

## EXAMINATION BOARD OF BOILERS

(MAHARASHTRA STATE)

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

### Boiler Technology-I

18th February 2017

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

(MAX. MARKS — 100)

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- Instructions to candidates.*— (1) Attempt any *five* questions.  
(2) Question No. 1 is *compulsory*.  
(3) All answers of one question should be at one place.  
(4) Answer in brief and to the point attract more marks.  
(5) Assume suitable data, if *necessary*.

#### Marks

1. (A) Out of the given options select most appropriate option as an answer:— 10
- (i) In case of industrial process heating, best quality of steam is .....
- (a) high pressure steam
  - (b) super-heated steam
  - (c) wet steam
  - (d) dry saturated steam.
- (ii) Size of the boiler tube is generally specified by .....
- (a) mean diameter and thickness
  - (b) inside diameter and thickness
  - (c) outside diameter and thickness
  - (d) inside diameter and outside diameter.
- (iii) In a boiler, various heat losses take place. The biggest loss is due to .....
- (a) moisture in fuel
  - (b) dry flue gases
  - (c) radiation and convection
  - (d) unburnt carbon.
- (iv) The capacity of induced draft fan compared to forced draft fan in a boiler is .....
- (a) same
  - (b) more
  - (c) less
  - (d) depending upon size of boiler.

- (v) The latent heat of vaporization at critical point is .....  
(a) less than zero  
(b) greater than zero  
(c) equal to zero  
(d) none of the above.
- (vi)  $O_2$  content in atmospheric air on volume basis is .....  
(a) 21%  
(b) 23%  
(c) 30%  
(d) 78%.
- (vii) Scale is formed on heat transfer surface when .....  
(a) water is acidic  
(b) water is alkaline  
(c) water contains dissolved gases  
(d) water contains dissolved calcium and magnesium salts.
- (viii) Which one of the following fuel has the highest hydrogen content and lowest sulphur content .....  
(a) coal  
(b) furnace oil  
(c) natural gas  
(d) LSHS.
- (ix) For boiler water treatment chemical dosing with small discharge at high pressure, pump preferred is .....  
(a) centrifugal  
(b) axial flow  
(c) propeller  
(d) reciprocating.
- (x) High % of carbon monoxide presence in the flue gas of boiler is an indicator of .....  
(a) complete combustion  
(b) good control of pollutants  
(c) low excess air  
(d) high excess air.

(B) Answer following questions in short :—

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- (i) Define vacuum efficiency of condenser.
- (ii) What is stress concentration? How does it occurs?
- (iii) Differentiate between wet steam and dry steam.
- (iv) If the pressure of condenser is 630mm of Hg, what will be the absolute pressure in the condenser?

	<b>Marks</b>
(v) Determine the mass of 0.15 m <sup>3</sup> wet steam at a pressure of 4 bar absolute and dryness fraction 0.8.	
2. (a) Why boiler drum manholes are usually elliptical in shape ?	4
(b) Why is a safety relief valve installed close to a pressure reduction valve in steam line?	5
(c) If you find boiler drum water level cannot be restored immediately, what will you do?	5
(d) A boiler generates 6.5 ton of steam per ton of coal fired. Steam generation is at 18kg/cm <sup>2</sup> (g) Boiler feed water temperature is 110°C at downstream of the deaerator. Boiler efficiency = 75% Factor of evaporation = 1.15 C <sub>p</sub> of steam = 0.55kCal/kg°C Determine: (i) Temperature of the steam (ii) Degree of superheat, if any (iii) Calorific value of coal.	6
3. (a) What would the causes of score or damage to safety valve seat?	4
(b) Describe boiler steam test.	5
(c) Explain mechanical de-aeration and chemical de-aeration	5
(d) The percentage composition of sample of liquid fuel by weight is as below: C = 84.8 %, and H <sub>2</sub> =15.2%. Calculate.— (i) Weight of air needed for complete combustion of 1 kg of fuel; (ii) Volumetric composition of the products of combustion if 15 % excess air is supplied.	6
4. (a) What may be the causes of fall in condenser vacuum in the surface condenser?	4
(b) Compare safety valve, relief valve and safety relief valve.	5
(c) List ten energy conservation opportunities available in a boiler system.	5
(d) Two boilers one with super heater and other without super heater are delivering equal quantities of steam into a common main. The pressure in the boilers and main is 20 bar absolute. The temperature of steam from a boiler with a super heater is 350°C and temperature of the steam in the main 250°C. Determine the quality of steam supplied by the other boiler. Assume specific heat of super-heated steam C <sub>p</sub> = 2.25 kJ/kg K	6

