In this article, we will learn about the IS (Indian Standard Code for the fabrication of pressure vessels in detail.

DEFINITION OF A PRESSURE VESSEL

A pressure vessel is a type of container or a vessel that is used to store liquid or the gas at a temperature higher than the surrounding temperature (ambient temperature).

For Example Gas cylinder at our homes, LPG Tanks, tankers, etc.

What is a code:

Code is the standard that should be followed by the manufacturer for the design, construction, installation, inspection, and testing of the pressure vessels.

Different countries follow different codes of construction for the fabrication of the pressure vessel.

For example – ASME Codes are the most popular code used in many countries. In India, the pressure vessels are fabricated based on IS-2825.

NEED of Pressure vessel codes

Codes were made to avoid the accidents and the explosion of the pressure vessels.

The boiler explosion which took place in 1905 in Brockton, Massachusetts killed hundreds of people.

This incident made the governing bodies to make certain rules and regulation for the construction of Boilers.

The first boiler and the pressure vessel code was published in the year 1915 then with the time necessary changes were made as per the requirements and development of industrial technologies.

After following the pressure vessel codes for the fabrication of the pressure vessel the quality was improved along with very less or no chances of mishappenings.

BUREAU OF INDIAN STANDARDS

The Bureau of Indian Standards is the Indian government authorized body under which the code of constructions for the Fabrication of pressure vessels are being standardized.

IS-2825 is the code of construction of pressure vessels in India.

IS- 2825 Code OF Construction:

We will read it in detail.

For making use of this code we should know about the following terms:

i) Maximum working pressure

As the name suggests it the maximum gauge pressure, at the coincidental metal temperature. That is permitted for the metal in operation.

It is more than the design pressure.

ii) Design Pressure:

It is the pressure at which the pressure vessel is to be designed.

The design pressure is given by the vendor for what pressure they want the pressure vessel to be designed.

iii) DESIGN TEMPERATURE:

The temperature used in the design should not be less than the mean metal temperature (throughout the thickness) expected under the operating conditions for the parts considered except that for the parts subject to direct radiation and/or the products of combustion when it shall not be less than maximum surface temperature expected under operating conditions.

iv) Minimum Thickness

The thickness obtained by the calculation according to the formulae in the code.

This is only a minimum value and requires to be increased to allow for other factors like corrosion allowance, mechanical abrasions, and other factors affecting the use of the pressure vessel.

v) **Weld joint Efficiency Factor(J):**

The ratio of the arbitrary strength of the welded joint to the strength of the plates welded expressed as a decimal.

vi) **Ligament Efficiency** :

The ratio of the strength of the ligament to that of the unpierced plate expressed as a decimal.

vii) POST- Weld Heat Treatment

Heat treatment of a vessel or portion of it at predetermined Temperature, to relieve the major portion of the residual stresses.

Viii) Allowable stress value:

The maximum stress permissible at the design temperature for any specified material.

ix) Inspecting Authority:

The duly authorized representative of the purchaser or any other competent authority recognized by the statutory regulations to inspect the vessel and determine its acceptability.

xi) Fusion welding:

Fusion welding is a type of welding in which the welding process in which the parent metal is melted and then joined.

It includes Arc Welding, Gas welding,Thermit welding, electron beam welding, and electro-slag Welding.

Classification of IS-2825

ISO- 2825 can be classified as

i) Class I vessels.

ii) Class II vessels.

iii) Class III Vessels.

Another important term here is

Category:

- The term category specifies the location of the joint in a vessel but not the type of joint.
- These categories are intended for specifying the special requirements regarding the joint type and degree of inspection for certain locations.
- The joints included in each category are designated as joint of categories as A, B, C, and D.

Let's discuss these categories in detail:

i) **Category A:**

Category A includes a longitudinal welded joint within the main shell of the pressure vessel, communicating chambers, transition in diameter and nozzles, and welded joint within a formed or flathead.

ii) **Category B:**

Circumferential welded joints within the main shell, communicating chambers, nozzle transition in diameter, any welded joint within a formed or flathead.

iii) **Category C:**

Welded joints that connect the flanges, van stope laps, tube sheets, and flathead to main shells, to formed head, to transition in diameter to the nozzle or communicating chambers.

