इंटरनेट मानक

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Mazdoor Kisan Shakti Sangathan
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Jawaharlal Nehru
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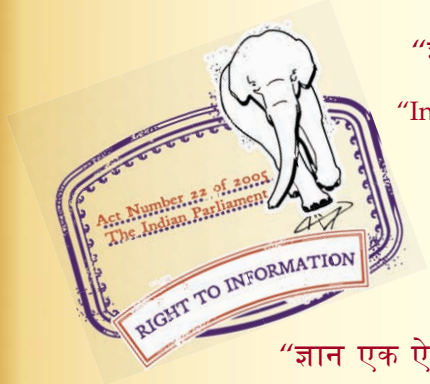
IS 12586 (1988): Brazed Low Carbon Steel Gas Cylinders Not Exceeding 13 Litre Water Capacity [MED 16: Mechanical Engineering]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

IS 12586 : 1988
(Reaffirmed 2007)

Indian Standard
BRAZED LOW CARBON STEEL GAS CYLINDERS NOT EXCEEDING 13 LITRE WATER CAPACITY — SPECIFICATION

भारतीय मानक

13 लिटर पानी की धारिता से अनधिक ब्रेजित निम्न कार्बन इस्पात के गैस सिलिंडर हैं — विशिष्टि

(First Reprint DECEMBER 1996)

UDC 621.642.02 [669.15-194]

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

September 1989

Price Group 5

Gas Cylinders Sectional Committee, EDC 16

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on 20 December 1988, after the draft finalized by Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard covers the requirements for brazed low carbon steel cylinders used for storage and transportation of low pressure liquefiable gases other than toxic gases.

Manufacture, possession, and use of any gas when contained in cylinders in a compressed or liquefied state is regulated under the Gas Cylinder Rules, 1981, of the Government of India. This specification has been prepared in consultation and agreement with the statutory authorities under these rules.

Technical Committee (TC 58) Gas Cylinders of the International Organization for Standardization (ISO) is actively concerned with standardization in this field. In preparing this specification the work to date at the international level and the proposed manufacturing practice in this Country have also been taken into account.

The relevant SI units and the corresponding conversion factors are given below for guidance:

Pressure, stress — 1 Pa (Pascal) = $1N/m^2$
$1kgf/mm^2 = 9.806\ 65$ MPa

AMENDMENT NO. 3 MAY 2002
TO
IS 12586:1988 BRAZED LOW CARBON STEEL GAS CYLINDERS NOT EXCEEDING 13 LITRE WATER CAPACITY — SPECIFICATION

(*Page* 2, *clause* **5.2.1**) — Substitute '2' *for* '200', in all the formulae for calculation of minimum thickness '*t*'.

(MED 16)

Reprography Unit BIS, New Delhi, India

AMENDMENT NO. 2 MAY 1998
TO
IS 12586 : 1988 BRAZED LOW CARBON STEEL GAS CYLINDERS NOT EXCEEDING 13 LITRE WATER CAPACITY — SPECIFICATION

(*Page* 2, *clause* **6.2.1**, *line* 6) — Substitute 'may' *for* 'shall'.

[*Page* 5, *clause* **11.1**(a)] — Substitute the following for the exisisting matter:

'a) *Tensile Test,* one in longitudinal direction on plate material of cylinder, and'

(*Page* 6, *clause* **11.7**) — Insert the following new clause after **11.7**:

'**11.8 Failure in Hydrostatic Stretch Test**

If in the hydrostatic stretch test the permanent stretch exceeds the limits given in **10.1.1** but the cylinder does not show visible local deformation, the manufacturer may:

a) either subject the entire batch to the hydrostatic stretch test in accordance with **10.1.1** and reject those that foil in the test, or

b) re-heat-treat the batch and offer for retest in accordance with **10.1.1, 11.1** and **11.2**. In case of failure in the retest the entire batch shall be rejected.'

(HMD 16)

AMENDMENT NO. 1 MAY 1992
TO
IS 12586 : 1988 BRAZED LOW CARBON STEEL GAS CYLINDERS NOT EXCEEDING 13 LITRE WATER CAPACITY — SPECIFICATION

(*Page* 1, *clause* **4.1**, *line* 13) — Substitute '(=186.32 N/mm^2)' *for* '(=86.32 N/mm^2)'.

