PIPING QUESTIONNAIRE

1) What are the points to be checked for the Reinstatement?
   
   - Flushing & hydro test complete and documented as accepted.
   - All test vents & drains plugged and seal welded
   - Lines drained and lay-up per customer approved specification
   - Valves (400 SS Trim) tested in-line removed, cleaned, & lubricated for Ambient lay-up
   - Jacking screws, process blinds (spectacles, spades, etc) correctly installed
   - Spring Hangers & components (bellows, etc) adjusted per mfg instructions.
   - Weep holes plugged with heavy grease (reinforcement pad air test complete)
   - Chain wheel operators installed
   - All instruments, control valves & check valves reinstalled in correct flow position
   - Restriction orifice/flow elements installed
   - Relief Valves are Pop tested/calibrated, tagged and SAP approved/installed
   - All Temporary Test Components (spools, test blinds, gaskets etc) are removed
   - Correct bolts/gaskets are installed and torque.
   - Check Valves and internals reinstalled (Internal Cleanliness & gasket check)
   - All Start-up items installed (strainers, filters, other items restricted from test)
   - Chemical Cleaning completed and documented
   - Final Line Check complete & meets all special process specs. See Spec Check.

2) What are the general points to be checked prior to hydro test? (pre-pressure checklist)
   
   - Seal weld threaded nipples from headers to root valves at (5) locations (hydrocarbon service) per JERES-L-109
   - Guides are in direct contact with piping horizontal run at 3 locations (6mm gap required). Relocate guides per drawing. These are welded to the pressure boundary.
• Check valve upstream clearance is not five (5) pipe diameters (40" required, 20" actual), in violation of JERES-L-108.

• Check valve is oriented in the wrong direction (flow arrow). Reverse check valve to assure correct flow direction. Reposition valve & restore internals immediately after test, COMPANY to witness.

• Piping clearance to structural bracing is 15 mm in violation of JERES-L-310, Sect 12. (50 mm spacing required). Engineering!

• Install permanent gaskets at flange sets 1, 4, 5, 6 on ISO dwgs per approved torque tables and install spectacle blinds oriented as per approved P&ID.

• Completely remove all water and debris from low point/valve cavity for the (3) in-line Valves (8" - 300 #) with SS 400 trim, do so immediately after test. Clean with dry compressed air and re-lubricate sealing surfaces with approved lubricant in preparation for "ambient" lay-up specified in test package.

• Indicate " No Punch items. " as applicable QA is reviewed/initialed/dated prior to package certification to verify completeness.

3) What are the general criteria checked for line-checking?

• All joints (flange, threaded, welded or mechanical seals) are left exposed for visual leak detection during the strength test.

• All permanent flange joints were inspected, gasket mat'l verified & properly torqued.

• Drains shall be provided at all low points of the piping system.

• Vents and drain valves, both temporary and permanent, conforms with the piping class or rating.

• Supports are installed. Additional temporary support may be installed as required.

• Expansion joints and spring hangers or spring supports are provided with temporary restraints.
• Arc strikes, gouges, and other indications of careless workmanship (such as surface porosity, uneven weld profiles, and undercut) shall be removed by grinding and inspected by magnetic particle or liquid penetrant method.
• Drains are provided immediately above check valves (vertical lines)
• All threaded joints up to the first block valve of hydrocarbon pipeline are seal welded. Thread engagement has been verified & accepted.
• The pressure testing manifold is separately pressure tested to at least 1.2 times the system test pressure but not less than the discharge pressure of the pump used for the pressure testing.
• Pressure gages and pressure recorders are calibrated within one (1) month before the test. Check stickers at the time of the test.
• Line compliance with Isometrics:
  A) Correct Materials utilized grade/schedule (Bill of Mat'ls)
  B) Correct flange and fittings rating
  C) Construction tolerances per JERES-L-350

4) Define Hydrostatic Test, Pneumatic Test, Pressure Test, Service Test

Hydrostatic test-A pressure test conducted using water or other approved liquid as the test medium.

Pneumatic Test- A pressure test conducted using air or other approved gas as the test medium or in conjunction with liquid.

Pressure Test- A test conducted to piping or equipment by subjecting it to an internal pressure using liquid or gas to ensure strength or tightness of the system at the test pressure.

Service Test- A leak test conducted at operating pressure using the service fluid.

