IS 3196 (Part 1) : 2013

(Reaffirmed 2019)

भारतीय मानक

अल्प दाब द्रवणीय गैसो के लिए 5 लिटर से अधिक जल क्षमता वाले बेल्डित अल्प कार्बन इस्पात के सिलिंडर

भाग 1 द्रवित पैट्रोलियम गैस (एल पी जी) के लिये सिलिंडर — विशिष्टि

(छठा पुनरीक्षण)

Indian Standard

WELDED LOW CARBON STEEL CYLINDERS EXCEEDING 5 LITRES WATER CAPACITY FOR LOW PRESSURE LIQUEFIABLE GASES

PART 1 CYLINDERS FOR LIQUEFIED PETROLEUM GASES (LPG) — SPECIFICATION

(Sixth Revision)

ICS 23.20.30

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 2013 **Price Group 7**

Gas Cylinders Sectional Committee, MED 16

FOREWORD

This Indian Standard (Part 1) (Sixth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was originally issued in 1965 and subsequently revised in 1968, 1974, 1982, 1992 and 2006. In this revision all the amendments have been incorporated and the following major changes have been made:

a) New material as per IS 15914 : 2011 'High tensile strength flat rolled steel plate (up to 6 mm) sheet and strip for the manufacture of welded gas cylinder' has been included for the manufacture of cylinders, in addition to IS 6240 : 2008 'Hot rolled steel plate (up to 6 mm) sheet and strip for the manufacture of low pressure liquefiable gas cylinder (*fourth revision*)'.
b) Welding and circulatory clause modified.
c) In fatigue testing number of cycles increased to 12 000 from 10 000.
d) Normalizing of cylinders is compulsory if manufactured from the steel as per IS 15914.
e) The observation of 'nominal hoop stress (0.95 of the minimum specified tensile strength)' of cylinder material has been replaced by the observation of 'measurement of bursting pressure (that is 225 percent of the Test Pressure, P_h)'.
f) Cylinder body integrity impact test for cylinder manufactured from the steel as per IS 15914 has been added in Annex C.

Assistance has been taken from ISO 22991 : 2004 'Gas cylinders — Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) — Design and construction'.

Manufacture, possession and use of any gas, when contained in cylinders of more than 500 ml water capacity in compressed or liquefied state, are regulated under the *Gas Cylinder Rules*, 2004 of the Government of India. This standard has been prepared in consultation and in agreement with the statutory authorities under those rules.

Welded low carbon steel cylinders exceeding 5 l water capacity for low pressure liquefiable gases are covered in 1S 3196. This standard has four parts. Other parts in the series are:

Part 2 Cylinders for liquefiable gases other than LPG
Part 3 Method of tests
Part 4 Cylinders for toxic and corrosive gases

Cylinders of water capacity up to 5 l are covered in 1S 7142 : 1995 'Welded low carbon steel gas cylinders for low pressure liquefiable gases not exceeding 5 litre capacity — Specification (*first revision*)'.

Welded stainless steel cylinders for liquefied petroleum gases (LPG) from 0.5 l to 250 l water capacity are covered in IS 15637 : 2006 'Welded stainless steel cylinders for liquefied petroleum gases (LPG) from 0.5 litre to 250 litre water capacity — Specification'.

Period inspection and testing of LPG cylinders is covered under IS 16054 'Periodic inspection and testing welded low carbon steel cylinders exceeding 5 litre water capacity for liquefied petroleum gas (LPG) — Code of practice' (*under print*).

The requirements for the inspection and re-conditioning of used LPG cylinders is covered under IS 13258 : 1991 'Welded low carbon steel cylinders exceeding 5 litre water capacity for low pressure liquefiable gas — Code of practice' for inspection and reconditioning of used LPG cylinders.

The composition of the Committee responsible for the preparation of this standard is given in Annex D.

(*Continued on third cover*)

Indian Standard

WELDED LOW CARBON STEEL CYLINDERS EXCEEDING 5 LITRES WATER CAPACITY FOR LOW PRESSURE LIQUEFIABLE GASES

PART 1 CYLINDERS FOR LIQUEFIED PETROLEUM GASES (LPG) — SPECIFICATION

(Sixth Revision)

1 SCOPE

1.1 This standard (Part 1) deals with welded low carbon steel cylinders intended for storage and transportation of liquefied petroleum gases (*see* 1S 4576) of nominal capacity exceeding 5 l up to and including 250 l water capacity. This standard lays down the minimum requirements for the materials, design, manufacture, construction, tests and marking on these cylinders.

2 REFERENCES

The standards given in Annex A contain provisions, which through reference in this text, constitute provisions to this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the following definitions in addition to given in IS 7241 shall apply.

3.1 Normalizing — Heat treatment in which, a cylinder is heated to a uniform temperature above the upper critical point (AC_3) of the steel to regenerate or homogenize the metallurgical structure of the steel and then cooled in a controlled or still air atmosphere.

3.2 Stress Relieving — Heat treatment given to a cylinder, the object of which is to reduce the residual stresses without altering the metallurgical structure of the steel, by heating to a uniform temperature below the lower critical point (AC_1) of the steel and then cooing in a controlled or still air atmosphere.

3.3 Stabilizing — Heat treatment given to a cylinder, in order to stabilize the structure of the steel by heating to a uniform temperature below the upper critical point (AC_3) of the steel and subsequently cooled to obtain the desired mechanical properties.

3.4 Critical Temperature — The temperature at which phase or magnetic changes takes place [*see* IS 1956 (Part l)].

3.5 Test Pressure (P_h) — The internal pressure required for the hydrostatic test and the hydrostatic stretch test of the cylinders.

NOTE — It is used for cylinder wall thickness calculation.

3.6 Burst Pressure (P_b) — Highest pressure reached in a cylinder during the burst test.

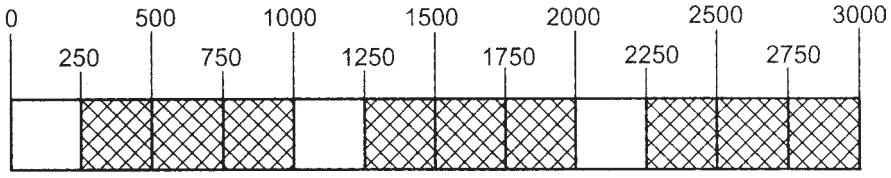
3.7 Batch — A batch shall consist of finished cylinders not exceeding 3 000 cylinders made consecutively by the same manufacturer using the same manufacturing technique, to the same design, size and material specifications on the same type of automatic welding machines and subject to the same heat treatment conditions. A batch shall contains material of one cast only.

3.7.1 *Inspection Lots* — For acceptance purposes the batch shall be divided into inspection lots not exceeding 1 000 cylinders. For selection of sample cylinders for either burst or mechanical tests, each lot is subdivided into sub-lots of 250 cylinders (*see* Fig. 1). The samples taken for 'mechanical or burst test' shall be alternated between the mechanical and burst tests.

4 MATERIAL

4.1 The steel used in the manufacture of cylinders shall conform to IS 6240 or IS 15914.

4.1.1 Suitable low carbon steel other than those given in **4.1** may be used with the prior permission of the statutory authority. In such a case, the minimum specified value of yield strength guaranteed by the cylinder manufacturer for the finished cylinder shall be used for the purpose of calculating the wall thickness of the cylinder. Such steel should be certified by the steel maker to be other than of rimming quality, suitable for pressing or drawing, with acceptable non ageing properties and shall be fully killed.



Size of Lot/ Sublot	Symbol	No. of Cylinders	Type of Test
250	□	2	One subjected to a brust test and one subjected to mechanical test
250	▨	1	One subjected to a brust test or to a mechanical test

FIG. 1 SAMPLE SIZE

4.1.2 The cylinder manufacturer shall obtain and provide certificate of cast (heat) analysis of the steels supplied for the manufacturer of the gas cylinders and establish means to identify the cylinders with the casts of steel from which they are made.

4.2 The bung/valve pad shall be hot forged from rolled steel bars either conforming to Class 1A or Class 2 of IS 1875 or 1S 2062. The bung machined from such forging shall be free from surface defects such as fissures, surface cracks, porosity, laminations, pinholes, etc (*see* **10.3**).

4.3 The materials used for foot ring, stout metal cap shroud and/stay plate shall conform to Grade 'O' of IS 1079 or IS 2062 or IS 6240 or any other material as approved by the statutory authority.

5 GENERAL

A fully dimensioned sectional drawing of the cylinder, together with design calculations, guaranteed yield strength and scheme of manufacture, shall be submitted by the manufacturer to the inspecting authority for final approval by statutory authority.

6 DESIGN

6.1 The cylinder shall be of welded construction having a cold or hot drawn or pressure formed cylindrical portion with hemi-spherical, ellipsoidal or tori-spherical ends welded to it, or two halves of cold or hot drawn and circumferentially welded together, or any other construction approved by the statutory authority.

