



**PRODUCT MANUAL FOR
REFILLABLE TRANSPORTABLE SEAMLESS
ALUMINIUM ALLOY GAS CYLINDERS
ACCORDING TO IS 15660:2017**

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 15660:2017
	Title	:	Refillable Transportable Seamless Aluminium Alloy Gas Cylinders
	No. of Amendments	:	Nil
2.	Sampling Guidelines:		
a)	Raw material	:	As per Clause 5 of IS 15660
b)	Grouping guidelines	:	Each new design of cylinder shall be tested for all requirements for considering GoL/ CSoL. New design of cylinder is defined at Clause 8.1 of IS 15660.
c)	Sample Size	:	Please refer ANNEX – A
3.	List of Test Equipment	:	Please refer ANNEX – B
4.	Scheme of Inspection and Testing	:	Please refer ANNEX – C
5.	Possible tests in a day:		Please refer ANNEX – D
6.	Scope of the Licence:		Please refer ANNEX – E

ANNEX A**Sample Size**

For considering GoL/CSoL, 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. Unless otherwise stated by the statutory authority, the trial batch shall be of minimum 50 prototype containers.

At present, there is no BIS recognized lab available for testing of the product and the licence is granted on factory testing basis. Complete testing of product shall be done in factory. If testing facility for requirements of material (Cl. 5), Inter-crystalline Corrosion Test & Stress Corrosion Test [Cl. 8.2.2 (a) (5)] and Sustained load cracking [8.2.2 (a) (6)] is not available in the factory, sample for these tests shall be drawn for independent testing and sent to labs as per CMD-I guidelines. The following samples shall be drawn for factory testing and independent testing:

Samples for Type approval (Type tests) in factory:

Sl. No.	Description of test	Clause reference	No. of samples
1.	Thickness of walls and ends	8.2.2, 6.2, 6.3, 6.4	Two
2.	Foot ring, Neck ring, Water capacity,	6.5, 6.6, 6.8	Five
3.	Welding, Neck forming, wall thickness, Surface imperfections and defects, neck threads, Out-of-roundness, Exposure of heat, Verticality, Stability, Straightness, Mean diameter	7.2 to 7.11	Every Cylinder
4.	Mechanical testing	9.1.3 (a)	Two
5.	Hydraulic burst test	9.1.3 (b)	Two
6.	Pressure Cycling test	8.2.3	Three
7.	Hydraulic test (Volumetric expansion test), Hardness Test, Leakage test, Examination for neck folds, Manufacturing defects, Colour identification	10, 13	Every Cylinder
8.	Leak Before Break Test, if applicable*	6.9, 8.2.4, 9.2.2, 9.5,	Two
9.	Flawed gas Cylinder Cycle test*	Annex B	Two

* Applicable for Gas cylinder made of High strength and/or low elongation Aluminium alloy

Samples for Independent Tests (IT Samples):

Sl. No.	Description of test	Clause reference	No. of samples
1	Inter-crystalline Corrosion Test & Stress Corrosion Test Sustained load cracking	8.2.2 (a) (5), 8.2.2 (a) (6)	Three Cylinders
2.	Test piece for chemical analysis	5	Five pieces

ANNEX B**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
	Test	Clause No	
1	Water Capacity	6.8	Digital Electronic Balance
2	Wall Thickness	7.4	Ultrasonic Thickness Gauge
2	Surface Imperfections and Defects	7.5, 10.7.2 Annex F	Visual Inspection, scope or dental mirror and Ultrasonic Testing Instrument with Reference Standard
3	Neck Threads	6.4.1, 7.6	Thread Inspection Gauges
4	Out of Roundness	7.7	Vernier calliper or outside Micrometer or set of Outside calliper and steel rule
5	Verticality	7.9	Fixture for measuring verticality
			Feeler gauge
			Steel rule/ Straight edge
6	Stability	7.10	Vernier calliper
			Scale
7	Straightness	7.11	Feeler gauge
			Steel rule/ Straight edge
8	Mean Diameter	7.12	Pi Tape
			Outside Calliper with Steel rule
			Micrometer
9	Inter-crystalline Corrosion Test & Stress Test	8.2.2 Annex C	Reagents: <ul style="list-style-type: none"> • Nitric acid (HNO₃) analytical grade, density 1.33 g/cm³. • Hydrofluoric acid (HF) analytical grade, density 1.14 g/cm³ (at 40%). • De-ionized or distilled water.
			Reagents for Corrosive Solution: <ul style="list-style-type: none"> • Sodium chloride (NaCl), crystallized, analytical grade • Hydrogen peroxide (H₂O₂), 100 to 110 volume • Potassium permanganate (KMnO₄), analytical grade • Sulphuric acid (H₂SO₄) analytical grade, density 1.83 g/cm³ • De-ionized or distilled water