5) What are the formats/ reports in a hydro test package?
   a) Table of contents
   b) Safety Instruction sheet for critical services
c) Flow Chart of Test Packages

d) Pre-Test Punch List

- Test Procedure & Pressure Test Diagram
- Related P&ID and Isometric Drawings
- Line List
- Pre-test Punch List Checklist I Form

e) QA/QC Documentation of the system to be tested.

- Weld Inspection Summary Sheet
- Weld Map
- NDE Record/s
- As-Built drawings
- Isolation valve Test Certificates
- Flange Joint Inspection Report
- Internal Cleanliness I Flushing Report

f) Pressure Testing

- Verification of Temporary gaskets
- Verification of Test blind rating
- Checklist for Verification of system readiness for Testing
- Calibration certificates for Pressure gauge & PSV
- Calibration certificates for Pressure & Temperature recorders
- Test manifold Certificate
- Water Analysis (test medium)
- Pressure Test Report Form
- System Lay-Up Certificate
- Re-Instatement or Final Assembly Inspection (Final Punch List)
6) What are the general requirements for test manifold and fittings?

- Pressure testing manifolds were separately pressure tested to at least 1.2 times system test pressure.
- Pressure rating or design of test manifold components (isolation valves, pipe nipples, fittings) exceed system test pressure by 20%.
- A blow down valve of adequate pressure rating is installed to depressurize the system safely.
- Test piping, fittings and hoses are designed or have adequate pressure ratings that match or exceed system class/ test pressure.
- Paddles or spectacle blinds & other fabricated test items used to isolate test sections are at least the same code class rating of systems under test.

7) What are the general requirements for test relief valves?

- Relief valve is located in the system under test and near the test pump with Isolation valves on the inlet and outlet of the relief valve sealed open during the test.
- Relief valve(s) of adequate capacity are set to relieve at 5%* above the hydrotest pressure.
- Relief valve(s) are tested, dated, and tagged (as valid) for a period of one week for project pressure tests. Stickers are legible & valid.

8) What are the general requirements for pressure gauges and recorders?

- A minimum of two pressure gages are required for test systems, with accuracy within 5% of one another.
- Pressure gages and pressure recorders are calibrated within (1) month prior to test. Stickers applied indicate latest calibration date.
- Test gauge is located at bottom of any equipment/system under test to enable reading test pressures inclusive of hydrostatic head.
- All gauges have a range such that the test pressure is within 30% to 80% of the full range.
9) What are the general requirements for Filling & Pressurization?

- Filling & pressurization is done upstream of check valves in system. Test fluid enters (shall be drained) at the lowest point in the system. All vents are open during filling. Minimize Trapped air.

- Remove air during filling by the following measures:
  A) Design/Plan Tests. Provide high point vents.
  B) Mechanically (Use scrapers as needed to remove air).
  C) On initial pressurization, pressure holds AFTER equalization at 50% test pressure. Gauge drops indicate a leak (acceptable for efficiency) or "inefficient" test crews leaving air in lines (unacceptable).

- After venting, valves used for venting are placed in the partially open position and plugged or blinded as applicable.

- Preliminary check for leaks at 50% of the strength test pressure was performed. Test crews were efficient in filling practices.

10) What are the general requirements for test pressure & duration for pressure testing of pipelines?

- Lube and seal oil piping shall be pressure tested with its own fluid. The test pressure shall be 1.5 times the design pressure or 690 kPa (100 psig) whichever is the greater. Test duration shall not be less than 30 minutes, to determine that there are no leaks.

- Underground process piping shall be tested prior to backfilling. The test pressure shall be maintained for a 4 hrs. If for justifiable safety reasons the line must be backfilled, then the joints shall remain exposed during testing, otherwise the test shall be a 24 hour recorded test.

- Flare lines 24-inch NPS and larger* with a design pressure of 517 kPa (75 psig) or lower may be pneumatically strength tested in accordance with paragraph 345.5 of ASME B31.3.
Piping in vacuum service shall be pressure tested to 1.5 times the differential external pressure not less than 100 kPa (15 psig). Test duration shall not be less than 30 minutes, to determine that there are no leaks.

Plant utility piping in air & inert gas services with designed pressure & equal to less than (150 psig).

Low pressure steam piping designed for 60 psig or less.

11) What are the tolerances to be followed in piping?

- The tolerance for axial dimensions, face-to-face, center-to-face and location of attachments shall be ±3 mm maximum.

- Flattening of bends, measured as the difference between the largest and the smallest outside diameter at any cross section, shall not exceed 5% of the nominal diameter of the pipe. Flattening of bends at weld ends shall not exceed 3% of the nominal pipe diameter.

