



**PRODUCT MANUAL FOR
WELDED LOW CARBON STEEL CYLINDERS
EXCEEDING 5 LITRE WATER CAPACITY FOR
LOW PRESSURE LIQUEFIABLE GASES -
CYLINDERS FOR TOXIC AND CORROSIVE GASES
ACCORDING TO IS 3196 (Part 4): 2001**

This Product Manual shall be used as reference material by all Regional/Branch Offices & licensees to ensure coherence of practice and transparency in operation of certification under Scheme-I of Bureau of Indian Standards (Conformity Assessment) Regulations, 2018 for various products. The document may also be used by prospective applicants desirous of obtaining BIS certification licence/certificate.

1.	Product	:	IS 3196 (Part 4): 2001
	Title	:	Welded low carbon steel cylinders exceeding 5 litre water capacity for Low Pressure liquefiable Gases - Cylinders for Toxic and Corrosive gases
	No. of Amendments	:	2
2.	Sampling Guidelines:		
a)	Raw material	:	Please refer ANNEX- A
b)	Grouping guidelines	:	Each Variety of Cylinders shall be tested for GoL/CSoL.
c)	Sample Size	:	Please refer ANNEX- B
3.	List of Test Equipment	:	Please refer ANNEX – C
4.	Scheme of Inspection and Testing	:	Please refer ANNEX – D
5.	Possible tests in a day:	:	All Test.
6.	Scope of the Licence:	:	Please refer ANNEX- E

ANNEX A

Raw Material

Raw Material	Requirement
Steel	IS 6240 (Other suitable low carbon steel as per Cl. 4.1.1 may be used with the prior permission of the statutory authority)
Bung	Class 1A or 2 of IS 1875 or IS 7283 or IS 9550
Backing Strip	IS 2062 Steel of equivalent or superior qualities may be used with the prior permission of statutory authority.
Foot ring	IS 1079 (Any other material having equivalent properties may be used)
Valve	IS 3224

ANNEX B

Sample Size

1. For considering grant of licence/inclusion of additional varieties, a trial batch of prototype cylinders as per the approved drawings shall be manufactured during the joint inspection of BIS and Statutory Authority after in-principle approval is received from the statutory authority.
2. One sample consists of the following cylinders drawn from the above batch of prototype cylinders:
 - i) One painted cylinder with valve - For all tests except Acceptance test, and Bung requirements.
 - ii) One cylinder without valve - For Acceptance tests and Bung requirements.

ANNEX C**List of Test Equipment***Major test equipment required to test as per the Indian Standard*

Sl No.	Tests used in with clause reference	Test Equipment(s)
1.	Valve pad/bung – Cl. 9, 10.3	Thread Plug Gauges (Go and No-Go).
2.	Pressings/Halves/Cylinder shell, Circularity, Profile regularity, Offset at the joint, Straightness, Eccentricity, wall thickness - Cl. 8.5, 12	Vernier caliper, Surface plate, Spirit level, Try square, Height Vernier gauge, Goose neck gauge, Offset thickness gauge with filler Gauge Ultrasonic thickness gauge, Dial gauge with arrangement for eccentricity measurement.
3.	Handle Test - Cl. 10.1	Handle test arrangement.
4.	Drop Test – Cl. 9.3	Drop test arrangement with Flat Hard Surface.
5.	Foot ring – Cl. 10.2	Vernier caliper, Angle protector.
6.	Dip Tube – Cl.10.4	Filler Gauge.
7.	Heat treatment – Cl. 11.0	Furnace with temperature recorder, graphs, thermocouples, temperature indicators.
8.	Radiographic Examination -Cl. 13.0	X ray machine, Gamma Ray Source, Darkroom with developing and viewing facilities of films.
9.	Liquid die penetration – Cl. 13.3	Chemicals for Cleaning, Penetration and developer, Magnifying Glass, Inspection Torch as per IS 3658
10.	Magnetic Particle – Cl. 13.3	Arrangement (Magnetic Yoke) as per IS 3703 with Fluorescent Powder, Filed Indicator and UV lamp.
11.	Checking for water capacity – Cl. 14	Weighing balance or measuring cans of appropriate capacity.
12.	Hydrostatic test – Cl. 15	HST test setup with pressure gauges.
13.	Valve fixing and Pneumatic leakage test – Cl. 9, 16	Torque Wrench and cylinder holding device, Pressure Gauge with water tank.
14.	Hydrostatic stretch test - Cl 17.1	Apparatus as per cl 6 of IS 3196(Part3).
15.	Burst Test Under Hydraulic Pressure - Cl. 17.2	Burst test setup with pump, pressure gauge, weighing balance.

