options and complete the following statements :—   10

(*a*) Higher the sulphur content in the fuel, dew point temperature will—

(*i*) Increase

(*ii*) Decrease

(*iii*) Same

(*iv*) No impact.

(*b*) High ash content will—

(*i*) Increase the handling cost

(*ii*) Causes clinkering and slagging

(*iii*) Reduce boiler capacity

(*iv*) All of the above.

(*c*) For the same diameter and thickness of tube, a water tube boiler compared with a fire tube boiler has size of boiler tube is specified by—

(*i*) Less heating surface

(*ii*) Equal heating surface

(*iii*) More heating surface

(*iv*) None of the above.

(*d*) Boiler stays are used to—

(*i*) Provide foundation of boiler

(*ii*) Provide support for boiler

(*iii*) Prevent flat surfaces from tearing apart

(*iv*) None of the above.

(*e*) Steam pipes comes under I.B.R. inspection if—

(*i*) Steam pressure exceeds 5.5 kg/cm^2 and internal diameter exceeds 250 mm.

(*ii*) Steam pressure exceeds 3.5 kg/cm^2 and internal diameter exceeds 254 mm.

(*iii*) Steam pressure exceeds 1.5 kg/cm^2 and internal diameter exceeds 25 mm.

(*iv*) Steam pressure exceeds 3.0 kg/cm^2 and internal diameter exceeds 150 mm.

[Turn over

(f) The operating excess air percentage is high in—
   (i) Spreader stoker coal fired boiler
   (ii) Oil fired boiler
   (iii) Bagasse fired boiler
   (iv) Wood fired.

(g) F and A (From and At) rating of the boiler is the amount of steam generated from—
   (i) Water at 0°C to steam at 100°C
   (ii) Water at 27°C to steam at 100°C
   (iii) Water at 77°C to steam at 100°C
   (iv) Water at 100°C to steam at 100°C.

(h) For flash steam calculation, flash steam quantity available depends upon—
   (i) Condensate pressure and flash steam pressure
   (ii) Pressure of steam in boiler
   (iii) Steam enthalpy at atmospheric pressure
   (iv) Total heat of flash steam.

(i) Calculate % O_2 in flue gases, if excess air is 15.38 % in FO fired boiler—
   (i) 4.2 %
   (ii) 2.8 %
   (iii) 1.4 %
   (iv) 3.6 %.

(j) Drain pockets are provided in a steam line for—
   (i) Storage of flash steam
   (ii) Storage of condensate
   (iii) Checking of steam line
   (iv) Effectively removal of condensate from the line.

B. Explain in brief importance of the following terms—   10
   (a) Sugar test in boiler water
   (b) Mountings and Accessories related to boiler
   (c) 'U' Seal for thermal deaerator
   (d) Boiler steam test
   (e) Flue gas analysis.

2. (a) What are the advantages of forced circulation over natural circulation ?   4

   (b) List out limitations of Bimetallic thermostatic steam traps and write steps involved in steam trap management.   5

   (c) What is the basic difference between sub-critical and supercritical boilers ? List out merits of supercritical boilers as compared to sub-critical boiler.   5

   (d) A close circular tank is to be installed in a boiler house as a feed water tank. Diameter and height of tank are 2.1 m and 6 m. respectively. Find water holding capacity of the tank. Also find the cost for insulating the tank including top with insulation thickness of 50 mm. Assume insulation cost Rs. 145 / m².   6

3. (a) Enlist tips to improve steam plant efficiency.   4

    (b) What are the comparative advantages and dis-advantages of fire   5
         tube and water tube boilers ?

    (c) Why are water tube boilers most frequently used for waste heat   5
         recovery ?

    (d) Find the volume of 1 kg of steam at a pressue of 14 kg/cm²(g), in   6
         each of the following cases :—

         (i)   When steam is dry saturated

         (ii) When steam is wet having a dryness fraction of 0.9

         (iii) When steam is superheated, the degree of superheat being
               40°C.

4. (a) Write important parameters to monitor of running boilers and what   4
         affects fuel bill ?

    (b) Explain effects of impurities on Boiler Components.   5

    (c) What are the causes, effects and control of the following losses—   5

         (i)   Boiler on-off loss

         (ii) Blow down loss

         (iii) Stack loss.

    (d) The following data was obtained during a test on two boilers working 6
         under similar conditions, except that the draught in the first
         boiler was produced by an induced draught fan and in the second
         fan by a forced draught fan—

         *   Air supplied / kg of fuel burnt : 19 kg.

         *   Density of air under given conditions : 1.205 kg/m³.

         *   Density of flue gases at he specified temp. : 0.769 kg/m³.