6.2 The calculation of the thickness of pressure parts of the gas cylinder is related to the minimum value of yield strength guaranteed by the cylinder manufacturer for the finished cylinder and the test pressure.

6.2.1 The agreed finished thickness shall not be lower than that calculated from the following formulae:

a) For cylindrical portion, greater of the following two:

1) $$t = \frac{P_h D_o}{200 \times 0.8\, J\, R_e + P_h} = \frac{P_h D_i}{200 \times 0.8\, J\, R_e - P_h}$$

2) $$t = 0.136 \times \sqrt{D_o}$$

NOTE — Formula (2) is not applicable for cylinders manufactured from the steel as per IS 15914.

b) For semi-ellipsoidal part or end (*see* Fig. 2):

$$t_e = \frac{P_h D_i}{200 \times 0.8\, J\, R_e + P_h} \times \frac{K(0.65 + 0.1K)}{4}$$

where

t = calculated minimum wall thickness of cylindrical shell in mm excluding any additional thickness to resist influences other than those of internal pressure and of external forces due to normal handling (*see* **8.4**);

t_e = calculated minimum wall thickness of semi-ellipsoidal ends, in mm;

P_h = test pressure in kgf/cm^2. The value of hydrostatic test pressure for LPG with vapour pressure not exceeding 16.87 kg/cm² (gauge) at 15°C shall be taken as 25 kg/cm². For LPG with vapour pressure exceeding 16.87 kg/cm² (gauge) at 15°C the value of hydotestatic test pressure shall be taken from IS 8867 and approved by statutory authority;

D_i = inner diameter in mm;

D_o = outer diameter in mm;

J = weld joint factor;

= 1.0 if each weld is to be fully radio graphed;

= 0.9 for cylinders with circumferential seam or seam only (not radio graphed);

= 0.9 for cylinders with seams other than circumferential which are spot radio graphed in accordance with **13.2**;

= 0.7 for all other cases;

R_e = yield strength (minimum value specified in **4.1** and **4.1.1**) in kgf/mm^2 . However, the value of 'R_e' shall not be more than the minimum value specified in the material specification;

h_0 = external height of domed ends, in mm;

h_i = internal height of domed ends, in mm; and

K = ratio D_0/h_0 $[(h_0/D_0) \geq 0.192]$.

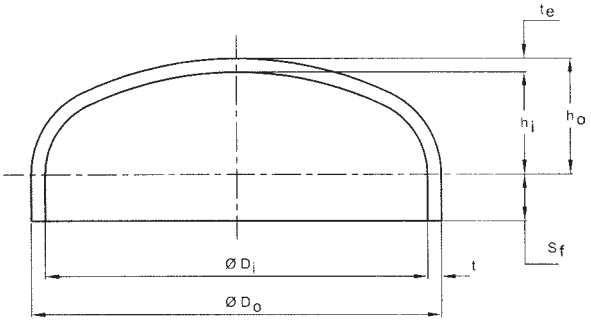


FIG. 2 SEMI-ELLIPSOIDAL

6.2.2 For the cylinders made out of steel conforming to IS 6240 the minimum wall thickness shall not be less than 2 mm for cylinders up to and including 13 l water capacity and not less than 2.4 mm for cylinders above 13 l water capacity.

6.2.3 For the cylinders made out of steel conforming to IS 15914 the minimum wall thickness of the cylindrical shell, t, and of the end, t_e, shall be not less than the value derived from any of the following formulae:

for $D_o < 100$ mm:

$$t_{Min} = t_{eMin} = 1.1 \text{ mm} \quad (1)$$

for 100 mm $< D_o <$ 150 mm:

$$t_{Min} = t_{eMin} = 1.1 + 0.008\,(D - 100) \text{ mm} \quad (2)$$

for $D_o > 150$ mm:

$$t_{Min} = t_{eMin} = (D/250) + 0.7 \text{ mm} \quad (3)$$

(with a minimum of 1.5 mm).

6.2.4 Not withstanding as stated above, higher thickness may be provided as agreed to between the purchaser and the manufacturer and subject to approval by statutory body.

6.3 Before the design is finally approved, the statutory authority may require one or more prototype cylinders to be subjected to various tests as specified in this standard or such other tests, as the authority deems fit.

6.4 Design of Openings

6.4.1 The location of all openings shall be restricted to one dished end of the cylinder.

6.4.2 Opening in the cylinder shall be reinforced, either by a valve boss or pad, of weldable and compatible steel, securely attached by welding and so designed as to be adequate strength and to result in no harmful stress concentrations. This shall be confirmed by design calculations or a fatigue test in accordance with **17.1**.

6.4.3 If the leak-tightness between the valve and the cylinder is assured by a metallic seal, a suitable internal valve boss can be fitted to the cylinder by a method which need not independently guarantee leak-tightness.

NOTE — Applicable for cylinders with water capacity up to 13 l only.

6.4.4 Unless otherwise specified, valve threads shall conform to IS 8737 or as approved by statutory authority.

6.4.5 *Closure of Openings*

Apertures in the finished cylinders shall be fitted with the appropriate valve in the closed position or fitting to protect the thread from damage and to prevent entry of moisture into the cylinder.

7 WELDING

7.1 Welding Qualification

7.1.1 The manufacturer, before proceeding with the production of a given design of cylinder, shall establish the welding procedures as per IS 7307 (Part 1), welders as per IS 7310 (Part 1) and IS 817 for all welding associated with the pressure envelope including the non-pressure-containing parts. Records of such approvals shall be retained by the manufacturer.

7.1.2 Welding procedure approval tests shall be made in such a manner that the welds shall be representative of those made in production.

7.1.3 Welders shall have passed the approval tests for the specific type of work and procedure concerned.

7.2 Prior to welding, components shall be examined in accordance with the requirements of **12.2**.

7.3 Manual arc welding shall not be employed for circumferential seam which shall consist of a joggle joint so that the external surface of the container is smooth. Joggle joint shall have overlap of minimum of three times the agreed finished thickness. A longitudinal seam shall consist of a butt joint without backing material. Manual arc welding shall not be employed for external longitudinal seam. For a typical joggled butt joint, *see* Fig. 3.

7.4 Surfaces of the plates at the seams shall not be out of alignment with each other at any point by more than10 percent of the plate thickness.

7.5 Welds, except the ends of longitudinal welds, shall not be dressed without the approval of the inspecting authority. The weld surface shall have a smooth contour. The weld joint shall be free from undercuts but slight intermittent occurrences may be disregarded provided that such undercut is not in the form of a sharp notch (*see* IS 817).

7.6 All welding of the shell and attachments shall be completed before the final heat treatment.

7.7 Before welding, the plates to be joined shall-be free from scale, grease, oil and dirt. Before the cylinders are closed, longitudinal welds, wherever used, shall be visually examined from both sides to ensure that the welds are satisfactory.

7.8 Welding consumables used shall be such that the desired properties of the weld are obtained and the physical values of the welded metal are not lower than the specified values of the parent metal.

7.8.1 As far as possible all welded joints shall be double welded butt joints. In case where second side welding is not possible, single welded butt joint may be used, provided sufficient care is taken to ensure complete fusion and penetration.

7.8.1.1 Butt weld shall have full penetration. The excess thickness shall be such that the weld integrity is not compromised.

7.8.1.2 Joggled butt welds shall have adequate penetration verified by macro etch, bend testing and tensile testing.

7.8.2 The fusion of the welded metal with the parent metal shall be smooth and free from overlapping, under cutting or abrupt irregularity. There shall be no cracks, notching or porous patches in the welded surfaces and the surface adjacent to the weld. The welded bead shall not be concave.

8 MANUFACTURE

8.1 The number of longitudinal seams in the welded cylinder shall not exceed one and the number of circumferential seams shall not exceed two.

8.2 When the welded cylinder contains a longitudinal seam, the edges of the plate forming the longitudinal joint of the shell shall be rolled or formed by pressure, not by blows, to the required curvature.

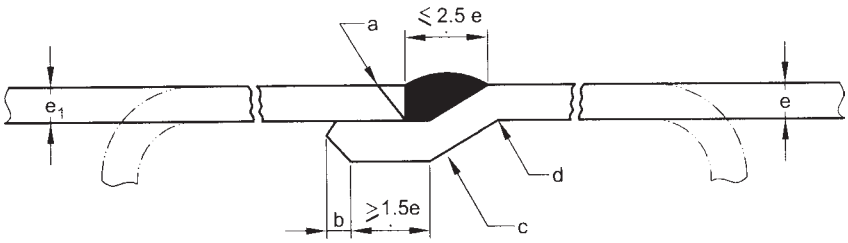
8.3 The end or dished part shall be of semi-ellipsoidal shape. The end shall have a cylindrical skirt or parallel portion of minimum length 20 mm or three times the shell thickness, whichever is greater.

