

Regn.No. _____

Paper - 1

Name: _____
(To be written by the candidate)

**FOURTH EXAMINATION FOR RECOGNITION OF COMPETENT
PERSONS FOR INSPECTION & CERTIFICATION OF
BOILERS - AUGUST 2017**

BOILER DESIGN ENGINEERING

Date : 20/08/2017

Time : 09:30 - 11:30 Hrs.

Marks: 100

Question I

- a. 1) For a plate material elevated temperature yield stress is not specified. Minimum specified tensile strength at room temperature is 490 Mpa. Calculate elevated temperature yield stress at 350° C. (1 mark)
- 2) Specify heat treatments that are to be carried out for T91 grade tubes during manufacture. (1 mark)
- b. 1) An automatic boiler having evaporation capacity of 2500 kg/hr is fitted with automatic water level alarms and firing controls which cannot be tested without altering level of water in the boiler. Does this comply with IBR code requirement? (1 mark)
- 2) What is maximum allowable axial stress for stay tube? (1 mark)
- c. 1) What are the limits for use of cast iron for boiler valves? (2 marks)
- d. 1) Mention the main objectives of the Boilers Act 1923 and Indian Boiler Regulations 1950? (1 mark)
- 2) For which material heat treatment process of solution annealing is related and for which stage of fabrication it is required? (1 mark)
- e. 1) What is the maximum mean diameter and thickness of the corrugated and plain furnace of the Horizontal Multi tubular boilers? (1 mark)
- 2) Define Class II boilers and give examples. (1 mark)

Question II**(30 marks)**

Given below are details of a plain furnace provided with stiffener used in Class I shell type boiler. Furnace is exposed to flame.

Boiler Design pressure	16 kg/cm ² (g)
Saturation temperature	205° C
Furnace outside diameter	1100 mm
Furnace thickness	20 mm
Length of furnace between effective points of support	1850 mm
Stiffener thickness	25 mm
Stiffener height	70 mm

Furnace material properties are given in the table below:

Temperature (°C)	275	300	325
Elevated temperature yield stress (Kgf/cm ²)	2143	2083	2024
Modulus Of Elasticity (Kgf/cm ²)	1967000	1947000	1921500

Check whether the thickness provided for the furnace is adequate.

Check whether the thickness and height provided for the stiffener is adequate.

Question III**(15 marks)**

Given below are the details of a superheater coil which is located in flue gas path and the heat transfer is by radiation

Superheater Design pressure	80 kg/cm ² (g)
Superheated steam temperature	490° C
Tube outside diameter	44.5 mm
Tube thickness	4.06 mm
Negative tolerance on tube thickness	0 %

Allowable stress values for tube material are as follows:

Temperature (°C)	475	500	525	550
Elevated temperature yield stress (Kgf/cm ²)	1020	825	652	486

Calculate minimum required thickness of the tube.

Question IV**(30 marks)**

A boiler drum with dished heads has the following parameters:

Design pressure	-	203.33 kg/cm ²
Design temperature	-	366° C
Bi-thickness Drum internal diameter	-	1770 mm

Allowable Stress values for the plate used for drum and dish heads

Temperature (°C)	300	325	350	375
Stress Value (kg/cm ²)	1454	1420	1380	1309

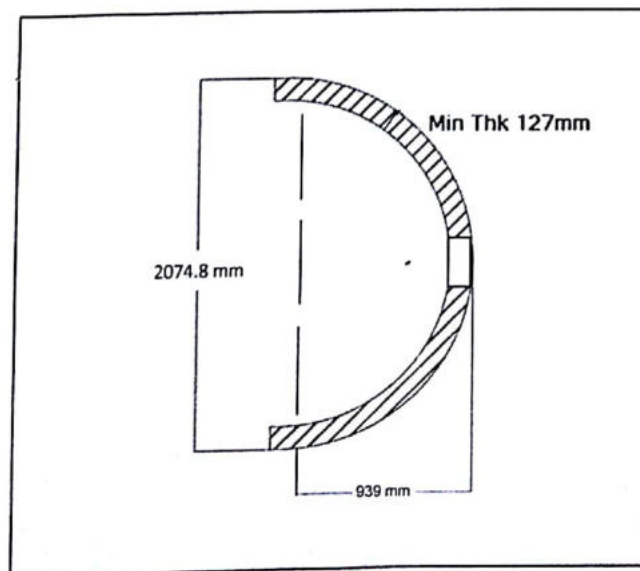
Drum Thickness

Thicker portion of drum shell	-	177 mm
Thinner portion of drum shell	-	148 mm
Drum head thickness	-	152.4 mm
Diameter of manhole opening	-	406.5 mm
Effective ligament efficiency		
Longitudinal	-	0.862
Diagonal	-	0.950
Circumferential	-	1.726

Details of drum heads are as per the attached sketch.

Calculate the maximum working pressure for the drum and heads as per IBR.

Verify the results and conclude.



Question V**(15 marks)**

In a thermal power station, four safety valves on the drum and one safety valve on the main steam line are provided. The capacity of the boiler is 1590 TPH, maximum working pressure of drum is 192.2 kg/cm^2 and the temperature of the main steam is 540°C . The dry saturated steam is maintained in the drum at a temperature of 368°C . There is a pressure drop of 12.2 kg/cm^2 across the superheaters. The constant for safety valves is 0.48. All the drum safety valves are having the same size of 63.5 mm diameter.

Calculate the size and relieving capacity of the main steam line safety valve.

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