(*Page* 1, *clause* **4.2**, *line* 5) — Substitute 'b) Class 1A of IS 1875 : 1978' *for* 'b) Class 1 of IS 1875 :1978'.

(*Page* 2, *clause* **6.1.2**) — Insert the following for the existing clause:

'6.1.2 The non-pressure attachments like foot ring, valve protection cap, hanging lugs, can be located in position by electric resistance spot welding/projection welding if brazed. The total length of brazing shall be not less than 75 percent of the joint coming in contact with the body.'

(*Page* 4, *clause* **6.5.1**) — Insert the following for the existing clause:

'6.5.1 The valve shall conform to IS 3224 : 1979 or shall be of any other type as agreed to between the manufacturer and the purchaser subject to their satisfying the safety requirements of the statutory authority.'

(*Page* 4, *clause* **6.5.2**) — Insert the following for the existing clause:

'6.5.2 In the case of liquefied petroleum gas (LPG) cylinders exceeding 5 litre water capacity the valve shall conform to IS 8737 (Part 2) : 1978 and shall conform to IS 8776 : 1978 for cylinders less than 5 litre water capacity or shall be of any other type as agreed to between the manufacturer and the purchaser subject to their satisfying the safety requirements of the statutory authority.'

(*Page* 4, *clause* **8.1.1**, *line* 2) — Substitute 'hydrostatic' *for* 'hydraulic'.

(*Page* 4, *clause* **9**, *line* 1) — Substitute 'hydrostatically' *for* 'hydraulically'.

(*Page* 4, *clause* **10.1.2**) — Substitute the following for the existing formula:

$$'f_b = \frac{P_h \times D_i}{2t'}'$$

(Page 5, *clause* **11.1.1.1**, *line* 3) — Substitute 'one' *for* 'two'.

(HMD 16)

Printed at Simco Printing Press, Delhi, India

Indian Standard

BRAZED LOW CARBON STEEL GAS CYLINDERS NOT EXCEEDING 13 LITRE WATER CAPACITY — SPECIFICATION

1 SCOPE

This standard deals with brazed low carbon steel cylinders intended for storage and transportation of low pressure liquefiable gases, other than toxic gases, of nominal capacity exceeding 500 ml but not exceeding 13 litres of water capacity. This standard lays down the requirements for the materials to be used in the manufacture of cylinders, their construction, marking and testing.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 7241 : 1981 shall apply.

4 MATERIAL

4.1 Cylinder

The steel used in the manufacture of cylinders shall conform to any one of the following specifications:

a) Grade A or B of IS 6240 :1976,

b) Grade DD or EDD of IS 513 : 1986,

c) Grade A of IS 10787 : 1984, and

d) Grade DD and EDD of IS 1079 : 1973.

The minimum yield strength (R_e) to be guaranteed after heat treatment of the finished cylinder by the cylinder manufacturer shall not be more than the yield strength guaranteed by the steel manufacturer and shall not be less than 18632 MPa (=86.32 N/mm^2). The yield strength (R_e) guaranteed by the cylinder manufacturer shall be used for the purpose of calculation of minimum wall thickness.

4.1.1 Suitable steel other than those mentioned in **4.1** may be used with the prior permission of the statutory authority. Such a steel should be certified by the steel maker to be suitable for pressing or drawing and should have acceptable non-ageing properties.

4.1.2 A certificate shall be supplied by the steel maker, giving analysis of the finished steel supplied for the manufacture of the cylinders, for each heat number. The inspecting authority shall be given the opportunity of making an independent check analysis if necessary. The manufacturer of gas cylinders shall establish means to identify the cylinders from the casts of steel from which they are made. These provisions shall be applicable to steel mentioned in **4.1** and **4.1.1.**

4.2 Valve Pad or Bong

The material used for the manufacture of valve pad or bung shall conform to any one of the following specifications:

a) IS 226 : 1975,

b) Class 1 of IS 1875: 1978, and

c) IS 7283 : 1974.

