Regn. No._____ **Paper - 1**

Name : _____

(To be written by the candidate)

SIXTH EXAMINATION FOR RECOGNITION OF COMPETENT PERSONS FOR INSPECTION & CERTIFICATION OF BOILERS - 2nd FEBRUARY 2020

BOILER ACT, INDIAN BOILER REGULATIONS AND THEIR COMPLIANCE AND BOILER DESIGN ENGINEERING

Date : 02/02/2020 **Time : 09:30 - 12:30 Hrs.** **Max. Marks : 150**

GENERAL INSTRUCTIONS :

1. **This Question paper contains two parts - Part - A & B.**
2. **Part - A contains multiple choice questions. Please use OMR sheet to answer these questions.**
3. **Part - B contains descriptive questions. Please use answer paper to answer.**
4. **All questions in Part-A & B are compulsory.**

Part-A **(50 X 1 = 50 marks)**

(i) Answer all the **50** questions

(ii) Each question carries **one** mark

(iii) Use OMR Sheets to answer

1. As per the Boilers Act, 1923 competent authority can
   a. Inspect and certify boilers and components
   b. Issue certificate to the welders for welding the boiler and components
   c. Register boilers
   d. Frame the Indian boiler regulations

2. As per The Boilers Act, 1923 penalty for breach of rules for the first offence is
   a. Fine which may extend to INR ten thousand
   b. Fine which may extend to INR five thousand
   c. Fine which may extend to INR one thousand
   d. Fine which may extend to INR two thousand

3. A coil type boiler with a volumetric capacity of 23 litres, installed in a process plant, generates steam at 7 kg/cm^2 (g) for oil heating application. Which of the following is true about this boiler?

   a. It comes under the purview of Boilers Act, 1923 as its working pressure is above 1 kg/cm^2 (g)

   b. It does not come under the purview of Boilers Act, 1923 as its volumetric capacity is less than 25 litres

   c. It does not come under the purview of Boilers Act, 1923 as the steam generated is not used external to itself

   d. It comes under the purview of Boilers Act, 1923 as its water is heated above 100^{0}C

4. A carbon steel steam pipeline of 273 mm outside diameter and 12.7 mm thickness is laid in a sugar factory to carry steam at 3 kg/cm^2 for its refinery division. Which of the following is true about this steam pipeline?

   a. It comes under the purview of Boilers Act, 1923 as its outside diameter exceeds 254 mm and steam pressure exceeds 1 kg/cm^2 (g)

   b. It does not come under the purview of Boilers Act, 1923 as its inside diameter does not exceed 254 mm and steam pressure does not exceed 3.5 kg/cm^2 (g)

   c. It does not come under the purview of Boilers Act, 1923 as its inside diameter does not exceed 254 mm and pipe material is carbon steel

   d. It comes under the purview of Boilers Act, 1923 as its average diameter exceeds 254 mm and steam pressure exceeds 1 kg/cm^2 (g)

5. Registry Number of a boiler is T/5658. The 'T' in the number indicates that it is a

   a. Tower type boiler b. Triple pass boiler

   c. Tubular boiler d. None of the above

6. Rating of a boiler as entered in its Certificate in Form VI refers to

   a. Heating surface area of the boiler in square metre

   b. Steaming capacity of the boiler in kg/hr

   c. Volumetric capacity of the boiler in cubic metre

   d. None of the above

7. For boiler quality steel materials used for fabricating boiler components at design temperatures above 454^{0}C, allowable stress is determined by

   a. Creep Strength at design temperature & Yield Strength at design temperature

   b. Creep Rupture Strength at design temperature

   c. Both (a) & (b)

   d. None of the above

8. Which of the following is true about a coil type small industrial boiler regulated in Indian Boiler Regulations, 1950?

