PIPING DESIGN QUESTIONAIRE

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Simple

1. What is the ASME code followed for design of piping systems in Process pipings (Refineries & Chemical Industries)?

(i) B31.1
(ii) B31.3
(iii) B31.5
(iv) B31.9

Answer (III)

2. **What do you mean by following items?**

i.)ISLB-400 ii) ISMB-600 iii) ISHB-350 iv) ISMC-300 v) ISJB-150 vi) ISLB-200 vii)ISMB-450 viii)ISWB-400 ix) ISJC-200 x) ISLC-350 xii) ISMC-250

Answer:

i. Indian STD light weight beam, Web size – 400
ii. Indian STD medium weight beam, Web size – 600
iii. Indian STD 'H' beam, Web size – 350
iv. Indian STD medium weight channel, Web size –300
v. Indian STD junior beam, Web size – 150
vi. Indian STD light weight beam, Web size – 200
vii. Indian STD medium weight beam, Web size – 450
viii. Indian STD wide flange beam, Web size – 400
ix. Indian STD junior channel, Web size – 200
x. Indian STD light weight channel, Web size – 350
xi. Indian STD medium weight channel, Web size – 250

3. What is this item?

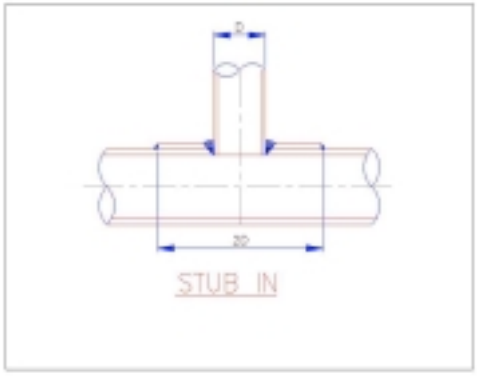
i.ISA-100X100X12 ii) ISA-80X50X10 iii)ISLT-100X100

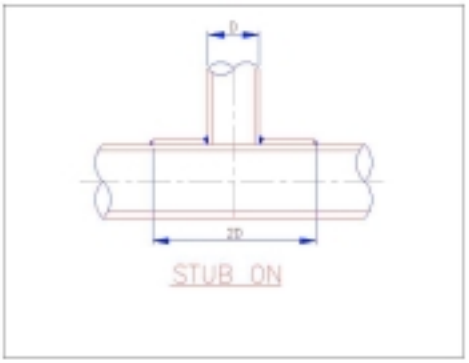
Answer:

i. Equal angle size 100x12 THK
ii. Unequal angle size 80x50x10 THK
iii. Indian STD light weight tee bar size 100x100

4. What is the difference between stub in and stub on branches? Describe with sketch.

Which one is preferred?





For branching of one size lesser of run pipe, Stub On is preferred. For other branching less than one size of run pipe stub in is preferred. The Design is based on ANSI B 31.3

5. What is the difference between Pipe and Tube?

Ans: Pipe is identified by NB and thickness is defined by Schedule whereas Tube is identified by OD.

6. From which size onwards NB of pipe is equal to OD of Pipe?

Ans: From the size 14" and onwards NB = OD of pipe.

7. Write down the outside diameter of following pipe?

i. 3 inch ii) 6 inch iii) 10 inch iv) 14 inch

Answer:

i. 3 inch = 88.9mm ii)6 inch = 168.28mm
iii) 10 inch = 273.06mm iv) 14 inch = 355 mm(OD= Size X 25.4)

8. What is the difference between machine bolt and stud bolt?

Answer:

Machine bolt has a head on one side and nut on other side but stud bolt have nuts on both sides.

9. What is soluble dam?

Answer:

Soluble dam is a water-soluble material used for restricting the purging gas within the pipe.

10. While welding of pipe trunion to pipe/reinforcement pad you have to put a hole or leave some portion of welding why?

Answer:

For venting of hot gas which may get generated due to welding

11. What do you mean by following type of welding

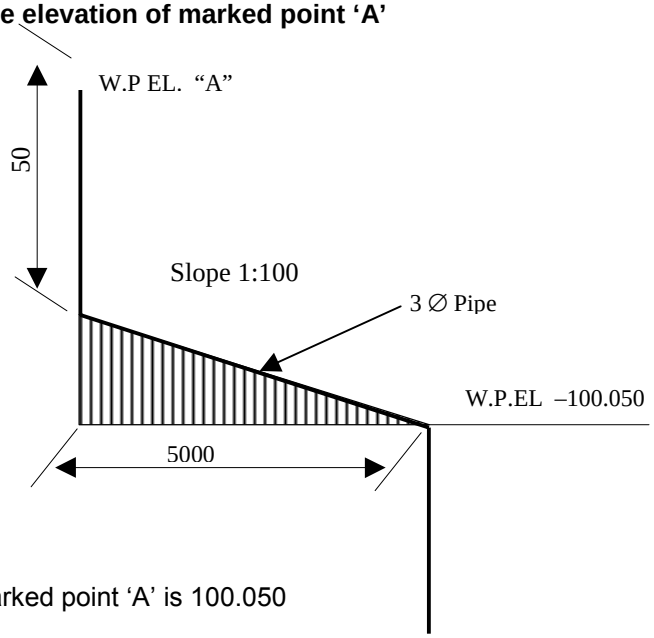
i. SMAW ii)TIG

Answer:

ii. SMAW = SHIELDED METAL ARC WELDING

iii. TIG = TUNGSTEN INTER GAS WELDING

12. Find out the elevation of marked point 'A'



Answer:
Elevation of marked point 'A' is 100.050

13. What should be the radius of long radius elbow?

Answer:
1.5D (Where "D" is the diameter of the pipe)

14. Normally where do we use the following?
i. Eccentric reducers ii)Concentric reducers

Answer:
i. Eccentric reducers = Pump suction to avoid Cavitation, To maintain elevation (BOP) in rack.
ii. Concentric reducers = Pump discharge, vertical pipeline etc.

