

BOILER OPERATION ENGINEERS' EXAMINATION - 2015
BOILERS-I

Time: 2 1/2 Hrs.

Max.Marks: 100

Note:

- 1) Candidates should attempt **SIX (6)** questions subject to alternative or limitations, if any, mentioned herein or in each question. If more questions are answered, the last extra answers will be ignored.
- 2) Parts of the same questions must be answered together and must not be interposed by answer(s) to other question(s).
- 3) Question No. **ONE** is compulsory.
- 4) Candidates candidates should answer the paper in **ENGLISH** only

** ** *

1. Answer all the questions briefly:

20x1=20

- 1.1 What type of super heater coil super heats the steam to higher than design temperature at low loads?
- 1.2 Latent heat of water at critical temperature and pressure will be _____
- 1.3 _____ Circulation used in Super critical boilers.
- 1.4 Which steam is most suitable for Process heating?
- 1.5 Which type of boiler is more efficient whether CFBC or AFBC?
- 1.6 In a FBC boiler during start up oil firing, which parameter of coal will decide the Coal feeding temperature?
- 1.7 Line safety valve setting pressure will be _____ than Drum safety valve setting pressure?
- 1.8 Saturation steam header temperature and drum water temperature will be _____?
- 1.9 Flash steam can be recovered from _____
- 1.10 In a basic Rankine Cycle, what part of the power plant represents Iso-entropic compression?
- 1.11 In HRSG boilers, _____ point is used in the sizing of the economizer?
- 1.12 Temperature, Time and Turbulance is the 3 T's required for complete combustion of fuel.
- 1.13 _____ chemical can be used instead of Tri Sodium Phosphate (TSP) in boiler HP dosing

1.14 Safety valve blow down shall be restricted within the range of _____ to _____%

1.15 _____ % BMCR is the minimum once-through load in supercritical boilers below which the circulation starts to ensure adequate cooling of evaporator coils.

1.16 What is the layer created (during alkali boil out) inside tubes to prevent corrosion?

1.17 What is PFBC means?

1.18 Amount of heat required to raise the temperature of 1kg. of substance by 1°C is called _____

1.19 How does superheated steam quality measured?

1.20 In a CBD tank the splash steam connected to De-aerator and water is connected to IBD tank. What will be the water temperature in CBD tank?

2. (a) A hollow shaft is to transmit 350 KW at 100 RPM .If the maximum shear stress allowed is 75 N/mm^2 and internal diameter is 0.7 times the external diameter find both the external diameter and internal diameter assuming the max.torque is 1.5 times the mean torque.

8

(b) What type of spring is used in DSL safety valves and when do you prepare to replace the spring?

3

(c) Calculate the total upward force on a valve disc 2.5" in diameter, if safety valve neck diameter is 3" and valve outlet diameter is 4" when the boiler steam pressure is 160 bar.

5

3. (a) Define Net Positive Suction Head. What is the importance of maintaining NPSH while operating boiler feed pump.

8

(b) A centrifugal water pump operates at $30 \text{ m}^3/\text{hr}$ and at 1440 RPM. The pump operating efficiency is 65% and motor efficiency is 89%. The discharge pressure gauge shows 3.4 kg/cm^2 . The suction is 3 m below the pump centerline. If the speed of the pump is reduced by 25 %, estimate the following:

8

- i) pump flow,
- ii) pump head and
- iii) motor power.

Assume motor and pump efficiency remains same at the reduced speed.

4. Answer any FOUR of the following:

4x4=16

1. Pulverised fuel firing
2. Precautions to be taken in the operation of Turbo Driven Feed Pump
3. Film Boiling
4. Hydrastep
5. Priming and Foaming
6. Name different types of steam traps

5. Calculate the efficiency of the Atmospheric Fluidised Bed Combustion Boiler by indirect method using the following data: 16

Analysis of blended coal (% by mass)

Carbon	:	53.9 %
Hydrogen	:	3.1 %
Nitrogen	:	1.1 %
Sulphur	:	0.3 %
Ash	:	23.8 %
Oxygen	:	10.5 %
Moisture	:	7.3 %
GCV	:	5060 kCal / kg

The boiler operating parameters are given below:

Steam pressure	:	62.0 kg / cm ² g
Steam temperature	:	470 °C
Actual air supplied	:	8.91 kg/kg of coal
Mass of dry flue gas	:	9.31 kg/kg of coal
Specific heat of flue gas	:	0.23 kCal/kg °C
Flue gas temperature	:	160 °C
CO ₂ in flue gas	:	14.7 %
CO in flue gas	:	325 ppm
GCV of bottom ash	:	800 kCal/kg
GCV of fly ash	:	452.5 kCal/kg
Ratio of bottom ash to fly ash	:	15 : 85
Ambient temperature	:	32.4 °C
Loss due to hydrogen in fuel	:	3.54 %
Loss due to moisture in fuel	:	0.93 %
Loss due to moisture in air	:	0.2 %
Surface heat losses	:	2 %
(as assessed)		