   a. Its pressure is limited to 12 kg/cm^2

   b. Its volumetric capacity is limited to 150 litres

   c. Both (a) & (b)

   d. None of the above

9. A welder qualification certificate is issued in

   a. Form II b. Form III

   c. Form XII d. Form XIII

10. A welder is issued certificate for alloy steel plate welding in flat position. Which of the following is true?

    a. He is qualified to weld alloy steel plate in horizontal position

    b. He is qualified to weld carbon steel plate in flat position

    c. He is qualified to weld carbon steel plate in horizontal position

    d. All of the above

11. Form III-F pertains to

    a. Forging b. Casting

    c. Tube d. Pipe

12. Form II is issued by

    a. Inspecting authority b. Competent authority

    c. Competent person d. None of the above

13. Steel Maker's certificate is issued in

a. Form IV
b. Form XII
c. Form III
d. None of the above

14. Any part of a feed pipe that is wholly or partially exposed to the flue gases for the purpose of recovery of waste heat is

a. Superheater
b. Reheater
c. Economiser
d. High pressure heater

15 For a boiler having an outer diameter greater than 3 feet 6 inches, but not exceeding 4 feet, the manhole or sight hole sizes shall be

a. 12 inches x 9 inches
b. 14 inches x 10 inches
c. 16 inches x 12 inches
d. 15 inches x 11 inches

16 For ordinary lift safety valve

a. Valve head lifts automatically a distance of at least D/24
b. Valve head lifts automatically a distance of at least D/12
c. Valve head lifts automatically a distance of at least D/16
d. Valve head lifts automatically a distance of at least D/8

17. The temperature of the water used as medium for hydraulic testing shall be

a. Between 30^0C to 60^0C
b. Between 0^0C to 40^0C
c. Between 15^0C to 35^0C
d. Between 20^0C to 50^0C

18. For Shell type boilers considering the ageing effect on boilers, the working pressure shall be reduced after 35 years to

a. 30%
b. 90%
c. 95%
d. 75%

19. For Shell type boilers, thickness of plain furnace shall be

a. Between 7 mm to 22 mm
b. Between 8 mm to 25 mm
c. Between 10 mm to 30 mm
d. Between 12 mm to 32 mm

20. Certificate issued by Inspecting Authority for site assembled boilers is in

a. Form II-B
b. Form II-A
c. Form II(1)
d. Form II(2)

21. Deviation of circularity of the drums during manufacturing when measured internally

a. Should not exceed 2% of nominal internal diameter
b. Should not exceed 1% of nominal internal diameter
c. Should not exceed 0.5% of nominal internal diameter
d. Should not exceed 3% of nominal internal diameter

22. For measuring upto and including 35 kg/cm^2 the range of pressure gauges shall be

a. From zero to same pressure
b. From zero to thrice the pressure
c. From zero to twice the pressure
d. None of the above

23. For Radiant superheater tubes, the design metal temperature shall be maximum steam temperature plus

a. 11^{0}C
b. 28^{0}C
c. 39^{0}C
d. 50^{0}C

24. The butt joints of boiler drum shall be tested by

a. 10% RT (Radiographical examination)
b. 20% RT
c. 30% RT
d. 100% RT

25. Hydraulic test at the makers's works shall be dispensed with, provided that the tubes are subjected to

a. Non-Destructive testing like UT or Eddy current or Stray flux testing
b. Destructive testing like bend, tensile test
c. Inspecting Authority witnesses the test
d. Not acceptable

26. Minimum length of visible portion of the level gauge glass shall be

a. 100 mm
b. 200 mm
c. 175 mm
d. 150 mm

27. Can a Safety valve in boiler drum have an isolation valve?

a. Not permissible
b. Permissible without any approval
c. Permissible with permission of the competent person
d. Permissible with permission of the Director of Boilers