8.4 Agreed Finished Thickness

The agreed finished thickness shall not be less than the minimum calculated wall thickness obtained by the application of formulae given in **6.2.1** and **6.2.2** or **6.2.3** at any point and at any transverse section of the cylindrical portion. Additional thickness may be provided to cover corrosion allowance and stresses due to horizontal acceleration and retardation during transportation. The amount of the allowance shall be as agreed to between the manufacturer and the purchaser and approved by statutory authority.

8.5 Examination of Cylinders Before Closing-in Operation

Cylinders shall be examined for wall thickness, before the closing-in operation, circularity of the cylindrical shell and the skirt portion of ends, external and internal



a — bevel optional
b — as desired
c — depth of offset e_1
d — inside of cylinder to avoid sharp break
e — thickness of metal which is offset
e_1 _ thickness of metal which is not offset

FIG. 3 ILLUSTRATION OF A TYPICAL JOGGLED BUTT JOINT

surface defects, the profile regularity of the ends, offset at the joints, and straightness. The manufacturer shall assure himself that the wall thickness is not less than the agreed finished thickness at any point. The eccentricity of bunghole centre line with respect to centre line of half/body of cylinder shall not be more than one percent of the nominal diameter of cylinder subject to a maximum of 2 mm.

8.5.1 *Circularity*

The out-of-roundness of the cylindrical shell shall be limited so that the difference between the maximum and the minimum outside diameter in the same cross-section is not more than 1 percent of the mean of these diameters, for two-piece cylinders, and 1.5 percent for three-piece cylinders. The measurement shall not be taken over any of the welds but shall be taken adjacent to the welds.

8.5.2 *Surface Defects*

The internal and external surfaces of the cylinder shall be free from defects which will adversely affect the safe working of the cylinder.

8.5.3 *Profile Regularity*

The contour of dished end shall not deviate from the approved dimensions by more than 1.25 percent of the nominal diameter in respect of radial dimensions and by more than 1 percent in respect of axial dimensions. Such deviations shall not be abrupt changes and shall be outside the specified shape.

8.5.4 *Straightness*

Unless otherwise shown on the drawing, the maximum deviation of the shell from a straight line shall not exceed 0.3 percent of the cylindrical length (*see* Fig. 4).

8.5.5 *Verticality*

Deviation from vertical shall not exceed 10 mm/m length (*see* Fig. 4).

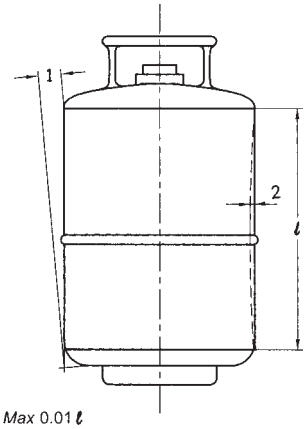


FIG. 4 ILLUSTRATION OF DEVIATION OF CYLINDRICAL PART OF SHELL FROM A STRAIGHT LINE AND FROM VERTICAL

9 VALVE CONNECTION, VALVE PAD AND VALVE PROTECTION

9.1 Valve Connection

The valve connection shall consist of a welded pad/ bung and shall be threaded to suit the type of valve specified in 1S 8737.

9.1.1 Prior to fitting the valve, the bung threads shall be cleaned using a machine tap of the same thread profile as the bung threads. The cleaning shall ensure freedom from grit, zinc and other foreign matter, if any. Also it shall ensure, breaking of scale formed on the thread and re-correction of any distortion, experienced during heat treatment. The valve shall be fitted using approved jointing compound at the specific torque, after ensuring that internal cleaning of the cylinder has been done for removal of any water, grit, welding slag, flux, metal or any other foreign particles.

9.1.2 Any other valve connection may be provided as agreed to between the manufacturer and the purchaser and approved by the-statutory authority.

9.2 Valve Pad

Single or two runs of welding shall be employed for bungs which have a backing pad (either on the outside or one on the outside and one on the inside). In the case of bungs without backing pad, one run of welding shall be given on the inside and one on the outside. If the positive projection of-bung inside the cylinder is 4 mm or more, the same may be welded with single or two runs of weld as per approved design and drawing.

9.3 Valve Protection

9.3.1 Cylinder shall have their valve protected against damage by the provision of a stout metal cap or shroud or metal cover or protective metal ring or grill as per approved design. Where the design of the cylinder provides for the valve lying wholly below the level of the body of the cylinder such a protection is not necessary. The metal cap or metal cover as per approved drawing when used, shall be vented and screwed onto the neck of the cylinder.

9.3.2 The protective metal ring or grill shall be welded to the upper end of the cylinder concentric with the neck. The eccentricity of the welded metal ring or grill with respect to the valve pad/bung shall not be more than 1 percent of the nominal diameter of cylinder subject to a maximum of 3 mm.

9.3.3 In case the protective ring is made out of tube/ pipe, the dimensions of tube/pipe should be as agreed to between the purchaser and the manufacturer.

9.3.4 The protective device shall be of adequate construction to prevent such damage to the valve as

would cause the escape of the product. When a water filled container with quantity being half the nominal water capacity is dropped from a height of 1.2 m, so that the protective device struck a hard flat surface, there shall be no damage to the valve.

NOTE — The drop test should only be carried out on de-pressurized cylinders, as it may cause release of dangerous high levels of energy resulting in injury or death to personnel.

10 FITTINGS OTHER THAN VALVES

10.1 Handle

Handle or other suitable arrangement for lifting the cylinder shall be provided. It shall be capable of withstanding static loading in any direction equal to twice the weight of the cylinder when filled with water.

10.2 Foot Ring

The foot ring, where fitted as a separate fixture to the bottom end of the cylinder, shall be at least 20 mm away from the circumferential weld. The thickness of the sheet from which the foot ring is made shall not be less than the calculated wall thickness of the cylinder body. The foot ring may be intermittently welded with body of the cylinder. In case, the bottom edge is curled, the curling shall be inwards to facilitate safe handling. It shall be provided with holes for ventilation, and if curled, drainage holes to be provided to avoid corrosion. The maximum permissible deviation from the vertical shall not exceed 1°. Foot rings shall be sufficiently strong and made of steel (*see* **4.3**) or any other material as approved by statutory authority. The bottom of the foot ring shall not be less than 8 mm below the outside bottom of the cylinder shell for cylinders up to 34 l nominal water capacity. For cylinders of more than 34 l nominal water capacity and up to 50 l nominal water capacity, this value shall be minimum 15 mm and for cylinders exceeding 50 I nominal water capacity, this value shall be minimum 25 mm.

NOTE — Attachment such as VP shroud or foot ring, when directly welded to pressure retaining parts shall be designed to prevent crevice corrosion. They may have intermittent contact, such as scalloping or attachment by ears. However they ought to be continuously welded at all points of contact with the pressure retaining body of the cylinder.

10.3 Bung

The requirements of bungs shall be in accordance with Annex B and its material shall be as specified in **4.2**.

11 HEAT TREATMENT

11.1 All cylinders shall be efficiently and uniformly normalized or stress relieved in accordance with the recommendations of steel manufacturers and approved by the inspecting authority after manufacture and completion of all welding (including that of attachments) and before hydrostatic test is applied. A complete record of the heat treatment cycle shall be maintained (*see* **3.1** and **3.2**).

11.2 Cylinder manufactured from the steel confirming to IS 15914 shall be normalized (*see* **3.1**) as per the material standard.

11.3 Localized heat treatment shall not be permitted.

12 INSPECTION

12.1 General

12.1.1 The purchaser and the inspecting authority shall have free access, at all reasonable time to that part of the manufacturer's works engaged in the execution of the order. They shall also be at liberty to inspect the construction at any stage and to reject any cylinder, or component of a cylinder that does not comply with the requirements of this standard.

12.1.2 The manufacturer shall supply the man power and equipment for such inspection and tests as are required and for any additional checks which may be agreed to between the inspecting authority and the manufacturer.

12.1.3 The visual inspection of cylinders should be carried out and the limits of defects shall be as per IS 9639.

12.2 Inspection of Components

12.2.1 All pressings, halves and cylindrical shells shall be examined for surface defects before any seam is welded. If there are defects which in the opinion of the inspecting authority would be detrimental to the sound construction of the container, the pressing or shell shall be rejected.

12.2.2 At the discretion of the inspecting authority, 2 percent or more of the pressings halves and the cylindrical shells shall be selected at random to be examined for minimum thickness before any seam is welded.

12.2.3 If any pressing, half or shell is less than the minimum specified thickness, the whole output from the relevant batch of material shall be examined for minimum thickness, and any pressing or shell which is less than the specified minimum thickness shall be de-shaped in such a way that it cannot be used at any stage.