4.2.1 Steel for non-pressure attachments like foot ring, valve protecting ring, hanging lugs or handle shall not have carbon content of more than 0.2 percent and sulphur and phosphorous content of more than 0.05 percent each.

4.2.2 Suitable steel other than those specified in **4.1** and **4.2** may be used with the prior permission of statutory authority.

5 DESIGNS

5.1 The cylinder shall be of brazed construction having a cold or hot drawn cylindrical portion with ellipsoidal or torispherical ends brazed to it, or two halves cold or hot drawn and circumferentially brazed together or any other construction approved by the statutory authority.

5.1.1 There shall be no longitudinal seam joint. Non-pressure retaining attachments shall either be brazed or welded. Electric resistance spot welding shall be permitted for locating the attachments in position prior to brazing. The lap joint for pressure retaining attachments shall not be less than 3 times the thickness of the material to be joined. The joint when tensile tested shall break in parent material. Joggle butt joints shall be uniform press fit with substantial metal to metal contact

between members. Such joints shall not be loose to be removed by normal hand pulling.

5.2 The calculation of the thickness of the 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.

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

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

$$t = \frac{P_h \; D_o}{200 \times 0{\cdot}8 \, J R_e + P_h}$$

or

$$\frac{P_h \; D_i}{200 \times 0{\cdot}8 \, J R_e - P_h}$$

b) For semi-ellipsoidal part or end (*see* Fig. 1A):

$$t = \frac{P_h \; D_o}{200 \times 0{\cdot}8 \, J R_e + P_h} \times \frac{K \, (0{\cdot}65 + 0{\cdot}1 \, K)}{4}$$

For torispherical part or end (*see* Fig. 1B):

$$t = \frac{P_h \; D_o}{200 \times 0{\cdot}8 \, J R_e + P_h} \times \frac{KZ}{5}$$

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* **5.2.2**);

P_h = test pressure in MPa (N/mm^2) above atmosphere;

D_i = inner diameter in mm;

D_o = outer diameter in mm;

R_e = yield strength (minimum value specified in **4.1** in MPa);

H = depth of dishing in mm;

K = the ratio D_o / H;

R = dishing radius in mm ($R \leq D_o$); and

r = knuckle radius in mm ($r \geq 0.1 \, D_o$);

J = brazed joint factor;

The joint factor to be used in the design of cylinder shall be 1.0 for joints in which visual examination assures that the brazing filler metal has penetrated through the entire joint and appears on both the sides of the joint. However, in cases where visual examination will not provide the proof that the brazing filler metal has penetrated the entire joint, the joint factor shall be 0.5.

$$Z = \frac{\frac{20r_i}{R_i} + 3}{\frac{20r_i}{R_i} + 1}$$

5.2.2 Thickness of shell shall not be less than 1 mm for cylinders up to and including 75 mm outside diameter and 1.4 mm for cylinders over 75 mm diameter up to 13 litre water capacity.

6 FABRICATION

6.1 Brazing

The cylinder halves may be brazed by copper or copper alloys. These shall be lap jointed according to Annex B. The brazing procedure including operators qualification and brazing methods shall be according to Annex G.

6.1.1 Before brazing, the parts to be joined shall be free from scale, greese, oil and dirt. In case of rolled-in scale, the same shall 'be removed by chemical or mechanical process before brazing.

6.1.2 The non-pressure attachments like foot ring, valve protection cap, hanging lugs, can be located in position by electric resistance spot welding/protection welding if brazed. The brazing shall be throughout the length of the joint coming in contact with the body.

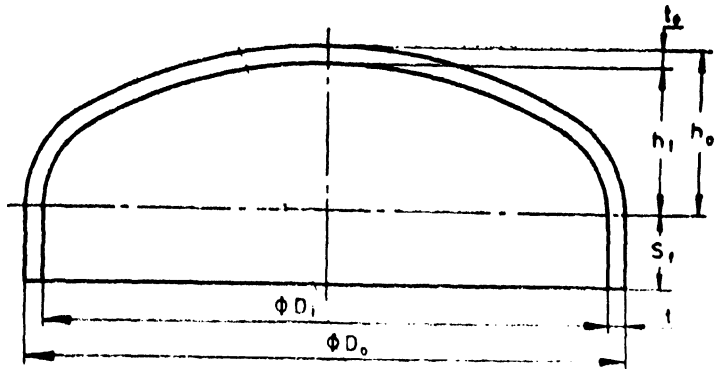
6.1.3 The brazing material generally shall be as specified in Annex D.