16.	Acceptance Test – Cl. 18	Universal testing machine with graph plotter, Suitable mandrels for bend test, Vernier caliper, CuSO ₄ Solution, Micrometer, Marker, Steel Scale, Center Punch.
17.	Nicked Bend Test – Cl. 18.1.6	Bench vice with holding device of sample for bending, Hacksaw.
18.	Internal Cleaning, drying – Cl. 22	Rod fitted with light source at one end

The above list is indicative only and may not be treated as exhaustive.

ANNEX D

Scheme of Inspection and Testing

1. LABORATORY – A laboratory shall be maintained which shall be suitably equipped (as per the requirement given in column 2 of Table 1) and staffed, where different tests given in the specification shall be carried out in accordance with the methods given in the specification.

1.1 The manufacturer shall prepare a calibration plan for the test equipments. The following equipments shall be calibrated at a frequency shown against each and records kept:

1.1.1 Tensile Testing Machine - Once in a year

1.1.2 Pressure Gauges - At least once in a month

1.1.3 Pyrometer used for heat treatment furnace - Once in six months

2. TEST RECORDS – The manufacturer shall maintain test records for the tests carried out to establish conformity. Records of all the tests made at the cylinder manufacturer's work shall be kept for the life time of the cylinder and copies of test certificates shall be forwarded to the purchaser of the cylinder and the inspecting authority.

3. LABELLING AND MARKING – As per the requirements of IS 3196 (Pt 4): 2001.

4. CONTROL UNIT – 202 cylinders or less of identical types and design, heat treated during one continuous running in the same manner and under similar conditions and constructed from steel of similar analysis and made by the same steel manufacturer shall constitute a Control Unit.

4.1 The identity of each control unit shall be maintained. The period of manufacture/inspection/test shall be taken from the date of release of steel to the date of final inspection/testing.

5. LEVELS OF CONTROL - The tests as indicated in Annexure '1' and Tables 1 and at the levels of control in column 3 of Table 1, shall be carried out on the whole production of the factory covered by this Scheme and appropriate records and charts maintained in accordance with paragraph 2 above.

5.1 A certificate as per Annexure 2 shall be issued by the BIS Inspecting Officer in respect of every batch/inspection lots of cylinders marked with BIS Standard Mark.

5.2 The period of test shall be taken from the date of release of steel to the date of final pneumatic test.

5.3 All pressing and cylindrical shells shall be examined for surface defects before any seam is welded. No pressing or shell having defects beyond the acceptable limits shall be used.

5.4 Should any pressing or shell be of thickness 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 rejected and reshaped by pressing.

6.0 DESIGN & FABRICATION - In all respect of design, fabrication and manufacture, the cylinder shall conform to clause 6 to 10 of IS 3196 (Part 4): 2006

6.1 A fully dimensioned sectional drawing of the cylinder including valve pad/bung, foot ring, valve protection ring together with design calculations guaranteed yield strength and scheme of manufacture shall be submitted by the manufacturer to the inspecting authority for approval by the Statutory Authority.

6.2 The cylinder shall be welded by any suitable fusion welding method and shall conform to the welding procedures and welder's performance qualification to the requirements of IS:2825 (Code for unfired pressure vessels). When cylinder welding is to be fully radiographed and to the requirements of IS:817 codes of practice for training and testing of metal arc welders (revised) when the cylinder welding is not to be fully radiographed.

6.3 The welding electrodes and the flux 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.

6.3.1 The Chemical Composition of the electrode wire employed for submerged arc welding shall be compatible (composition falling within the range of grade of particular specification) with the Parent Metal. To ensure this chemical analysis shall be arranged by the firm on the samples of drillings of weld wire and flux combination. The tests may not be necessary if test certificate is received along with the consignment (flux and wire). Nevertheless, samples shall be analyzed once in every quarter as a confirmatory check.