12.2.4 For the purpose of this clause batch of material is defined to mean pressings or cylindrical shells manufactured in a continuous production run.

13 RADIOGRAPHIC EXAMINATION

13.1 Radiographic examination, when required shall conform to the techniques and acceptability criteria

set forth in the relevant Indian Standards. For general guidance, reference may be made to IS 1182, IS 2595, IS 3657 and IS 4853 and **8.7** of IS 2825. The radiographic technique used shall be sufficiently sensitive to reveal a defect having a thickness equal to 2 percent of the combined thickness of the weld and the strip.

13.2 Spot Radiography (*see* definition of *J* under **6.2.1**).

13.2.1 One out of every 50 consecutive cylinders from continuous production shall be taken at random for spot radiography.

13.2.2 In addition, after a change in the type or size of cylinder or the welding procedure (including machine settings) or after a break in the production exceeding 4 h, the first cylinder welded shall be taken for spot radiography.

13.3 For testing details of radiography [*see* IS 3196 (Part 3)].

14 CHECKING OF WATER CAPACITY

The water capacity of the cylinders shall be checked. This shall be done by weighing method. The tolerance for water capacity shall be +5/0 percent for cylinders up to and including 13 l water capacity and +3/0 percent or 0.65 l whichever is more for cylinder above 13 l water capacity.

15 HYDROSTATIC TEST

15.1 Each heat treated cylinder shall be subjected to hydrostatic test. During the hydrostatic test the pressure shall be increased gradually till the required test pressure is reached. After the test pressure is reached and the external surfaces of the cylinder are dried, it shall be retained for a period of not less than 30 s. Any reduction in pressure noticed during this retention period or any leakage or visible bulge or deformation shall be treated as a case of failure in the test. Any cylinder which does not pass the test shall be rejected.

15.1.1 The value of hydrostatic test pressure for LPG with vapour pressure not exceeding 16.87 kg/cm² (gauge) at 15°C shall be taken as 25 kg/cm². For LPG with vapour pressure exceeding 16.87 kg/cm² (gauge) at 15°C the value of hydrostatic test pressure shall be taken from IS 8867 and approved by statutory authority.

15.1.2 Hydrostatic test shall be carried out according to IS 3196 (Part 3).

16 PNEUMATIC LEAKAGE TEST

16.1 Each cylinder, after it has been dried, and fitted with valve using a suitable jointing material as agreed to between the purchaser and the manufacturer, shall be tested for leakage by subjecting to air pressure of not less than 1.180 MPa (12 kgf/cm^2) for a period of 1 min while immersed in water and shall show no leakage from the body of the cylinder and valve pad joint. This test shall be carried out by using dry air after fixing the safety cap on the valve.

NOTE — Suitable air drying methods may be adopted as long as they ensure no condensate is present in the cylinders.

16.1.1 Alternatively any other method approved by the statutory authority may be used.

16.1.2 Pneumatic leakage test shall be carried out according to IS 3196 (Part 3).

17 FATIGUE TEST

17.1 Fatigue Testing/Cycle Testing

17.1.1 For the purpose of this test, three cylinders which are guaranteed by the manufacturer to be representatives of the minimum end(s) thickness set by design and which shall include all markings shall be filled with non-corrosive liquid and subjected to successive reversals of hydraulic pressure. This test shall be considered as type test.

17.1.2 The test shall be carried out as type test an upper cyclic pressure, either:

a) equal to two-thirds of the test pressure, in which case the cylinder shall be subjected to 80 000 cycles without failure; and
b) equal to the test pressure, in which case the cylinder shall be subjected to 12 000 cycles without failure.

The values of lower cyclical pressure shall not exceed 10 percent of the upper cyclic pressure. The frequency of reversals of pressure shall not exceed 0.25 Hz (15 cycles/min). The temperature measured on the outside surface of the cylinder shall not exceed 50°C during the test.

17.1.3 After the test the cylinders shall be burst tested and meet the requirements of **17.2**.

17.2 Burst Test under Hydraulic Pressure

One cylinder selected at random from those which have passed the hydrostatic test shall then be subjected to a hydrostatic pressure gradually till it bursts. The pressure at which the cylinder bursts shall be recorded.

17.2.1 Bursting test shall be carried out according to 1S 3196 (Part 3). The rate of pumping shall not exceed five times the water capacity of the cylinder per hour.

17.2.2 The criteria adopted for the interpretation of the burst test are as follows:

a) Volume of the water used between the time when the pressure starts to rise and at the time of bursting, and

b) Difference between the volume of the cylinder at the beginning and the end of the test (*see* **17.2.3**).

17.2.3 *Minimum Test Requirement*

The measured bursting pressure P_b shall not under any circumstances be less than 225 percent of the test pressure P_h, and shall conform to the following requirements:

a) Cylinder shall burst without fragmentation. During burst test in case leakage starts from any welding before fracture or before achieving bursting pressure, the specimen shall be discarded and fresh test specimen shall be taken;

b) The fracture shall not occur in the direction parallel to circumferential weld within 10 mm from the edge of the circumferential weld;

c) Main fracture shall not show any brittleness, that is the edges of the fracture shall not be radial but shall be at an angle to a diametrical plane and display a reduction of area throughout their thickness;

d) Fracture shall not reveal a visible defect in the metal; and

e) The ratio of the volumetric expansion of the cylinder to its initial volume shall be greater than or equal to the following values:

1) 20 percent, if the length of the cylinder is greater than its diameter; and

2) 17 percent, if the length of the cylinder is equal to or less than its diameter.

18 ACCEPTANCE TESTS

18.1 For every batch of heat-treated and finished cylinders, sample shall be taken as per **3.7.1**. The test cylinder shall be selected at random and the various acceptance tests shall be carried out on test specimens taken from this cylinder.

18.1.1 Number of test specimen and method of testing shall be in accordance with IS 3196 (Part 3).

18.1.2 The percentage elongation and yield strength, wherever applicable and tensile strength thus determined shall not be less than the respective requirements for the material specified in **4**.

18.1.3 The bend test specimen having cracks or any other open defects, which exceed 3 mm, measured in any direction on the convex surface of the specimen, shall be treated as a failure.

18.1.4 The weld shall show a good penetration and absence of lack of fusion.

18.1.5 The thickness shall not be less than the calculated thickness.

18.1.6 Where a batch contains material from more than one cast, the manufacturer shall arrange for samples tested to represent each cast of material used.

19 ADDITIONAL TEST

For cylinders manufactured from the steel as per IS 15914 additional test such as cylinder body integrity impact test and drop test shall be carried out as per Annex C. These tests shall be considered as type test.

20 MARKING

20.1 General Instructions

a) Each cylinder shall be clearly and permanently marked by stamping or similar processes on such a part, which is inseparably bound with the cylinder which is not or only negligibly affected by stresses due to the gas pressure within it;

b) Name plate shall not be affixed to the cylinder's shoulder, if there is a risk of corrosion or embrittlement;

c) In conjunction with the original markings, space shall be provided for stamping the date of the test;

d) Marking shall be so carried out and the letters and numerals used shall be of such shape and size that the marking is legible; and

e) Stamps used for marking shall have small radii at changes of section to avoid formation of sharp edges in the stamped marking.

20.2 Each cylinder shall be permanently stamped with the following:

a) Serial number, abbreviated name, monogram of the manufacturer and identification of the owner;

b) Number of this Indian Standard;

c) Maximum working pressure, in MPa;

d) Test pressure, in MPa and date of hydrostatic test as the case may be (such as 3/05 for March 2005);

e) Agreed finished thickness, in mm;

f) Tare weight in kg, gross weight in kg and water capacity in litres;

g) Inspecting agency's official mark;

h) Letter 'N' or 'SR' next to IS number, if the cylinder is normalized or stress relieved; and

j) Name of gas.

NOTE — The tare weight shall include the weight of the valve fitted to the cylinders.

20.2.1 *BIS Certification Marking*

Details available with the Bureau of Indian Standards.

20.2.1.1 The use of the Standard Mark is governed by the provisions of *the Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

20.3 The marking may be made at any of the following places:

a) Foot ring;
b) Any non-pressure part;
c) Dished end, provided it can be demonstrated in the bursting test that fracture does not initiate in the markings; and
d) A plate of material compatible to the body of the cylinder may be welded soundly at an appropriate place on the cylinder.

21 COLOUR IDENTIFICATION

The cylinder shall be painted externally in accordance with the signal red colour (Shade No. 537 of IS 5) or any other colour approved by statutory authority.

22 RECORD

A record shall be kept of all test made at the cylinder manufacturer's works and copies shall be made available to the inspecting authority and the purchaser of the cylinder (if desired). A test certificate duly approved and signed by the inspecting authority shall be forwarded to the statutory authority and the purchaser.