			Beaker and appropriate glassware
			Stop watch
			Wire made of aluminium of other inert material
			Hot air oven/ Heater with thermometer
			Crystallizing dish or large beaker
			Water bath with magnetic stirrer
			Contact Thermometer
			Casting Dishes
			Epoxy casting resin plus hardener, or equivalent system.
			Abrasive paper, a diamond compound and/or magnesia polishing compound
			Microscope for Micrographic Examination (300X)
			pH meter
			Brine solution
			Angle protractor
			Stress application instrument by means of a threaded bolt and two nuts as per Fig 15, Annex C of IS 15660
10	Sustained Load Cracking Test	8.2.2 Annex D	Equipment for sustaining constant load
			Scanning Electron Microscope
11	Pressure Cycling Test	8.2.3	Pressure Gauge
			Temperature Sensor
			Non-Corrosive liquid
			Pressure Cycling Set Up
			Stop Watch
12	Test for High Strength and/ or low elongation gas cylinder design	8.2.4 Annex B	Pressure Gauge
			Pressure Cycling Setup
			Stop Watch
			Cutter for machining of specimen
13	Tensile Test	9.2	Universal Testing Machine
			Vernier Calliper
			Micrometre
			Air Conditioner
14	Bend Test	9.3.1	Universal Testing Machine
15	Flattening Test	9.3.2	Flattening machine having wedge shaped knife with a 60-degree included angle.
16	Hydraulic Bursting Test	9.4	Pressure Gauge
			Test Fluid Reservoir
			Tank for measurement of test fluid

			Pump
			Pressure/ Volumetric expansion curve recorder
			Vent of air release valve
			Test Well
			High Pressure Pump
17	Hydrostatic Test (Volumetric Expansion Test)	10.2 Water Jacket Method	Overflow
			Hydraulic Line Valve
			Water Supply
			Jacket Filling Valve
			Air Bleed Valve
			Pump
			Relief Device
			Drain
			Calibrated Burette
			Priming Valve
			Stop Watch
			Pressure Gauge
			Weighing Balance- Electronic
		Non-Water Jacket Method	Water Tank
			Bleed Valve
			Pump
			Pressure Gauge
Stop Watch			
			Weighing Balance- Electronic
18	Hardness Test	10.3	Hardness Testing Machine (Brinell or Rockwell)
19	Leakage Test	10.4	Pressure Gauge
			Tank With lighting arrangement
20	Examination for Neck Folds	10.5	Dentist mirror, scope, tactile
			Ultrasonic Testing machine with standard reference sample
21	Colour Identification	13	Coating thickness Gauge

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

ANNEX C

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 equipment. The following equipment 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 Impact Testing Machine - Once in a year

1.1.3 Pressure Gauges - At least once in a month

1.1.4 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 requirement of IS 15660:2017.

4. BATCH - Quantity of up to 200 cylinders plus cylinders for destructive testing of the same nominal diameter, thickness and design, made successively from the same steel and same heat and subjected to the same heat treatment for the same duration of time shall constitute a batch.

4.1 The identity of each batch shall be maintained. Each batch conforming to all the requirements shall be accompanied by a Certificate in accordance with clause 11 of IS 15660:2017.

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

6. Design drawing- A fully dimensioned drawing (including tolerance) shall be prepared which includes the specification of the material, details of mechanical properties, neck threads, heat treatment parameters (as applicable), hardness range, working pressure, test pressure, water capacity, length and weight and shall be submitted to inspecting authority for final approval by statutory authority.

6.1 In respect of design and manufacture, the requirements of clause 6 and 7 of IS 15660: 2017 shall be complied with.

7. HEAT TREATMENT - The heat treatment of cylinders shall be done as per clause 5.2 of IS 15660:2017. The cylinders shall be punched with serial number before heat treatment to maintain traceability throughout the 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. INSPECTION AND TESTING/ RE-TESTS

8.1 In order to ensure that the cylinders are in compliance with IS 15660:2017, they shall be subjected to Inspection and Testing in accordance with clause 8, 9 and 10 (as applicable for type test, batch test and tests on every cylinder) of IS 15660:2017.

8.2 In the event of failure of cylinders in meeting the requirements, procedure in accordance with clause 5.4 of IS 15660:2017 shall be followed for retesting/re-heat treatment.