28. Saturated steam discharge capacity of safety valve is represented by which of the following equation (where E: Rated discharge C: Constant A: Area P: Pressure)

a. $E = CA/P$
b. $E = C/AP$
c. $E = CAP$
d. $E = CP/A$

29. Standard flange size and thickness can be obtained from the

a. Appendix J
b. Appendix JB
c. Appendix JA
d. Appendix E

30. When all the boiler components of the boiler in the manufacturer's premises have not been tested hydraulically during manufacturing, the hydro test on completion of erection shall be subjected to a test pressure of

a. 1.25 times the maximum working pressure
b. 1.15 times the maximum working pressure
c. 2.0 times the maximum working pressure
d. 1.5 times the maximum working pressure

31. Remnant life assessment is mandatory for Boilers operating with main steam temperature more than 400^0C after

a. Operation of 1,00,000 hours
b. Operation of 3,00,000 hours
c. Operation of 4,00,000 hours
d. Operation of 50,000 hours

32. How many water level indicators shall be provided with every boiler?

a. One no. b. Two nos.

c. Three nos. d. Four nos.

33. The Boiler's Act 1923 is not applicable to following device/equipment

a. Flue gas air preheater b. Feed pipe

c. Reheater d. Superheater

34 Boiler Certificate ceases to be in force when,

I It is transferred from one state to another

II Heating surface area of boiler is increased by addition of water wall tubes

III An accident occurs

IV Boiler registration number is not marked upon it within stipulated time

a. I only b. IV only

c. I, II & III d. All of the above

35. A person who fails to report an accident of a boiler

a. Shall be punishable with imprisonment upto 24 months

b. Can be punishable with a fine upto INR one lakh

c. Can be punishable with a fine upto INR one lakh and imprisonment upto 24 months

d. All of the above are true

36. Competent person cannot inspect the Boiler during

a. Manufacture b. Use

c. Registration d. Erection

37. Boiler attendants & Boiler Operation Engineers Rules are framed by

a. Central Government b. State Government

c. Chief Inspector of Boilers d. Boiler Examination Board

38. Accident means

I Weakening of boiler pressure parts

II Heavy bulging of furnace due to low water level in boiler

III Explosion in integral economiser

IV Explosion of "steam pipe" as mentioned in The Boiler's Act 1923

a. I, II
b. I, II, IV
c. II, III, IV
d. All of the above

39. What is the minimum thickness required of stay tube of a boiler having tube diameter 50.8 mm?

a. 2.81 mm
b. 3.12 mm
c. 3.38 mm
d. 2.28 mm

40. What is the extent of RT required for 219.1 mm OD Class I pipe line not subjected to hydraulic test after completion?

a. 10% weld per welder with minimum 2 joints per welder

b. RT not required, as pipeline is going to be hydraulic tested after completion

c. 2% weld per welder with minimum one weld per welder

d. 100%

41. The maximum accumulation of steam pressure allowed during steam test for a boiler is

a. 10%
b. 20%
c. 5%
d. Not allowed

42. Minimum diameter required for branch pipe in welder qualification is

a. 127 mm
b. 141 mm
c. 89 mm
d. Not applicable

43. Which of the following boiler components is partly or wholly exposed to flue gases for the purpose of raising the temperature of steam beyond the saturation temperature at that pressure?

a. Economizer
b. Superheater
c. Water wall
d. Shell

44. How many feed apparatus are required for boiler having heating surface area more than 20 square meters?

a. One
b. Two
c. Three
d. Four

45. Stress relieving soaking temperature for pipe to pipe butt welding of 2¼ Cr 1 Mo material is

a. Atleast 600°C
b. 620°C to 650°C
c. 620°C to 660°C
d. 625°C to 750°C

46. What is the holding time required for hydraulic test of boilers?

a. 30 minutes
b. 10 minutes
c. 15 minutes
d. 5 minutes

47. Boiler quality plate not intended for hot forming can be supplied without normalizing or as rolled condition, if thickness of the plate is

a. ≤12 mm
b. >12 mm
c. Any thickness
d. <25 mm {Carbon<0.3%}

48. How many fusible plugs are required for a shell type boiler having wet back reversing chamber?

a. One
b. Two
c. Three
d. Not required

49. Which mechanical tests are required for Class III boiler?

a. One tensile, one all weld metal tensile test, two bend test, two impact test, one micro and one macro
b. One tensile, one bend test, one reverse bend test, one nick break test
c. One forward bend test, one reverse bend test
d. One forward bend test, one reverse bend test