6.2 Manufacture

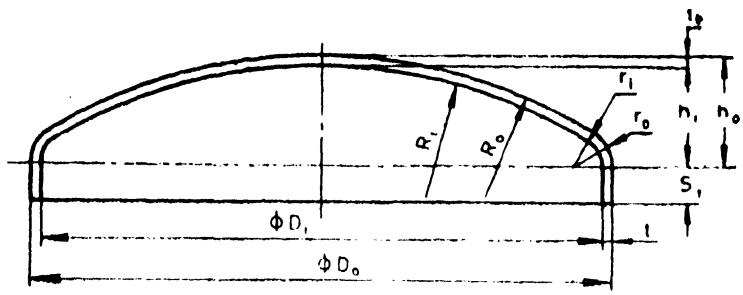
The end of deep drawn parts shall be of semi-ellipsoidal or torispherical ends. The end shall have a cylindrical skirt or parallel portion of minimum length 10 mm or 3 times the shell thickness, whichever is greater.

6.2.1 *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 **5.2.1** or by **5.2.2** at any transverse section of the cylindrical portion. Additional thickness shall also be provided to cover corrosion allowance, manufacturing tolerances and stress due to horizontal acceleration and retardation during transportation. The amount of this allowance shall be as agreed to between the manufacturer and the purchaser.



1A SEMI-ELLIPSOIDAL



1B TORISPHERICAL

FIG. 1 DOMED ENDS

6.3 Examination of the Cylinders Before Closing-in Operation

Each cylinder shall be examined for wall thickness before the closing-in operation. The manufacturer shall check for circularity of the cylindrical shell and the skirt portion of ends, external and internal surface defects, the profile regularity of the ends and offset at the joints. The manufacturer shall assure himself that the wall thickness is not less than the agreed finished thickness at any point. For this, the standard laid down by manufacturers and the inspecting authority shall form the guidelines.

6.3.1 *Circularity*

The out of roundness of the cylindrical shell shall be limited to such a value that the difference between the maximum and minimum outside diameter in the same cross section is not more than one percent of the mean of these diameters when assembled.

6.3.2 *Surface Defects*

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

6.3.3 *Profile Regularity*

The inner surface of the end shall not deviate from the prescribed shape by more than 1.25 percent of the nominal diameter of the head skirt. Such deviations shall not be abrupt.

6.3.4 *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.

6.4 Water Capacity

Water capacity of the cylinder shall have a tolerance of $^{+5}_{0}$ percent on calculated or declared capacity.

6.5 Valves

The valve connections shall consist of a brazed pad, boss or nipple, and shall be threaded to suit the type of valve used.

6.5.1 The valve shall conform to IS 3224: 1979 or IS 8737 (Part 2) : 1978 or shall be of any other type as agreed to between the manufacturer and the purchaser subject to their satisfying the safety requirements of the statutory authority.

6.5.2 In the case of liquefied petroleum gas (LPG) cylinder the valve shall conform to IS 8776 : 1978 or shall be of any other type as agreed to between the manufacturer and the purchaser subject to their satisfying the safety requirements of the Statutory authority.

6.6 Fittings Other than Valves

Handle or other suitable attachments for lifting the cylinder may 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.

6.7 Foot Ring

The foot ring, where fitted as a separate fixture to the bottom end of the cylinder, shall be atleast 20 mm away from the circumferential joint. In case the foot ring is made out of sheet, 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. Alternately, steel rods of adequate strength may also be used. The foot ring may be intermittently brazed. It shall be provided with holes for ventilation, as well as draining holes to avoid corrosion. The maximum permissible deviation from the vertical shall not exceed 1°. Foot ring shall be sufficiently strong, made of steel compatible with that of the cylinder. The bottom of foot ring shall not be less than 5 mm below the outside bottom of the cylinder shell.