15.Concentric reducer is used in pump suction. (Yes / No). Explain.

Answer:
No. Air pockets may form if concentric reducer is used at pump suction, which results in Cavitation, and cause damage to Pump. To avoid this problem, Eccentric Reducer with Flat Side Up (FSU)is used in Pump Suction.

16. What do you mean by Cavitation in Pump?

A pump is designed to handle liquid, not vapour. Vapour forms if the pressure in the pump falls below the liquid's vapour pressure . The vapour pressure occurs right at the impeller inlet where a sharp pressure drop occurs. The impeller rapidly builds up the pressure which collapses vapour bubbles causing cavitation and damage . This is avoided by maintaining sufficient NPSH.

(Cavitation implies cavities or holes in the fluid we are pumping. These holes can also be described as bubbles, so cavitation is really about the formation of bubbles and their collapse. Bubbles form when ever liquid boils. It can be avoided by providing sufficient NPSH.)

17. What do you mean by NPSH? How do you calculate it?

NPSH: Net Positive Suction Head. NPSH is the pressure available at the pump suction after vapour pressure is substarcted.
It is calculated as : Static head + surface pressure head - the vapor pressure of your product - the friction losses in the piping, valves and fittings.
It thus reflects the amount of head loss that the pump can sustain internally before vapour pressure is reached.

18. What is the ASTM code for the following?

i. CS pipe ii) CS fittings iii)CS flanges iv)AS pipe P5/P11 v)Cast CS Valves

Answer:

i. CS pipe = A106 Gr.B
ii. CS fittings = A234 Gr.WPB/WPBW
iii. CS flanges = A105
iv. AS pipe = A335 Gr P1/P11
v. Cast CS Valves = A216 Gr.WCB

19. What is the thumb rule to calculate spanner size for given bolt?

Answer:
1.5 x diameter of Bolt

20. What is the thumb rule to calculate Current required for Welding?

Answer:
Current (Amp) = [Diameter of Electrode (mm) X 40] $\pm$ 20

21. What is steam tracing? How do we decide the location of SSM & CRM.

Answer:

Steam Tracing is a process which is used to prevent the fluid passing through a process line from freezing by keeping the temperature high enough for free flow of fluid and thus maintaining pumpability.
SSM and CRM are generally located 38M max for open system and 24 M max for closed system when we use LP Steam up to 3.5 kg/sq cm. as a heating media.

22. Which piping items will you drop down before conducting Flushing and Hydrotest?

Ans: Items like Control Valve, Orifice plates, Rotameters, safety valves , Thermowells are dropped or replaced with temporary spools before hydro test.

23. *Why do we provide a Dampner in the Piping of Reciprocating Pump?*

Ans: To take care of Pulsation.

24.Why do we provide Full Bore Valve in connecting pipeline of Launcher / Receiver?

Ans: For Pigging.

25. Which parameters will u check during checking Piping Isometrics?

Ans: Bill of Material, Pipe Routing wrt GAD, Supporting arrangement , details of insulation, hydrotest pressure, painting specs and provision of Vent and Drains at appropriate locations.

26. What is the ANSI/ASME dimensional standard for steel flanges & fittings?

(i) B16.3
(ii) B16.5
(iii) B16.9
(iv) B16.10

Answer (II)

27. How can flanges be classified based on facing?

a. Flat Face b. Raised Face c. Tongue and groove d. Ring type joint

28. What do you mean by AARH (Flange Finish)?

Ans: Arithmetic Average Roughness Height.

29. Which are the different types of Gaskets?

Ans: Full Face, Spiral Wound, Octagonal Ring Type, Metal Jacketed and Inside Bolt Circle.

30. What should be the relative hardness between the RTJ gasket and flange groove

Ans: For a RTJ flange , the joint ring should have a 30-40 Vickers hardness less than that of the mating face of flange.(Brinnel hardness for RTJ groove shall be 20-50 BHN more than the corresponding gasket hardness)

31. From which side of pipe will you take a branch connection?

Ans: When Fluid is Gas, Air or Steam and Cryogenic Service – Topside.
When Fluid is Liquid – Bottom Side.

32. Why don't we take a branch for Cryogenic Service from bottom side though the fluid is in liquid state?

Ans: There is the chance of Ice formation during normal operation and since ice flows from the bottom of the pipe it will block the branch pipe connection.

33. Why do we provide Drip Leg in Steam Line?

Ans: To remove Condensate when there is a rise in the pipe along the flow direction. If we do not provide the drip leg in steam line, the condensate which forms inside the pipe will result in Water Hammer effect causing damage to piping system.

34. How do you support any small size HDPE/PVC (Plastic) pipe?

Ans: It should be supported continuously by using channel or Angle so that line should not Sag or fall from the sleeper/rack due to uneven expansion because of Hot Temp.