6. Discuss about "De-aerator" with neat sketch and classify. Discuss about the precautions to be taken for safe operation of De-aerator. 16
7. (a) Write about water treatment in Reverse Osmosis method. 8
 (b) Discuss about caustic embrittlement. 8
8. (a) How do you control draft in response to the boiler load. 8
 (b) Define Air Fuel ratio. Why excess air is required in combustion? 8
9. (a) What are the Types of Economizers? *insert* 4
 (b) Why natural circulation is only possible in sub-critical boilers? Explain. 6
 (c) What is shrinking and swelling effect in boilers? Explain about its impact on drum level control? 6

BOILER OPERATION ENGINEERS' EXAMINATION - 2015
BOILERS - II

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* * * * *

1. Answer all the questions briefly:

(10+10=20)

(A)

10x1=10

1.1. How many water level gauge glass sets are to be provided for 660MW super critical Boiler?

1.2. what is the minimum pressure, ID fan has to develop at the inlet of the chimney?

1.3. In a safety valve setting, the set pressure is 200 kg/cm² and safety valve reseal pressure is 194 kg/cm². What is the blow down %?

1.4. What is the load variation limit allowed in a Variable Load Spring support?

1.5. What is the process used to capture SO₂ and SO₃ emission in CFBC boilers? *orabat*

1.6. What is the mechanical dust collector used in Boilers or in thermal power plants?

1.7. What is the Material specification of tube used for Economizer Coils?

1.8. PH value means _____?

1.9. Which part is prone to be subjected to cold end corrosion in Boiler?

1.10. Suggest the material to be used for steam pipeline of which working temperature is 550°C?

5x2=10

(B)

1. How thermal shock happen in Boiler feed pump?

2. What are the parameters to be checked to find tube leakage during Boiler Operation and in a noisy environment?

3. O₂ analyzer on Boiler is showing faulty reading, showing higher value than actual. What will be the impact on Boiler?

4. In a normal operating Boiler drum level increased suddenly and feed water flow is not changed. What would be the reasons for drum level increase?

5. Define "steam pipe" as per the Boilers Act 1923.

3 kg/cm²

25

2. (a) Why chimneys are designed in circular cross section? What are the precautions to be taken in the construction of foundation of chimney? 6
- (b) Two Boilers are connected with parallel to a chimney. Each Boiler is 250 kg/s steam flow with enthalpy 3450 kJ/kg and efficiency is 88.05% , fuel used is 34.3 MJ/kg and 8% Sulphur. Calculate the chimney height. 10
3. (a) Differentiate between boiler mountings and Boiler accessories? 4
- (b) Explain about Safety valve setting in a boiler? 4
- (c) What are all the safety precautions taken during settings? 4
- (d) What is blow down? What will the impact if it has been set less or higher? 4
4. (a) In a boiler 150 KL of water is filled. The Phosphate PPM in a boiler water observed as 1 PPM. The Phosphate is to be increased to 10 PPM. How much Tri Sodium Phosphate is to be added ? Consider the PO_4 in commercial TSP as 25% 6
- (b) State the methods used to remove SO_3 from boiler exit gas(any three)? And explain about any one method? 10
5. (a) Discuss about internal inspection of boiler during shutdown and important points/areas to be inspected? 10
- (b) What are the precautions to be taken before entering into the boiler for inspection? 6
6. What are the methods available for preservation of Boiler for short term and long term? Discuss in detail? 16
7. (a) What are the commonly used instruments in a Boiler and discuss about their role for safe and economical operation? 6
- (b) Discuss about any one such instrument with neat sketch. 10
8. (a) How do you find condenser tube leakage? 6
- (b) What are the methods available for condenser cleaning? Discuss in detail? 10
9. Answer any FOUR: 4x4=16
1. Corrosion and erosion
 2. Ash disposal system in modern power plants
 3. Stress relieving
 4. Give four reasons for furnace pressure fluctuation
 5. Attemperator
 6. What are the four steps to be taken by control room operator when drum level goes low?

BOILER OPERATION ENGINEERS EXAMINATION – 2015

TIME: 2 hrs.