         *   Combustion rate : 150 kg of fuel / hr.

         *   Fan draught produced in each case : 75 mm. of water.

         *   Efficiency of fan in both cases : 50 %.

         Calculate Brake Horsepower of fan in each case.

5. (a) What are classifications of pulverised coal burners and oil burners ? 4
         (only classification).

    (b) Write formula to calculate chimney draught produced in mm. of   5
         water column and what are the main factors which determine the
         amount of boiler draught necessary ?

    (c) Draw a schematic diagram of Mechanical ash handling system and   5
         enumerate the requirements of a good ash handling system.

    (d) During the test of an oil fired water tube boiler, the following data 6
         was obtained—

         *   Steam pressure : 16 kg/cm² (ab)

         *   Wt. of water evaporated : 283 kg/min.

         *   Boiler feed water temp. : 76°C

         *   Quality of steam : 99%

         *   Wt. of fuel burnt : 22.45 kg/min.

             Calculate.—(a) Actual evaporation per kg. of fuel oil

                        (b) Factor of equivalent evaporation

                        (c) Equivalent evaporation from and at 100°C

                        (d) Boiler horsepower.

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

    (*a*) Best practices for condensate removal on steam lines.   5

    (*b*) Two element drum level control.   5

    (*c*) Types of boiler furnaces used in Bagassed fired boilers in sugar industry.   5

    (*d*) Boiler Safety.   5

    (*e*) Boil out procedure for cleaning new water tube boiler.   5

EXAMINATION BOARD OF BOILERS

(MAHARASHTRA STATE)

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

Boiler Technology - II

5th July 2014

(Time : 2-00 p.m. to 5-00 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) State whether the following statements are *True* or *False* :—   10

   (i) Stiochiometric air required for combusion of bagasse is about 3.2.

   (ii) Forced steam jet draught is produced by placing the steam jet in the flue gas entrance of ecomomiser in oil fired boiler operation.

   (iii) Bomb calorimeter is used to determine calorific value of gaseous fuels.

   (iv) Blending of coal means mixing of excessive fines with large lumps of coal and high GCV coal with low GCV coal.

   (v) Chemical deaeration of feed water with hydrazine as oxygen scavenger removes oxygen but decreases TDS level.

   (vi) The coefficient of thermal expansion of refactory material should be less.

   (vii) If steam and water can coexist at 1.033 kg./cm² and 100⁰C, at this condition, steam is called saturated vapour and water is called saturated liquid.

   (viii) Fyrite apparatus is used for measuring smoke density of flue gases.

   (ix) Suspension burning as well as grate burning takes place in spreader stoker boiler.

   (x) Inverted bucket steam traps operates on the principle of difference in temperature between steam and condensate.

   (b) Define the following terms :—   5

   (i) Circulation ratio and its value for natural and forced circulation boiler.

   (ii) Water space and steam space in boiler shell.

   (iii) 'Boiler' as per IBR Act, 1923.

   (iv) Conductivity of boiler feed water and its relation with TDS.

   (v) Swelling index of coal.

[Turn over

    (c) Covert it :— *kCal*   5

        (i) 122.5×10^9 to .... MTOE.

        (ii) Delta *60* °C to .... Delta °F.

        (iii) 19.97 m³/Sec. to .... CFM.

        (iv) 167 mm of Hg to .... mm of water column.

        (v) Evaporation of 976 Kg. of water/hr to .... Boiler HP.

2. (a) What are the adverse effects of improper air venting through steam   4
        system ?

    (b) What are the causes of boiler accidents and its prevention ?   5

    (c) Write name of various types of high pressure boilers and state the   5
        essential requirements of high pressure boilers.

    (d) Estimate the pipe size required to carry dry saturated steam at   6
        65 kg./cm² (g) Pressure from boiler giving steam flow
        68750 kg./hr. Assume steam velocity 38 m./sec.

3. (a) What are the merits of biomass based briquettes as compared to coal   4
        or oil ?

    (b) State the various components of a condensing plant with their   5
        functions in one line only.

    (c) Explain the working of circulating fluidised bed combustion boiler   5
        with the help a schematic diagram.

    (d) Following observations are noted during coal fired boiler trial :—   ·6

      • Ultimate analysis of coal : H2-2%, O2-5%, C-38%, S-1%, Moisture-5%.

      • O2 in Flue gases : 3%.

      • Flue gas temperature. at boiler exist : 140°C.

      • Ambient air temperature : 40° C.

      • GCV of coal : 3400 kCal/Kg.

      • Sp. heat of flue gas : 0.23 kCal/Kg °C.

      • Sp. heat of superheated steam : 0.45 kCal/kg °C.