35. Why do we provide High Point Vent (HPV) and Low Point Drain (LPD) in piping?

Ans: HPV – for removing Air during Hydro-test.

LPD – for draining water after conducting Hydro-test.

36. Which standard and codes will you refer while designing the piping?

Ans: Following are the codes and standards –

- ASME SEC I : Rules for construction of Power Boilers.
- ASME SEC VIII : Rules for construction of Pressure Vessels.
- ASME B 31.1 : Power Piping
- ASME B 31.3 : Process Piping
- ASME B 31.4 : Pipeline Transportation system for liquid hydrocarbon and other liquids.
- API RP 520 : Sizing selection and installation of Pressure Relieving Devices in refineries
- API Std 610 : Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Services.
- ANSI/NEMA SM 23 : Steam Turbines for Mechanical Drive Services.
- API Std 617 : Centrifugal Compressor for Petroleum, Chemical and Gas Industry Service.
- EJMA : Expansion Joints Manufacturer's Association.
- OISD – 118 : Layout for Oil and Gas Installations.
- IBR : Indian Boiler Regulations.
- NACE MR – 0175 : Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment.
- NACE MR – 0284 : Evaluation of Pipeline and Pressure Vessel Steel for Resistance to Hydrogen Induced Cracking.
- NACE TM – 0177 : Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking in H2S Environment.

37. What do you mean by IBR and Which lines comes under IBR purview?

Ans: IBR: Indian Boiler Regulation Act.

Steam lines with conditions listed bellow comes under IBR purview –

- Lines for which design pressure is 3.5 kg/sq cm and above.
- Line size above 10" having design pressure 1.0 kg/sq cm and above.
- Boiler feed water lines to steam generator, condensate lines to steam generator and flash drum.

38. What are Weldolet and Sockolet? And where they are used?

Ans: Weldolet and Sockolet are basically self reinforced fittings.

Weldolet is used for Butt weld branch connection where standard tee is not available due to size restrictions and the piping is of critical / high pressure service.

Sockolet is used for socket welding branch connection, which require reinforcing pad.

39. What is the MOC for Superheated high pressure Steam Lines?

Ans: A 335 Gr P I / P II
Composition : 0.5 Mo(P1) /1.25 % Cr-.5 Mo(P11)

40. What is the normal upstream and downstream straight length of orifice flow meter?

Answer : Upstream - 15D Downstream - 5D

41. What are the essential data required for the preparation of equipment layout?
Ans : 1)PFD and P&ID 2. Project Design data 3. Equipment Sizes & Buildings

42. What are the various statutory requirements to be considered during layout?
State Industrial Development Corporation (SIDC)
Central / State Enviromental Pollution Control Boards (PCBS)
Factory Inspectorate
State Electricity Boards
Chief Controller of Explosives (CCOE)
Static & Pressure Vessel Rules (SMPV)
Tariff Advisory Committee
Aviation Laws
Chief Inspector of Boilers (CIB)
Oil Industry Directorate (OISD)
Food and Drug Administartion (FDA)
Ministry of Environment and Forest (MoEF)

43. What do you mean by Composite Flange?

The flange that is made up of more than one MOC is called a Composite flange.

a. Lap Joint Flanges

Insert Flanges are a specialty in the arena of pipe size flanges and consist of two parts - the insert and the flange ring. The flange ring is the outer part of the insert flange assembly, containing the bolt holes.

The two piece construction of the insert flange also offers the economy of matching the insert material to the process pipe (usually some corrosion resistant alloy) while the outer flange ring may be manufactured from steel. When the environment req uires the flange ring to be made of some alloy the rotating feature is still maintained.

b. RF flanges with Raised of one MOC and rest of the flange with different MOC

c. RF blind flange with an overlay of 90/10 Cuni for Sea water service.

44. What do you mean by Insulated Joint?

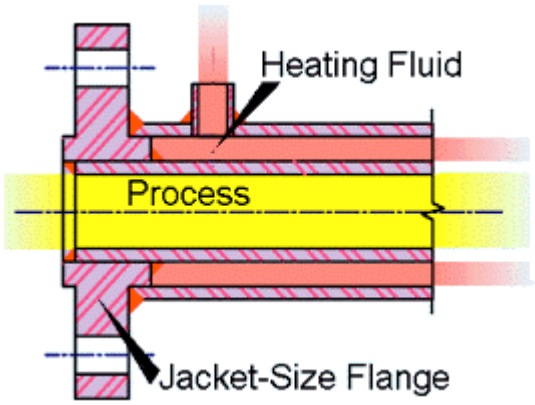
Ans: Insulating Joints are a prefabricated, non separable union used to isolate specific sections of Pipelines to prevent corrosion caused by stray electrical currents or interference from other pipelines and power transmission cables.

45. What are Insulating Gasket Kits?

Ans: Insulation gasket kits are designed to combat the effects of corrosion often found in flanged pipe systems. Galvanic corrosion between dissimilar metal flanges (flow of currents) , flange insulation associated with cathodic protection of underground piping are also the places where Insulating gasket kits are used. It consists of

Gasket	Neoprene faced Phenolic /Glass Reinforced Epoxy(G10)
Insulation sleeve	Reinforced Phenolic/Nylon/Polyethylene/(G10)
Insulation washer	Reinforced Phenolic/Nylon/Polyethylene/(G10)
Plated Washer	Electro plated steel washer

46. What do you mean by Jacketed Piping?
Ans:



Piping which is recognized as providing the most uniform application of heat to the process, as well as maintaining the most uniform processing temperatures where steam tracing is not capable of maintaining the temperature of fluid constant. Usually used for molten sulphur, Polymers service.

