PRODUCT MANUAL FOR WELDED LOW CARBON STEEL CYLINDERS EXCEEDING 5 LITRES WATER CAPACITY FOR LOW PRESSURE LIQUEFIABLE GASES – CYLINDERS FOR LIQUEFIABLE NON TOXIC GASES OTHER THAN LPG ACCORDING TO IS 3196 (PART 2): 2006

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 2): 2006
	Title	:	Welded Low Carbon Steel Cylinders exceeding 5 Litres Water Capacity for Liquefiable Nontoxic Gases other than LPG
	No. of Amendments	:	3
2.	**Sampling Guidelines:**		
a)	**Raw material**	:	Please refer ANNEX- A
b)	**Grouping guidelines**	:	Each Variety of Cylinder 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 :**	:	Please refer ANNEX – E
6.	**Scope of the Licence :**	:	Please refer ANNEX- F

ANNEX A

Raw Material

Raw Material	Requirement
Steel	IS 6240 or IS 15914 (Other suitable low carbon steel as per Cl. 4.1.1 may be used with the prior permission of the statutory authority)
Bung/Valve pad	Class 1A or Class 2 of IS 1875 or IS 2062
Foot ring, Stout metal cap, shroud /vertical stay plate	Grade 'HR1' of IS 1079 or IS 2062 or IS 6240 or IS 15914 (Any other material as approved by the statutory authority may also be used)
Backing strip, if used	IS 2062
Valve fittings	IS 3224
Grit blast	Sa 3to Sa 2 1/2 of IS 9954
V P Ring	As per approved designs

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, Fatigue/Cycle test and Bung requirements.

   ii) One cylinder without valve - For Acceptance tests and Bung requirements.

   iii) Three cylinders - For Fatigue/ Cycle test.

ANNEX C

List of Test Equipment

Major test equipments 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
2.	Pressings/Halves/Cylinder shell, Circularity, Profile regularity, Straightness, Verticality – Cl. 8.5, 12	Vernier caliper, Surface plate, Spirit level, Try square, Height Vernier gauge, Goose neck gauge, Ultrasonic thickness gauge
3.	Foot ring – Cl. 10.2	Vernier caliper, Angle protector
4.	Heat treatment – Cl. 11	Furnace with temperature recorder, graphs, thermocouples, temperature indicators
5.	Checking for water capacity – Cl. 14	Weighing balance or measuring cans of appropriate capacity
6.	Hydrostatic test – Cl. 15	HST test setup with pressure gauges
7.	Valve fixing and Pneumatic leakage test – Cl. 9, 16	Torque Wrench, Pressure gauge
8.	Fatigue Testing/Cycle Testing – Cl. 17.2	Test setup with counter, Pressure gauge, temperature indicators
9.	Hydrostatic stretch test, Cl. 17.1	Apparatus as per Cl. 6 of IS 3196 (Part 3)
10.	Burst Test Under Hydraulic Pressure - Cl. 17.3	Burst test setup with pump, pressure gauge, weighing balance
11.	Acceptance Test – Cl. 18	Universal testing machine with graph plotter , Suitable mandrels for bend test , Vernier caliper, $CuSO_4$ Solution
12.	Impact and Drop test - Cl 18.2, Annex C	Striker, Arrangement for impact and drop test
13.	Internal cleaning, drying - Cl 9.1	Rod fitted with light source at one end
14.	Coating thickness - Cl 22	Elcometer

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 (Part 2): 2006.

4. CONTROL UNIT – All cylinders subjected to heat treatment at a time in a furnace as per clause 11 of IS 3196 (Part 2):2006 shall constitute one control unit or alternatively one hour's production in continuous cycles furnace shall constitute one control unit.

4.1 Batch –One batch shall consist of 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.

4.3 The identity of each batch 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 Full composition/chemical analysis of the cast as given in the steel supplier Test Certificate shall be reproduced in the test certificate issued for release of cylinders.

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

5.4 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.

5.5 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 deshaped 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 2): 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 radio graphed and to the requirements of IS:817 codes of practice for training and testing of metal are 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 analysed 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 2): 2006. 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 Sample**	**Frequency**	**Remarks**
		Clause	**Reference**				
5, 6	Design and Drawing	5, 6	IS 3196 (Part 2)	--	--	--	Drawings shall be approved by statutory authority. The agreed finished thickness shall not be less than that calculated as per clause 6 of IS 3196 (Part 2)
4	**Material**						
	Material for cylinder shell	4.1, 4.1.1, 4.1.2	IS 3196 (Part 2)	S	--	Each consignment	i. The materials shall be ISI marked and the cylinder manufacturer shall obtain test certificates for each consignment. ii. Approved material as per drawing shall only be used.
	Bung/ Valve pad	4.2	IS 3196 (Part 2)	S	--		
	Backing strip, if provided	4.3	IS 3196 (Part 2)	S	--		
	Foot ring/ Stout metal cap shroud/ Stay plate	4.4	IS 3196 (Part2)	S	--		
	Protective ring	10.2	IS 3196 (Part 2)	S	--		
	Valves	9.1	IS 3196 (Part 2)	S	--		
22.2	Grit	22.2	IS 3196 (Part 2)	S	--		No further testing is required, if accompanied with test certificate or ISI marked. The approved material as per drawing shall only be used.