9. 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 R: required (or) S: Sub-contracting permitted	Levels of Control			
Cl.	Requirement	Test Method		No. of Sample	Frequency	Remarks	
		Clause	Reference				
5, 6	MATERIAL						
5.1	General Requirements	5.1 Annex A	IS 15660	S	One	Each Heat	The cylinder manufacturer shall obtain and provide certificates of cast (heat) analysis of the material supplied for the construction of gas cylinder. In case the consignment is received with Test Certificate showing compliance to the specification no further testing is necessary.
	Material for Neck Ring and foot rings	6	As per design/ drawing	-----	Two	Each Consignment	
6	DESIGN						
6.4	Neck Design	6.4	IS 15660	R	Each Cylinder		---
6.5	Foot Rings	6.5	IS 15660	R	Each Cylinder		---
6.6	Neck Rings	6.6	IS 15660	R	Five	Every Batch	---
6.8	Water Capacity	6.8	IS 15660	R	Each Cylinder		---
7	CONSTRUCTION AND WORKMANSHIP						
7.1	General	7.1	IS 15660	R	Each Cylinder		---
7.3	Neck Forming	7.3	IS 15660	R	Each Cylinder		---
7.4	Wall thickness	7.4	IS 15660	R	Each Cylinder		---
7.5	Surface imperfection and defects	7.5, Annex F	IS 15660	R	Each Cylinder		---
7.6	Neck Threads	7.6	IS 15660	R	Each Cylinder		---

7.7	Out of Roundness	7.7	IS 15660	R	Each Cylinder		---
7.9	Verticality	7.9	IS 15660	R	Each Cylinder		---
7.10	Stability	7.10	IS 15660	R	Each Cylinder		---
7.11	Straightness	7.11	IS 15660	R	Each Cylinder		---
7.12	Mean Diameter	7.12	IS 15660	R	Each Cylinder		---
8	TYPE APPROVAL PROCEDURE						
8.2.2	Inter-crystalline Corrosion Test & Stress Corrosion Test	8.2.2 Annex C	IS 15660	S	One Cylinder		Each new design of cylinder as per details given in clause 8.1 of IS 15660 shall be subjected to prototype testing. Any change in design shall also require the prototype testing in accordance with clause 8 of IS 15660. If the results are satisfactory type approval certificate shall be issued as per clause 8.3 of IS 15660.
	Sustained Load Cracking Test	8.2.2 Annex D	IS 15490	S	One Cylinder		
8.2.3	Pressure Cycling Test	8.2.3	IS 15660	R	Three Cylinders		
8.2.4	Test for high Strength and/or low elongation gas cylinder design	8.2.4 Annex B	IS 15660	R	Four Cylinders		
9	BATCH TEST						
9.1	General Requirements	9.1	IS 15660	R	Each Cylinder		---
9.2	Tensile Test	9.2	IS 15660	R	One	---	---
9.3	Bend Test	9.3.1	IS 15660	R	Two	Each batch	Either Bend Test or Flattening test shall be carried out.
	Flattening Test	9.3.2	IS 15660	R	One	Each batch	
9.4	Hydraulic Bursting Test	9.4	IS 15660	R	One	Each batch	---
9.5	Test for high Strength and/or low elongation gas cylinder design	8.2.4 Annex B	IS 15660	R	As per Annex B		---

10	TEST ON EVERY CYLINDER					
10.2	Hydraulic Test (Volumetric Expansion Test)	10.2	IS 15660	R	Each Cylinder	---
10.3	Hardness Test	10.3	IS 15660	R	Each Cylinder	---
10.4	Leakage Test	10.4	IS 15660	R	Each Cylinder	---
10.5	Examination for Neck Folds	10.5	IS 15660	R	Each Cylinder	---
10.6	Marking	10.6	IS 15660	R	Each Cylinder	---
10.7	Surface feature	10.7	IS 15660	R	Each Cylinder	---
13	Colour Identification	13	IS 15660	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.

ANNEX D

Possible Tests in a day

1. Wall thickness and other dimensions/requirements as per approved drawing (Cl. 5, 6)
2. Surface feature (Cl. 10.7)
3. Hardness Test (Cl. 10.3)
4. Tensile Test (Cl. 9.2)
5. Bend test (Cl. 9.3)
6. Water Capacity (Cl. 6.8)
7. Hydrostatic Stretch Test (Cl. 10.2)
8. Leakage Test (Cl. 10.4)
9. Hydraulic Bursting Test (Cl. 10.4)

ANNEX E**Scope of the Licence**

Licence is granted to use Standard Mark as per IS 15660:2017 with the following scope:	
Name of the Product	Refillable Transportable Seamless Aluminium Alloy Gas Cylinders
Variety	Material Water Capacity (litre) Diameter (mm) Wall thickness (mm) Working Pressure (bar) Test Pressure (bar) Bottom Profile
Any other aspect	PESO approved drawing number and approval number