47. What is the min. distance to be maintained between two welds in a pipe

The rule of thumb is that the minimum distance between adjacent butt welds is 1D. If not, it is never closer than 1-1/2". This is supposedly to prevent the overlap of HAZ s.

Minimum spacing of circumferential welds between centrelines shall not be less than 4 times the pipe wall thickness or 25 mm whichever is greater.

48. What are the different hardness tests carried out?
Ans:
Brinell Hardness Test
Rockwell Hardness test
Vicker Hardness Test

49. What is the relation between Brinell Hardness No and Rockwell Hardness No?

Ans:

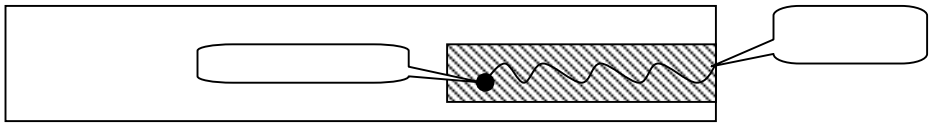
22 HRC (Rockwell Hardness) = 238 BHN (Brinell Hardness No)

Harder

1.During fabrication you observed that one small crack has appeared on a fresh plate, what type of measure you will take to obtain desired quality with minimum wastage?

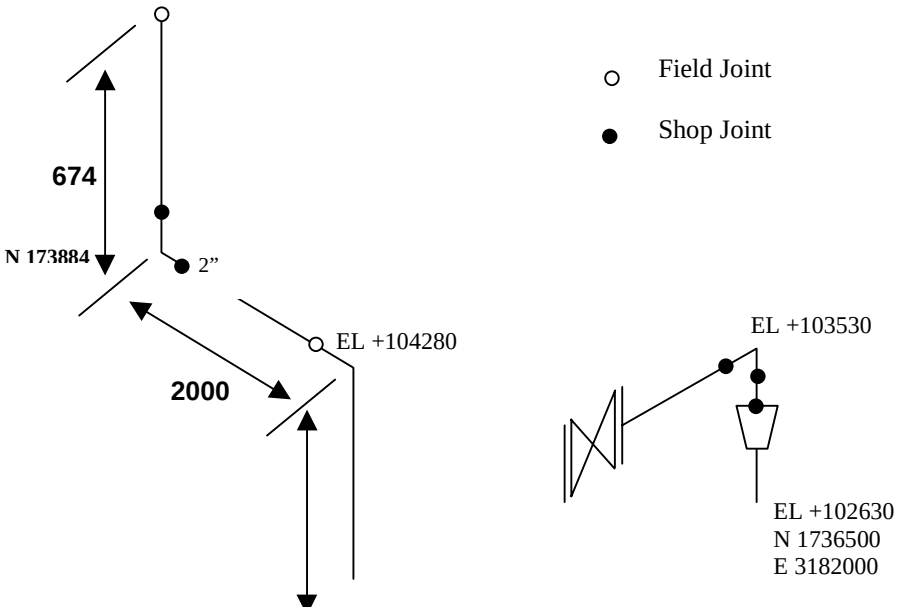
Answer:

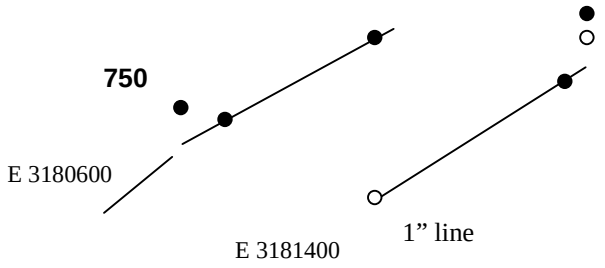
First identify the exact length of crack by DP test. Drill on the end point to resist further crack. Remove the crack portion by cutting the strip.



2. ISOMETRIC :-

i. What are the fittings required for fabrication of the isometric.
ii. Find out the length of pipe required.
iii. Do joint numbering and show the following things in the isometric.
   a) Shop joint
   b) Field joint
   c) Spool no





Answer:

- 2 INCH ELBOW – 4NOS
- 2 INCH WNRF FLANGE – 2NOS
- 2 INCH GATE VALVE – 1NO
- 2 x 1 INCH CONC. REDUCER – 1NO
- 1 INCH ELBOW 90 DEG – 1 NO
- 2 INCH PIPE - 4.210 MTRS
- 1 INCH PIPE – 1.424 MTRS

3. Describe different types of destructive and non-destructive tests?

Answer:

DESTRUCTIVE TEST: Bend test, Tensile test, Impact test, and Hardness test.
NON-DESTRUCTIVE TEST: DPT, MPT, Radiography and ultrasonic test

4. What is mean by 'PWHT'? Why it is required?

Answer:

"POST WELD HEAT TREATMENT" This is done to remove residual stress left in the joint which may cause brittle fracture.

