

Name: _____
(To be written by the candidate)

**EXAMINATION FOR COMPETENT PERSONS FOR INSPECTION
AND CERTIFICATION OF BOILERS – OCTOBER 2015**

BOILER DESIGN ENGINEERING

Date : 11/10/2015

Time : 09:30 – 11:30 Hrs.

Marks: 100

Question I

5 x 2 = 10 marks

- a. 1) Whether Inspecting authority can inspect a boiler meant for export?
What is the form in which he will certify?
2) What is the minimum thickness of the boiler plate allowed by IBR?
- b. 1) When a shell is made of more than one ring, how the longitudinal joints of the adjacent rings are placed?
2) In the tube thickness calculations, how the constant “c” varies with the working pressure?
- c. 1) Name any three boiler mounting fittings to be provided essentially in every boiler.
2) In shell type boilers, is it allowed to form the uptakes and cross tubes through ERW process?
- d. What are the limiting criteria for using?
1) Ellipsoidal heads
2) Partial spherical heads
- e) After how many hours/years the boilers shall be tested for Remnant Life Assessment Organization of its components.
1) The boilers which are operating at a temperature of 400°C (main steam outlet temperature)
2) The boilers which are operating at a temperature of less than 400°C (main steam outlet temperature)

Question II

30 marks

Design a Boiler Drum with the following parameters

Design Pressure - 170 Kg/ Cm²

Design temperature - 354°C

Drum inside diameter - 1778 mm

Drum thickness - 155 mm

Drum material - SA299

Stress values for the Shell plate

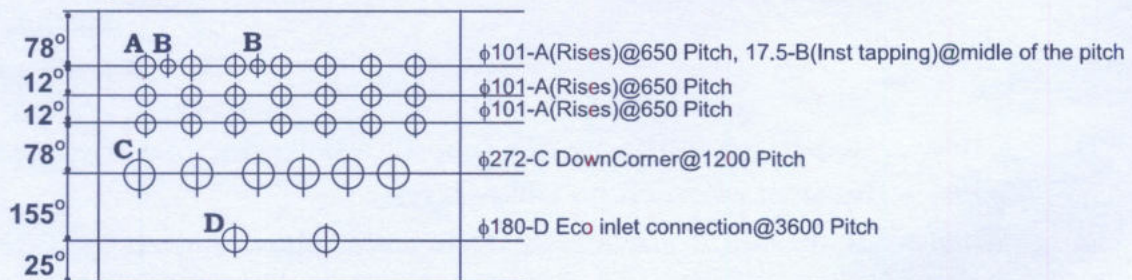
Temp °C	300	325	350	375
Stress Value Kg/Cm ²	1454	1420	1380	1309

Hole drilling pattern in the Drum is as per the attached Sketch.

Assume that the down comer pipe and eco inlet connection pipe are self-compensated. Diagonal efficiency need not be considered.

- Calculate the minimum ligament efficiency.
- Calculate the maximum working Pressure for the Drum as per the code.
- Check whether the Down comer Nozzle needs compensation for the given design parameters.

DRUM



Question III

10 marks

Manifold Header with Hemi Spherical dish end for the following design condition.

Header Outside diameter = 127mm

Drum pressure = 56kg/Cm²

Header Pressure drop before drum=3kg/Cm²

Medium Temperature = 271 Degree C

Thickness = 18mm

Header material = SA234WPC

Assume C Value

Height = 61.50mm

The Hemi Spherical Header dish end is located outside the furnace. Check whether the provided thickness is sufficient.

