BUREAU OF INDIAN STANDARDS

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भारतीय मानक **मसौदा**

सिलेंडर वाल्वों के लिए और परिवहनीय पुनः भरने योग्य सिलेंडरों हेतु दबाव राहत वाल्व

Draft *Indian Standard*

PRESSURE RELIEF VALVES FOR CYLINDER VALVES AND FOR TRANSPORTABLE REFILLABLE CYLINDERS

ICS 13.240; 23.060.01

Gas Cylinders Sectional Committee, MED 16	Last date or receipt of comments: **03 April 2025**

FOREWORD
(*Formal clauses will be added later*)

This standard is to keep pace with the latest technological developments and international practices. Also, the standard has been brought into the latest style and format of Indian Standards. BIS certification marking clause has been mentioned to align with the revised *Bureau of Indian Standards Act*, 2016.

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 IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft *Indian Standard*

PRESSURE RELIEF VALVES FOR CYLINDER VALVES AND FOR TRANSPORTABLE REFILLABLE CYLINDERS

1 SCOPE

This standard specifies the design, testing and marking requirements for spring loaded pressure relief valves (PRV) for gaseous applications. These PRVs can be either an integral part of a cylinder valve or a separate device, PRVs covered in this standard will be used for valve or gas cylinder having capacity below 1 000 litres. This standard does not exclude the use of other designs of pressure relief devices that provide a similar level of safety.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of 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 these standards.

3 TERMS AND DEFINITIONS

3.1 For the purposes of this document, terminology as given in IS 5903 shall be applicable.

3.2 Terms used with PRVs are described graphically in Annex B.

4 OPERATING CONDITIONS

Valves designed in accordance with this standard shall be suitable for:

a) A minimum operating temperature of -20 °C; and
b) A maximum operating temperature of 65 °C.

5 MATERIALS

5.1 General

5.1.1 Materials in contact with gas in use shall be physically and chemically compatible with gas under all normal operating conditions for which the valve is intended and shall meet the requirements in accordance with IS/ISO 11114-1 and IS/ISO 11114-2.

5.1.2 Materials for valve components shall be selected to give adequate strength in service. Consideration shall be given to all modes of failure including atmospheric corrosion, brass dezincification, stress corrosion, impact or material failure.

5.1.3 Alternative materials to those listed in **5.2** are not precluded, providing they can be shown

to be equivalent.

5.1.4 Where PRVs are an integral part of a cylinder valve, the material requirements for the cylinder valve standard shall be complied with.

5.2 Metallic Materials

5.2.1 Wrought brass components shall be used. Castings will not be used for any component.

Brass material used shall be as per any of the following:

a) IS 6912;
b) IS 8737; or
c) IS 319.

Cold drawn brass rods up to 45 mm wide in cross-section shall only be used after heat treatment/stress relieves and testing for internal cracking. Cold drawn brass rods greater than 55 mm wide in cross-section shall not be used.

Components produced from forged brass shall not exhibit cold shuts, also known as folds, or surface defects shall not be accepted.

5.2.2 Springs shall be manufactured from stainless steel in accordance with EN 10270-3 or IS 4454 (Part 4) or equivalent standard.

Components, when made from stainless steel, shall contain not less than 16 percent chromium and not less than 7 percent nickel.

5.3 Non-metallic Components

Non-metallic materials in contact with gas shall not distort, harden or adhere to the body or seat face to such an extent as to impair the function of the valve.

Non-metallic materials in contact with gas shall meet the requirements for resistance to gas (pentane test), lubricants, ageing, compression, ozone (where the material is exposed to the atmosphere) in accordance with IS 3400 (Part 1), IS 3400 (Part 2), IS 3400 (Part 4), IS 3400 (Part 18) and IS 3400 (Part 20).

Non-metallic materials which are exposed to the atmosphere shall be UV resistant as confirmed by the material manufacturer.

5.4 Lubricants, Sealants and Adhesives

Lubricants, sealants and adhesives used on operating threads and seals, shall be compatible with gas not interfere with the operation of the valve.

