

**DIRECTORATE OF STEAM BOILERS**  
(MAHARASHTRA STATE)

Examination for certificate of proficiency as a Boiler Operation Engineer  
(Under Boiler Operation Rules, 2021)

**Boiler Technology - II**

25th February 2023

(TIME : 2-30 P.M. TO 5-30 P.M.)

(Max. Marks—100)

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*Instructions to Candidates:—*

- (1) Attempt any *Five* questions.
- (2) Question No. 1 is *compulsory*.
- (3) Answer each next main question on a new page.
- (4) Answer in brief and to the point attract more *marks*.
- (5) Assume suitable data, if necessary.

**Marks**

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|---|----|
| 1. (A) True or False :—   | 10 |
| (i) The major axis of elliptical manholes on the shell should be provided circumferentially.                |    |
| (ii) Difference between GCV and NCV will be smaller in Natural Gas compared to Coal.                        |    |
| (iii) In a recuperative air preheater, the heat is transferred by direct mixing.                            |    |
| (iv) A rise in the conductivity of Boiler feed water indicates increase level of dissolve solids.           |    |
| (v) The low combustion temperature in FBC boilers results in minimal formation of NO <sub>x</sub> .         |    |
| (vi) The pressure of reheat steam after passing through reheater compared to inlet condition is less.       |    |
| (vii) The function of injector used in small capacity boilers is to inject chemical solution in feed pump.  |    |
| (viii) In locomotive boilers, the draught in furnace is increased by utilizing exhaust steam from engine.   |    |
| (ix) Once through Boiler can operate at subcritical as well as supercritical pressures.                     |    |
| (x) The temperature of flue gases at air heater outlet should be above dew point temperature of flue gases. |    |
| (B) Give Definition of the following :—   | 5  |
| (i) Dew Point   |    |
| (ii) Attemperator   |    |
| (iii) Boiler mountings  |    |
| (iv) Turndown ratio   |    |
| (v) Cast Iron.  |    |

[Turn over

- (C) Convert the Units as mentioned :—
- (i) 1 Gallon = ..... Litres.
- (ii) 990 °F = ..... °C.
- (iii) 2 Sq. Inch = ..... Sq. mm.
- (iv) 1 KG = ..... Pound.
- (v) 1 ATA = ..... Bar.
2. (a) Write note on handling of HFO/LSHS. 4
- (b) What is the Bed slumping in FBC boiler and what care should be taken for slumped compartment? 5
- (c) Explain why dry saturated steam is preferred over wet or super heated steam for process. Describe various precaution/measures one must take to supply saturated steam. 5
- (d) 200 TPH steam is generated in a Boiler at 100 kg/cm<sup>2</sup> pressure and 500°C temperature. If feed water inlet temperature is 135°C and 52 Tons of coal is consumed per Hour then calculate :— 6
- (i) Equivalent evaporation from and at 100°C.
- (ii) Equivalent evaporation from and at 100°C per Ton of coal.
- (iii) Boiler HP.
3. (a) Classify the various types of insulation as per temperature and give an example for each type. 4
- (b) What is draft? Explain different types of drafts. 5
- (c) Describe various causes of Boiler Tube Failures. 5
- (d) The insulation of a steam pipeline is to be upgraded. With the following data. Calculate the simple payback period for the insulation upgradation project :— 6

Length of the steam pipeline	100 m
Bare pipe external diameter	100 mm
Heat loss from the pipe with existing 25 mm insulation thickness.	2000 kcal/m <sup>2</sup> /hr
Thickness of insulation to be added	25 mm
Heat loss after insulation upgradation	400 Kcal/m <sup>2</sup> /hr
Boiler efficiency	75%
GCV of coal	4000 kcal/kg
Annual operating hours	8000 hrs
Cost of coal	Rs. 2000/Ton
Investment for insulation upgradation	Rs. 4 Lakhs

4. (a) Various ways to improve efficiency of bagasse fired boiler. 4
- (b) Enumerate reasons for incomplete combustions of solid, liquid and gaseous fuels. 5
- (c) List out different temperatures to be measured during the boiler (steam generation) audit. 5
- (d) What quantity of heat is required to raise the temperature of 450 grams of water from 15°C to 85°C ? The specific heat capacity of water is 4.18 J/g/°C. 6
5. (a) Explain the difference between excess air and excess oxygen 4
- (b) Describe spring loaded Safety valve setting procedure with neat diagram. 5
- (c) Explain Chain grate or Traveling grate Stoker Boiler with neat sketch. 5
- (d) A 500 MW coal plant based on conventional pulverized fuel has a gross efficiency of 38%. The Gross calorific value of the coal used is 4000 kCal/kg with 40% total carbon. A supercritical unit of 500 MW replaces the plant with a gross efficiency of 40% using the same characteristic coal. Calculate the following :— 6
- (i) Specific coal consumption after replacement.
- (ii) Amount of coal and carbon dioxide saved during a year if the plant works for 8000 hours.
6. Write short note on following :— 20
- (a) Steam blowing
- (b) Chemical cleaning of pressure part
- (c) Hot Banking of Boiler
- (d) Automatic Blowdown System.
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