- Lateral transition of branches and connections from the centreline of the run shall not exceed ±1.5 mm.

- Flange bolt holes shall straddle the established centerlines. Rotation of flanges, measured as the offset between elevations of bolt holes on opposite sides of a flange centerline, shall not exceed ±2.4 mm.

- The tilt of a flange measured at the periphery across any diameter shall not exceed 1.6 mm from the square position.

- For piping over 3-inch NPS connected to machinery/equipment, flange alignment shall be within the following limits
  a) Vertical bolt hole offset: ±2.4 mm
  b) Horizontal bolt hole offset: ±2.4 mm
  c) Rotational offset: ±2.4 mm
d) Flange face tilt across diameter: 0.001 inch per inch of flange outside diameter up to a maximum of 0.030 inch, and 0.010 inch for all flanges with an outside diameter less than 10 inches.

e) Flange face separation, gasket thickness: ±1.6 mm

f) Combination of vertical, horizontal and rotational offset: ±3.2 mm

If a spectacle plate is installed between two flanges, these tolerances can be increased by 30% except for tolerances for flange face tilt across diameter and flange face separation.

12) For the verification/traceability of materials what are the different procedures to be used?

- PMI – Positive Material Inspection (JERES-A-0206)
- Marking & Colour Coding (PFI-ES-11, PFI-ES-22 - Piping Fabrication Institute)
- Spools are stamped, stencilled, or clearly marked with a permanent marking method, properly colour-coded and uniquely identified, labelled & traceable to Isometric Drawings (JERES-L-350)

13) What are piping joint limitations?

- Socket Welded pipe in hazardous services is 1½-inch maximum
- For sour service, socket-welded joints are not allowed.
- The axial gap between male and female components a maximum of 3 mm and minimum of 1.5 mm. This gap is obtained prior to welding
- In hazardous services, the maximum size of threaded connections is 1½-inch for standard fittings and valves
- In non-hazardous services, the maximum size of threaded connections is 3-inch for standard fittings and valves
- The minimum number of the engaged pipe threads per nominal size is as follows:
- For 1/2" & 3/4", 6 threads must be engaged
- For 1" through 1-1/2", 7 threads must be engaged
- For 2" through 3", 8 threads must be engaged

14) **What are the special welding activities?**
   A) Branch connections
   B) Tie-ins
   C) Sleeve installations
   D) Hot-tap & Stopple Installations
   E) Temperature tie-ins

15) **What are the acceptable branch connections and fittings? Also mention the limitations?**

**Chart 1 – Branch Connections**

| Header Size | 0.5 | 0.75 | 1 | 1.5 | 2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 | 30 | 40 | 48 | 56 | 60 |
|-------------|-----|-----|---|-----|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Branch Size | 0.5 | 0.75 | 1 | 1.5 | 2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 | 30 | 40 | 48 | 56 | 60 |

**Legend**
- Region 1: Equal Tee
- Region 2: Reducing Tee
- Region 3: Reducing Tee or branch weld with reinforcing pad or full encirclement sleeve
- Region 4: Welded or branch weld with reinforcing pad
- Region 5: Weldolet, Socketelet, Threadolet or Welding boss per SASD AE-03175 and AE-036643
- Branch connections on any fittings are not allowed
- Branch connection is not a dead leg with any internal corrosion concerns.
- Branch connections 4 inch and smaller (drain and vent valves and drip legs of all sizes excluding dummy legs) are spaced a minimum horizontal distance of 24 inches from fixed supports/obstructions.

17. What are the general conditions to be checked for flange joint inspection, bolting and gasket verification?

- Pressure rating of mating flanges conforms with the line specification noted in piping.

<table>
<thead>
<tr>
<th>First Field of Line Class</th>
<th>Nominal Pressure Rating, Flange Face</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ASME B16.5/B16.47 Flange Class)</td>
</tr>
<tr>
<td>1</td>
<td>150 RF</td>
</tr>
<tr>
<td>3</td>
<td>300 RF</td>
</tr>
<tr>
<td>6</td>
<td>600 RF</td>
</tr>
<tr>
<td>9</td>
<td>900 RJ</td>
</tr>
<tr>
<td>15</td>
<td>1500 RJ</td>
</tr>
<tr>
<td>25</td>
<td>2500 RJ</td>
</tr>
<tr>
<td>(ASME B16.1 Cast Iron Flange Class)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>125 FF</td>
</tr>
<tr>
<td>13</td>
<td>250 RF</td>
</tr>
<tr>
<td>(Specific Rating Designations)</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Non-pressure FF</td>
</tr>
<tr>
<td>85</td>
<td>Pressure Class 75/150 RF</td>
</tr>
<tr>
<td>90</td>
<td>Class 3000, API 6A, RJ</td>
</tr>
<tr>
<td>95</td>
<td>Class 10000, API 6A, RJ</td>
</tr>
</tbody>
</table>