BOILER DRAWING

MAX.MARKS 100

NOTE: ANSWER ALL QUESTIONS IN ENGLISH ONLY


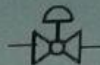

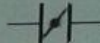



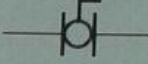


Q. I Read the typical HRSG Pressure Parts Drawing and Answer the following: 20x2=40

1. At what Elevation IP Drum is located with reference to bottom headers of Module? 21639
2. What should be the length between top header and bottom header of Economizer coil? 16562
3. If thickness of IP drum is 70mm then what should be the OD of IP drum? 1445
4. What is the Inside Dia of Integral Deaerator? 2400
5. At what Elevation Integral Deaerator is situated with reference of HP Drum ~~2000~~ 1153
6. What is the distance between Attemperator header and HP Drum along vertical axis? 4256
7. At what elevation of bottom headers of HP & IP Economizer are located? 7176
8. What is the distance between HP Economizer-3 (1st header) and IP Eco Outlet? (from HRSG front side) 6496
9. What is the OD of HP Steam Drum if its thickness is 4"? 1900
10. What is the distance between IP Economizer outlet header -2 Header? 1600
11. At what elevation Attemperator header is situated with reference to top headers of module? 25900
12. At what distance IP super heater outlet header is located with reference to CPH outlet header? 7748 8088
13. At what elevation HP Drum is located with reference to horizontal axis line of HP Economizer-3 outlet header? 2100
14. What is the distance between CPH inlet header and IP Economizer Inlet header? 2248
15. What is the distance between IP Super Heater Outlet to IP Economizer Outlet? 5389
16. What is the distance between Attemperator header and IP Drum along vertical axis? 5939 1400 4038
17. What is the distance between vertical axis of HP Drum and vertical axis of Integral deaerator? 4538, 4038
18. What would be the elevation of Top Headers if bottom headers elevation is 2000 mm? 1550
19. What is the distance between HP Economizer-3 (2nd header) and CPH inlet header? (from HRSG front side) 9424
20. How many headers are shown in the drawing?

Contd..2

Q. II Name the valve from symbols shown below.

10x2=20

- | | | | |
|---|---|----|---|
| 1 |  | 6 |  |
| 2 |  | 7 |  |
| 3 |  | 8 |  |
| 4 |  | 9 |  |
| 5 |  | 10 |  |

Q. III Name the parts of Control Valve from fig-2

10x1=10

Q. IV Draw Sectional view of float type steam trap and name the parts.

5

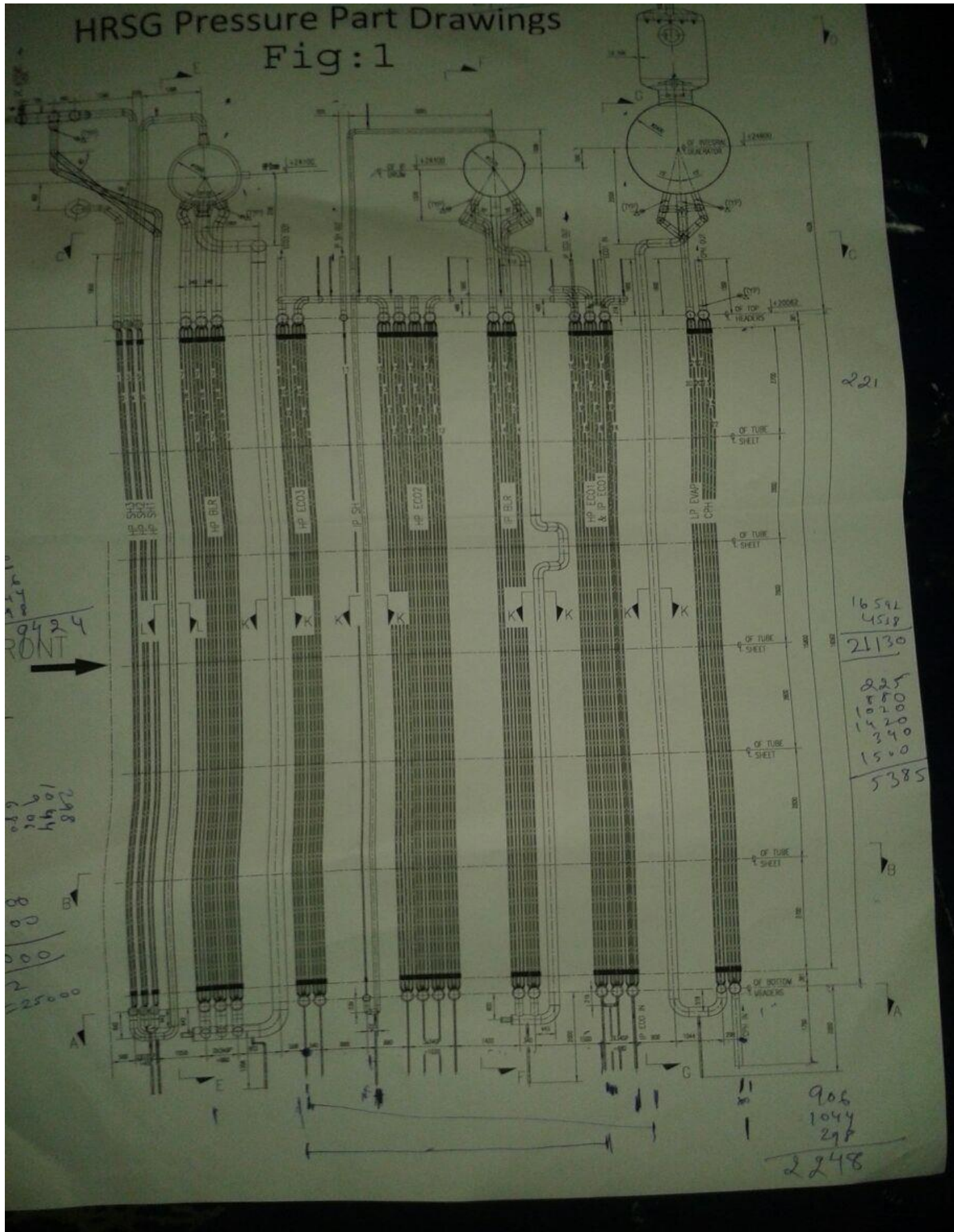
Q. V Draw line diagram of Boiler with Travelling grate and name all the parts of boiler with suitable name duly showing water path and steam path.