7, 8, 12	**Welding/ Manufacture/ Inspection**					
	Pressings/ Halves/ Cylinder shell	8.3, 8.4, 8.5, 12.1.3	IS 3196 (Part 2) IS 9639	R	i. 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 deshaped in such a way that it cannot be used at any stage. ii. 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 relevant batch 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. iii. Circularity, profile regularity, straightness and verticality 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. iv. The above examination shall be done after degreasing.	
	Blanking or circle cutting, deep drawing, Bung Hole Punching	6, 8	IS 3196 (Part 2)	R	Each Piece	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, 10.1 10.2, 10.3	IS 3196 (Part 2)	R	Each Cylinder	Joggle joint shall be according to 7.3 of IS 3196 (Part2) and as per approved drawing. One sample from each consignment of backing strip shall be checked.
11	Heat Treatment	11	IS 3196 (Part 2)	R	Each cylinder	Please see **clause 7** of SIT also.

13	Radiographic examination	13.1, 13.2, 13.3 10	IS 3196 (Part 2) IS 3196 (Part 3)	S	As per 13.2.1, 13.2.2 of IS 3196 (Part 2)		If the sample is found defective, procedure as per clause 10.4 of IS 3196 (Part 3) shall be followed.
14	Checking of Water Capacity	14	IS 3196 (Part 2)	R	One cylinder	Every100 cylinders or part there of	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 7	IS 3196 (Part 2) IS 3196 (Part 3)	R	Each cylinder		The test may be carried out using suitable adapter at the bung. For rejected cylinders, procedure as per Clause 7.2 and 7.3 of IS 3196 (Part 3) shall be followed.
16	Valve fixing and Pneumatic leakage test	16, 8	IS 3196 (Part 2) IS 3196 (Part 3)	R	Each cylinder		For rejected cylinders, procedure as per Clause 8.4 of IS 3196 (Part 3) shall be followed.
17.1	Hydrostatic stretch test	17.1 6	IS 3196 (Part 2) IS 3196 (Part 3)	R	One cylinder taken at random for each batch of 403 or less		In case of failure in stretch test follow the procedure at Clause 6.4 of IS 3196 (Pt. 3)
17.2	Fatigue Testing/ Cycle testing	17.1	IS 3196 (Part 2)	R	Three cylinders as per clause 17.2.1 of IS 3196 (Part 2).		This is a Type Test and shall be done for initial approval or whenever there is a change in design/ raw material of cylinder or asked by BIS for specific reason.
17.3	Burst Test Under Hydraulic Pressure	17.3 9	IS 3196 (Part 2) IS 3196 (Part 3)	R	One in a lot of two consecutive batches of cylinders		In case of failure, procedure as per clause 9.2 of IS 3196 (Part 3) shall be followed.

18	Acceptance Test (Mechanical Tests)	18 5	IS 3196 (Part 2) IS 3196 (Part 3)	R	One in a batch of cylinders	Every batch	**Clubbing of Cast no. for acceptance tests:** In order to accommodate smaller heats, clubbing of heats of steel sheets of same grade and manufactured by the same steel manufactured may be permitted. In case of failure, if the inspecting authority consider 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 and the defective test shall be ignored otherwise at the cylinder manufacturer's discretion one of the following procedure shall be adopted: a) The test in which the failure occurred shall be repeated on the cylinder and in addition all the tests given in 5 of IS 3196 (Pt.3) shall be carried out on another cylinder from same batch. If both cylinders satisfy the test requirements the batch shall be accepted. If the sample fails in any of the test carried out as per this clause, the method given in 5.7.1 (b) or 5.7.2 of IS 3196 (Pt.3) as applicable shall be adopted
22	Painting & Finishing a) Metalizing coating thickness and appearance		As per approved drawing and cl.22.2 of IS 3196 (Pt.2):2006	R	One	Each lot of 50 cylinder	Records to be maintained for thickness of coating.
	b)Primer coating			R			
	c) painting			R			
	d) Internal cleaning			R	Each cylinder		

	e) Bung thread checking			R	Each cylinder		
	f) Tare weight			R	Each cylinder		
10.1	Test for Handle or other suitable arrangement	10.1	IS 3196 (Part 2)	R	One	Each lot of 400 cylinders	In case of failure, all the remaining cylinders shall be checked and the rejected cylinders shall be deshaped.
18.2	Additional Test (Cylinder body integrity impact test and drop test)	Annex C	IS 3196 (Part 2)	R	As per Annex C of IS 3196 (Part 2)		i) This test is applicable for cylinders manufactured from steel as per IS 15914. ii) This is a Type Test and shall be done for initial approval or whenever there is a change in design/ raw material of cylinder or asked by BIS for specific reason.
22	Colour Identification	21	IS 3196 (Part 2)	R	Each cylinder		--
19	Marking	19	IS 3196 (Part 2)	--	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.