- The flange facing, particularly the seating area, is clean and no damage (such as scratches) in excess of the permissible imperfections
- Gasket type was verified to be compatible with the flange facing.
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>Flat face flanges for most acid services up to 70% concentration and to 65°C. &lt;br&gt;Full face synthetic rubber gasket, ASTM D1418 Class CSM. (JERES-L-109, Para. 11.3.4)</td>
</tr>
<tr>
<td>9.</td>
<td>Flat face flanges for sulfuric acid above 70 percent concentration (including oleum), and nitric acid (all concentrations). &lt;br&gt;Full face ASTM D1418 class FKM elastomer. (JERES-L-109, Para. 11.3.4)</td>
</tr>
<tr>
<td>10.</td>
<td>Raised face flanges for sulfuric acid above 70 percent concentration (including oleum), and nitric acid (all concentrations). (NOTE: The flange finish shall be 3.2 to 6.4 micrometers Ra.) &lt;br&gt;PTFE-filled spiral wound Alloy 20 stainless steel with stainless steel inner ring. (JERES-L-109, Para. 11.3.4)</td>
</tr>
<tr>
<td>11.</td>
<td>Flanges used in other acids &lt;br&gt;Type of gasket requires approval by the Chairman of Piping Standards Committee in CSD. (JERES-L-109, Para. 11.3.4)</td>
</tr>
</tbody>
</table>

- Gaskets are free from any damage particularly in the seating element.
- Not more than one gasket is used between mating surfaces of flanges. Gaskets shall be suitable for intended service & compatible with the flange facing, the strength of the flange, and bolting.
- The ring gaskets have the following identification:
  a. manufacturer's name or identification trademark
  b. gasket number prefixed by the letters R,RX,or BX followed by the gasket material identification.
  c. The gasket is marked with an ASME B 16.20 designation.
- The spiral wound gasket has the filler flush with the metal windings, not below the metal windings.
- Spiral Wound gasket for use in operating temperatures below minus 45°C has guide rings made of type 304 stainless steel material.
- Spiral-wound gaskets are marked with a color code
- Bolts and nuts have no physical damage to shanks or threads.
- Stud bolts and nuts have identification markings and verified to be suitable to the service temperature as follows:
  A. Materials for Process and general services:
a. (-20 to 450°C)  A193 Gr B7/A194 Gr 2H

B. Materials for Low Temp Services:
b. LT (-18°C to -101°C)  A320 Gr L7/ A194 Gr 4 or 7
c. LT (-18°C to -73°C)  A320 Gr L7M/ A320 Gr 7M
d. LT up to -30°C  A193 Gr B7/A194 Gr 2H
e. LT up to -45°C  A193 Gr B7/A194 Gr 7M

C. Materials for upper intermediate temperature services:
a. t=Up to 450°C  A193 Gr B7 or B7M/A194 Grade 7 or 7M
b. t=450 to 510°C  A193 Grade B16/ A194 Grade 7

D. For sour service, no direct exposure or bolts are not covered:
a.  A193 Gr B7/A194 Gr 2H
b.  A320 Gr L7/ A194 Gr 4 or 7

E. For sour service, direct exposure or bolts are covered:
a.  A193 Gr B7M/ A194 Gr 2HM
b.  A320 Gr L7M/ A320 Gr 7M

Flat-faced cast-iron or non-metallic flanges in non-sour service:
a.  A307 Gr B/A563 Gr D

- Bolt Length: Bolts extend completely through their nuts (full thread engagement).

18. What are the criteria for cold bending?
- Cold bends are made below 649°C. (below 315°C for grades of pipe strengthened by cold work).
- Only seamless Grade B pipes are be used.
- For wet sour service, cold bends to a radius of 5D or less, are heat treated at 593°C to 649°C for one hour per 25.4 mm of nominal wall thickness, and not less than one hour.
- For cold bends with a radius of less than 30D, the nominal diameter (O.D.) divided by the nominal wall thickness does not exceed 35.0.
- For wet sour service, each bend has a hardness measurement made at the outer radius of the bend area. Maximum allowable hardness is 237 Brinell (22 HRC).