5. What is the minimum thickness of pipe that requires stress relieving to be done as per B31.3?
Ans: 19 mm thk.

6. What is the difference between Thermostatic and Thermodynamic Steam Trap?
Ans: Thermostatic Trap is actuated by Temp differential and is economic at steam pressure less than 6 PSI. It is operated by the movement of liquid filled bellows or by bimetal element which may get damaged by Water Hammer.
Thermodynamic traps are most suited to applications where the pressure downstream of trap is always less than about ½ the upstream pressure. These are suitable for pressure higher than 8 PSI. Water hammer doesn't affect it.

7. What is the Code for Sour Service?
Ans: Code for Sour Service is NACE (NACE MR – 0175)
NACE: National Association of Corrosion Engineers.

8. How much should be the pressure for Hydro-Test?

Ans: Hydrotest pressure should be calculated as follow excecpt as provided against point no-4.

1. 1.5 Times of Design Pressure.

2. For a design temperature above the test temperature, minimum test pressure can be calculated as:

Pt = (1.5 X P X St) / S

Where:-

Pt: Minimum Test Pressure.

P : Internal design pressure.

St: Allowable stress at test temperature.

S : Allowable stress as design temperature.

(see SE in table A-1 or S in table B-1/2/3).

3. If a test pressure as per above would produce a stress in excess of the yield strength at test temp. the test pressure may be reduced to maximum pressure that will not exceed the yield strength at test temp.

4. If the test pressure of piping exceeds the vessel pressure and it is not considered practicable to isolate piping from vessel, the piping and vessel may be tested together at test pressure of the vessel when approved by owner and provided the test pressure for vessel is not less than 115% of piping design pressure adjusted for temperature as per point no 2.

9. How do you calculate the pipe spacing?

Ans: Pipe Spacing (mm) = (Do + Dt) / 2 + 25mm + Thickness of Insulation (mm).

Where: D0 : OD of Small size Pipe (mm).

Dt : OD of Flange of Large size Pipe (mm).

10. How do you calculate the width of Pipe rack?

Ans: W = (f X n X s) + A + B.

Where: s=

f : Safety Factor

= 1.5 if pipes are counted from PFD.

= 1.2 if pipes are counted from P&Id.

n : number of lines in the densest area up to size 450 NB

= 300 mm (estimated average spacing)

= 225 mm (if lines are smaller than 250 NB)

A : Additional Width for –

- Lines larger than 450 NB.
- For instrument cable tray / duct.
- For Electrical cable tray.

s : 300 mm (estimated average spacing)
: 225 mm (if lines are smaller than 250 NB)

B : future provision

= 20% of (f X n X s) + A

11. Which fluid is used in Heat Exchanger in shell side and tube side?
Ans: Generally corrosive fluid is used from the tube side (as tube can be easily replaced) and cleaner fluid is used from shell side. Sometimes Hot fluid is also used from the shell side.

12. What is Reynold's number and what is the value of Reynold's number upto which the flow is laminar?

Ans: It's a dimensionless number to classify the nature of flow.

Re=□vd/□

Where: Re : Raynold's no.
□□□ass Density of fluid.
d : diameter of Pipe.
V : average velocity of fluid.
□□Viscocity of fluid.

Flow is laminar upto Re=2100

13. What are Glandless Piston Valves. Where these are used?
Ans: Glandless piston valves are maintenance free valves used in the steam service.
14. How do you carry out Estimation?
Ans:

1. **Input from Bid:-**

- P&Id, Line list, Temperature, Pressure.
- Overall Plant Layout and Piping corridor plan.
- Scope of work and the Specifications for the Job.
- Specifications for materials like PMS and VMS.

2. **Value Addition:-**

- Items like Valves, Flanges, Speciality items, Reducers can be estimated from P&Id.
- Length of Pipes, Elbows, Width of Pipe Rack can be estimated by referring P&Id and Overall Plot Plan.
- No of Tires (on rack) can be estimated by referring the spacing required for pipes and also the space available.
- MTO for Steam Traps, Valves (for Vent and drain) can be calculated by using Thumb Rules.

3. **Loads:-**

- **Hydro Test Loads:** Can be estimated by assuming all the Pipes (on a grid) empty except some bigger size lines filled with Water.
- **Actual Operating Loads:** Gas lines to be considered as empty and rest of the lines to be considered as filled with the Fluid (which they are suppose to carry in operating condition).

The loads which ever is higher from above two cases should be referred for structural loading.

Stress

1. What is the objective of stress analysis?

Answer :

1. To ensure that the stresses in piping components in the system are within allowable limits
2. To solve dynamic problems developed due to mechanical vibration, fluid hammer, pulsation, relief valves, etc
3. To solve problems associated due to higher or lower operating temperature such as a) Displacement stress range b) Nozzle loading on connected equipments c) Pipe displacements d) Loads & moments on supporting structure

2. What are the steps involved in stress analysis (or any stress package carries out)?

Answer :

1. Identify the potential loads that the piping system would encounter during the life of the plant
2. Relate each of these loads to the stresses and strains developed
3. Get the cumulative effect of the potential loads in the system
4. Decide the allowable limits the system can withstand without failure as per code
5. After the system is designed to ensure that the stresses are within safe limits

3. What are the different types of stresses that may get generated within pipe during normal operation?

Ans: Axial Stresses (Tensile / Compressive), Shear Stresses, Radial Stresses, Hoopes Stresses.

