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

Name : _____

(To be written by the candidate)

FIFTH EXAMINATION FOR RECOGNITION OF COMPETENT PERSONS FOR INSPECTION & CERTIFICATION OF BOILERS – DECEMBER 2018

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

Date : 16/12/2018 **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 and use OMR sheet to answer.

3. Part - B contains descriptive questions and use answer paper to answer.

4. All questions in Part-A & B are compulsory.

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Part-A **(50 X1 = 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, which of the following is not a "Boiler Component"?

   a) Superheater b) Economiser

   c) Air preheater d) Reheater

2. As per the Boilers act 1923, Steam Pipe is defined as a pipe through which steam passes if,

   a) Internal Diameter of pipe exceeds 254mm and steam pressure exceeds 1 kg/cm^2 gauge

   b) Internal Diameter of pipe exceeds 254mm and steam pressure less than 1 kg/cm^2 gauge

   c) Internal Diameter of pipe 114.3mm and Steam pressure less than 3.5 kg/cm^2 gauge

   d) All of the above

3. Power to exempt any boiler from the operations of the Boilers Act, is with the _____

a) Central Government
b) Central Boiler Board
c) State Government
d) None of the above

4. Boiler operating at 400^{0}C and above which is subjected for remnant life assessment and if found satisfactory, the life of such boiler is extended for a further period of _____

a) Six years
b) Twelve years
c) Ten years
d) No limit

5. A special class Boiler repairer is eligible to undertake repair of a boiler operating at a pressure up to _____

a) 17.5 kg/cm^2
b) 40.0 kg/cm^2
c) 125.0 kg/cm^2
d) Any boiler pressure

6. Water holding capacity of a shell type Small Industrial Boiler shall not exceed_____

a) 22.75 liters
b) 25.0 liters
c) 150 liters
d) 500 liters

7. A boiler without an integral super heater shall be fitted with a minimum of _____

a) Three safety valves
b) Two safety valves
c) One safety valve
d) Four safety valves

8. Any person who uses the boiler without any certificate or order being in force, shall be _____

a) Punishable with fine which may extend to one lakh rupees
b) Punishable with imprisonment which may extend to two years
c) Punishable with fine which may extend to rupees ten lakhs
d) Not punishable

9. The longitudinal weld joint of the internal flue shall be placed at _____

a) Upper portion of the flue
b) Lower portion of the flue
c) At 12 O' clock position of flue
d) Any angle

10. All butt welds of boiler and super heater tubes shall be tested as required under regulation _____ of IBR 1950.

a) 151 (h) b) 360 (d)

c) 265 d) 561

11. The minimum thickness of stay tube of nominal outside diameter of 70mm but not exceeding 76.2mm is _____

a) 3.12mm b) 3.38mm

c) 3.96mm d) 2.81mm

12. The minimum thickness of boiler plate shall not be less than _____

a) 8.0mm b) 12.0mm

c) 10.0mm d) 6.35mm

13. For manufacturing of drum, the bending of shell shall be done by _____

a) Local heating b) Hammering

c) Machine d) Manually

14. If the design pressure of a pipeline exceeds 17.6kg/cm^2, such pipeline is classified as _____

a) Class I Pipe line b) Class II Pipe line

c) Class III Pipe line d) Class IV Pipe line

15. The size of a relief valve to be provided on an economiser should have a minimum diameter of _____

a) 19mm b) 76.2mm

c) 50.8mm d) 25.4mm

16. The length of covered electrode used for metal arc welding shall not exceed_____

a) 18 inch b) 6 inch

c) 12 inch d) 24 inch

17. Boilers shall be inspected at all stages of construction as prescribed in _____

a) Appendix 'B' b) Appendix 'D'

c) Appendix 'J' d) Appendix 'A'