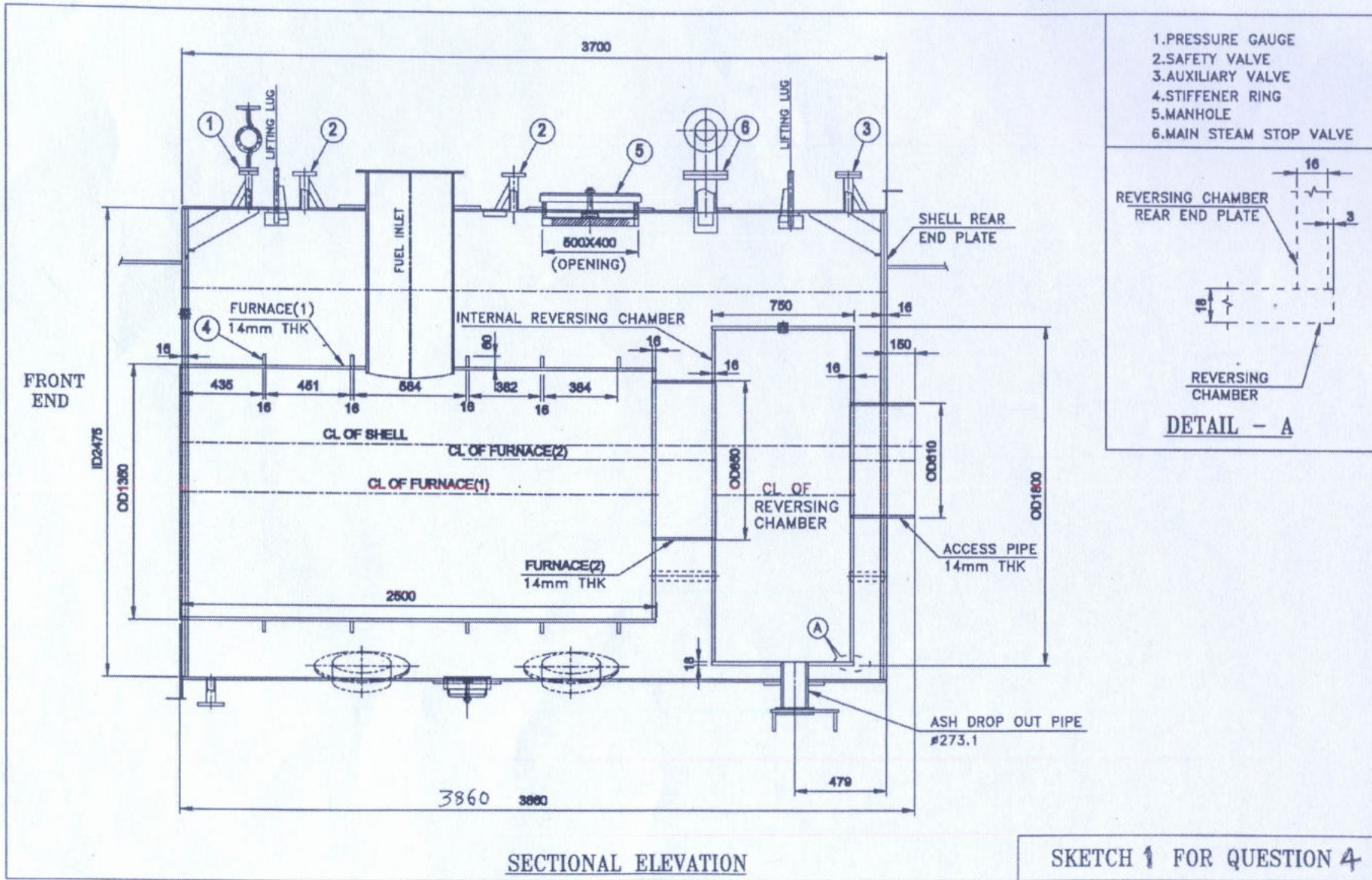
Question IV

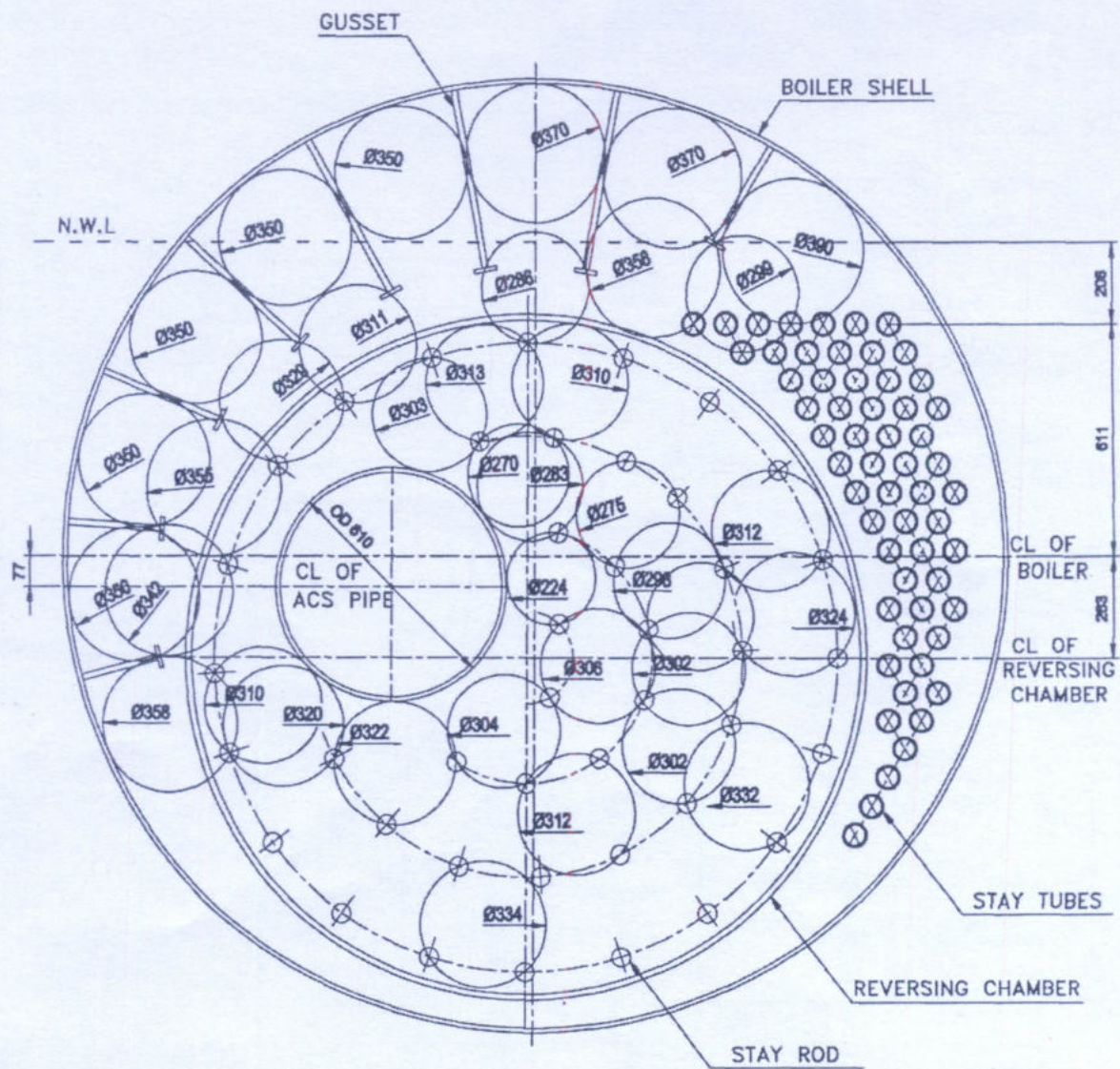
30 marks

Refer the sketches 1 to 3. The horizontal multi tubular boiler is to be designed for a maximum working pressure of 10.54 kg/cm²

Check whether the thickness provided for : (a) Furnace and (b) Shell end plates.