10+10=20

Q. VI Draw five numbers of weld joints used in Boiler Manufacturing/Repairing and name them.

5x1=5

HRSG Pressure Part Drawings Fig:1



9424
FRONT
→

298
1044
988

80
0
0
2500

221

1654
4518
21130
225
1880
1020
1420
340
1500
5385

906
1044
298
2248

Control Valve

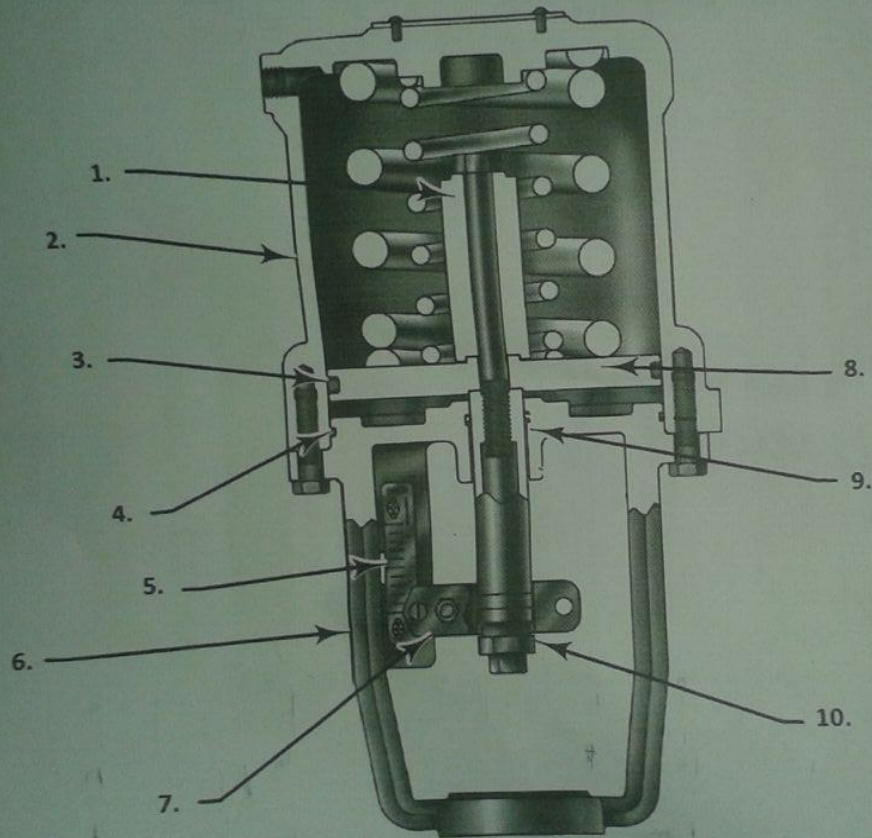


Fig-2 Typical Double-Acting Piston Actuator with Bias Spring