

PRESSURE VESSELS

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AGENDA

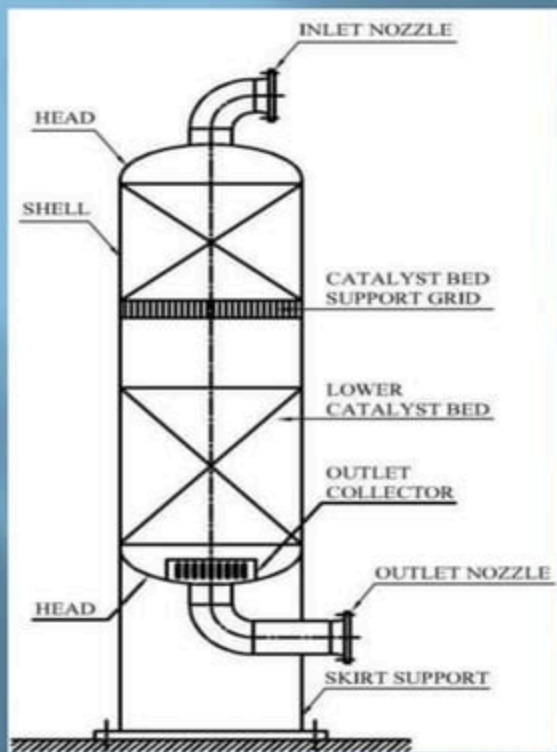
1. Definitions of Pressure Vessels
2. Typical Components of Pressure Vessels
3. Classification of Pressure Vessels
4. Uses of Pressure Vessels
5. ASME Codes Used for Pressure Vessels
6. Design Criteria
7. Comparison Of Pressure Vessels Designed Under the Standard Codes
8. Non-Destructive Tests Performed On Pressure Vessels
9. Leak- Testing Methods On Pressure Vessels

DEFINITION

- A **pressure vessel** is a closed container designed to hold gases or liquids at a pressure substantially different from the gauge pressure.
- **Pressure Vessels** are defined in ASME Section VIII, Div 1 introduction:

“ **Pressure Vessels** are containers for the containment of pressure either external or internal. The pressure may be obtained from an external source, or by the application of heat from a direct or indirect source, or any combination thereof.”

TYPICAL COMPONENTS



1. Cylindrical or Spherical Shell
2. Formed Heads
3. Blind Flanges, Cover Plates, Flanges
4. Openings And Nozzles
5. Supports

CLASSIFICATION OF PRESSURE VESSELS

➤ **Based on Manufacturing Methods:**

- 1) Welded Vessels
- 2) Forged Vessels
- 3) Multiwall Vessels
- 4) Multiwall Wrapped Vessels
- 5) Band Wrapped Vessels

➤ **Based on Manufacturing Materials:**

- 1) Steel Vessels
- 2) Non Ferrous Vessels
- 3) Non Metallic Vessels

➤ **Based on Geometric Shapes:**

- 1) Cylindrical Vessels
- 2) Spherical Vessels
- 3) Rectangular Vessels

4) Combined Vessels

➤ Based on Installation Methods:

- 1) Vertical Vessels
- 2) Horizontal Vessels

➤ Based on Pressure-Bearing Situation:

- 1) Internal Pressure Vessels
- 2) External Pressure Vessels

➤ Based on Wall Thickness:

- 1) Thin Wall Vessel
- 2) Thick Wall Vessel

➤ Based on Technological Processes:

- 1) Reaction Vessel
- 2) Heat Exchanger Vessel
- 3) Separation Vessel
- 4) Storage Container Vessel

➤ **Based on Operating Temperature:**

- 1) Low Temperature Vessels (less than or equal to -20°C)
- 2) Normal Temperature Vessels (Between -20°C to 150°C)
- 3) Medium Temperature Vessels (Between 150°C to 450°C)
- 4) High Temperature Vessels (more than or equal to 450°C)

➤ **Based on Design Pressure:**

- 1) Low Pressure Vessels (0.1MPa to 1.6MPa)
- 2) Medium Pressure Vessels (1.6MPa to 10MPa)
- 3) High Pressure Vessels (10MPa to 100MPa)
- 4) Ultra High Pressure Vessels (More than 100MPa)

➤ **Based on Usage Mode:**

- 1) Fixed Pressure Vessel
- 2) Mobile Pressure Vessel

USES OF PRESSURE VESSELS

- 1) Industrial compressed air receivers
- 2) Domestic hot water storage tanks
- 3) Diving cylinders
- 4) Recompression chambers
- 5) Distillation towers
- 6) Autoclaves
- 7) Oil refineries and petrochemical plants
- 8) Nuclear reactor vessels
- 9) Pneumatic And Hydraulic Reservoirs
- 10) Storage vessels for liquified gases such as ammonia, chlorine, propane, butane, and LPG.