4. How are the loads classified in stress analysis package?

Ans : a. Sustained Loads 2. Occasional Loads 3. Displacement Loads (Self limiting stresses due to thermal effects)

What are the Inputs for stress analysis of a piping system

i) Pipe Size ii) Fluid Temperature iii) Pipe Material
iv)Design pressure v)Insulation Thickness
vi)Specific gravity vii)Friction coeff. viii) Model

5. What are the sources of sustained loads generated in piping system?

Ans a. Pressure b. Dead weight of Pipe and attachments
Sustained load is calculated as
Weight of Pipe with Fluid + Pressure load + Load due to springs

W+P1

6. How do you calculate the operating load?

W+P1+T1

T1 – Load due to thermal expansion

7. Give some Examples for occasional Loads.

Wind, wave & earthquake

8. Mention some of Primary Loads (Have their origin in force)

Dead Weight, Pressure, forces due to relief or blowdown, force due to water hammer effects

9. Mention some of secondary Loads (Have origin in displacement)
Force on piping due to tank settlement
Vessel nozzle moving up due to expansion of vessel
Pipe expansion or contraction
Vibration due to rotational equipments

10. What is the failure theory subscribed under ASME B31.3?
(i) Maximum principal stress theory (Rankines Theory)
(ii) Maximum Shear Theory
(iii) Tresca Thory
Answer : (I)

11. What are the types of failures encountered in Piping?
Answer : 1. Catastrophic Failure 2. Fatigue Failure

12. Select the failure stress range for fatigue failure due to thermal expansion as per B31.3
(i) (1.6Sc+1.6Sh)f
(ii) 0.78 Sh
(iii) (1.25 Sc+0.25Sh)f
(iv) Sc+Sh

Answer : (III)
Sc and Sh –Basic Allowable material stress in cold & hot condtions respectively.
f ---- is the stress range reduction factor(1 for 7000 cycles

13. What is desired life cycle for Piping in operation?
Ans: Desired life cycle for Piping in operation is 20 Years (7000 Cycles).
The normal no. of cycles for which the displacement or thermal stresses are designed is
7000 cycles

14. How do you calculate the stress developed due to thermal expansion?

Stress developed = E x e/L

E – Young's Modulus
e- Increase in length due to thermal expansion
L – Original Length of the pipe

15. How do you calculate the thermal expansion in a pipe?

e= □ x L x Rise in Temperature
□ – Co.efficeint of expansion
L- Length of pipe

16. What do you mean by Stress Intensity Factor (SIF)? Give some examples.

Stress Intensity Factor (SIF) is the ratio of maximum stress intensity to normal stress. It is used as safe factor to account for the effect of localised stress on piping under respective loading. In piping it is applied to welds, fittings, branch connections etc where stress concentration and possible fatigue failure may occur.

Eg: SIF for Reducer and Weldneck Flange : 1.0
SIF for socket weld flange : 1.3

17. Which is the Criteria for Pipe Supporting?

Ans: Following are the points which should be taken into account for proper supporting –

- Load of bare pipe + fluid + insulation (if any).
- Load of bare pipe + waterfill.
- Load of valves and online equipment and instrument.
- Thermal loads during operation.
- Steam out condition, if applicable.
- Wind loads for piping at higher elevation, if required.
- Forced vibration due to pulsating flow.

Bare pipe with size above 12" shall be supported with Pad or Shoe

18. What is the basic span of supports for 2"/6"/10"/24" pipe.

Answer:

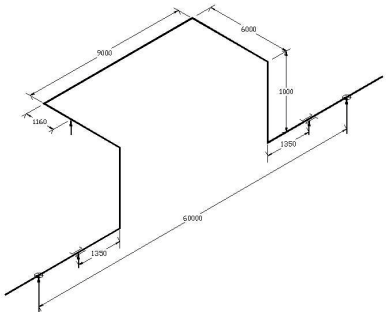
Basic Span is 5.5m / 9m / 11.5m / 15m respectively.

19. How do we decide the anchor / cross guide and guide for offsite rack piping

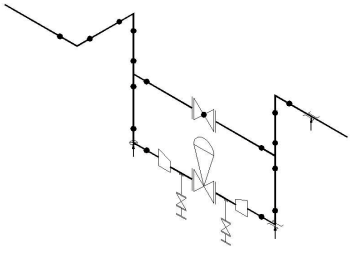
Answer:

Anchor is provided to restrict all the axial and rotational movements of Pipe, whereas Cross Guide is provided to restrict displacements of Pipe along with the axis perpendicular to it's centreline and Guide is provided to restrict the longitudinal movements of pipes along with it's axis.

20. Define a typical 6D loop supporting details (Anchor/Guide)



21. Provision of anchor / cross guide for control valve.



22. What are the things to be taken care of while doing pump piping?

Answer:
Pipe strain may distort equipment alignment, so welding should be done in such a way that the tension in the equipment flange is minimised

23. What is the Steam out condition?
Ans: Hydrocarbon lines are usually subjected to Steam Out condition and designed and anlysed at low pressure steam design temperature (should be minimum 180 degree C) or design temp. whichever is more . Lines having negative design temp. is analysed for both conditions seperately.

24. Where do you provide Anchor and Slotted Support of Heat Exchanger?
Ans: Anchor support of Heat exchanger is provided on the side from which Tube Bundle will be pulled out for the purpose of Maintenance work also it is based on the growth of the connecting piping as exchanger should grow with the piping.