        Calculate— (a) % Heat loss due to dry flue gas, (b) Heat loss
        due to evaporation of water formed due to H2 in fuel, (c) Heat
        loss due to evaporation of moisture present in combustion air.

4. (a) What are the advantages of finned tubes over plain tubes used in the   4
        economiser ?

    (b) Distinguish between air and steam atomised oil burner.   5

    (c) Explain routine maintenance activities (daily, weekly, monthly,   5
        quartely, six monthly and yearly) of biomass briquette or bagasse
        or coal handling system.

    (d) A 5000 kg./hr. boiler operates at 10.5 kg Cm² (g) and has a maximum   6
        allowable boiler TDS of 3500 ppm. Calculate blowdown rate in
        kg./hr. If same boiler is operated with manual blowdown and

assuming that boiler water TDS is maintained at 2500 ppm. Assume boiler feed water TDS is 300 ppm and feed water temperature is 30^0C. Calculate energy loss due to excess blowdown.

5. (a) Write approx. values of Calorific Value in kCal/kg. and sulhpur in % of following fuels :—   4

    (i) Indian coal   (ii) Biomass briquettes

    (iii) Furnace oil   (iv) Bagasse.

  (b) Enlist some of the important causes of boiler furnace explosions and their corrective measures to be taken.   5

  (c) How is the preservation of boilers by wet method carried out ?   5

  (d) Calculate the total heat of 1 kg. of steam at a pressure of 9 kg./cm ^{2} (g) when,——   6

    (i) Steam is wet having dryness fraction is 0.85.

    (ii) Steam is dry saturated.

    (iii) Steam is superheated at 205 ^{0} C. Considering specific heat of superheated Steam (Cp) is 0.55.

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

    (a) Steam jet air ejector.   5

    (b) Problems, probable causes, action plan of multi-stage BFW centrifugal pump.   5

    (c) Types of dearerators.   5

    (d) Cyclone type mechanical dust collector.   5

    (e) Condensate contamination sources and prevention.   5

EXAMINATION BOARD OF BOILERS

(MAHARASHTRA STATE)

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

Engineering Drawing

6th July 2014

(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*) Ref. Fig. No. 1 line application Nos. and write name of line application in tabulated form.   10

   (*b*) Draw a schematic sketch of typical steam distribution header system.   5

   (*c*) Draw a TD traps assembly piping (15 mm diameter) which is installed for main steam line.   5

2. The Fig. No. 2 shows view of an object. Draw a following views by first angle method of projection.

   (*a*) Plan.   5

   (*b*) Elevation looking at 'X'   5

   (*c*) Side view   5

   (*d*) Give all dimensions.   5

3. Draw a neat proportional free hand sketches and name all parts of following (any *two*) :—   20

   (*a*) Thermodynamic steam trap.

   (*b*) Inspector's Test gauge cock.

   (*c*) Parallel slide blow down valve.

4. Ref. The Figure No. 3 shows Front View and Top View of an object.

   (*a*) Draw an isometric view.   15

   (*b*) Give all dimensions.   5

5. Ref. the Figure No. 4 for Boiler feed water pump. List out all pump components and draw a free hand sketches components (minimum 5 Nos).   20

6. Draw a P and I diagram of Demineralised Water Treatment Plant (DM Plant) and identify all names of equipment and also draw a neat sketch of internal construction of only Cation Bed.   20
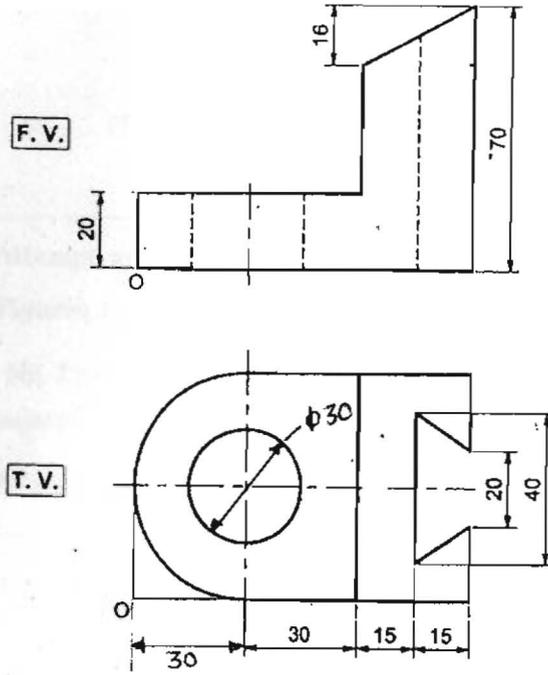
Fig No. 1

Fig No. 2

Fig No. 3

Fig No. 4