	<b>Marks</b>
5. (a) List out the data required for calculation of boiler efficiency using 'indirect method'.	4
(b) Differentiate between natural circulation and force circulation boiler.	5
(c) Propose the steps involved in boiler tube replacement after failure ?	5
(d) (i) Find out the efficiency of the furnace oil fired boiler by direct method with the data given below :— Type of boiler: Furnace oil fired Quantity of steam (dry) generated = 5 Ton per hour (TPH) Steam pressure = 10 kg/cm <sup>2</sup> (g) Steam temp = 180 °C Quantity of oil consumed = 0.350 TPH Feed water temperature = 75 °C GCV of Furnace oil = 10400 kCal/kg Enthalpy of saturated steam at 10 kg/cm <sup>2</sup> = 665 kCal/kg Enthalpy of feed water = 75 kCal/kg	6
(ii) The above furnace oil fired boiler was converted to coconut shell firing. Determine the boiler efficiency by direct method after conversion. GCV of coconut shell fuel = 4565 kCal/kg Quantity of coconut shell consumed for the same steam demand and pressure = 850 kg/hr	
(iii) The cost of fuel and operating hour of boiler are given below :— Operating hour/ year = 5000 hr Cost of furnace oil = Rs 40000/ton Cost of coconut shell = Rs 5000/ton Find out the annual cost saving due to fuel substitution in above boiler ?	
6. Write short notes on :—	20
(a) important provisions of Indian Boiler Act.	
(b) Fusible plug.	
(c) Membrane type water wall.	
(d) Role of three T's in efficient combustion.	

**EXAMINATION BOARD OF BOILERS**

( MAHARASHTRA STATE )

( Under the Boiler Operation Engineers Rule, 2011 )

**Boiler Technology-II**

18th February 2017

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

(MAX. MARKS : 100)

- General Instructions.*—(1) The question paper is divided into *two* sections.  
 (2) **Section-1** is *compulsory*.  
 (3) Answer any *four* questions from **Section-2**.  
 (4) Answer should be brief and to the point.  
 (5) All Answers of one question should be at one place only.

**Section-1**

Answer all questions.

**Marks**  
10

- 1 (A) Choose the right answer :—
- (i) Thermal power plant with Steam Turbine Operates on .....
- (a) Carnot Cycle (b) Otto Cycle  
 (c) Brayton Cycle (d) None of the above.
- (ii) Largest loss of boiler is .....
- (a) Blowdown Loss (b) Heat Loss in flue gas  
 (c) Radiation Loss (d) None of the above.
- (iii) During hot banking, boiler is kept in .....
- (a) Depressurized Condition (b) Pressurized Condition  
 (c) High air flow condition (d) Firing Condition.
- (iv) Which condition leads to boiler starvation ?
- (a) Non availability of load in running boiler  
 (b) Non availability of coal in running boiler  
 (c) Non availability of feed water in running boiler  
 (d) None of the above.
- (v) Thermocouple is used for .....
- (a) Measurement of steam flow  
 (b) Measurement of differential pressure  
 (c) Measurement of thermal expansion  
 (d) None of the above.
- (vi) ..... is a energy saving method of any boiler.
- (a) Damper control of fans (b) Duct by pass  
 (c) Speed control of fans (d) None of the above.

- (vii) Excessive blow down .....
- (a) Reduces Efficiency (b) Increase Chemical Consumption.
- (c) Increases make up water (d) All the above.
- (viii) Oxygen in flue gas is measured by .....
- (a) Orsat Apparatus (b) Zirconia Sensor
- (c) Bomb Calorimeter (d) Opacity Meter.
- (ix) Efficiency of a thermal power plant is roughly .....
- (a) 80% (b) 70%
- (c) 35% (d) Above 80%.
- (x) 456 Kcal is equal to ..... KJ.
- (a) 250 (b) 1908
- (c) 3027 (d) Cannot be changed.
- (B) Define following terms in one or two sentence :— 10
- (i) BMCR
- (ii) Indirect method of Boiler efficiency calculation
- (iii) Soot Blowing
- (iv)  $T_{11}$  Boiler Tube
- (v) Over heat degree of superheat (OHDR).