19. What are the criteria for hot bending?
- Furnace hot bends are only be used for Grade B pipe
- Furnace hot bends are made at 871°C to 954°C, but may be finished below 871°C provided the bend is started above 871°C. The pipe is not heated above 954°C prior to the start of bending. After bending, the bend is cooled in still air.
20. Why do we provide Drip Leg in Steam Line?
   • To remove condensate when there is a rise of same in the pipe along the flow direction. If drip leg is not provided in steam line, the condensate which forms inside the pipe will result in Water Hammer effect causing damage to piping system.

21. What are the different types of hardness tests carried out?
   • Brinell Hardness Test.
   • Rockwell Hardness Test.
   • Vicker Hardness Test.

22. What is the function of providing the anchor, cross guide and guide for piping?
   • 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 its centerline and Guide is provided to restrict the longitudinal movements of pipes along with its axis.

23. What should be the content of chlorine in water while conducting hydrotest for CS & SS pipes?
   For SS pipes - should not be greater than 50 ppm
   For CS pipes - should not be greater than 250 ppm.

24. What do you mean by Jacketed Piping?
   • 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.

25. What are the different types of mating flanges and where they are generally used?
   Slip – on. : - The Slip-on type flanges are attached by welding inside as well as outside. These flanges are of forged construction.
   Socket Weld. : - The Socket Weld flanges are welded on one side only. These are used for small bore lines only.
   Screwed. : - The Screwed-on flanges are used on pipe lines where welding cannot be carried out.
   Lap Joint. : - The Lap Joint flanges are used with stub ends. The stub ends are welded with pipes & flanges are kept loose over the same.
   Welding Neck. : - The Welding neck flanges are attached by butt welding to the pipe. These are used mainly for critical services where the weld joints need radiographic inspection.
   Blind. : - The Blind flanges are used to close the ends which need to be reopened.
Reducing: - The reducing flanges are used to connect between larger and smaller without using a reducer. In case of reducing flanges, the thickness of flange should be that of the higher diameter.

Integral: - Integral flanges are those, which are cast along with the piping component or equipment.

26) What is the procedure for stud bolt tightening?

**Stud Bolt Tightening Procedure**

Step 1  Align flanges and gasket. Forced tightening is not allowed to overcome non acceptable alignment tolerances. Clamp securely in place.

Step 2  Apply lubricants to stud threads over length and nut engagement and to face of nut which contacts flange. Ensure that the nuts run freely down the thread of the studs.

Step 3  Install all studs and nuts hand tight, ensure that studs pass freely through the flange holes. Position the nut on one end of the stud such that only the crown of the stud projects beyond the face of the nut. The excess stud length should project beyond the nut on the other side.

Step 4  Number each stud according to its position in the flange as shown on Figure 1: Stud Bolt Tightening Sequence.

Step 5  For insulating gaskets like PIKOTEK, enough gap (½” of gap is recommended) should be available between flange faces to avoid any damage to seals during inserting the gaskets, if due to any reasons, seals are damaged, change the seal before installing PIKOTEK.

Step 6  Matting flange faces and the gaskets should be dry and free from grease, oil or water.

Step 7  Tighten studs per the Stud Bolt Tightening Sequence, for 4 to 32 bolts use Figure JERES-351-01 and for 36 to 68 bolts see Figure JERES-351-02 for bolts numbering and then follow the tightening sequence of Table JERES-351-04. An appropriate tool should be used such as an air impact wrench or equivalent.

Step 8  For joints containing RTJ or Spiral Wound Gaskets, repeat step 7.

Step 9  Tighten the stud bolts in stages to obtain the final required torque from the appropriate torque Table-JERES-351-02. The first stage should not be more than 30% of the final torque. The final torque shall be within ±5% of the required torque value.
28) What are the services used for piping?

- Cryogenic temperature service (service temp. -50°C and minimum metal temperature as low as -150°C)
- High temperature service (service temp. and maximum metal temperature as low as 538°C)
• Intermediate temperature service (service temp. 29°C to 425°C)
• Low temperature service (service temp. and minimum metal temperature as low as 45°C)
• Category D Fluid Service: the design temperature is from −29°C (−20°F) through 186°C (366°F)
• Normal Fluid Service: a fluid service pertaining to most piping covered by this Code, i.e., not subject to the rules for Category D, Category M, or High Pressure Fluid Service.

29) Which gasket is generally used as a substitute for spiral wound gaskets and what are their applications?
   • Metal grooved gaskets are the alternative for spiral wound gaskets in piping systems.
   Recommended for following services
   • Piping system subject to daily temperature cycling of 200°C.
   • Flanges of 36 inch diameter and larger
   • High temperature service piping system of 350 & higher.

