**Doc: PCD 12 (24845) F**

***भारतीय मानक***

***Indian Standard***

 **IS XXXX : 2024**

**पॉलीकार्बोनेट लाठी — विशिष्टि**

**Polycarbonate *Lathi* — Specification**

ICS 83.140.99

© BIS 2024

भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDARDS

मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG

NEW DELHI - 110002

[www.bis.gov.in](http://www.bis.org.in) [www.standardsbis.in](http://www.standardsbis.in)

**December 2024 Price Group X**

Plastics Sectional Committee, PCD 12

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

The modernization of traditional weaponry has led to innovative adaptations, and *lathi* made of polycarbonate is being used by the security personnel. The polycarbonate *lathi* is crafted from a durable and lightweight thermoplastic polymer. This material provides increased strength and resistance to impact, making it an ideal choice for those seeking a more resilient and long-lasting alternative.

The polycarbonate *lathi*’s are generally used in conjunction with other items of protective clothing and equipment such as helmets, body and limb protectors, shield, gloves and protective footwear.

The composition of the Committee responsible for formulation of this standard is given in Annex C.

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.

*Indian Standard*

POLYCARBONATE *LATHI* — SPECIFICATION

**1 SCOPE**

This standard specifies the requirements and the methods of sampling and test for polycarbonate *lathi*.

**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 the standards listed in Annex A.

**3 TERMINOLOGY**

**3.1** For the purpose of this standard, the definitions given in IS 2828 shall apply.

**4 REQUIREMENTS**

**4.1 Raw Material Requirements**

**4.1.1** The polycarbonate material for manufacture of *lathi* shall be natural conforming to IS 14434.

NOTE ― The polycarbonate material may contain additives, processing aids and stabilizers (for example UV stabilizers), etc.

**4.1.2** The polycarbonate material shall also comply with the requirements given in Table 1 when tested as prescribed in col (4) of the Table 1.

**Table 1 Requirements for Polycarbonate Material**

(*Clause* 4.1.2)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No.** | **Characteristics** | **Requirement** | **Method of Test, Ref to IS** |
| (1) | (2) | (3) | (4) |
| i) | Melt flow index, g/10, *Min* [at 300 ºC under 1.2 kg load when measured after pre-drying of the material at (120 ± 5) ºC up to 4 h] | 1. For extrusion/ thermoforming: 1.5 to 8
2. For injection moulding: 8 to 15
 | IS 13360 (Part 4/Sec 1/Subsec 1) / IS 13360 (Part 4/Sec 1/Subsec 2) |
| ii) | Specific gravity | 1.19 to 1.22 | IS 13360 (Part 3/Sec 10) / IS 13360 (Part 3/Sec 11) / IS 13360 (Part 3/Sec 12) |
| iii) | Flexural modulus, *Min*, MPa (with crosshead speed of 1.2 mm/min and a span to depth ratio of 16 to 1 (test specimen size, 4 mm × 10 mm) | 2200 | IS 13360 (Part 5/Sec 7) |
| iv) | Izod impact strength, notched, *Min*, kJ/m2 (test specimen thickness of 3 mm and notch radius of 0.25 mm) | 60 | IS 13360 (Part 5/Sec 4) |
| v) | Deflection temperature under load at 1.82 MPa, *Min*, °C | 120 | IS 13360 (Part 6/Sec 17) |

**4.2 Physical Requirements**

**4.2.1** *Description*

**4.2.1.1** The polycarbonate *lathi* shall be of cylindrical shape. There shall be no variation in thickness of *lathi* throughout the length between shoe and hand-grip. The dimensional requirements of the *lathi* shall be as agreed to between the buyer and supplier.

**4.2.2** *Manufacturing Process*

The polycarbonate *lathi* shall be manufactured by thermoforming or injection moulding process adhering to code of good fabricating practices as given at Annex A of IS 16864.

**4.2.3** The total weight of the polycarbonate *lathi* shall be 275 g (*Max*). The transparency of the *lathi* shall be as agreed to between purchaser and supplier.

**4.2.4** Polycarbonate sheet formed from the specified material (*see* **4.1.1**) to be used for the manufacturing of *lathi* shall comply with the requirements given in Table 2.

**Table 2 Requirements for Polycarbonate *Lathi***

(*Clause* 4.2.4)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No.** | **Characteristics** | **Requirement** | **Method of Test, Ref to IS** |
| (1) | (2) | (3) | (4) |
| i) | Dart drop impact, J (at 27 ºC), *Min* | 150 | Annex B of IS 16864 |
| ii) | Flammability test (Test specimen thickness (3.18 + 0.13) mm) | 94 HB class | Annex C of IS 16864 |

**4.2.5** *Polycarbonate Material Identification*

**4.2.5.1** The polycarbonate body of the *lathi* shall meet all the test requirements detailed below. The test specimen for the following tests shall be taken from flattened area of the polycarbonate *lathi*.

**4.2.5.1.1** *Fourier transform infrared (FTIR) spectroscopy*

The results are to be recorded as a plot of the percent transmittance of the infrared radiation through the specimen versus the reciprocal wavelength (cm-1) or wavenumber of the radiation. The infrared spectra obtained by this method shall consist of a minimum wavenumber range of 4000 cm-1 to 400 cm-1. Signature peaks for polycarbonate are 1770 cm-1 assigned to C=O and a set of three peaks in the range of 1000 cm-1 to 1300 cm-1 assigned to C-O. Library matching shall confirm to at least 95 percent.

**4.2.5.1.2** *Differential scanning calorimetry (DSC)*

The mid-point of glass transition temperature of the test specimen measured in the second heating cycle shall be above 140 °C when tested in accordance with the test method prescribed in ISO 11357-2.