### Section-2

Answer any four questions. Answer should be short and to the point only.

2. (a) Write about any four water parameters along with its range, which is tested at Laboratory to monitor Boiler water quality. 4
- (b) Explain about erosion of Boiler tube. How it can be avoided ? 5
- (c) List out various losses during Boiler operation. 5
- (d) Efficiency of a 300 TPH, 100 kg/cm<sup>2</sup>, 520°C Coal fired boiler is 84%. Calculate increase in fuel cost per month if rate of coal increases from Rupees 2,500 per ton to Rs. 2,550 per ton. The boiler runs in full load. Consider feed water temperature 140°C and GCV of coal 3600 Kcal/kg. 6
3. (a) Explain the term Starvation of Boiler. Why it is dangerous ? 4
- (b) Explain the procedure of annual inspection of Boiler for renewal of certificate as per Indian Boiler Regulation (IBR). 5
- (c) What is furnace purging ? Why it is required ? 5
- (d) A power boiler consumes 350 tons of coal per hour. Sulphur percentage as per ultimate analysis of the coal is 1.0%. Calculate quantity of sulphur dioxide generated per day from the Boiler. 6

	<b>Marks</b>
4. (a) What are the conditions to conform about Boiler tube leakage ?	4
(b) What is " master fuel trip " of a Boiler ? Write about some abnormal conditions responsible for this.	5
(c) Explain the term hammering of pipe line. How it can be avoided ?	5
(d) Answer both questions :—	6
(i) If speed of a centrifugal fan is reduced to half, then what will be reduction in power consumption ?	
(ii) Exhaust flue gas temperature of a Boiler is 142°C. If ambient temperature is 36°C, then calculate energy loss in flue gas per kilogram in Kcal/kg. Consider specific heat of flue gas as 0.23 Kcal/kg.	
5. (a) What are the main reasons of Boiler tube failure ? How it can be avoided ?	4
(b) Explain about Control extraction, Non control extraction and Back pressure turbine.	5
(c) Describe function of steam trap. Why blocking and passing traps are not desired ?	5
(d) Efficiency of a 250 TPH, 80 kg/cm <sup>2</sup> , 500°C Boiler is 82%. Coal having GCV of 3,400 Kcal/kg and 46% ash is used in the Boiler. Calculate number of trucks required per day to remove total ash generated when boiler is operated at full load. Consider feed water temperature 135°C and net loading capacity of the truck is 10 Tons.	6
6. Write short notes (any four) :—	20
(a) Dry mode operation of supercritical Boiler	
(b) Off season maintenance of Baggase fired Boiler	
(c) ND Test	
(d) Pipe Support and Hangers	
(e) Station Heat Rate.	

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

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

**Engineering Drawing**

19th February 2017

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

(MAX. MARKS — 100)

- Instructions to candidates.*— (1) Attempt any *five* questions.  
 (2) All questions carry *equal* marks.  
 (3) Figures to the right indicates *full* marks.  
 (4) Assume suitably missing data if any.

	<b>Marks</b>
1. (a) Draw a schematic sketch of thermodynamic steam trap and name the internal parts.	5
(b) Draw a schematic sketch of an eye foundation bolt.	5
(c) Draw schematic free hand sketch of the following :—	
(i) Locking arrangements of nuts (any <i>two</i> types).	5
(ii) Steam pipe supports (any <i>two</i> types).	5
2. Ref. Fig. No. 1 showing machine component. Draw following views :—	
(a) Draw its view from the front,	5
(b) Draw view from above,	5
(c) Draw view from right, and	5
(d) Indicate all essential dimensions.	5
The arrow indicates direction to obtain view from the front.	
3. Draw proportionate free hand sketch of the following and name the important parts :—	
(a) Typical steam distribution header system.	5
(b) Steam pipe expansion joints (any <i>two</i> types).	5
(c) General arrangement of boiler feed water pump and its accessories.	5
(d) Moisture separator.	5
4. Fig. No. 2 shows the front elevation and plan of an object. Make an isometric drawing with corner "A" nearest to you.	15
Indicate all dimensions.	5