30) What are PIKOTEK Gaskets and what are their limitations?
   • It is non-metallic gaskets made of self-energized Teflon seal supported by glass reinforced epoxy laminated to 316 stainless steel core.
   • The minimum required gap shall be 3.2 mm.
   • It shall not be used services with temp. 154°C or higher
   • It shall not be used in hydrocarbon gas service in which flange rating is 300 or higher.
   • It shall not be used in Chemical incompatibility of non-metallic component with the service media.

31) What are jackscrews and when are they required?
   • They are located at flanged connections to facilitate maintenance and removal of spectacle and orifice plates to facilitate maintenance.

32) What is often overlooked during orifice flange fabrication?
   • Grinding butt welds flush and seal welding orifice.

33) What NDT methods are required during orifice flange installations?
   • Visual and PT/MT
34) What is cold spring?
- Application of mechanical stress (bending twisting pulling) upon a piping segment to achieve bolting and connection to another segment.

35) How many threads can be visible after seal welding threaded joints?
- Zero, seal welding must cover all threads.

36) What is the minimum fillet weld size for a socket welded connection?
- 1-1/4t but not less than 3.2mm.

37) What are common failures in the quality system during fit up that leads to hydrotest failures?
- Failure to properly clean, deburr and degrease fittings and piping prior to welding. Oil residue from cutting causes through weld porosity and leakage during hydro tests.

38. How to describe a piping line class description?

<table>
<thead>
<tr>
<th>Representation</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Fifth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eg:</td>
<td>103</td>
<td>CH</td>
<td>2</td>
<td>S</td>
<td>M</td>
</tr>
</tbody>
</table>

| Explanation    | Flange face rating | HIC carbon resistant steel | 3 mm corrosion allowance | Wet H2S sour service | Category M service |

39. What is the corrosion allowance factor in piping line class?

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Corrosion allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1.5 mm</td>
</tr>
<tr>
<td>2</td>
<td>3 mm</td>
</tr>
<tr>
<td>3</td>
<td>4.5 mm</td>
</tr>
<tr>
<td>4</td>
<td>6.0 mm</td>
</tr>
<tr>
<td>9</td>
<td>Corrosion allowances for specified cases</td>
</tr>
</tbody>
</table>

40. What are the service groups in piping line class?

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Acid</td>
</tr>
<tr>
<td>B</td>
<td>Boiler external and piping joint</td>
</tr>
<tr>
<td>C</td>
<td>Caustic</td>
</tr>
<tr>
<td>----</td>
<td>-----------------</td>
</tr>
<tr>
<td>D</td>
<td>Amine</td>
</tr>
<tr>
<td>E</td>
<td>Catalyst and slurry</td>
</tr>
<tr>
<td>F</td>
<td>Flare</td>
</tr>
<tr>
<td>H</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>J</td>
<td>External jacketing fluid</td>
</tr>
<tr>
<td>N</td>
<td>Ammonium disulphide</td>
</tr>
<tr>
<td>P</td>
<td>Process</td>
</tr>
<tr>
<td>Q</td>
<td>Chlorination gas</td>
</tr>
<tr>
<td>S</td>
<td>Wet H2S sour service</td>
</tr>
<tr>
<td>SM</td>
<td>Sour, sour + H2, sour + amine</td>
</tr>
<tr>
<td>T</td>
<td>Process high temperature services</td>
</tr>
<tr>
<td>V</td>
<td>Highly viscous</td>
</tr>
<tr>
<td>W</td>
<td>Water</td>
</tr>
<tr>
<td>X</td>
<td>Toxic, benzene</td>
</tr>
<tr>
<td>XB</td>
<td>Benzene</td>
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<tr>
<td>Y</td>
<td>Chlorine gas</td>
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41. **What is the general procedure if the hydro testing of piping cannot be done?**

- Consider the joints as a golden or tie in joints in which 100% NDE is to be done. For the joints less than 2 inch PT to be done, for the joints above 2 inch RT to be done and it shall be fully witnessed by Subcontractor/Contractor/Owner.

42. **What is HRC?**

- Rockwell C Hardness- A hardness value obtained by use of a cone shaped diamond intender and a load of 150 kg in accordance with ASTM E18.

43. **What is shot peening?**

- Inducing chemical stress in a material surface layer by bombarding it with a selected medium under controlled conditions.
44. What are the applicable piping standards for JER?

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