ASME CODES USED FOR PRESSURE VESSELS

- ASME BPVC Section II
 - Part A - Ferrous Material Specifications
 - Part B - Nonferrous Material Specifications
 - Part C - Specifications for Welding Rods, Electrodes, and Filler Metals
 - Part D - Properties (Customary)
 - Part D - Properties (Metric)
- ASME BPVC Section V - Non destructive Examination

- ASME Section VIII : Boiler and Pressure Vessel Code (BPVC)

Division 1- Rules for Construction of Pressure Vessels

Division 2 - Alternative Rules

Division 3 - Alternative Rules for Construction of High Pressure Vessels

DESIGN CRITERIA

- **Selection Of The Type Of Vessel:**
 - i. The operating temperature and pressure.
 - ii. Function and location of the vessel.
 - iii. Nature of fluid.
 - iv. Necessary volume for storage or capacity for processing
- **Design Loads**
- **Materials**
- **Allowable Stress**

COMPARISON OF PRESSURE VESSELS DESIGNED UNDER THE STANDARD CODES

Item	IS-2825	ASME Code Section VIII	BS-5500	AD- Merkblatter
Scope	•Unfired fusion welded pressure vessels •Pressure < 20 N/mm² •Do/Di < 1.5 •Di > 150 mm •Water capacity > 50 litres	•Welded, riveted, forged and brazed vessels •Water capacity>120 gal •Operating pressure > 15 psi •Di>6"	• Unfired fusion welded pressure vessels •Medium and high pressure storage vessels •Excludes transportable vessels.	•Do/Di < 1.7 •Vessels and vessel parts predominantly under static load.
materials	•Carbon and low alloy steels, high alloy steel, Cu and Cu alloys, Al and alloys, bolting and casting alloys	•Same as IS-2825 •Cast iron, lined material cast iron, ferritic steel •Composite Materials	•Carbon, ferritic alloy(low and high) and austenitic steels	All metallic materials and graphite, glass.

COMPARISON OF PRESSURE VESSELS DESIGNED UNDER THE STANDARD CODES

Item	IS-2825	ASME Code Section VIII	BS-5500	AD- Merkblatter
Design pressure	Maximum working pressure including static head + 5% maximum working pressure.	Maximum pressure at most severe conditions	Maximum pressure at most severe conditions	Based on permissible service pressure
Design temperature	Highest metal temperature expected under operating conditions	Actual metal temperature expected under operating conditions	Actual metal temperature expected under operating conditions + margin for uncertainties	Highest temperature expected under working conditions

COMPARISON OF PRESSURE VESSELS DESIGNED UNDER THE STANDARD CODES

Standard codes	Tensile Strength (N/m ²)	Yield strength (N/m ²)	Sr(rupture stress) (N/m ²)	Creep stress (N/m ²)
ASME: VIII Div-1	4	1.6	-	1
ASME: VIII Div-2	3	1.5	-	-
BS-1515	4	-	-	-
BS-1515 Part II	2.5	1.5	1.5	1
BS-5500	2.35	1.5	1.3	1
ANCC	-	1.5	1.5	-
IS-2825	3	1.5	1.5	1

NON-DESTRUCTIVE TESTS **PERFORMED ON PRESSURE** **VESSELS**

The five principle methods of NDT used are:

1. Visual testing (VT)
2. Penetrant testing (PT)
3. Magnetic particle testing (MT)
4. Ultrasonic testing (UT)
5. Radiographic testing (RT)

LEAK TESTING METHODS

There are many different methods for pressure and leak testing in the field. Seven of these are:

1. Hydrostatic testing
2. Pneumatic or gaseous-fluid testing
3. Combined pneumatic and hydrostatic testing
4. Initial service testing
5. Vacuum testing
6. Static head testing
7. Halogen and helium leak detection test

REFERENCES

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- 3) http://campaign.asme.org/bpvc10/Pressure_Vessels.cfm
- 4) http://www.wermac.org/others/ndt_pressure_testing.html
- 5) <http://www.hzdr.de/db/Cms?pOid=25139&pNid=1004>
- 6) http://www.china-ogpe.com/buyingguide_content/Pressure_vessel_1531.html
- 7) <http://www.pv-book.com/PVBOOK.pdf>