50. As per IBR, recognition of competent authority, inspection authority, well known steel maker shall be valid for

a. Five years
b. Two years
c. Three years
d. Four years

Part-B **(5 X 20 = 100 Marks)**

(i) Answer all the **five** questions

Question No. 1 **(20 Marks)**

A 5 m long carbon steel header contains a single row of stubs at a pitch of 450 mm. The size of the header pipe is 141.3 OD x 6.55 mm nominal thickness with a maximum negative tolerance of 12.5% on the nominal thickness. The size of each stub is 63.5 mm OD x 4.5 mm thickness. Allowable stress of the header pipe material is 1200 kg/cm^2.

Calculate the maximum allowable working pressure of the header in kg/cm^2 as per Indian Boiler Regulations, 1950.

Question No. 2 **(20 Marks)**

A carbon steel plate is used for the fabrication of shell of a wet back shell type boiler. The size of the shell is 2170 mm OD x 10 mm thickness. The minimum specified ultimate tensile strength of the plate at room temperature is 49 kg/mm^2 and its minimum specified yield strength at design temperature is 26 kg/mm^2. Assuming an efficiency factor of 1.00, calculate the maximum allowable working pressure of the shell in kg/cm^2 as per Indian Boiler Regulations, 1950.

Question No. 3 **(20 Marks)**

Design a boiler drum with following parameters:

Calculate the steam drum shell thickness and dished end thickness.

Maximum allowable pressure : 128 kg/cm^2 (g)

Saturation temperature : 329^{0}C

Drum is located outside flue gas path.

Temperature ^{0}C	Allowable stress kg/cm^2
325	1345.57
350	1304.79

Distance between nozzles : 960 mm

Diameter of nozzle : 168.3 mm

Thickness of nozzle : 19.20 mm

Shell material : SA 516 GR 70

Nozzle material : SA106 Gr.A

Dished end : SA 516 GR 70

Dished end shape : Hemispherical

Shape factor for dished end ; K : 0.78

Question No. 4 **(20 Marks)**

Calculate the total heating surface of boiler as per the following parameters:

Capacity of boiler : 250 TPH

Steam pressure at outlet of superheater : 110 kg/cm^2 (g)

Steam temperature at outlet of superheater : 540^{0}C

Description	Tube outside diameter, mm	Total lengths of tubes, m
Front wall	76.1	1853.97
Pass-I Rear wall	76.1	1410.65
Pass-II Rear wall	51	1308.3
Side wall (both)	76.1	4035.5
Hanger Tube	44.5	1350
Primary Superheater - I	38.1	7669
Primary Superheater - II	38.1	4440
Secondary Superheater	44.5	3090

Question No. 5 **(20 Marks)**

CFBC boiler with following specification :

Capacity of boiler : 450 TPH

Maximum working pressure : 181 kg/cm^2 (g)

Maximum steam temperature in Radiant Superheater : 550^{0}C

Radiant Superheater material : SA213T91

Tube outside diameter convective superheater : 38.1 mm

Temperature ^{0}C	Allowable stress kg/cm^2 - SA 213T91
550	1090.75
600	662.59
625	463.81

Tube material of convective superheater coils : SA213 T22

Tube outside diameter convective superheater coils : 44.5 mm

Maximum steam temperature in Radiant Superheater : 393^{0}C

Temperature ^{0}C	Allowable stress kg/cm^2 - SA 213T22
400	1162
425	1162
450	1162

1. Calculate the minimum thickness of the tube for Radiant Superheater coils
2. Calculate the minimum thickness of the tube for Convective Superheater coils

********** **End of the question Paper** **********

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