7. HEAT TREATMENT - The heat treatment of the cylinders shall be done as per clause 11 of IS 3196 (Part 4): 2011. The cylinders shall be punched with serial number before heat treatment to maintain traceability throughout manufacturing process.

7.1 Adequate care shall be taken to ensure the consistency of heat treatment cycle. The deviation of temperature shall be within the specified temperature range. In case the temperature goes outside the specified limits, furnace shall be stopped and all such cylinders shall be segregated. Heat treatment shall be resumed only after attaining the requisite temperature and the furnace temperature is maintained between the specified limits. The complete records of heat treatment cycle and interruptions of cycle shall be maintained.

8. REJECTIONS – Disposal of non-conforming product shall be done in such a way so as to ensure that there is no violation of provisions of BIS Act, 2016.

TABLE 1

		(1)	(2)	(3)			
		Test Details		Test equipment requirement Required (R) or Sub-contracting permitted (S)	Levels of Control		
Cl.	Requirement	Test Method			No. of samples	Frequency	Remarks
		Clause	Reference				
4, 9, 10	Material						
	Steel sheets / plates	4.1, 4 1.1, 4.1.2, 4.1 3	IS 3196 (Pt 4)	S	--	Each heat Each consignment received 1. The materials shall be ISI marked and the cylinder manufacturer shall obtain test certificates for each consignment. 2. Approved material as per drawing shall only be used.	
	Bung	4.2, 9.1					
	Backing strip	4.3					
	Valves	9.2					
	Foot Ring	10.2					
5, 6	General and Design	5, 6		--	--	Drawings shall be approved by statutory authority. The agreed finished thickness shall not be less than that calculated as per Cl. 6 of IS 3196 (Part 4)	
7, 8, 12	Welding, Manufacture, Inspection						
	Pressings/ Halves/ Cylinder shell	8.3, 8.4, 8.5, 12	IS 3196 (Pt 4) IS 9639	R		1. Each pressing, half and cylindrical shell shall be examined for surface defects (external and internal) before closing in operation and only those conforming shall be used for further processing. All rejections shall be reshaped in such a way that it cannot be used at any stage. 2. 2% or more of the pressings, halves and cylinder shell shall be examined at random for minimum thickness before any seam is welded. If any piece is less than the minimum specified thickness, the whole output from the	

				<p>relevant batch (as defined in Cl. 12.2.2) of material shall be examined for minimum thickness and any piece which is less than the specified minimum thickness shall be deshaped in such a way that it cannot be used at any stage.</p> <p>3. Circularity, Profile Regularity, offset at the Joint, Straightness shall be checked according to 8.5.1, 8.5.3, 8.5.4 and 8.5.5. All rejections shall be deshaped in such a way that it cannot be used at any stage.</p> <p>4. The above examination shall be done after degreasing.</p>			
	Blanking or circle cutting, deep drawing, Bung Hole Punching	6, 8	IS 3196 (Pt 4)	Each piece shall be checked by gauging. In case of any non-conformance, the piece shall be rejected and deshaped in such a way that it cannot be used at any stage.			
	Welding of Cylinder and attachments/ fittings	7, 8.1, 8.2, 9.3.1, 9.4 10.2, 10.3, Annex B, 10.4 (Fig.2)	IS 3196 (Pt 4) IS 2825 IS 817	<table border="1"> <tr> <td>Each Cylinder</td> <td>--</td> <td>Joggle joint shall be according to 7.3 of IS 3196 (Pt 4) and as per approved drawing. One sample from each consignment of backing strip shall be checked.</td> </tr> </table>	Each Cylinder	--	Joggle joint shall be according to 7.3 of IS 3196 (Pt 4) and as per approved drawing. One sample from each consignment of backing strip shall be checked.
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10.1	Handle	10.1	IS 3196 (Pt 4)	In case of failure, all the remaining cylinders shall be checked and the rejected cylinders shall be deshaped.			
11	Heat treatment	11	IS 3196 (Pt 4)	--			
13	Radiographic Examination	13.1 to 13.5	IS 3196 (Pt 4)	<table border="1"> <tr> <td>Each Cylinder</td> <td>--</td> <td>If sample found defective, procedure as per Cl. 13.5 of IS 3196 (Part 4) shall be followed. (Please see Note 3)</td> </tr> </table>	Each Cylinder	--	If sample found defective, procedure as per Cl. 13.5 of IS 3196 (Part 4) shall be followed. (Please see Note 3)
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14	Water capacity	14	<table border="1"> <tr> <td>One Cylinder</td> <td>Every batch of 403 cylinders or part thereof.</td> <td>In case of failure, all the remaining cylinders shall be checked for water capacity and the rejected cylinders shall be deshaped. The production shall be stopped and the reasons for failure shall be ascertained. Normal production</td> </tr> </table>	One Cylinder	Every batch of 403 cylinders or part thereof.	In case of failure, all the remaining cylinders shall be checked for water capacity and the rejected cylinders shall be deshaped. The production shall be stopped and the reasons for failure shall be ascertained. Normal production	
One Cylinder	Every batch of 403 cylinders or part thereof.	In case of failure, all the remaining cylinders shall be checked for water capacity and the rejected cylinders shall be deshaped. The production shall be stopped and the reasons for failure shall be ascertained. Normal production					