23 PREPARATION FOR DESPATCH

23.1 All cylinders shall be thoroughly cleaned and dried internally before being fitted with valves.

23.2 The outside surface shall be grit (*see* IS 4683) blasted with minimum SA 2.5 grade of blast (*see* IS 9954) and shall be given following protective coatings:

a) Spraying zinc to give a coating of minimum thickness of 37 microns unless otherwise agreed to between the purchaser and the manufacturer. The zinc wire used for spraying shall be as per IS 12447 and the zinc spraying shall be as per IS 6586;
b) One coat of zinc chromate primer conforming to IS 2074 of agreed colour as agreed to between the purchaser and the manufacturer;
c) One coat of synthetic enamel paint conforming to IS 2932 of signal red colour (Shade No. 537 of IS 5) or any other colour approved by statutory authority. Both the layers of the primer and paint shall have a total thickness of minimum 30 microns; and
d) As an alternate to (a), (b) and (c) cylinders shall be powder coated (as per IS 13871) or stoving primer coated (as per IS 2074) and enamel coated (as per IS 2932) as per the agreement between the manufacturer and the buyer. The total minimum combined thickness shall be 67 microns.

NOTE — Procedure for measurement of coating of thickness:

1 Five gauge readings for each spot shall be taken moving the probe a short distance for each new gauge reading within an approximate area of 2 cm × 2 cm. Discard any unusually high or low gauge reading that can not be repeated consistently. Take the average of the five gauge readings as a spot measurement.

2 Make five such spot measurements approximately evenly spaced over the surface of the cylinder.

3 Each spot measurement shall not be below 80 percent of the specified minimum thickness and average of the five spot measurements shall not be below the specified thickness.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
5 : 2007	Colours for ready mixed paints and enamels (*sixth revision*)
817 : 1966	Code of practice for training and testing of metal arc welders (*revised*)
1079 : 1994	Hot rolled carbon steel sheets and strips — Specification (*sixth revision*)
1182 : 1983	Recommended practice for radiographic examination of fusion welded butt joints in steel plates (*second revision*)
1875 : 1992	Carbon steel billets, blooms, slabs and bars for forgings (*fifth revision*)
1956 (Part 1) : 1976	Glossary of terms relating to iron and steel: Part 1 General metallurgy, heat treatment and testing (*first revision*)
2062 : 2011	Steel for general structural purposes (*seventh revision*)
2074 : 1992	Ready mixed paint, air drying, red oxide zinc chrome, priming (*second revision*)
2595 : 2008	Code of practice for radiographic testing (*second revision*)
2825 : 1969	Code for unfired pressure vessels
2932 : 2003	Enamel, synthetic, exterior (a) undercoating, (b) finishing — Specification (*third revision*)
3196 (Part 3) : 2012	Welded low carbon steel cylinders exceeding 5 litre water capacity for low pressure liquefiable gases: Part 3 Methods of test (*fifth revision*)
3657 : 1978	Radiographic image quality indicators (*first revision*)
4576 : 1999	Liquefied petroleum gases — Specification (*second revision*)
4683 : 1968	Chilled iron shot and grit for use in foundries
4853 : 1982	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes (*first revision*)
6240 : 2008	Hot rolled steel plate (up to 6 mm) sheet and strip for the manufacture of low pressure liquefiable gas cylinder (*fourth revision*)
6586 : 1989	Recommended practice for metal spraying for protection of iron steel (*first revision*)
7142 : 1995	Welded low carbon steel gas cylinders for low pressure liquefiable gases not exceeding 5 litre capacity — Specification (*first revision*)
7202 : 1974	Inspection gauges for checking threads of gas cylinders valves for use with breathing apparatus
7241 : 1981	Glossary of terms used in gas cylinder technology (*first revision*)
7307 (Part 1) : 1974	Approval tests for welding procedures: Part 1 Fusion welding of steel
7310 (Part 1) : 1974	Approval tests for welders working to approved welding procedures: Part 1 Fusion welding of steel
8737 : 1995	Valve fittings for use with liquefied petroleum gas (LPG) cylinders of more than 5 litre water capacity (*first revision*)
8867 : 1978	Saturated vapour pressure and test pressure for low pressure liquefiable gases contained in gas cylinders
9122 : 2008	Inspection gauges for checking type 2 taper threads of gas cylinder valves, taper 3 in 25 — Specification (*first revision*)
9639 : 1980	Code of practice for visual inspection of newly manufactured low pressure welded steel gas cylinders during manufacturer
9954 : 1981	Pictorial surface preparation standards for painting of steel surfaces
12447 : 1988	Zinc wire for sprayed zinc coatings
13258 : 1991	Welded low carbon steel cylinders exceeding 5 litre water capacity for low pressure liquefiable gas — Code of practice for inspection and reconditioning of used LPG cylinders
13871 : 1993	Powder coatings — Specification
15637 : 2006	Welded stainless steel cylinders for liquefied petroleum gases (LPG) from 0.5 litre to 250 litre water capacity — Specification
15894 : 2011	Inspection gauges for checking type 1 (sizes 1, 2 and 3) taper threads of gas cylinder valves and cylinder necks — Taper 1 in 16 on diameter
15914 : 2011	High tensile strength flat rolled steel plate (up to 6 mm) sheet and strip for the manufacture of welded gas cylinder

IS No.	*Title*	*IS No.*	*Title*
16054 (*under print*)	Periodic inspection and testing welded low carbon steel cylinders exceeding 5 litre water capacity for liquefied petroleum gas (LPG) — Code of practice		

ANNEX B
(*Clause* 10.3)

REQUIREMENTS OF BUNGS

B-1 FINISH

The bung, shall be clean, even, without chatter and free from any visual defects and shall have the required machining finish. The threads shall be of smooth finished and shall not be broken at any point. The cylinder manufacturer shall check on each finished machined bung the dimensions that match with the corresponding dimensions on the cylinder, such as neck diameter that fits into bung hole, chamfer angle at the skirt, etc. Bung threads shall be inspected for conformity with the required sizes using all the gauges as laid down in anyone of the following standards depending upon the nominal size and specification of the thread:

a) IS 7202
b) IS 9122
c) IS 15894

B-2 After welding and before fitting the valve, the bung thread shall be cleaned with appropriate tap and checked for conformity to threads using only taper thread plug gauges as laid down in anyone of the following standards depending upon the nominal size and specification of the thread:

a) IS 7202
b) IS 9122
c) IS 15894

B-3 However, the inspecting authority for the purpose of carrying out the inspection shall test 3 percent of the lot of machined bungs. In the event of any failure a second sample size of double the above shall be drawn and inspected. In case of failure of anyone out of the second draw, the whole lot shall be rejected.

B-4 One bung out of the sample size shall be sectioned and checked for conformity to thread form and finish.

ANNEX C
(*Foreword* and *Clause* 19)

IMPACT AND DROP TESTS

C-1 CYLINDER BODY INTEGRITY IMPACT TESTS

C-1.1 General

The ability of the cylinder design (thickness, materials and mechanical properties) to withstand loadings other than internal pressure shall be demonstrated by a series of impact tests.

Each type of test shall be carried out on cylinder without internal pressure and cylinders pressurized to P_t/1.2.

The specified impact energy and striking velocity shall be achieved by striking the test cylinder with a moving striker or by dropping the cylinder from an appropriate height. In all cases, the location of the impact shall be as specified in the test procedure and the direction of impact shall intersect with the axis of the cylinder.

The strikers (flat surface and edge) shall be of metallic material having a hardness higher than that of the cylinder and sufficiently robust to prevent the impact energy being absorbed by deflection of the striker.

C-1.2 Flat Surface Impact Test

C-1.2.1 *Procedure*

The striker shall be a flat surface with a length equal to the overall cylinder length and width equal to the

cylinder diameter.

The impact energy, F, shall be determined by:

$$F = 30\ M$$

where

F — energy, in Joules, and

M — maximum operating mass of the cylinder, in kg.

The striking velocity shall be between 7 m/s and 8 m/s.

Two un-pressurized cylinders shall each be impacted with the surface parallel to the cylinder. The cylinders shall then be impacted on the shoulder of the end, with the surface at 45 to the cylinder axis (*see* Fig. 5).

On completion of both impacts, the cylinders shall be visually examined for signs of damage and assessed against the rejection criteria established in accordance with IS 16054.

If both cylinders show damage equal to or worse than these rejection criteria, then on completion of both impacts, both cylinders shall be subject to a burst test in accordance with **17.2**.

If the cylinder withstand any of the impacts with visible damage below the rejection criteria, or if the rejection criteria have not been established, then on completion of both impacts, one cylinder shall be subject to the burst test in accordance with **17.2** and the other subject to a fatigue test in accordance with **17.1**.

C-1.2.2 *Requirement*

After impacts, the pressurized cylinders shall not leak.

Cylinders subject to the burst test shall meet the requirements of **17.2**.

Cylinders subject to the fatigue test shall meet the requirements of **17.1**.