18. Permissible variation in minimum wall thickness at any point under the nominal wall thickness in hot finished and cold finished seamless pipes shall not be more than _____

a) 7.5% b) +1%

c) -7.5% d) -12.5%

19. The minimum length of the visible portion of the water gauge glass shall be _____

a) 200mm b) 175mm

c) 150mm d) 100mm

20. Welding electrodes after initial check tests shall be subjected to periodic check tests after every _____

a) Twelve months b) Six months

c) Three months d) Two months

21. The temperature of water used as a medium of pressure during hydraulic test of a boiler shall not be greater than _____

a) 50^0C b) 20^0C

c) 30^0C d) 10^0C

22. Memorandum of Inspection Book of each boiler shall be in _____ of IBR:1950.

a) Form I b) Form II

c) Form III A d) Form IV

23. Each tube of boiler and super heater shall be tested by the tube manufacturer to a hydraulic pressure of _____

a) 1.0 kg/mm^2 b) 0.7 kg/mm^2

c) 0.4 kg/mm^2 d) 0.5 kg/mm^2

24. Certificate for use of boilers is in _____ of IBR:1950

a) Form III b) Form II

c) Form VI d) Form I

25. Shorter axis of man hole shall be _____

a) Parallel to the longitudinal central line of the boiler

b) Placed in any angle

c) Perpendicular to the longitudinal central line of the boiler

d) Any angle

26. Hydraulic test of a sub-critical boiler during subsequent examination shall be _____

a) From 1¼ to 1½ times the working pressure of the boiler

b) At the maximum working pressure of the boiler

c) From 1¼ to 1½ times the sub-critical outlet pressure

d) None of the above

27. If an owner has applied for renewal of boiler certificate before the expiry of the previous certificate, be entitled to use the boiler at the maximum pressure entered in the former certificate, pending the issue of orders on the application.

a) No

b) Yes

c) Permitted to run at a lower pressure

d) Permitted to run at a higher pressure

28. Which of the following are the prerequisite conditions before manufacturing a boiler component?

I. Person engaged for welding of boiler component holds welder certificate

II. Proper facilities for design and construction

III. Materials used must meet criteria as laid down in IBR 1950

IV. Design and drawing is approved by inspecting authority

a) II & IV only b) IV only

c) I & II only d) I,II,III & IV

29. Boiler component manufacturer shall engage a _____ before start of manufacturing.

a) Competent Authority

b) Quality Inspector

c) Inspecting Authority

d) Not required for well-known Manufacturer

30. An Inspecting Authority is empowered to:

I. Inspect boiler during manufacturing

II. Carry out stage inspection during erection of a boiler for registration

III. To approve design and drawing of boiler and boiler component

a) I only b) III only

c) II only d) I,II & III

31. Boiler registry number is assigned by

a) Boiler manufacturer
b) Chief Inspector of Boilers
c) Inspector of Boilers
d) Boiler owner

32. Use of the boiler is prohibited under the following condition(s):

I. At a pressure higher than the maximum pressure recorded in certificate or provisional order
II. Boiler certificate is not in force
III. When boiler is not in charge of qualified persons holding certificate of proficiency or competency as required by rules
IV. Without registration as required by the Boilers Act 1923

a) I only
b) IV only
c) I,III & IV
d) I,II,III & IV

33. A firm has fraudulently marked a registry number which is not assigned to their boiler, then the firm_____

a) is punishable for imprisonment up to 24 months
b) is punishable for fine up to one lakh rupees
c) is punishable for fine up to one lakh rupees and imprisonment up to 24 months
d) Any of the above

34. Alteration, addition or renewal of steam pipe is to be carried out by a/ an_____.

a) Approved repairer
b) Boiler component manufacturer
c) a or b
d) None of the above

35. Penalty for use of boiler at a higher pressure than the certified in the boiler certificate is,

a) Imprisonment up to two years
b) Fine of two lakh rupees
c) Fine up to One lakh rupees
d) Imprisonment up to two years and fine up to one lakh rupees

36. Validity of provisional order is for

a) Three months
b) Six months
c) Twelve months
d) Nine months

37. An owner of boiler is bound to produce current boiler certificate to following authority(ies),

a) Commissioner of Police
b) District Magistrate
c) Chief Inspector of Factories
d) All of the above