7 HEAT TREATMENT

7.1 All cylinders passing through the brazing furnace shall be considered as heat treated provided they meet physical properties as specified in **4.1** when tested as per **11**.

7.1.1 The manufacturer shall have the option to normalize or stress relieve the cylinder subsequent to brazing operation.

8 PROOF TEST

8.1 Proof test shall be carried out hydrostatically at the maximum testing pressure which shall be one and a half times of the design pressure.

8.1.1 The proof test may also be carried out pneumatically as an alternate to hydraulic test at a maximum of one and a half times design pressure for cylinder of water capacity not exceeding 5 litre. Such a test shall be carried out by providing protective steel jacket which shall withstand the rupture of the cylinder during testing.

8.1.2 The pressure shall be raised to the test pressure under proper control and shall be maintained at the test pressure for not less than 30 s. If the proof test is carried out pneumatically, special precautions shall be taken to protect personnel against consequences of cylinder rupture. The cylinder shall not be struck during testing. Any cylinder which leaks or develops a visible bulge shall be rejected and destroyed.

9 LEAKAGE TEST

Subsequent to the proof test if done hydraulically, every cylinder shall be dried and tested for leakage by subjecting to air pressure of not less than 686 kPa while immersed in water, and shall show no leakage.

10 BURSTING TEST

10.1 One cylinder taken at random from each batch of 403 or less shall be subjected to an internal hydrostatic pressure till it bursts.

10.1.1 The cylinder taken for bursting shall be first subjected to hydrostatic stretch test. The permanent stretch suffered by the cylinder due to the application of test pressure shall not exceed 10 percent of the total stretch suffered during the test.

10.1.2 The nominal hoop stress corresponding to the pressure at which destruction occurs shall be calculated as given in the following formulae:

$$f_b = \frac{P_b \times D_i}{20{\cdot}4\, t'}$$

where

f_b = nominal hoop stress in MPa (N/mm^2) at which destruction occurs;

P_b = internal hydrostatic pressure in MPa (N/mm^2) at which cylinder bursts;

D_i = nominal original internal diameter in mm of the cylinder; and

t' = minimum agreed finished thickness in mm as specified on the drawing (including corrosion allowance) (*see* **6.2.1**).

10.1.2.1 The value of f_b shall not be less than 0.95 of the minimum specified tensile strength of the material of the cylinder.

10.1.2.2 The cylinder shall burst without fragmentation and fracture shall not occur in the direction parallel to circumferential joint

within 10 mm from the edge of circumferential joint.

11 ACCEPTANCE TESTS

11.1 The following tests shall be made on test pieces taken at random out of each batch of 202 or less heat-treated cylinders:

a) *Tensile Test,* one in a longitudinal direction on plate material; and

NOTE — Test specimens that are not sufficiently flat shall be pressed by cold pressing.

b) *Minimum Thickness Test,* one.

11.1.1 *Tests on Plate Material*

11.1.1.1 *Tensile test on plate material*

The tensile test shall be carried out in accordance with IS 1894: 1972 or IS 1663: 1972 or IS 1608 : 1972 on two proportional test pieces of gauge length $5.65\sqrt{S_O}$ cut from the cylinder, where *So* is the original cross-sectional area of the test specimen in square millimetres. The tensile strength and percentage of elongation thus determined shall not be less than the minimum value specified for the parent material. The value of yield strength thus determined shall not be less than the value of yield strength (*Re)* guaranteed by the cylinder manufacturer for the finished cylinder and used for the design thickness calculation in **5.2.1.**

11.1.1.2 *Bend test on plate material*

The width of the test piece shall be 25 mm or 4 times the agreed finished thickness of the cylinder as specified on the drawing (including corrosion allowance) whichever is greater. The face and back of the test piece shall not be machined except that the edges may be rounded off. The test piece shall not crack when bent round a mandral of diameter equal to twice the plate thickness for actual tensile strength (of parent metal) up to and including 422 MPa = 422 N/mm^2) and a mandral of diameter equal to thrice the plate thickness for actual tensile strength more than 422 MPa (= 422 N/mm^2).