6 DESIGN

6.1 General

6.1.1 PRVs shall be designed to operate with a pop action within the overpressure of the valve.

The valve components shall be designed with adequate strength and clearances to ensure correct operation in service.

6.1.2 Design and construction of PRVs shall ensure that the fitting of a PRV to the cylinder under normal conditions and in accordance with the instructions of the manufacturer does not affect its performance. When a PRV is integral with a cylinder valve, it shall be ensured that fitting of the cylinder valve to the cylinder in accordance with the instructions of the manufacturer does not affect the performance of the PRV.

6.1.3 The sealing element carrier (pad holder) shall be manufactured from a metallic material with a minimum melting point of 450 °C. Non-metallic materials can be used if they are able to meet the same requirements without deformation or degradation which would impair the operation of the valve.

6.1.4 The design shall incorporate guiding arrangements for the sealing element to ensure reliable operation and leak tightness.

6.1.5 The sealing element shall be secured to prevent it becoming loose in operation.

6.1.6 Means shall be provided to lock and/or to seal the PRV in order to prevent and/or reveal any tampering with the settings. Adhesive shall not be used.

6.1.7 When PRVs are provided with a means of protection (such as a disc or cap) to prevent the ingress of foreign material/particle, such protection shall be designed so as not to be easily displaced except by the discharge from the PRV and shall not interfere with the proper operation of the valve.

6.1.8 The nominal set pressure for pressure relief valves shall be as decided between manufacturer and user. Normally it should be more than 80 percent and less than 90 percent of the test pressure of cylinder.

6.1.9 *Resetting Pressure*

It shall be 80 percent of nominal set pressure.

6.1.10 The flow rating pressure shall be 120 percent of the nominal set pressure.

6.1.11 In certain liquid off take applications where the PRV, during correct use, is located below the liquid level, an internal tube of sufficient internal cross-sectional area communicating with the vapour space shall be fitted to the PRV. It shall be secured in place, during the service life of

the PRV, and when the PRV is discharging at full capacity.

6.1.12 No shut-off device, other than that which may be built into the safety device itself, shall be installed in either the approach channel or the discharge channel. Dust caps, if installed on downstream side, shall blow away at a pressure not more than 2 kgf/cm^2 (g).

6.2 Flow Capacity

6.2.1 *For Use with Non-liquefiable Gas*

The minimum required flow capacity of pressure-relief valves, for installation in non-insulated cylinders for non-liquefied gas shall be calculated by the following formula:

$$Q_a = 0.082PW_c = 0.00136PW_c m^3/min$$

where

Q_a = flow capacity in m^3/min of free air;
P = flow capacity pressure in kgf/cm^2 (absolute); and
W_c = water capacity of the cylinder in litres, which in any case shall not be taken as less than 5 litres.

6.2.2 *For Use with Liquefiable Gas*

The minimum required flow capacity of pressure-relief valves for installation in non-insulated cylinders for liquefied gas shall be calculated by the following formula:

$$Q_a = 0.164\ PW_c = 0.00273PW_c\ m^3/min$$

where

Q_a = flow capacity in m^3/min of free air;
P = flow rating pressure in kgf/cm^2 (absolute); and
W_c = water capacity of the cylinder in litres, which in any case shall not be taken as less than 5 litres.

6.3 Threads

The end connections for PRVs intended to be directly fitted into the cylinder or isolating valve, shall either be a taper thread or a parallel thread combined with a sealing and securing method, the size of the thread will be as per customer specific.

Threads will be gauged with gauges as per the relevant specifications.

A PRV intended to be used with a vent extension or a discharge pipe shall be threaded or otherwise constructed to allow for their connection to the PRV body.

7 TYPE TESTING AND INSPECTION OF THE DESIGN

7.1 General

7.1.1 5 Nos. samples which shall be marked 1, 2, 3, 4, 5 shall be taken for Type testing. Sampling plan shall be as per Table 1. Type test shall be carried out as per **7.3** to **7.10**.

7.1.2 The test sequence and valve sample numbers are identified in Table 1.

7.1.3 The test medium shall be air or nitrogen for all tests unless otherwise stated.

7.1.5 The test equipment for use in measuring the discharge capacity shall be accurate to within ±2 percent of the nominal discharge capacity.