38. Which of the following heat treatment(s) can be applied to cold drawn carbon steel tubes?

a) Sub-critical annealing
b) Full annealing
c) Normalising
d) Any one of the above

39. What is the minimum tempering temperature of SA 335 grade P91 cold drawn pipes in the final heat treatment?

a) 1040°C
b) 650°C
c) 730°C
d) 675°C

40. In which of the following conditions Post Bend Heat Treatment is required for T91 tube bends?

a) % Thinning is more than 25%
b) OD ≤ 141.3 mm & R/D ≤ 1.5
c) OD > 141.3 mm & R/D ≤ 2.5
d) As specified in material specification

41. Remnant Life Assessment shall be carried out of Heat recovery steam generator operated at a temperature of 480°C

a) after 100,000 Hours of operation
b) after 25 years
c) after 10,000 Hours of operation
d) None of the above

42. In which of the following conditions post weld heat treatment is not required for 1 Cr ½ Mo Pipe butt joints?

a) Outside Diameter less than 127mm
b) Thickness less than 13mm
c) Preheated to 125°C
d) All of the above

43. Maximum and minimum permitted thickness for plain furnace in a shell type boiler is

a) 22mm & 7mm
b) 16mm & 6mm
c) 10mm & 6mm
d) 22mm & 10mm

44. Stress relieving is required for Class I boilers if

a) Carbon content of the steel plate is more than 0.25 %

b) Plate thickness is 20mm

c) Alloy steel is used in manufacturing of boiler

d) All of the above

45. A welder qualified for groove welding for plates is

a) also considered to be qualified for fillet welds in plates

b) also considered to be qualified for branch welding

c) also considered to be qualified for tube butt joint welding

d) None of above

46. Minimum diameter of safety valve to be used for Small Industrial Boiler is

a) 12.7mm b) 12.0mm

c) 10.5mm d) 10.0mm

47. A water tube boiler is operated at a pressure < 50 kg/cm^2 and main steam outlet temp < 400^{0}C; which of the following tests is/are necessary for the purpose of remnant life assessment?

a) Ultrasonic testing b) Magnetic particle testing

c) Dye penetrant testing d) All of the above

48. The space between the coils when the valve is lifted to ¼th of its diameter shall be not less than _____ for full lift valves.

a) 1.6mm b) 1.8mm

c) 2mm d) 1.4mm

49. In shell type boiler the reduction in working pressure is considered when,

a) Age of the boiler exceeding 25 years

b) Age of the boiler exceeding 15 years

c) Working hours of the boiler exceeds 1,00,000 hours at which the boiler operating at 400^{0}C and above

d) None of the above

50. For Small Industrial Boilerwhich of the following statements is true?

a) The fee for inspection is not required

b) The certificate of manufacture of the boiler is not required

c) Operator for these boilers is not required

d) Operator for these boilers shall be a pass in class X or equivalent

Part-B

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

Question No: I **(8 X 2 = 16 Marks)**

1) What is the formula for the portion of the branch available for compensation?

2) Whether tube holes in a header/drum are allowed in welded seams and if yes, explain.

3) Why the syphonic arrangement is provided in the Pressure Gauges of the High pressure steam pipe lines?

4) What is the minimum included angle of bevel ('V' type edge preparation) in fusion welded longitudinal seams?

5) Calculate the working metal temperature for Radiant super heater tube having maximum steam outlet temperature of 440^{0}C.

6) Calculate the working metal temperature for Integral economiser tubes having maximum water outlet temperature of 210^{0}C.