25. What do you mean by Hoop Stresses and how do you calculate it?
Ans: Stresses which are generated circumferancially due to the action of Internal pressure of pipe are called as Hoop Stress. It is calculated by
Hoop Stress (Sh) = Pdo / 4t
Where P = Force Acting from Inside.
Do = OD of Pipe.
t= Pipe Thickness.

26. How does Hoop Stress affect the system?
Ans: As per membrane theory for pressure design of cylinder, as long as hoop stress is less than yield stress of Moc, the design is safe. Hoop stress induced by thermal pressure is twice the axial stress (SL). This is widely used for pressure thickness calculation for pressure vessel.

27. What is the design standard followed for the calculation of allowable forces / Moments in nozzles of centrifugal compressor & Steam turbines nozzle?

For strain sensitive equipment piping to be routed and supported to limit nozzle loadings and moments in equipment within allowable limits furnished by respective vendors or in absence of vendor data API 560/610/615/621/661 & NEMA SM23.

NEMA – SM 23 (Referred by API 617) is used for compressor & steam turbine nozzle.

28. What is the mill tolerence to be considered for the thickness of pipe during stress analysis as per ASME B31?

(i) 1%
(ii) 2.5%
(iii) 7.5%
(iv) 12.5%

Answer : iv

29. What is the purpose of providing Graphite Pads in supports below shoes?
Answer : To reduce the friction factor. The co-efficient of friction for Graphite Pads is 0.1

30. How is piping to Tank inlet nozzle is supported and why?

Ans: Piping to Tank Nozzle is supported with Spring type support (first support from Nozzle) in order to make the Nozzle safe from the loads which occurs due to the displacement of pipe (thermal expansion of pipe / tank material, tank settlement etc).

31. What are the two types of flexible spring hangers?
1. Constant Spring and 2. Variable Spring

32. What is the difference between Variable Spring Hanger and Constant Spring Hanger?

Ans: Variables use coiled springs to support a load and allow movement. The resistance of the coil to a load changes during compression, which is why these devices are called "variables". Constant Spring Hanger provides constant support force for pipes and equipment subjected to vertical movement due to thermal expansion at locations where maintaining a constant stress is critical. This constant resistance is achieved by having two moment arms pivoted about a common point. The load is suspended from one of these arms, and a spring is attached to the other. With an appropriate choice of moment arms and spring properties, a resisting force can be provided that is nearly independent of position.
Constant support hangers are principally used to support pipes and equipment subjected to vertical movement due to thermal expansion at locations where transfer of stress to other supports or equipment can be critical. The maximum recommended variation according to MSS standard from the operating load is 25% for variable spring hangers. If the variation exceeds 25%, a constant support hanger should be used.
The constant resistance to a load is achieved by combining a spring coil with a cam which rotates about a main pivot point. The cam is designed such that the distances from the main pivot changes to compensate for the variable resistance during compression of the coil. The MSS standard provides for a tolerance of 6% in the constant load through the travel range. Constant support hangers are designed per MSS, ANSI, and ASME standards.
The sizing of constants primarily depends on the total travel and load.

33. How much should be the difference between the load which will be taken by Variable Spring Hanger during Cold and Hot condition of Pipe?
Ans: It should be Maximum 25% of Load for which Spring is designed.

34. Differentiate between static load and dynamic load.
Ans: A piping system may respond far differently to a dynamic load than it would to a static
load of the same magnitude. Static loads are those which are applied slowly enough that the system has time to react and internally distribute the loads, thus remaining in equilibrium. In equilibrium, all forces and moments are resolved (i.e., the sum of the forces and moments are zero), and the pipe does not move.

With a dynamic load—a load which changes quickly with time—the piping system may not have time to internally distribute the loads, so forces and moments are not always resolved—resulting in unbalanced loads, and therefore pipe movement. Since the sum of forces and moments are not necessarily equal to zero, the internally induced loads can be different—either higher or lower—than the applied loads.

35. Give different types of dynamic loads with example
Ans:
1. Random – Wind, Earthquake

2. Harmonic – Equipment Vibration, Pulsation, Acoustic Vibration
Impulse – Fluid Hammer, relief valve opening, slug flow
76. What is Dynamic Analysis and why it is used?
Ans: Dynamic analysis is performed for all two phase lines in order to ensure that the line supported is safe from vibrations loads which may occur during normal operation as well as in start up or any upset condition.(Diesel mixed with hydrogen in DHDT process)

36. What is WRC 107 / WRC 297?

Ans: Localised stresses at Nozzle to Shell is calculated by WRC 107 / 297 and these computed stress values shall be limited in accordance with ASME Sec VIII for Pressure Vessels.

37. How to get the Foundation Loads?
Ans: Foundation Loads for pipe rack should include the loads of Pipes, Cable Trays and Instrumentation duct at that location and also the design load for future tier shall be full load of the most heavily loaded tier in addition to all other wind/seismic/fraction and piping thermal loads for future pipes.

Load of pipes filled with water(Largest of **1st case** – During hydrotesting dead weight(wt/m X piperack spacing) of pipes + 2 –3 maximum size pipes filled with water **2nd case** – Actual commissioned condition except the gas lines) + Proportionate wt of extra space required by client (normal 30%) + Load of 1 heavily loaded tier + Electrical cables + Instrument duct + Guide load for 50% of lines

Guide Load = 0.3X(Dead wt of pipes at including water)
The maximum induced thermal loads on the Anchor at the battery limit shall be limited to
F in kg <= 150 X NB of pipe in inches (It should be <2 tonnes)
M in Kgm <=75 X NB of pipe in inches.