							shall be resumed only after taking corrective actions and 100% cylinders shall be checked for water capacity for the next four inspection lots.
15	Hydrostatic test	15.1, 15.1.1, 15.1.2 7	IS 3196 (Pt 4) IS 3196 (Pt 3)		Each Cylinder	--	The test may be carried out with suitable adapter at the bung. For rejected cylinders, procedure as per Cl. 7.2 and 7.3 of IS 3196 (Pt 3) shall be followed.
16	Pneumatic leakage test	16.1, 16.1.1 8	IS 3196 (Pt 4) IS 3196 (Pt 3)				For rejected cylinders, procedure as per Cl. 8.4 of IS 3196 (Pt 3) shall be followed.
17.1	Hydrostatic stretch Test	17.1.1, 17.1.2 6	IS 3196 (Pt 4) IS 3196 (Pt 3)	R	One Cylinder	Every batch of 403 cylinders or part thereof.	In case of a failure provision given in Cl. 6 of IS 3196 (Pt 3) shall be applicable.
17.2	Bursting test	17.2.1, 17.2.2, 17.2.3 9	IS 3196 (Pt 4) IS 3196 (Pt 3)				In case of a failure provision given in Cl. 9 of IS 3196 (Pt 3) shall be applicable.
18	Acceptance Test	18.1, 18.1.1 to 18.1.7 5	IS 3196 (Pt 4) IS 3196 (Pt 3)				One Cylinder
19	Marking	19.1, 19.2, 19.2.1, 19.3	IS 3196 (Pt 3)	--			
20	Colour Identification	20	IS 3196 (Pt 3) IS 4379	R	Each cylinder	--	--

Note-1: Sub-contracting is permitted to a laboratory recognized by the Bureau or Government laboratories empanelled by the Bureau.

Note-2: The control unit and levels of control as decided by the Bureau are obligatory, to which the licensee shall comply with.

Note-3: Subject to the prior permission of the statutory authority, the requirement of radiographic examination may be relaxed to the extent permitted by the statutory authority.

ANNEX 1

STAGE INSPECTION FOR MANUFACTURE OF LPG CYLINDERS

1. **Material:** Check dimensions and surface defects (visual). Check test for physical and chemical properties for each heat. Bung material, backing strip, foot ring material to be checked for chemical properties.
2. **Manufacture/Assembly of Components:**

Components	Inspections
Body shell and dished ends	a. Check pressing for thickness and surface defects such as cracks and laminations. b. Random check of height to maintain water capacity.
Bung	a. Check blanks forging for cracks and other surface defects. b. After manufacturing check dimensions & threading by gauges. c. Random check for data stamped.
Backing Strip (where provided)	a. Check dimensions and surface defects.
Foot ring	a. Check for dimensions defects. b. Random check for data stamped.
Cap and Handles (where provided)	a. Check for surface defects. b. Check thread with gauges. c. Random check for data stamped.

