CHAPTER II
CONSTRUCTION AND FITMENTS OF PRESSURE VESSELS

12. Design code. —
(1) Vessels shall be designed, constructed and tested in accordance with the Indian Standard 2825; as amended from time to time, or such other standard or code approved by the Chief Controller.
(2) A test and inspection certificate issued by the manufacturer of the vessel duly countersigned by an Inspector that the vessel meets with the requirements of the standard or code referred to in sub-rule (1) shall be furnished to the Chief Controller.

13. Design pressure.—
The design pressure of a vessel shall not be less than –
(a) the vapour pressure of the gas in the vessel at 55 degree celsius, if the vessel is meant for the storage of liquefiable gases: Provided that if the vessel is insulated, the vapour pressure of the gas in the vessel shall correspond to the maximum temperature that is likely to be attained by the gas in the vessel;
(b) the developed pressure of the gas in the vessel at 55 degree celsius, if the vessel is meant for the storage of a permanent gas.
(c) the maximum allowable service pressure with additional allowances for vacuum and static head or surge due to acceleration or deceleration, as the case may be, in respect of the cryogenic liquid proposed to be stored or transported.

14. Design of vessels for gases at low temperature —
(1) Refrigerated vessels.—
(i) Vessels used for storage of refrigerated gases shall be designed in accordance with low temperature requirements under the Design Code referred to in sub-rule (1) of Rule 12.
(ii) The capacity of the refrigeration system shall be adequate to maintain the gas in the vessel at a temperature so that its vapour pressure does not exceed the design pressure of the vessel and shall also remain below the pressure-setting of the relief valve on the vessel.

(2) Insulated vessels:—
(i) The shell of the vessel and its manhole nozzle shall be insulated with a material approved by the Chief Controller. The entire insulation shall be covered with a metal jacket of a thickness not less than 3 mm. nominal and flashed around all openings so as to be weather-tight.
(ii) The insulation shall be of sufficient thickness so that the thermal conductance at 15 degree celsius (expressed in calories or sq. cm. Per hour per degree centigrade temperature differential) does not exceed the limit prescribed by the Chief Controller.

(3) Cryogenic pressure vessel:—
(i) The design service temperature of the cryogenic pressure vessel shall not be warmer than the normal boiling point of the cryogenic liquid;
(ii) The materials of construction of the inner vessel, its piping and fittings shall be suitable for the service temperature and compatible for the specific cryogenic liquid;
(iii) The outer vessel shall be made of steel not less than 3mm nominal thickness or of aluminium not less than 4mm nominal thickness and shall have required structural strength and capable for supporting the inner vessel together with cryogenic liquid, insulation and other fittings. The outer vessel of vacuum insulated cryogenic tanks shall be designed for a minimum collapsible pressure of the atmosphere (gauge). The suitable protecting coating shall also be provided with vessel to
avoid corrosion. The outer vessel shall also be provided with suitable lifting arrangement and supports for installation or mounting;
(iv) The inner supports between the inner vessel and the outer vessel and the outer vessel shall be of non-inflammable material and capable of supporting the inner vessel together with the maximum allowable cryogenic liquid. The supports shall be able to withstand expansion or contraction within the operating temperature range. Cryogenic pressure vessels meant for transport purpose, shall be able to withstand combined loading of vertical down of two, vertical upward of one and a half, longitudinal of one and a half and lateral of one and a half times the weight of the vessel with attachment and the full load of cryogenic liquid. The factor of safety of the supports shall be as per the design code.

(v) The air in the annular space shall be filled with suitable insulating material compatible with the particular cryogenic liquid.

15. Filling capacity and filling pressure
(1) The Maximum quantity of liquefiable gas filled into any vessel shall be limited to the filling density of the gas and shall be such that the vessel shall not be liquid-full due to expansion of the contents with rise of the temperature to 55 degree celsius. If vessel is uninsulated, or to the highest temperature which the contents are likely to reach in service, if the vessel is refrigerated or insulated, this requirement shall be applicable irrespective of the ambient temperature of the product at the time of filling.
(2) No vessel shall be filled with any permanent gas in excess of its design pressure.
(3) The water capacity of the cryogenic pressure vessel shall be rated in terms of gross water capacity and the usable water capacity in litres at 15 degree celsius. The usable water capacity shall not exceed 95% of the gross water capacity. An overflow pipe shall be provided at the maximum usable capacity level as a safeguard against filling the vessel beyond the maximum usable capacity.

16. Markings on pressure vessels
Every vessel shall have a metal plate permanently fixed to it showing the following particulars which shall be visible from the ground level, namely:
(i) manufacturer’s name and identification marks;
(ii) the standard or code to which the vessel is constructed;
(iii) official stamp of the Inspector;
(iv) design pressure in Kg/Cm2;
(v) date of initial hydrostatic test and the subsequent test;
(vi) hydrostatic test pressure in Kg/Cm2;
(vii) water capacity in liters;
(viii) gas capacity, if filled with liquifiable gas; and
(ix) name or chemical symbol of the gas for which the vessel is to be used.