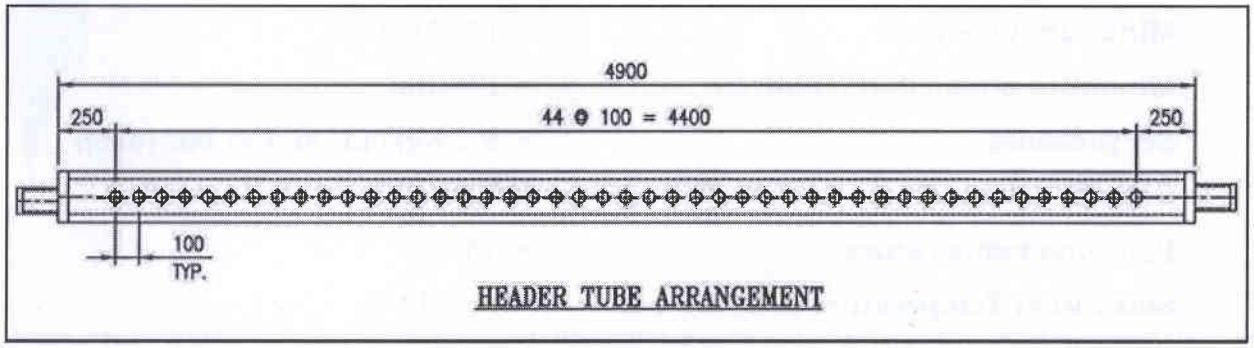
7) Calculate the heat treatment cycle (Soaking temperature and soaking time) for the following component.
   a. Component – Header
   b. Material – SA335 P22 (2¼ Cr-1 Moly)
   c. Pipe schedule – 219.1 X 32 thk
   d. Flat End plate butt welded with thickness 45mm

8) What is the minimum temperature required to perform stress relieving heat treatment of a fabricated carbon steel pipe line?

Question No: II **(4 Marks)**

Calculate the Ligament efficiency for the following header application as per IBR requirement.

Header diameter	:	219.1mm
Header tube hole diameter	:	50mm
Pitch of the hole	:	100mm



HEADER TUBE ARRANGEMENT

Question No: III **(25 Marks)**

Design a Boiler Drum with the following parameters:

Design pressure	- 190 kg/cm^2
Design temperature	- 368.6^{0}C
Thickness of the drum	- 190mm
OD of the drum	- 2118mm
Longitudinal efficiency	- 0.85
Diagonal efficiency	- 0.87
Circumferential efficiency	- 1.572
Material of the drum	- SA 299
R value at room temperature	- 5368.09 Kg/cm^2

Permissible working stress shall be calculated as Per IBR, since E_t value is not available.

a) Calculate the working pressure of the drum and its suitability for this particular application?

b) Calculate the maximum diameter of opening without any compensation?

Question No: IV **(2 X10 = 20 Marks)**

a) Find the thickness of the casting for the safety valve with the following parameters:

Working pressure	- 12 Kg/cm^2
Maximum internal diameter of the chest	- 288 mm
Working temperature	- 343^{0}C
Material for casting	- ASTM 216 Gr.WCB
Maximum Allowable Stress @ 343^{0}C	- 1252 Kg/cm^2

b) What is the discharge capacity of the safety valve having the following parameters:

Minimum bore area	= 18941mm^2
Minimum nozzle bore diameter	= 156mm
Set pressure	= 5.5 Kg/cm^2 (6.405 bar (abs))
Constant value	= 0.48
Relieving temperature	= 330^{0}C
Saturation Temperature @ 6.405 bar	= 161.18^{0}C

Question No: V **(20 Marks)**

Find out (a) tube metal temperature (b) select a suitable tube material and (c) calculate minimum thickness required as per IBR for the following:

Application : Radiant superheater coil

Steam temperature : 450°C

Working pressure : 115 Kg/cm²

Superheater tube diameter (OD) : 44.5mm

Allowable stress value (in Kg/cm²):

Material	400°C	450°C	500°C	550°C
SA-210 Gr.A1	906.53	639.39	322.23	129.50
SA-213 T11	1040.1	988.11	782.12	374.24
SA-213 T22	1162.48	1162.48	824.95	486.4

Question No: VI **(15 Marks)**

Find out the minimum plain tubes thickness for a shell type boiler and check the suitability of thickness provided.

External diameter of the tube = 63.5mm

Nominal thickness of the tube = 3.66mm

Negative tolerance = 12.5 %

Material specification = BS 3059 part I ERW Gr. 320

Max. Permissible stress = 877 kg/cm²

✓ Working Pressure = 10.54 Kg/cm².

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

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