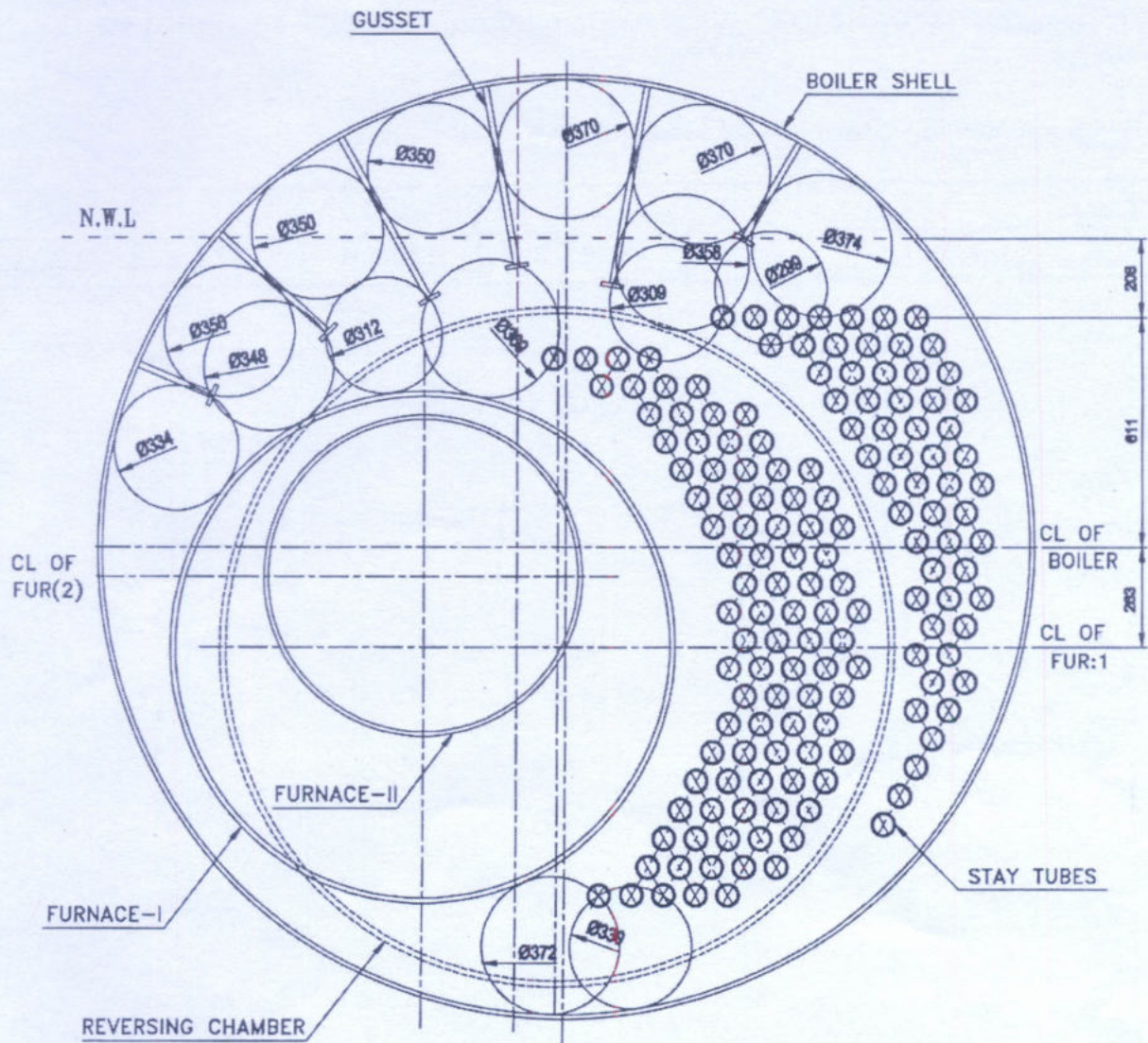
Material used for construction is conforming to SA 515 Gr.70. The saturation temperature is 185°C





PRESSURE CIRCLE DIAGRAM FOR SHELL REAR END PLATE

SKETCH 2 FOR QUESTION 4



PRESSURE CIRCLE DIAGRAM FOR SHELL FRONT END PLATE

SKETCH 3 FOR QUESTION 4

Question V**20 marks**

During renovation of a boiler, the owner was planning to install an integral economizer coil with the tube of size OD 51mm and material SA210Gr A1 in the convection pass of the boiler. The various tube thicknesses available are 4.5mm, 5mm and 5.2 mm. Previous to the installation the economizer working pressure was 225 Kg/Cm² and the design temp was 345°C. What is the minimum thickness required for the tube and justify.

Allowable stress values can be taken from the table below:

Temp°C	325	350	375	375
Stress Value Kg/Cm ²	1202.3	1177.0	1071.2	1309

----- End of Question Paper -----