11.2 Brazed Joint Test

11.2.1 *Tensile Test of Brazed Joint*

The test specimen shall be cut from the cylinder used for the tensile test. The specimen taken from across the braze when tested shall not break from the braze.

11.2.2 *Peel Test*

The braze joint shall be peel tested according to Annex E. Before taking the sample for this test it shall be checked for penetration of brazing material in the joints.

11.2.3 One section test to check penetration.

11.3 Minimum Thickness Test

A ring shall be cut from the thinnest portion of the cylinder used for the tensile test and examined for wall thickness. At no point shall thickness be less than the calculated thickness.

11.4 Retest

If the sample fails in any of the mechanical tests specified in **11.1** and **11.2** and the inspecting authority considers that the failure was due to an error in carrying out the test, a fresh test shall be made on a test piece taken from the same cylinder. The defective test shall be ignored but otherwise at the cylinder maker's discretion one of the following procedures shall be adopted:

a) The mechanical test in which the failure occurred shall be repeated on the same cylinder and in addition, the tests specified in **11.1** and **11.2** shall be carried out on another cylinder from the same batch. If both cylinders comply with the test requirements of **11.1** and **11.2** the batch may be accepted.

b) The batch may be reheat treated in accordance with 7 and the tests specified in **11.1** and **11.2** shall be carried out on two cylinders which have not previously been tested. If both cylinders then comply with the requirements of **11.1** and **11.2** the batch may be accepted.

11.5 If the sample fails in any of the mechanical tests saecified in **11.4** (a) the batch may be reheat treated and rested in accordance with **11.4** (b).

11.5.1 If any of the tests specified sn **11.4** (b) fails, the batch shall be tendered unserviceable for holding gas under pressure.

11.6 The cylinders which have been rejected before or after heat treatment due to pin holes in the brazing or due to leak at the braze in proof or pneumatic leakage test may be repaired and re-offered for inspection provided following conditions are satisfied:

a) The cylinder has been reheat-treated if procedure calls for;

b) The cylinder has been subjected to prescribed proof and pneumatic leakage tests;

c) Proper records of such repairs have been maintained; and

d) Not more than two attempts for repair have been made.

11.6.1 Cylinders showing leaks in the hydrostatic or pneumatic leakage test at any place other than the brazed area shall be rejected and rendered unserviceable.

11.7 Failure in Bursting Test

If a cylinder fails due to non-compliance of the requirements of **10.1.2.1** or **10.1.2.2** then the following procedure shall be adopted:

a) All cylinders belonging to the control unit in which the cylinder failed shall be rejected. From the rest of the batch, one cylinder from each control unit shall to selected at random and cylinders shall be passed or failed control unit wise, depending upon the results of the burst tests.

b) If failure can be attributed to a cause which is discernible even before the test, all cylinders with such defects shall be segregated and reprocessed after repair. From the balance of the cylinders two more cylinders shall be selected at random and tested. If one or both fail, the procedure laid down for testing control unitwise above shall be adopted.

12 MARKING AND COLOUR IDENTIFICATION

124 Each cylinder shall be permanently stamped with the following:

a) Month and year of manufacture of cylinder, such as 8/87 for August 1987;

b) Serial number of cylinder;

c) Identification symbol of manufacturer;

d) Tare mass and gross mass of cylinder in kg;

e) Identification symbol of owner, If required;

f) The number of standard;

g) Maximum working pressure in MPa (N/mm^2);

h) Test pressure in MPa (N/mm^2) and date;

j) Water capacity in litres; and

k) Inspector's official mark.

12.1.1 All the marking shall be either at the foot ring or on any non-pressure part of the cylinder. In case it is not possible to mark on the foot ring or non-pressure part of the cylinder the details may be marked on a plate of the same composition as the body of the cylinder and it may be brazed soundly on shoulder of the cylinder.

12.1.2 The stamp used for marking shall have small radii at changes of section to avoid formation of sharp edge in the stamped marking.

12.2 Colour Identification

The cylinder shall be painted externally in accordance with the colour scheme specified in IS 4379: 1981.