7.1.6 When changes are made in the design of a PRV which affect its flow path or discharge capacity, for example, a tube fitted to the PRV inlet, or if the set pressure is to be modified by more than 10 percent, new tests shall be carried out.

Table 1 Valve Type Test Requirements

(*Clauses* 7.1.2 *and* 7.8)

Sl No.	Test	Test detail	Clause	Condition of test valve/test sequence	Temperature at which the test is performed °C	Valve sample number	Number of cycles per valve
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	1	Dimensional checks	7.3	As received	Room temperature	1	1
ii)	2	Hydraulic pressure proof	7.4	As received	Room temperature	2	2
iii)	3	Leak tightness test before ageing	7.5	As received	Room Temperature	3, 4 and 5	1
iv)	4	Start to discharge pressure	7.6	From test no. 3	Room temperature	3, 4 and 5	3
v)	5	Discharge capacity	7.7	From test no. 4	Room temperature	3, 4 and 5	1

vi)	6	Leak tightness	7.8	From test no. 5	Room temperature, $65^{+2.5}_{-2.5}$ °C -20^{+5}_{-5}°C	3, 4 and 5	1
vii)	7	Endurance	7.9	From test no. 6	Room temperature	3, 4 and 5	10
viii)	8	Visual Inspection	7.10	From test no. 7	Room Temperature	3, 4 and 5	1

7.2 Test Requirements

7.2.1 There shall be no chatter, flutter, sticking or vibration during the tests that interferes with the satisfactory operation of the PRV.

7.2.2 The PRV shall comply with the design type specification submitted (*see* **7.3**).

7.2.3 The PRV shall withstand a hydraulic pressure proof test without visible permanent deformation, rupture or leak (*see* **7.4)**.

7.2.4 The PRV shall be subjected to a start to discharge pressure test, (*see* **7.6)**. The start to discharge pressure shall be within ± 15 percent of the nominal set pressure. The average of the three measurements of each valve shall be taken as the average start to discharge pressure for that valve. The average start to discharge pressure for each valve shall be within a 5 percent band for the results of three valves.

7.2.5 The PRV shall be subjected to a discharge capacity test, (*see* **7.7)**. The lowest value of the discharge capacity of the tested PRVs shall be deemed to be the nominal discharge capacity of the PRV. The results of the discharge capacity test for each PRV shall be within +20/−0 percent of the nominal discharge capacity of the PRV. The reseat pressure shall be not less than 70 percent of the nominal set pressure after pop-up takes place at flow rating pressure.

7.2.6 The PRV shall withstand leak tightness tests, (*see* **7.5** *and* **7.8)**. The leakage rate shall not exceed 15 cm^3/h at STP.

7.2.7 The PRV shall withstand a further 10 cyclic discharge capacity tests, (*see* **7.9**). The start to discharge pressure shall remain within ± 15 percent of the nominal set pressure, and the reseat pressure shall be not less than 70 percent of the nominal set pressure.

7.2.8 The PRV shall be visually inspected for damage, deformation, wear and cracks (*see* **7.10)**. Any failure, deformation, excessive wear or cracks that affect the normal operation of the PRV shall be a cause of rejection.

7.3 Dimensional Checks

The sample valve shall initially be subjected to dimensional checks for conformity with the design type specification.

7.4 Hydraulic Pressure Proof Test

The test shall be carried out in the following manner:

a) The body seat of the PRV shall be blanked off so that the pressure is only applied to those parts on the inlet side of the seat;
b) The test medium shall be water or other suitable liquid;
c) The PRV shall be subjected to a hydraulic proof pressure of not less than 1.5 times working pressure or 1.43 times of nominal set pressure or whichever is more;
d) The pressure shall be applied through a fitting reproducing the cylinder connection;
e) The pressure shall be raised continuously and gradually;
f) The pressure shall be maintained for two minutes after the proof pressure is achieved;
g) Point (e) and point (f) shall then be repeated with the PRV operating mechanism in the open position, and with the outlet sealed.

The PRV shall conform to the requirements of **7.2.3**. If the sample fails to meet the requirements, the design shall be rejected.