ANNEXURE 1

STAGE INSPECTION FOR MANUFACTURE OF CYLINDERS

1. **Materia**l: Check dimensions and surface defects (visual). Bung material (forgings) and V.P. ring material to be checked for chemical properties.

2. **Manufacture/Assembly of Components:**

Body	**Bung**	**Backing strip**	**Foot ring**	**V.P.Ring**
(Upper half and lower half)	Check forgings for surface defects (each piece- visual)			
a) Check pressing for Thickness and surface defects such as cracks and laminations.	a) Check blanks forgings for cracks and other surface defects	Check dimensions and surface defects	Check for Marking (hourly 5 pieces)	Check dimensions and surface defects
b) Check of height to maintain water capacity	Welding - each piece	--	Random check for date stamped	b) Random check for data stamped on vertical stay plates.

3. **Assembly & Manufacture**

a) Check top and bottom half for defects and traces of oil.
b) Inspect task welding of backing strip, if provided.
c) Inspect welding defects of the body, bung, foot ring and V.P.Ring.
d) Check for defects after hydraulic test & Pneumatic test.
e) Select cylinders for acceptance test, bursting test and water capacity and hydrostatic stretch test.
f) Check for quality of protective metal coating, finishing and painting.
g) Check bung threads, leakage between valve, and bung and leakage of the cylinder (pneumatically).
h) Check weight and details stamped on the cylinder.

ANNEXURE 2

TEST CERTIFICATE

Purchaser: _____ Certificate No. :_____
Order No. : _____ Date: _____
Batch No.: _____
Cylinder Description: _____litres water capacity. Two/three piece, working pressure_____
Test pressure _____ Kgf/Cm2 . Manufacturer's Identification Mark _____

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.2):2006, Drawing No. _____. The cylinders have been fitted with ISI marked valves.

Method of Manufacture

1. Welding process:
2 Method of Support: : Joggling/backing strip
3 Heat treatment: Normalized/Stress Relieved at _____ ºC for_____ min.

Acceptance Test

Sl. No. of Cylinders:

INSPECTION	Min	Max
The cylinders have been inspected and tested in accordance with Scheme of Inspection and Testing attached with BIS licence no. CM/L-_____	Yield stress (MPa)	
	Tensile Strength (MPa)	
	% Elongation	

Material for Cylinder: IS 6240/IS 15914

TESTS

Hydrostatic Test: Satisfactory
(Test Pressure_____Kgf/Cm2)
Pneumatic leakage test: Satisfactory
(Test Pressure _____ Kgf/Cm2)

Hydrostatic stretch test

Bend Test
Face: Satisfactory
Root: Satisfactory

Bursting Test:
Sl. No. of Cylinders
Burst Pressure (MPa): Min. - Max. -
Cylinder bursted without fragmentation
Nominal Hoop Stress (MPa)

Macro Examination
Body: Satisfactory
Neck: Satisfactory
Min. Thickness: ___ mm

Cylinder Nos. _____ to_____ of _____ Batch are covered under Acceptance test cylinder no. _____ and burst test cylinder no. _____ of _____ Batch. These have been heat treated in the same manner and manufactured from steel of similar chemical composition and mechanical properties which had been produced by same steel manufacturer _____

QUANTITY INSPECTED: Cylinders Serial No. from _____ to _____inclusive
Serial No. of REJECTED CYLINDERS _____
TOTAL No. of Cylinders Passed _____

(Signature)
Name & Designation of the firm's representative

(Signature)
INSPECTING OFFICER (BIS)

Body steel used: IS 6240/ IS 15914

Cast no-
Certificate no-.
Manufacturer's name-

Note: 1. The steel shall be fully Aluminium killed.

2. The nitrogen content shall not exceed 0.009 per cent

PROPERTIES OF RAW MATERIAL USED FROM SUPPLIERS TEST CERTIFICATE

C	Si	Mn	P	S	Al	N	UTS	YS	% El

(Signature)

Name & Designation of the Officer representing the Company

BIS Inspecting Officer

ANNEX E

Possible Tests in a Day

1. Water capacity (Cl. 14)
2. Hydrostatic test (Cl. 15)
3. Valve fixing and Pneumatic leakage test (Cl 16)
4. Hydrostatic stretch test, Cl. 17.1
5. Burst test (Cl 17.3)
6. Acceptance test (Cl 18)
7. Internal cleaning and drying (Cl 9.1 & 22)
8. Tare weight (Cl 22)
9. Coating thickness (Cl 22)
10. Test for handle (Cl 10.1)
11. Additional test - Impact and Drop test (Cl 18.2)

ANNEX F

Scope of Licence

"Licence is granted to use Standard Mark as per IS 3196 (Part 2): 2006 with the following scope:	
Name of the product	Welded Low Carbon Steel Cylinders exceeding 5 Litres Water Capacity for Low Pressure Liquefiable Nontoxic Gases other than LPG
Variety	Water capacity (litres)
Any other aspect	PESO approved drawing number and approval number