C-1.3 Edge Impact Test

C-1.3.1 *Procedure*

The profile of the striker shall be as shown in Fig. 6 and the length shall be as shown in Fig. 7.

The impact energy, F, shall be determined by:

$$F = 12\ M$$

where

F — energy, in Joules, and

M — maximum operating mass of the cylinder, in kg.

The striking velocity shall be between 4 m/s and 5 m/s.

Two un-pressurized cylinders shall each be impacted with the edge parallel to the cylinder axis (*see* Fig. 7). The cylinders shall then be impacted with the edge perpendicular to the cylinder axis (*see* Fig. 8). The position of the two impacts shall be separated by a minimum of 45° round the cylinder circumference.

On completion of both impacts, the cylinders shall be visually examined for signs of damage and assessed against the rejection criteria established in accordance with IS 16054.

If both cylinders show damage equal to or worse than these rejection criteria, then on completion of both impacts, both cylinders shall be subject to a burst test in accordance with **17.2**.

If the cylinders withstand any of the impacts with visible damage below rejection criteria, or if the rejection criteria have not been established, then on

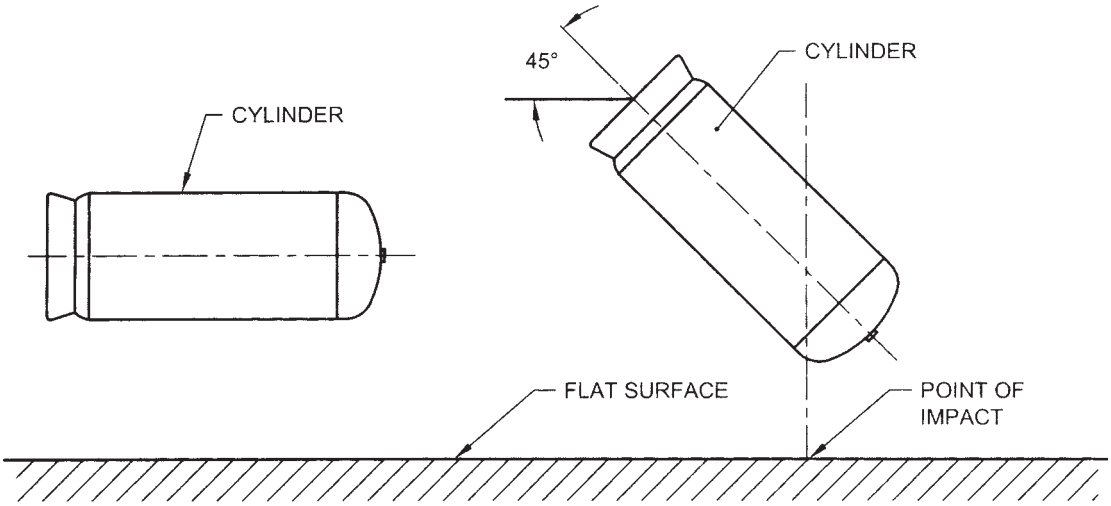


FIG. 5 IMPACT TEST WITH A FLAT SURFACE

completion of both impacts, one cylinder shall be subject to a burst test in accordance with **17.2** and the other subject to a fatigue test in accordance with **17.1**.

The test shall be repeated with two further cylinders, which have been pressurized to P_t/1.2.

C-1.3.2 *Requirement*

After impacts, the pressurized cylinders shall not leak.

Cylinders subject to burst test shall meet the requirements of **17.2**.

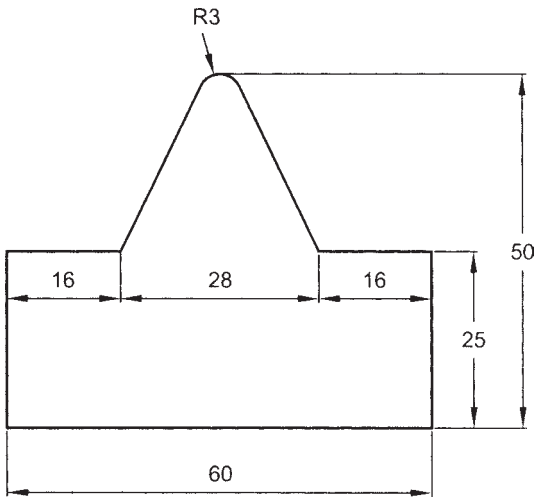
Cylinders subject to the fatigue test shall meet the requirements of **17.1**.

C-2 DROP TESTS

C-2.1 Procedure

Two finished cylinders, including any foot-ring and/or value protection, shall be weighted to represent the maximum operating mass and pressurized to P_t/1.2.

The cylinders shall each be dropped twice into a flat surface from 1.2 m, in each of the five different orientations illustrated in Fig. 9 that is, 10 drops per cylinder.



All dimensions in millimetres.

FIG. 6 STRIKER PROFILE

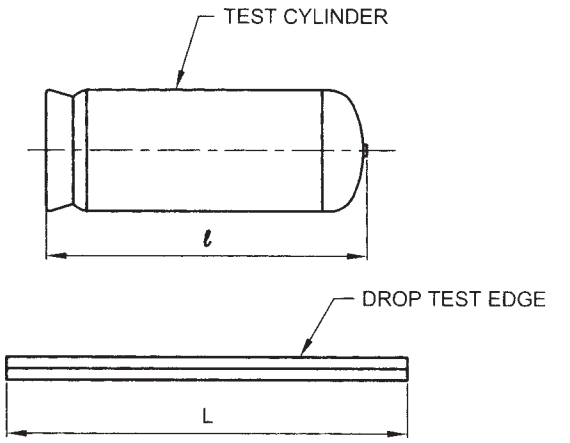


FIG. 7 IMPACT TEST WITH CYLINDER AXIS PARALLEL TO EDGE, *L*

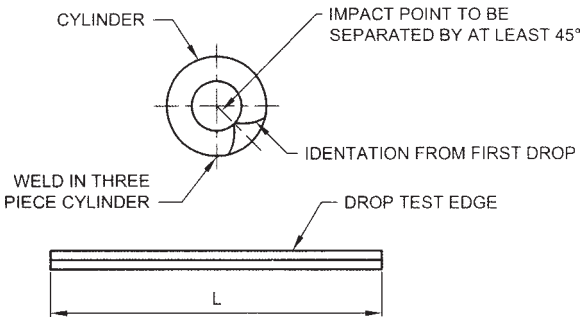


FIG. 8 IMPACT TEST WITH AXIS PERPENDICULAR TO EDGE, *L*

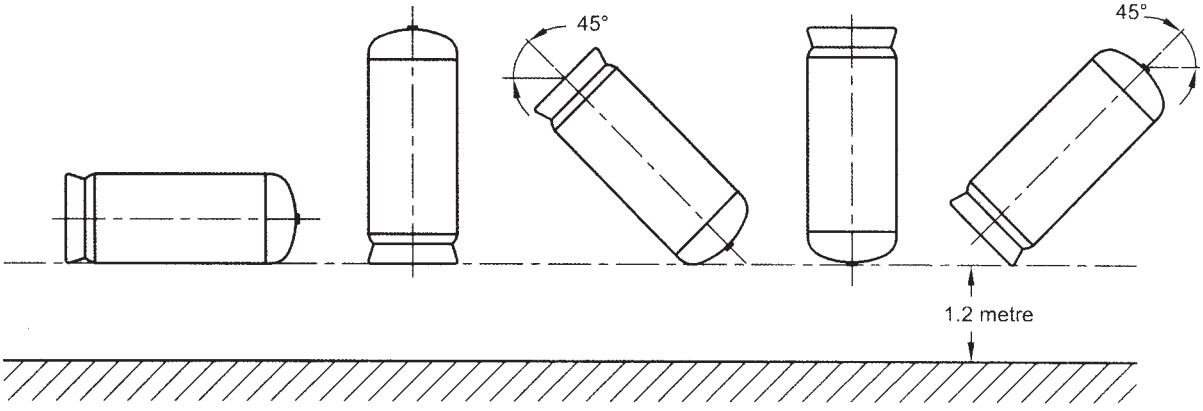


FIG. 9 ORIENTATION FOR 1.2 METRE DROP ONTO FLAT SURFACE

The surface shall consist of a steel plate, 10 mm thick, sufficiently flat so that the difference between any two points on the surface is no more than 2 mm. It shall be replaced if the surface no longer meet this requirement. The plate shall rest on a flat, smooth concrete bed, at least 100 mm thick. The plate shall be in full contract with the concrete so that it is fully supported.

After each drop, the cylinders shall be visually examined for signs of damage and assessed against the rejection criteria established in accordance with IS 16054.

If both cylinders show damage equal to or worse than these rejection criteria, then on completion of all ten drops, both cylinders shall be subject to a burst test in accordance with **17.2**.