3. **Assembly & Manufacture**

- a) Check shell, top and bottom dished ends and traces of oil.
- b) Inspect tack welding of backing strip, if provided.
- c) Inspect welding defects of the body, bung, valve protection and foot ring.
- d) Check for defects/ leakage after hydraulic and pneumatic test.
- e) Select cylinders for acceptance test, burst test, water capacity and hydrostatic stretch test.
- f) Check for quality of finishing and painting.
- g) Check bung threads, leakage between valve bung and leakage of the cylinder (Pneumatically).
- h) Check weight and details stamped on the cylinder.
- i) Inspect fitting of cap on cylinder.

ANNEX 2

TEST CERTIFICATE

Manufacturer: _____ Certificate No.: _____
 Purchaser: _____ Date: _____
 Order No.: _____
 Control Unit No.: _____

Cylinder Description: _____ litres water capacity. Two/three-piece welded gas cylinder, working pressure _____ kgf/cm².

This is to certify that the cylinders manufactured, inspected and tested as mentioned below during the period from _____ to _____ at M/s _____ meet the requirements of specification IS 3196 (Pt.4):2001, Drawing No. _____. The cylinders have been fitted with ISI marked valves (IS 3224 or any valves approved by CCOE). The cylinders have been inspected and tested in accordance with the Scheme of Inspection and Testing of Product Manual (PM/ IS 3196 (Part 4)/ 1/ November 2020)

MANUFACTURING DETAILS

Steel used	:	Name of Steel Manufacturer:
Cast No.	:	
Welding process	:	
Method of Support	:	Backing Strip/ Jogging
Heat Treatment	:	Normalized/ Stress Relieved at _____ °C for _____ min.

INSPECTION

Shells and Dished Ends :
 Bung and Bung welding :
 Foot Ring welding and marking :
 Internal examination before closing in operation :
 Circumferential welding and Sl. No. stamping :
 Check for :
 i) Bung threads :
 ii) Cap threads (if provided) :
 iii) Leakage with valve attached to cylinder (where applicable) :
 Valve caps/ Collar :
 Finishing and painting :

TESTS

Hydrostatic test at _____ MPa
 Date of Hydrostatic test:
 Leakage test at _____ MPa
 Acceptance test: Refer to Certificate No. _____ at Annex 2A
BURSTING TEST:
 Sl. No. of Cylinders:
 Burst Pressure (MPa): Min- Max-
 Nominal hoop stress (MPa)
 Cylinder burst without fragmentation.

Quantity Inspected: Sl. No. of Cylinders from _____ to _____ inclusive
 Serial No. Rejected Cylinders:
 Total No. of Cylinders Passed:

(Signature)
 Name & Designation of firm's representative

(Signature)
 Inspecting Officer (BIS)

ANNEX 2A

ACCEPTANCE TEST

Certificate No.:

Date:

Test Cylinder No :
 Batch/ Control Unit No. :
 Cylinder No. From : to
 Tested at : M/s
 In the presence of :

Particulars	Circumferential with weld C W	Longitudinal with weld L W	Circumferential P Metal C	Longitudinal Parent Metal L	Dished End Parent Metal D
Width, mm					
Thickness, mm					
Area, mm ²					
Gauge length, mm (5.65/Area)					
Yield load, N					
Yield strength, MPa					
Tensile load, N					
Tensile Strength, MPa					
Elongation, mm					
Elongation, percent					
Exact position of Fracture					

Bend Test on Parent Metal

Longitudinal:

Transverse:

Dished End:

Bend Test Across Weld

Longitudinal Face:

Longitudinal Root:

Circumferential Face:

Circumferential Root:

Nicked Bend Test

Longitudinal:

Circumferential:

Macro and Micro Examination

Neck:

Body:

Non-Pressure Parts:

Minimum thickness (mm):

Minimum declared thickness (mm):

(Signature)

Name & Designation of firm's representative

(Signature)

Inspecting Officer (BIS)

ANNEX E

Scope of Licence

“Licence is granted to use Standard Mark as per IS 3196 (Part 4): 2011 with the following scope:	
Name of the product	Welded Low Carbon Steel Cylinders exceeding 5 Litre Water Capacity for Low Pressure Liquefiable Gases – Cylinders for Toxic and Corrosive Gases.
Variety	Water Capacity (in litres)
Any other aspect required as per Standard	PESO approved drawing number and approval number