13 RECORDS

A record shall be kept of all tests made at the cylinder manufacturer's works and copies shall be forwarded to the purchaser of the cylinder and to the inspecting authority.

14 PREPARATION FOR DESPATCH

Before being fitted with valves all cylinders shall be thoroughly cleaned and dried internally. The outside shall be given suitable protective coating before painting and despatch as agreed to between the buyer and the manufacturer.

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
IS 226 : 1975	Specification for structural steel (standard quality) *(fifth revision)*	IS 1079 : 1973	Specification for hot rolled carbon steel sheet and strip (*third revision)*
IS 513 : 1968	Specification for cold rolled low carbon steel sheets and strips (*third revision*)	IS 1608 : 1972	Method for tensile testing of steel products *(first revision*)

IS No.	*Title*
IS 1663 : 1972	Method for tensile testing of steel sheet and strip of thickness 0.5 mm to 3 mm (*first revision*)
IS 1875 : 1978	Specification for carbon steel billets, blooms, slabs and bars for forgings (*fourth revision*)
IS 1894 : 1972	Method for tensile testing of steel tubes (*first revision*)
IS 3224 : 1979	Specification for valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders (*second revision*)
IS 4379 : 1981	Identification of the contents of industrial gas cylinders (*first revision*)
IS 6240 : 1976	Specification for hot-rolled steel plate (up to 6 mm), sheets and strip for the manufacture of low pressure gas cylinders (*first revision*)
IS 7241 : 1981	Glossary of terms used in gas cylinder technology (*first revision*)
IS 7283 : 1974	Specification for rolled bars for production of bright bars
IS 8737 (Part 2) : 1978	Specification for valve fittings for use with liquefied petroleum gas (LPG) cylinders of more than 5 litre capacity : Part 2 Valve fittings for newly manufactured LPG cylinders
IS 8776 : 1978	Specification for valve fittings for use with liquefied petroleum gas (LPG) cylinders up to and including 5 litre water capacity
IS 10787 : 1984	Specification for hot rolled micro-alloyed steel plate, sheet and strip for the manufacture of low pressure liquefiable gas cylinders

ANNEX B

(*Clause* 6.1)

JOINT DESIGN

B-1 The easiest joints to braze and which give the best results are those where the component parts of the assembly are self-locating and need no external jigs to hold them on their correct relationship to one another. Sometimes the design of the joint needs to be varied in accordance with the manner in which the filler metal is to be fed to it.

B-2 Examples of basic designs for brazing are shown in Fig. 2

B-3 As a general rule the overlaps should be three times the thickness of the parent metal. This may be varied according to the circumstances and the type of joint required. Excessive overlap may not improve the strength of the joint and may cause undesirable features such as porosity, gas and flux inclusions.

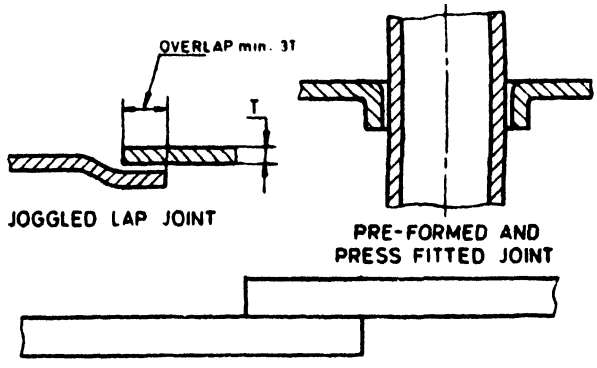


FIG. 2 BASIC DESIGNS FOR BRAZING

ANNEX C
(*Clause* 6.1)

BRAZING PROCEDURE AND PERFORMANCE QUALIFICATION

C-1 The manufacturer shall establish the brazing procedure and shall demonstrate that the procedure meets with the test required for the acceptance tests for cylinder and the minimum requirement of the test as specified for the cylinders in various clauses.

C-2 The main variables for the brazing procedure are listed below:

a) Base metal;

b) The joint design;

c) Braze material;

d) Brazing process as:

i) Furnace brazing; or ii) Torch brazing

e) Brazing temperature;

f) Brazing atmosphere in the furnace; and

g) The position of How.