If the cylinders withstand any of the drops with visible damage below the rejection criteria, or if the rejection criteria have not been established, then on completion of all ten drops, one cylinder shall be subject to a burst test in accordance with **17.2** and the other subject to a fatigue test in accordance with **17.1**.

C-2.2 Requirement

After ten drops, the cylinders shall not leak.

Cylinders subject to the burst test shall meet the requirement of **17.2**.

Cylinders subject to the fatigue test shall meet the requirements of **17.1**.

ANNEX D
(*Foreword*)

COMMITTEE COMPOSITION

Gas Cylinders Sectional Committee, MED 16

Organization	*Representative(s)*
Petroleum and Explosive Safety Organization, Nagpur	Shri T. R. Thomas (***Chairman***) Shri D. K. Gupta (*Alternate*)
All India Industrial Gases Manufacturers Association, New Delhi	Shri Saket Tiku Shrimati Veena Peter (*Alternate*)
Bharat Petroleum Corporation Limited, Mumbai	Shri Vishnu D. Sonawane Shri A. Prabhakar (*Alternate*)
Bharat Pumps and Compressors Limited, Allahabad	Shri Mohan Kumar Shri P. G. Choudhury (*Alternate*)
BOC India Limited, Kolkata	Shri Ramana Vutukuru Shri K. P. Pradeep Kumar (*Alternate*)
Everest Kanto Cylinder Limited, Mumbai	Shri P. M. Samvatsar Shri A. K. Khamkar (*Alternate*)
Hindustan Petroleum Corporation Limited, Mumbai	Shri M. Selvakumar Shri Alok Kumar Gupta (*Alternate*)
Indian Oil Corporation Limited, Mumbai	Shri Shankar Sharan Shri S. M. Rambhal (*Alternate*)
Indraprastha Gas Limited, New Delhi	Shri Praveen K. Pandey Shri Ujwal Bhandari (*Alternate*)
International Industrial Gases Limited, Kolkata	Shri Devendra K. Garg Shri Nikhilesh K. Garg (*Alternate*)
Kabsons Gas Equipments Limited, Hyderabad	Shri Satish Kabra Shri Kunal Kabra (*Alternate*)
Kosan Industries Limited, Mumbai/Surat	Shri S. K. Dey Shri S. B. Bolmal (*Alternate*)
LPG Equipment Research Centre, Bangalore	Shri P. Krishnan Kutty Shrimati Karobi Mukherjee (*Alternate*)
Mahanagar Gas Limited, Mumbai	Shri Raghunath Kulai Shri Arun Nayak (*Alternate*)
Maruti Koatsu Cylinders Limited, Mumbai	Shri Nitin J. Thakkar Shri A. S. Saran (*Alternate*)
Ministry of Defence (DGQA), Pune	Shri J. P. Tiwari Shri K. Sudhakaran (*Alternate*)
Praxair India Ltd, Bangalore	Shri Milan Sarkar Shri Arindam Das (*Alternate*)
Research and Development Establishment (Engineers), Pune	Shri P. K. Chattopadhyay Shri A. Basu (*Alternate*)
Sakha Engineers Private Limited, New Delhi	Shri Amarjit S. Kohli
SICGIL India Limited, Chennai	Shri Farooque Dadabhoy Shri R. Padmanaban (*Alternate*)
Society of Indian Automobile Manufacturers (SIAM), New Delhi	Shri K. K. Gandhi Shri Pankaj Kumar Karn (*Alternate*)
Steel Authority of India Limited, Salem	Shri M. Prabakaran Shri N. K. Vijayavargia (*Alternate*)
Steel Authority of India Limited, Ranchi	Shri Debashis Karmakar Dr B. K. Jha (*Alternate*)
Supreme Cylinders Limited, Delhi	Shri M. L. Fathepuria
Tata Motors Limited, Pune	Shri P. K. Banerjee Shri Amul Verma (*Alternate*)

Organization	*Representative(s)*
Tekno Valves, Kolkata	Shri Y. K. Behani Shri R. Behani (*Alternate*)
The Automotive Research Association of India, Pune	Dr S. S. Thipse Shri S. D. Rairikar (*Alternate*)
Trans Valves (India) Private Limited, Hyderabad	Shri A. K. Jain Shri Anuj Jain (*Alternate*)
Vanaz Engineers Limited, Pune	Shri K. P. Velayudhan Shri S. J. Vispute (*Alternate*)
In personal capacity (*Menon & Patel, 14/1, Mile, Mathura Road, Faridabad*)	Shri Ebrahim M. Patel
In personal capacity (*303, Shantikunj, Pandav Bunglows Lane, Athwalines, Surat*)	Shri L. D. Thakkar
BIS Directorate General	Shri T. V. Singh, Scientist 'F' and Head (MED) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri Vishal Tomer
Scientist 'C' (MED), BIS

Composition of Low Pressure Gas Cylinders Sub-committee, MED 16 : 2

Hindustan Petroleum Corporation Limited, Mumbai	Shri Alok Kumar Gupta (***Convener***)
All India Industrial Gases Manufacturers Association, New Delhi	Shri Saket Tiku Shrimati Veena Peter (*Alternate*)
Bharat Petroleum Corporation Limited, Mumbai	Shri Vishnu D. Sonawane Shri A. Prabhakar (*Alternate*)
Bhiwadi Cylinders Private Limited, New Delhi	Shri Manvinder Singh Shri Rajneesh Chopra (*Alternate*)
Hindalco Industries Limited, Mumbai	Shri Subhankar Gupta Shri V. Ramaswamy (*Alternate*)
Ideal Engineers Private Limited, Hyderabad	Shri Satish Kabra Shri Deepak Kabra (*Alternate*)
Indian Oil Corporation Limited, Mumbai	Shri Shankar Sharan Shri S. M. Rambhal (*Alternate)*
J. R. Fabricators Limited, Halol	Shri Ashwin H. Mehta Shri S. Sesh Kumar (*Alternate*)
Jindal Stainless Limited, Hissar	Shri L. C. Jain Shri Pravain Goel (*Alternate*)
LPG Equipment Research Centre, Bangalore	Shri U. V. Munnar Shrimati Karobi Mukherjee (*Alternate*)
Ministry of Defence (DGQA), Pune	Shri J. P. Tiwari Shri K. Sudhakaran (*Alternate*)
Petroleum and Explosive Safety Organization, Nagpur	Shri T. R. Thomas Shri D. K. Gupta (*Alternate*)
Sahuwala Cylinders (P) Limited, Visakhapatnam	Shri P. K. Gupta Shri P. Srinivas (*Alternate*)
Shri Shakti Cylinders Private Limited, Hyderabad	Shri D. V. Raja Sekhar Shri Younus Geelani (*Alternate*)
Shiv Energy India Limited, Hyderabad	Shri R. R. Raj
Steel Authority of India Limited, Salem	Shri M. Prabakaran Shri N. K. Vijayavargia (*Alternate*)
Supreme Cylinders Limited, Delhi	Shri M. L. Fathepuria
Tata Iron and Steel Company Limited, Jamshedpur	Dr Sudipto Sarkar Shri A. N. Bhagat (*Alternate*)
In personal capacity (*Menon & Patel, 14/3, Mathura Road, Faridabad*)	Shri E. M. Patel

(*Continued from second cover*)

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with 1S 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc No.: MED 16 (1207).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices: *Telephones*

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002 — 2323 7617, 2323 3841

Eastern : 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi, KOLKATA 700054 — 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022 — 260 3843, 260 9285

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 — 2254 1216, 2254 1442, 2254 2519, 2254 2315

Western : Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400093 — 2832 9295, 2832 7858, 2832 7891, 2832 7892

Branches: AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. KOCHI. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. VISAKHAPATNAM.

Published by BIS, New Delhi

AMENDMENT NO. 1 AUGUST 2015
TO
IS 3196 (PART 1) : 2013 WELDED LOW CARBON STEEL GAS CYLINDERS EXCEEDING 5 LITRES WATER CAPACITY FOR LOW PRESSURE LIQUEFIABLE GASES

PART 1 CYLINDERS FOR LIQUEFIED PETROLEUM GAS (LPG) — SPECIFICATION

(Sixth Revision)

(*Page* 1*, clause* **3.7**) — Substitute the following for the existing clause:

'**3.7 Batch**

A batch shall consist of finished cylinders not exceeding 3 000 cylinders made consecutively by the same manufacturer using the same manufacturing technique, to the same design, size and material specifications on the same type of automatic welding machines and subject to the same heat treatment conditions. A batch may contain material from more than one cast.'

[*Page* 2, *clause* **6.2.1** b), *equation*] — Substitute 'D_O' *for* 'D_i'.

[*Page* 3, *clause* **6.2.3**, *equation* 2] — Substitute 'D_O' *for* 'D'.