Alternatively, pneumatic testing may be carried out, if a similar level of sensitivity and safety is provided.

7.5 Leak Tightness Test before Ageing

If test no. 2 is satisfactory, valves nos. 2, 3 and 4 shall be subjected to a leak tightness test at room temperature.

The PRV shall be tested to ensure leak tightness at any pressure below the start to discharge pressure and above 0.1 bar. The inlet of the PRV shall be connected to a pressure fixture and be pressurized to 70 percent of the nominal set pressure.

The PRV shall conform to the requirements of **7.2.6**. If the sample fails to meet the requirements, the design shall be rejected.

The valves shall then be subjected to an aging process in advance of the remainder of the tests.

The ageing process shall be carried out by elevating and maintaining the temperature of the valve to 65 °C for a period of 5 days.

7.6 Start to Discharge Pressure Test

Samples of the PRV set at the same nominal set pressure shall be used. Any activation indicator,

dust or protection cap shall be removed. Any features (for example an internal tube to the vapour space as required in **6.1.11**) of a PRV, which can affect the flow characteristics, shall be included in the samples being tested.

The start to discharge pressure shall be determined in the following manner;

a) The start to discharge pressure shall be measured three times for each of the PRVs;
b) The pressure shall be increased to approximately 85 percent of the nominal set pressure. A leak tightness test shall then be carried out in accordance with **7.8**;
c) The pressure shall then be further increased slowly at a rate not exceeding 0.15 bar/s until the first bubbles are observed from the outlet of the PRV;
d) The pressure at which the first bubbles appear as the start to discharge pressure of the PRV shall be recorded; and
e) The average of the three measurements of each valve shall be taken as the average start to discharge pressure for that valve.

The PRV shall conform to the requirements of **7.2.4**. If the sample fails to meet the requirements, the design shall be rejected.

7.7 Discharge Capacity Test

The discharge capacity shall be determined in the following manner:

a) The pressure shall gradually be increased until the flow rating pressure is reached;
b) This pressure shall be maintained until the discharge capacity has been recorded; and
c) The pressure shall gradually be decreased at a rate not exceeding 0.15 bar/s until the PRV reseats and the reseat pressure shall be recorded.

The PRV shall conform to the requirements of **7.2.5**. If the sample fails to meet the requirements, the design shall be rejected.

7.8 Leak Tightness Tests

The PRV shall be leak tightness tested to ensure tightness at any pressure below 85 percent of the nominal set pressure and above 0.1 bar. The leak tightness test shall be carried out at different temperatures (room temperature, high and low temperatures) in the sequence as given in Table 1.

For valves which are used under extreme low temperature conditions (temperatures below -20 °C) the low temperature test shall be carried out in accordance with Annex B.

The PRV shall conform to the requirements of **7.2.6**. If the sample fails to meet the requirements, the design shall be rejected.

7.9 Endurance Test

The endurance test shall be carried out in the following manner:

a) The pressure shall gradually be increased until the start to discharge pressure is reached and the start discharge pressure shall be recorded;
b) The pressure shall gradually be increased until the flow rating pressure is reached; and
c) The pressure shall gradually be decreased until the PRV reseats and the reseat pressure shall be recorded.

The cycle shall be repeated 10 times for each sample.

The PRV shall conform to the requirements of **7.2.4**, **7.2.5** and **7.2.7**.

7.10 Visual Inspection

The valve shall be dismantled and visually inspected for damage, deformation, wear and cracks. The PRV shall conform to the requirements of **7.2.8**.

8 TEST RECORDS

The following data shall be recorded for each valve design:

a) Manufacturer's name;
b) Valve type number with reference to the design type specification;
c) Valve sample number; and
d) Results of tests **7.3**, **7.4**, **7.5**, **7.7**, **7.8**, **7.9** and **7.10**.

9 PRODUCTION TESTING

9.1 General

The manufacturer should implement a conformity assessment procedure to ensure that the quality and performance of the manufactured PRVs comply with the quality and performance of the design.

9.2 Raw Material

All the raw material used for manufacture of the PRVs including spring will be procured with test certificate certifying physical and chemical and relevant test parameters of the specification.