- Any welded joint connecting to the one side of the plate to another side plate of a flat-sided vessel.

iv) **Category D:**

- Welded joints connecting communication chambers or nozzle to the main shell, to spheres, to transition in diameter, to heads and communication chambers

Now, let's discuss each one of them in detail:

i) **Class I vessels:**

- These vessels are made to contain lethal or Toxic substances.
- Vessels designed for operation below -20 degrees Celcius.
- Vessels can further be designed on mutual understanding between the purchaser and the manufacturer.

The important requirements of the class 1 vessel are as follows:

a) Weld- Joint Efficiency Factor(J): J=1

b) **Radiography:** Class I vessels are fully radiographed.

c) Let us talk about the limitations:

i) **Permissible Plate Material:** Any material allowed except steels to:

- IS: 226-1962
- IS: 961-1962
- IS: 2062- 1962
- IS 3039- 1965.

ii) **Shell or the endplate thickness:**

- No limitation on thickness.

D) **Type of joints:**

- Double welded Butt joint with full penetration Excluding butt joints with metal backing strips which remain in place.
- Single welded butt joints with a backing strip(J=0.9).

E) **QUALITY CONTROL:**

i) **MATERIAL**

- Inspection and test at steel makers works.
- Identification and marking of the plate and other components.
- Inspection of material and plate edges

ii) **During Fabrication:**

- Visual Inspection of surface for objectionable defects.
- Assembly and alignment of vessel sections before welding.
- Identification and stamping of weld test plates.
- Inspection during welding in progress including second side welding grooves after preparation by chipping, gouging, grinding, or machining.
- Inspection of main seams after dressing.
- Calibration and dimensional check on completion.

6) **Mechanical tests:**

Mechanical tests on longitudinal seams:

i) All weld metal Tensile test

ii) One reduced section tensile test.

iii) Three notched bar impact test.

iv) Bend test outer surface in tension.

v) bend test inner surface in tension.

vi) Macro and micro examination.

Class-II Vessels

Now we shall discuss class II- Vessel code in detail:

1) **Weld Joint Efficiency factor** (J): 0.85

2) **Radiography**: Spot Radiographed

3) **Limitations** :

a) Permissible Plate Material

--- Any Material is allowed except steels to:

- IS: 226-1962
- IS: 961-1962
- IS: 2062- 1962
- IS 3039- 1965.

b) Shell or the End thickness

The maximum thickness is 38mm after adding a corrosion allowance.

4) **TYPE OF JOINTS**

- Double welded Butt joint with full penetration Excluding butt joints with metal backing strips which remain in place.
- Single welded butt joints with a backing strip(J=0.80).

5) **Quality control**

Quality control is the same as that for CLASS I Vessels.

-----Mechanical test, welding Procedure, and operator qualification, and finally the pressure test is similar to that of CLASS- I Vessels.

Class-III Vessels

These are the Vessels for the relatively lighter duties, having

i) **Plate Thickness:** Plate Thickness should not be more than 16mm

ii) Working Pressure: Working Pressure should not exceed 3.5 kgf/cm^2 vapor pressure or 17.5kgf/cm^2 hydrostatic design pressure.

iii) **Temperature**:

- The Temperature should not exceed 250-degree Celcius and is unfired.
- Class III vessels are recommended for service at a temperature below 0-degree Celcius.

Important standard Codes for Class III Vessels

1) **weld joint efficiency factor (J):**

The value of J ranges from 0.50 to 0.70

2) **Radiography:**

No Radiography is required for the class is required.

3) **Limitations:**

a) Permissible Plate Material:

Permissible Plate Material for Class III Pressure Vessels includes Carbon and low alloy steels:

i) IS 226- 1962.

ii) IS 961- 1962.

iii) IS 2062 – 1962.

iv) IS 2041- 1962.

v) IS 1570- 1961.

vi) IS 2002- 1965.

vii) IS 3039- 1965.

b) **Shell or endplate thickness:**

- Maximum Thickness of 16mm before corrosion allowance is added.

2) **Type of Joints:**

- Double welded Butt joint with full penetration Excluding butt joints with metal backing strips which remain in place.

- Single welded butt joints with a backing strip(J=0.55 to 0.65).

-----Mechanical test, welding Procedure, and operator qualification, and finally the pressure test is similar to that of CLASS- I vessels.

For further material of construction and design of pressure vessel and design of flanges read my next article on "*DESIGN OF PRESSURE VESSEL AS PER IS 2825*".

If you have any queries, please write it in the comment section.