[*Page* 3, c*lause* **6.2.3**, *equation* 3] — Substitute 'D_O' *for* 'D'.

(MED 16)

Publication Unit, BIS, New Delhi, India

AMENDMENT NO. 2 JULY 2017
TO
IS 3196 (PART 1) : 2013WELDED LOW CARBON STEEL GAS CYLINDERSEXCEEDING 5 LITRES WATER CAPACITY FOR LOW PRESSURE LIQUEFIABLE GASES

PART 1 CYLINDERS FOR LIQUEFIED PETROLEUM GAS (LPG) — SPECIFICATION

(SixthRevision)

[*Page* 3, *clause* **6.2.3**, *equation* 1] — Substitute '$t_{\text{e Minimum}}$' *for* '$t_{\text{e Min}}$'.

[*Page* 3, *clause* **6.2.3**, *equation* 2] — Substitute '$t_{\text{e Minimum}}$' *for* '$t_{\text{e Min}}$'.

[*Page* 3, *clause* **6.2.3**, *equation* 3] — Substitute '$t_{\text{e Minimum}}$' *for* '$t_{\text{e Min}}$'.

(*Page* 5, *clause* **9.3.1**) — Insert the following sentence at the end of clause:

'The shroud may be metallic or non-metallic as approved by statutory authority. Arrangement for fixing shroud on the cylinder shall be made of compatible steel.'

(*Page* 5, *clause* **9.3.2**) — Substitute the following for the existing clause:

'**9.3.2** The protective metal ring or grill shall be welded or fixed to the upper end of the cylinder concentric with the neck. The eccentricity of the welded metal ring or grill with respect to the valve pad/bung shall not be more than 1 percent of the nominal diameter of cylinder subject to a maximum of 3 mm.'

(MED 16)

Publication Unit, BIS, New Delhi, India

AMENDMENT NO. 3 AUGUST 2019
TO
IS 3196 (PART 1) : 2013 WELDED LOW CARBON STEEL GAS CYLINDERS EXCEEDING 5 LITRES WATER CAPACITY FOR LOW PRESSURE LIQUEFIABLE GASES

PART 1 CYLINDERS FOR LIQUEFIED PETROLEUM GASES (LPG) — SPECIFICATION

(Sixth Revision)

(*Page* 9, *clause* **23.2**) — Substitute the following for the existing clause:

'**23.2** The outside surface shall be grit (*see* IS 4683) blasted with minimum SA 2.5 grade of blast (*see* IS 9954) and shall be given following protective coatings:

a) Spraying zinc to give a coating of minimum thickness of 37 microns unless otherwise agreed to between the purchaser and the manufacturer. The zinc wire used for spraying shall be as per IS 12447 and the zinc spraying shall be as per IS 6586;
b) One coat of primer as per IS 2074 (Part 1) or IS 12744 (Part 1) shall be used in case of enamel paint. If cylinder is painted with polyurethane paint, one coat of epoxy primer as per IS 13238 shall be used. Colour of the primer shall be as agreed to between the purchaser and the manufacturer. Any other primer may be used as per agreement between the manufacturer and the purchaser with approval of Statutory Authority;
c) One coat of synthetic enamel paint conforming to IS 2932 (Part 1) or polyurethane paint conforming to IS 13213, of signal red colour (Shade No. 537 of IS 5) or any other colour as approved by statutory authority. Both the layers of the primer and paint shall have a total thickness of minimum 30 microns. Any other paint may be used as per agreement between the manufacturer and the purchaser with approval of Statutory Authority;
d) As an alternate to (b) and (c) above, cylinders shall be powder coated conforming to IS 13871 of signal red colour (Shade No. 537 of IS 5) or any other colour as approved by statutory authority. Powder coating shall have a thickness of minimum 30 microns.
e) The total combined thicknesses of above protective coatings shall be minimum 67 microns.

NOTE — Procedure for measurement of coating of thickness:

a) Five gauge readings for each spot shall be taken moving the probe a short distance for each new gauge reading within an approximate area of 2 cm × 2 cm. Discard any unusually high or low gauge reading that can not be repeated consistently. Take the average of the five gauge readings as a spot measurement.

b) Make five such spot measurements approximately evenly spaced over the surface of the cylinder.

c) Each spot measurement shall not be below 80 percent of the specified minimum thickness and average of the five spot measurements shall not be below the specified thickness.'

(*Page* 10*, Annex* A) — Substitute 'IS 2074 (Part 1) : 2015 Ready mixed paint, air drying, red oxide — Zinc chrome, priming — Specification : Part 1 For domestic and decorative applications (*third revision*)' *for* 'IS 2074 : 1992 Ready mixed paint, air drying, red oxide zinc chrome, priming (*second revision*)'.

(*Page* 10*, Annex* A) ─ Substitute 'IS 2932 (Part 1) : 2013 E namel, synthetic, exterior: (a) undercoating (b) finishing — Specification Part 1 For domestic and decorative applications (*fourth revision*)' *for* 'IS 2932 : 2003 Enamel, synthetic, exterior (a)undercoating, (b) finishing ─ Specification (*third revision*)'.

(*Page* 10*, Annex* A) ─ Insert the following new entries at an appropriate places:

'*IS No*.	*Title*
2931 (Part 1) : 2013	Ready mixed paint, air drying, red oxide — Zinc phosphate, priming — Specification: Part 1 For domestic and decorative applications (*first revision*)
12744 (Part 1) : 2013	Ready mixed paint, air drying, red oxide — Zinc phosphate, priming — Specification: Part 1 For domestic and decorative applications
13213 : 2018	Polyurethane full gloss enamel (two pack) — Specification (*first revision*)
13238 : 1991	Epoxy based zinc phosphate primer (two pack) — Specification'

(MED 16)

Publication Unit, BIS, New Delhi, India

AMENDMENT NO. 4 TO NOVEMBER 2020

TO

IS 3196 (PART 1) : 2013 WELDED LOW CARBON STEEL GAS CYLINDER EXCEEDING 5 LITRE WATER CAPACITY FOR LOW PRESSURE LIQUEFIABLE GASES

PART 1 CYLINDERS FOR LIQUEFIED PETROLEUM GAS (LPG) — SPECIFICATION

(Sixth Revision)

[*Page* 9, *clause* **23.2** b) (*see also Amendment No*. 3)] — Substitute the following for the existing clause:

'b) One coat of primer as per IS 12744 shall be used in case of enamel paint. If cylinder is painted with polyurethane paint, one coat of epoxy primer as per IS 13238 shall be used. Colour of the primer shall be as agreed to between the purchaser and the manufacturer. Any other primer may be used as per agreement between the manufacturer and the purchaser with approval of Statutory Authority;'

[*Page* 9, *clause* **23.2** c), first line (*see also Amendment No*. 3)] — Substitute 'IS 2932' *for* 'IS 2932 (Part 1)'

[*Page* 9, *clause* **23.2** d) (*see also Amendment No*. 3)] — Substitute the following for the existing clause:

'd) The total combined thicknesses of above protective coatings shall be minimum 67 microns.'

[*Page* 9, *clause* **23.2** e) (*see also Amendment No*. 3)] — Substitute the following for the existing clause:

'e) As an alternate to a), b) and c) above, cylinders shall be powder coated conforming to IS 13871 of signal red colour (Shade No. 537 of IS 5) or any other

colour as approved by statutory authority. The minimum thickness of powder coating shall be 50 microns.'

[*Page* 10, *Annex* A (*see also Amendment No*. 3)] — Delete the following referred Indian Standard:

'IS 2074 (Part 1) : 2015 Ready mixed paint, air drying, red oxide — Zinc chrome, priming — Specification Part 1 For domestic and decorative applications (*third revision*)'

[*Page* 10, *Annex* A (*see also Amendment No*. 3)] — Delete the following referred Indian Standard:

'IS 2931 (Part 1) : 2013 Ready mixed paint, air drying, red oxide — Zinc phosphate, priming — Specification Part 1 For domestic and decorative applications (*first revision*)'

[*Page*10, *Annex* A (*see also Amendment No*. 3)] — Substitute 'IS 2932 : 2013 Enamel, synthetic, exterior: a) undercoating b) finishing — Specification (*fourth revision*)' *for* 'IS 2932 (Part 1) : 2013 Enamel, synthetic, exterior:—(a) undercoating (b) finishing — Specification Part 1 For domestic and decorative applications (*fourth revision*)'

[*Page* 10, *Annex* A (*see also Amendment No*. 3)] — Substitute 'IS 12744 : 2013 Ready mixed paint, air drying, red oxide — Zinc phosphate, priming — Specification (*first revision*)' *for* 'IS 12744 (Part 1) : 2013 Ready mixed paint, air drying, red oxide — Zinc phosphate, priming — Specification: Part 1 For domestic and decorative applications (*first revision*)'

Publication Unit, BIS, New Delhi, India