9.3 Setting and Leak Testing of PRVs

Setting and leak testing at room temperature shall be carried out pneumatically for all PRVs using air or nitrogen.

Each PRV shall be adjusted so that the start to discharge pressure is at the nominal set pressure.

At any inlet pressure between $0.1^{+0.5}_{0}$ bar and the leakage rate through the valve shall not exceed 15 cm^3 per hour at STP. Also at any inlet pressure between 70 percent and 85 percent of the nominal set pressure, the leakage rate through the valve shall not exceed 15 cm^3 per hour at STP.

Any subsequent testing of the set pressure shall result in the start to discharge pressure being within ± 15 percent of the nominal set pressure.

9.4 Dimension Check

Inlet and outlet dimension shall be checked and number of samples to be taken shall be as per Table 2.

Table 2 Scale of Sampling

(*Clause* 9.4)

Sl No (1)	**Batch Size** (2)	**Sample Size** (3)
i)	Up to 500	10
ii)	501 up to 1 000	15
iii)	1 001 up to 2 000	20
iv)	2 000 to 3 000	25

9.5 Hydraulic pressure test

The test shall be carried out at not less than 1.5 times working pressure and 1.43 times the nominal test pressure whichever is more.

Number of samples shall be as per Table 3.

Table 3 Scale of Sampling

(*Clauses* 9.5 *and* 9.6)

Sl No. (1)	**Batch Size** (2)	**Sample Size** (3)
i)	3 up to including 3 000	2

9.6 Discharge capacity test

The test shall be carried out as per **7.7**. Number of samples shall be as per Table 3.

10 MARKING

10.1 The following minimum information shall be marked on the body of all PRVs, except

where the information is already included on cylinder valve with an integral PRV:

a) Manufacturer's name or trademark;
b) Type number;
c) Date code, indicating year of manufacture and month, for example YY/MM;
d) The set pressure for which the valve is 'set to start to release';
e) The flow rating pressure in bar or kgf/cm^2 gauge at which the flow capacity of the valve is determined; and
f) The flow capacity in m^3/min of free air;

10.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

11 DOCUMENTATION

The following information shall be supplied with PRVs:

a) Test report summarizing all tests carried out and the results obtained;
b) Performance characteristics;
c) User/installation instructions including a requirement not to interfere with the setting of the valve;
d) Method and torque requirements for sealing taper threads, in order to provide the correct thread engagement;
e) Valve identification;
f) Manufacturers details and name;
g) Maintenance and reconditioning recommendations; and
h) Declaration of conformity with this standard.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No./Other Standards	*Title*
IS 319 : 2007	Free cutting brass bars, rods and section — Specification (*fifth revision*)
IS 2500 (Part 1) :2000/ ISO 2859-1 : 1999	Sampling procedures for inspection by attributes: Part 1 Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection (*third revision*)
IS 3400	Methods of test for rubber, vulcanized or thermoplastic
(Part 1) : 2021/ ISO 37 : 2017	Tensile Stress-strain properties (*fourth revision*)
(Part 2)	Determination of hardness
(Sec 1) : 2022/ ISO 48-1 : 2018	Introduction and guidance
(Sec 2) : 2023/ ISO 48-2 : 2018	Hardness between 10 IRHD and 100 IRHD (*fifth revision*)
(Sec 3) : 2022/ ISO 48-3 : 2018	Dead-load hardness using the very low rubber hardness (VLRH) scale
(Sec 4) : 2022/ ISO 48-4 : 2018	Indentation hardness by durometer method (shore hardness) (*second revision*)
(Sec 5) : 2022/ ISO 48-5 : 2018	Indentation hardness by IRHD pocket meter method (*second revision*)
(Sec 6) : 2023/ ISO 48-6 : 2018	Apparent hardness of rubber covered rollers by IRHD method
(Sec 7) : 2022/ ISO 48-7 : 2020	Apparent hardness of rubber covered rollers by shore-type durometer method
(Sec 8) : 2022/ ISO 48-8 : 2018	Apparent hardness of rubber covered rollers by pusey and jones method
(Sec 9) : 2022 ISO 48-9 : 2018	Calibration and verification of hardness testers
IS 3400 (Part 4) : 2012/ ISO 188 : 2011	Methods of test for vulcanized rubber: Part 4 accelerated ageing and heat resistance (*third revisio*n)
IS 3400 (Part 18) : 2021/ ISO 1432 : 2013	Methods of test for vulcanized rubber: Part 18 Stiffness at low temperature (gehman test) (second revision)
IS 3400 (Part 20) : 2018/ ISO 1431-1 : 2012	Methods of test for vulcanized rubbers: Part 20 Resistance to Ozone cracking — Static strain test (*second revision*)
IS 4454 : (Part 4) : 2001	Steel wire for mechanical springs — Specification: Part 4 Stainless steel wire (sec*ond revision*)
IS 5903 : 2014	Recommendation for safety devices for gas cylinders
IS 6912 : 2005	Copper and copper alloys forging stock and forging — Specification (sec*ond revision*)
IS 8737 : 2017	Valve fittings for use with liquefied petroleum gas (LPG)