Horizontal Load = 0.3 X (Dead wt of pipes including water)
This load is used for designing of foundation bolts.

Foundation loads for any vessel having agitator mounted on top should contain weight of tank at operating or design condition (whichever is more) plus 20% of it for dynamic loading.

38. What is the maximum expansion absorbed in loops in normal design?

Ans:10 Inches

39. What is the limiting factor in deciding the length of the spool in Jacketed piping?
Ans: Force exerted by dissimilar expansion of inner pipe = Force exerted by dissimilar expansion of jacket pipe

The stress developed due to this should be within limits as per ANSI B31.3

(Also fabrication constraints)

40. What is the factor to be checked concerning the expansion of header attached to air cooler piping?
Ans: Vendor drawing to be checked to see how much movement is permitted to compensate line expansion. To accommodate the diff. Expansion between inlet and outlet (The inlet temperature >The outlet temperature) offset can be built in to outlet piping to compensate for diff.expansion.

Since the tubes are of floating design the nozzle flange is of 150# and loads transferred are to be kept minimum.

Since the tubes are of floating design, the nozzle flange is 150#. Load of the nozzle to be kept minimum.

41. What is the maximum no. of cell nozzles connected to a single header of air cooler piping header in normal practice?
Ans: Six nos.

42. What is fluid hammer and how it is generated?

Ans: When the flow of fluid through a system is suddenly halted at one point, through valve closure or a pump trip, the fluid in the remainder of the system cannot be stopped instantaneously as well. As fluid continues to flow into the area of stoppage (upstream of the valve or pump), the fluid compresses, causing a high pressure situation at that point. Likewise, on the other side of the restriction, the fluid moves away from the stoppage point, creating a low pressure (vacuum) situation at that location. Fluid at the next elbow or closure along the pipeline is still at the original operating pressure, resulting in an unbalanced pressure force acting on the valve seat or the elbow.
The fluid continues to flow, compressing (or decompressing) fluid further away from the point of flow stoppage, thus causing the leading edge of the pressure pulse to move through the line. As the pulse moves past the first elbow, the pressure is now equalized at each end of the pipe run, leading to a balanced (i.e., zero) pressure load on the first pipe leg. However the unbalanced pressure, by passing the elbow, has now shifted to the second leg. The unbalanced pressure load will continue to rise and fall in sequential legs as the pressure pulse travels back to the source (or forward to the sink). The ramp up time of the profile roughly coincides with the elapsed time from full flow to low flow, such as the closing time of the valve or trip time of the pump. Since the leading edge of the pressure pulse is not expected to change as the pulse travels through the system, the ramp down time is the same. The duration of the load from initiation through the beginning of the down ramp is equal to the time required for the pressure pulse to travel the length of the pipe leg.

43. What is the purpose of expansion bellows?
Ans: Expansion bellows are used absorb axial compression or extension, lateral shear or angular torsion developed in the pipes (specially near nozzles)

44. You have to connect a 20” pipe to a manhole of existing tank , how will you go about in carrying out the suitability of the manhole flange.

45. What should be the material of shoes for supporting AS pipes & why?
Ans: If CS shoes are used Pad in contact with the pipe to be of Alloy steel to avoid dissimilar welding at pipe. To avoid alloy steel welding and dissimilar welding fabricated clamps either of CS or SS can be used.

46. What is the allowable stress range for CS pipes.
Ans: 2070 kg/cm^2

47. What are sway braces?
Ans: Sway Braces are essentially a double-acting spring, housed in a canister. Unlike variable effort supports, Sway Braces are not intended to carry the weight of pipework; their purpose is to limit undesirable movement. Sway Braces act like a rigid strut until a small preload is reached, whereafter the restraining force increases in proportion to the applied deflection. *Fig. 1*

Undesirable movement can occur due to many phenomena, such as wind loading, sympathetic vibration, rapid valve closure, relief valves opening, two phase flow or earthquake. It may be necessary to limit this type of deflection to prevent the generation of unacceptable stresses and equipment loadings.

The Sway Brace is a cost-effective means of limiting pipework deflection. It should be noted however that it does provide some resistance to the thermal movement of the pipework and care should be taken when specifying to ensure that this is acceptable. Installation of Sway Braces will have the effect of raising the fundamental frequency of vibration of a pipework system; this is likely to reduce undesirable deflections. Sway Braces are often used to solve unforeseen problems of resonant vibration. For situations where the resistance to thermal movement provided by Sway Braces is unacceptable, you are referred to Pipe Supports Limited's range of hydraulic snubbers and dampers.

48. Give a typical stress report including input and output and what is interpreted form the output.

49. For offshore structures what analysis is performed by Caesar.

50. In an offsite pipe rack change in direction during analysis it is found two adjacent pipes are having unequal expansion with the inner pipe having 50 cm thermal expansion. What can be done to eliminate collision during hot condition.
Ans: Use Cold Pull technique. Calculate the thermal expansion of the inside pipe, cut an equal length form the elbow joint and then reweld with a shorter length to take care of expansion in hot condition.

51. What are the Insulation material used for piping systems.
Ans:
1. Fibrous – Rock & Glass Wool
2. Rigid - Calcium silicate, Polyisocyanurate, cellular Glass