C-2.1 For the purpose of these specifications, IS 10787 : 1984 should be considered as one class of material and IS 6240 : 1976, IS 513 : 1986 and IS 1079: 1973 shall be considered as another class of material.

C-2.2 The manufacturer shall specify the required details for serial No. (a) to (g) of **C-2** and shall qualify the brazing procedure. The test pieces shall be cut and tested in accordance with **11.2, 11.2.1, 11.2.2,** and **11.2.3** and shall meet the minimum requirement. In case any of the above variables are altered, fresh procedure shall be qualified.

The manufacturer shall then prove the procedure by conducting again the tests specified for the braze joint according to **11.2.**

C-3 PERFORMANCE TEST

C-3.1 Brazers

Each brazer who brazes the cylinders in accordance with this specification shall have passed the test prescribed for performance qualifications after brazing one cylinder according to the agreed and approved procedure. The test specimens shall be cut for tensile test, for section test and for peel test. If the test results meet the requirement specified for the braze joint test of the cylinders, the brazer shall be qualified to braze the cylinders using the same brazing process or procedure approved.

C-3.2 Whenever there is a change in brazing procedure, the brazers shall be re-qualified according to the performance test.

ANNEX D
(*Clause* 6.1.3)

BRAZING MATERIAL

D-1 COPPER FILLER METALS

The following three are the standard copper brazing filler metals:

a) Filler metal having a minimum of 99.90 percent copper and a maximum of 0.10 percent of other elements. It is available in strip, rod and wire on spools.

b) Filler metal having a minimum of 99.0 percent copper and a maximum of 0.30 percent of other metallic elements. It is available as a powder in two standard sieve analyses, medium-1 and medium-2. It is applied as a powder in some applications, but is frequently mixed with a liquid vehicle and applied as a paste. In most applications, (a) and (b) are interchangeable.

c) Filler metal available in the form of a paste having a minimum of 86.5 percent copper and a maximum of 0.50 percent other metallics and 1.3 percent non-metallic contaminants including chlorides, sulphates and matter insoluble in nitric acid or soluble in acetone. The remainder is oxide. The paste is a suspension of particles of copper and cuprous oxide in a volatile vehicle.

D-2 COPPER FILLER METALS COMMONLY USED IN FURNACE BRAZING

Classification	*Minimum Copper (Percent)*	*Brazing Temperature*
a)	99.90	1 080°C to 1 150°C
b)	99.0	1 080°C to 1 150°C
c)	86.5	1 080°C to 1 150°C

ANNEX E

(Clause 11.2.2)

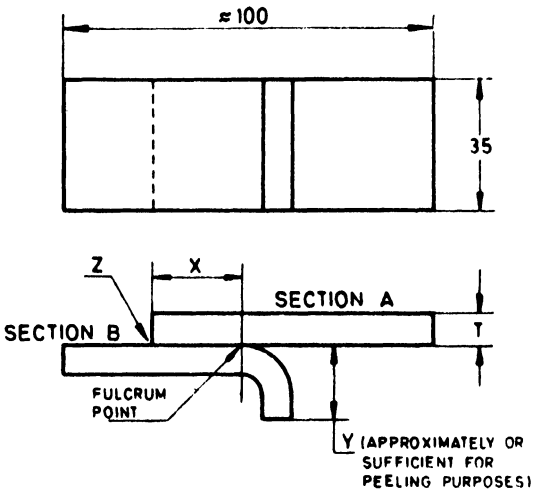
PEEL TEST — ACCEPTANCE CRITERIA

the specimen shall be separated or peeled by suitable means and the separated faying surfaces of joints shall meet the following criteria (*see* Fig. 3) :

a) The total area of defects (unbrazed area flux inclusion, etc) shall not exceed 30 percent of the total design area of any individual faying surfaces.

b) The sum of the length of defects measured on any one line in direction of the lap, shall not exceed 25 percent of the lap.

c) No defect shall extend continuously from one edge of the joint to the other edge irrespective of the direction of the defects



All dimensions in millimetres.

FIG. 3 LAP JOINT PEEL SPECIMEN

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