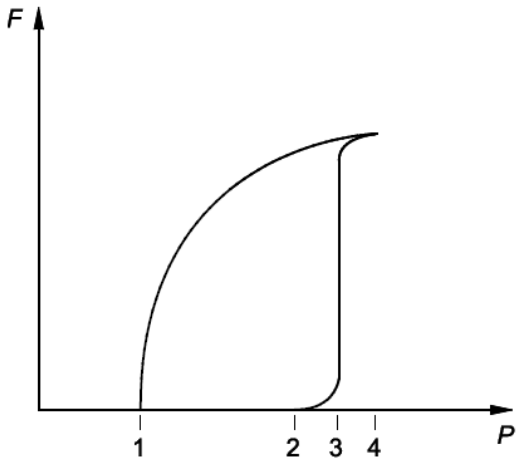
	cylinders for more than 5 litre water capacity — Specification (*second revision*)
IS/ISO 11114-1 : 2020	Gas cylinders — Compatibility of cylinder and valve materials with gas contents: Part 1 Metallic materials (fi*rst revision*)
IS/ISO 11114-2 : 2013	Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents: Part 2 Non-Metallic materials
EN 10270-3	Steel wire for mechanical springs — Part 1: Patented cold drawn unalloyed spring steel wire

ANNEX B

(*Informative*)

(*Clauses* 3.2 *and* 7.8)

TERMS USED WITH PRESSURE RELIEF VALVES



Key

1 Re-seat pressure
2 Start to discharge pressure
3 Pop action
4 Flow rating pressure
P Pressure
F Flow

FIG. 1 TERMS USED WITH LPG SAFETY VALVE

ANNEX C

(*Informative*)

PRODUCTION TESTING

C-1 GENERAL

The manufacturer should implement a conformity assessment procedure to ensure that the quality and performance of the manufactured PRVs comply with the quality and performance of the design.

C-2 SETTING AND LEAK TESTING OF PRVs

Setting and leak testing shall be carried out pneumatically using air, or nitrogen.

Each PRV shall be adjusted so that the start to discharge pressure is at the nominal set pressure.

At any inlet pressure between $0.1^{+0.5}_{0}$ bar and the leakage rate through the valve shall not exceed 15 cm^3 per hour at STP. Also at any inlet pressure between 70 percent and 85 percent of the nominal set pressure, the leakage rate through the valve shall not exceed 15 cm^3 per hour at STP.

Any subsequent testing of the set pressure shall result in the start to discharge pressure being within ± 15 percent of the nominal set pressure.

C-3 BATCH SAMPLES

Batch samples should be taken in accordance with IS 2500 (Part 1)/ISO 2859-1 and the following tests and inspections carried out:

a) Material suitability;
b) Dimensional verification; and
c) Marking.

C-4 REJECTION CRITERIA

Valves not meeting the requirements of **C-2** should be rejected.

Batches of valves not meeting the requirements of **C-3** should follow the rejection criteria of IS 2500 (Part 1)/ISO 2859-1.

B-5 DOCUMENTATION

Results of production testing should be recorded and retained.