17. Painting of vessels
Vessels shall be adequately painted externally to prevent corrosion and shall have a reflecting surface.

18. Fittings
(1) General.
   (i) Fittings. – Each vessel shall be provided with each of the following fittings all of which should be suitable for use with the gas at pressures not less than the design pressure of the vessel to which they are fitted and for temperatures appropriate to the characteristics of the gas and operating conditions, namely,
   - Pressure relief valve connected to the vapour space;
   - Drains;
   - Contents gauge or maximum level indicator;
(ia) for cryogenic pressure vessel, the outer vessel shall be provided with a vacuum valve and safety relief device (disc) to release internal pressure. The discharge area of such device shall be at least 0.34 sq.mm/litre of water capacity of the inner vessel. The relief device shall function at a pressure not exceeding the internal design pressure of the outer vessel;

(ii) Vessel connections. – Connections of vessels shall be designed and attached to the vessels in accordance with the Design code referred to in Rule 12. All static vessels for storage of corrosive, flammable or toxic gas in liquefied state shall not have more than one pipe connection to the bottom for inlet or outlet, apart from the drainage. The drainage pipe, if provided, shall be extended beyond the shadow of the vessel and provided with two shut-off valves. No drainage pipe shall be provided direct from spherical vessel. The bottom inlet or outlet pipe for spherical vessel shall be integrally welded to the vessel and extended upto three metres beyond the shadow of the vessel, at the end of which, combination of manual and remote operated valve shall be provided;"
prescribed proforma. Relief valves shall be tested for correct operation not less than once in a year and a record of such test shall be maintained.

(3) Shut-off and emergency shut-off valves.---
(i) all liquid and vapour connections on vessels, except those for relief valves, plugged openings, and those where the connection is not greater than 1.4 mm diameter opening shall have shut-off valves located as close to the vessel as practicable;

(ii) all liquid and vapour connections on vessels, except those for relief valves, and drainage connections of small diameter, shall have an emergency shut-off value, such as, an excess flow valve, an automatically operated valve or a remotely controlled valve. The emergency shut-off valve referred to in clause unless the emergency shut-off valve referred to in clause (i), unless the emergency shut-off valve is a remotely controlled valve which can be operated from a safe area and shall be of a type which shall not fail

(iii) Provided that the emergency shut-off valve is not required in cases where the connection to vessel is not greater than 3mm in diameter for liquid and 8mm in diameter for vapour, or for vessels meant for storage of non-corrosive, non-flammable or non-toxic gas.

(4) Liquid level gauging device.—
(i) a vessel used for liquefiable gas or dissolved gas shall be equipped with a liquid level gauging device to afford ready determination of the amount of liquid in the vessel at any time;
(ii) all liquid level indicators shall be suitable for operation at the design pressure of the vessel;
(iii) every vessel shall, in addition, be equipped with a fixed maximum level indicating device depending upon the liquefiable gas or dissolved gas filled in the vessel;
(iv) gauging devices that require bleeding of the contents of the vessel such as a rotary tube, fixed tube and slip tube shall be designed in such a manner that the same cannot be completely withdrawn in normal gauging operations.

(5) Pressure gauge. –
Every vessel shall be provided with at least one pressure gauge.

19. Periodic testing of pressure vessels in service:—
(1) All vessels shall be hydraulically tested by a competent person at a pressure marked on the vessel at intervals of not more than five years after the date of first test, provided that in the case of vessels, containing corrosive or toxic gases, the periodic test shall be done at an interval of two years. In case of vessels which are so designed, constructed or supported that they cannot be safely filled with water or liquids for hydraulic testing or which are used in services where traces or water cannot be tolerated, the Chief Controller may permit pneumatic testing alongwith non-destructive tests instead of hydraulic testing, as per procedure laid down in vessel fabrication code; after satisfying himself about the adequacy of the safety precautions undertaken;
(1A) Cryogenic pressure vessel and vessel for liquid Carbon Dioxide shall be periodically tested with pneumatic at 1.1 times of maximum allowable working pressure.
(2) the competent person carrying out the test as required under sub-rule (1) shall issue a certificate of test in prescribed proforma.

20. Precautions to be observed in carrying out hydraulic test.—
In carrying out the hydraulic test referred to in Rule 19, the following precautions shall be observed, namely:-
(i) before the test is carried out, each pressure vessel shall be thoroughly cleaned and examined externally, and as far as practicable, internally also for surface defects, corrosion and foreign matter. During the process of cleaning and removal of sludge, if any, all due precautions shall be taken against fire or explosion, if such sludge is of pyrophoric nature or contains spontaneously combustible chemicals;
(ii) as soon as the test is completed, the vessel shall be thoroughly dried internally and shall be clearly stamped with the marks and figures indicating the person by whom the test has been carried out and the date of test and a record shall be kept of all such tests;
(iii) any vessel which fails to pass the hydraulic test or which for any other reason is found to be unsafe for use shall be destroyed or rendered unsuitable under intimation to the Chief Controller.