**4.2.6** *Protective Shoe/Stud (Optional Requirement)*

The protective shoe shall be made up of polymeric fibre or any other material as agreed to between purchaser and supplier and shall be a ring shaped with a length of (50 ± 5) mm. It shall be firm and properly fixed with *lathi*. It shall also be fire and water resistant.

**4.2.7** *Handgrip*

The handgrip shall be made up of polymeric fibre or rubber and shall be of (100 ± 10) mm in length. It shall be firm and properly fixed with *lathi*. It shall also be fire and water resistant. It shall allow user to comfortably hold the *lathi*.

**4.2.8** *Wrist Band*

The wrist band shall be made up of cotton/nylon and shall be provided on the top of handgrip for providing security from *lathi* snatching. The loop diameter for wrist band shall be of 15.24 cm to 20.32 cm (6 inches to 8 inches).

**4.3 Performance Requirements**

**4.3.1** *Resistance to Environmental Stress Cracking*

**4.3.1.1** Environmental stress cracking resistance (ESCR) test shall be performed on polycarbonate body of the *lathi* by constant strain method as per IS 13360 (Part 8/Sec 9).

**4.3.1.2** The test specimen shall be taken from the polycarbonate *lathi* as flat strip of size 125 mm × 15 mm cut from centre. The test specimen shall be conditioned at (27 ± 2) °C for at least 24 h to relieve internal stresses.

**4.3.1.3** Test shall be carried out on a set of three test specimens under a constant strain of 0.5 percent at (27 ± 2) °C. Chemicals, namely, 10 percent hydrochloric acid solution, 10 percent sulphuric acid solution, kerosene, petrol, diesel and Molotov cocktail, shall be applied on the test specimen. The exposed surface of the test specimen shall be examined after 10 min for signs of cracks, surface changes or pealing of coating, if any.

 NOTES

1. Chemical should be applied or wiped gently on/from the surface using cotton. Care should be taken not to touch cut edge of the test specimen; this can adversely affect test results.
2. Another set of test specimen exposed to the same environmental conditions without the chemical acts as control. These test specimens should be used as reference for comparing with exposed strips.

**4.3.2** *Resistance to Surface Abrasion*

The test specimen of polycarbonate *lathi* when tested for resistance to surface abrasion in accordance with ASTM D1044 for 100 cycles under 500 g load, shall have haze percent not more than 20 percent.

**5 PACKING AND MARKING**

**5.1 Packing**

The polycarbonate *lathi* shall be suitably packed as agreed to between the purchaser and the supplier.

**5.2** **Marking**

**5.2.1** Each polycarbonate *lathi* shall be permanently marked/tagged with the following:

a) Indication of the source of manufacture and trademark;

b) Batch or lot number;

c) Month and year of manufacture;

d) Total weight;

e) Length and thickness; and

f) Any other statuary requirements.

**5.2.2** *BIS Certification Marking*

**5.2.2.1** 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 products may be marked with the Standard Mark.

**6 SAMPLING**

The samples of the polycarbonate *lathi* shall be drawn and the criteria for conformity determined as prescribed in Annex B.

**ANNEX A**

(*Clause* 2)

**LIST OF REFERRED STANDARDS**

|  |  |
| --- | --- |
| *IS No./Other Standards*  | *Title* |
| IS 2828 : 2019 / ISO 472 : 2013 | Plastics — Vocabulary (*second revision*) |
| IS 4905 : 2015 / ISO 24153 : 2009 | Random sampling and randomization procedures (*first* *revision*) |
| IS 13360 | Plastics — Methods of testing |
| (Part 3/Sec 10) : 2021 / ISO 1183-1 : 2019 | Physical and dimensional properties, Section 10 Determination of density of non-cellular plastics — Immersion method, liquid pyknometer method and titration method (*first revision*) |
| (Part 3/Sec 11) : 2021 / ISO 1183-2 : 2019 | Physical and dimensional properties, Section 11 Determination of density of non-cellular plastics — Density gradient column method (*first revision*) |
| (Part 3/Sec 12) : 2016 / ISO 1183-3 : 1999 | Physical and dimensional properties, Section 12 Determination of density of non-cellular plastics — Gas pyknometer method |
| (Part 4/Sec 1/Subsec 1) : 2018 / ISO 1133-1 : 2011 | Rheological properties, Section 1 Determination of melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics, Subsection 1 Standard method (*first* *revision*) |
| (Part 4/Sec 1/ Subsec 2) : 2018 / ISO 1133-2 : 2011 | Rheological properties, Section 1 Determination of melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics, Subsection 2 Method for materials sensitive to time-temperature history and/or moisture (*first* *revision*) |
| (Part 5/Sec 4) : 2021 / ISO 180 : 2019 | Mechanical properties, Section 4 Determination of Izod impact strength (*second revision*) |
| (Part 5/Sec 7) : 2022 / ISO 178 : 2019 | Mechanical properties, Section 7 Determination of flexural properties (*second revision*) |
| (Part 6/Sec 17) : 2017 / ISO 75-2 : 2013 | Thermal properties, Section 17 Determination of temperature of deflection under load — Plastics and ebonite (*second* *revision*) |
| (Part 8/Sec 9) : 2022 / ISO 22088-3 : 2006 | Permanence / chemical properties, Section 9 Determination of resistance to environmental stress cracking (ESC) — Bent Strip method (*first revision*) |
| IS 14434 : 2023 | Polycarbonate moulding and extrusion materials — Specification (*first* *revision*) |
| IS 16864 : 2018 | Polycarbonate protective shield ― Specification  |
| ISO 11357-2 : 2020 | Plastics — Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature and step height |
| ASTM D1044-24 | Standard test method for resistance of transparent plastics to surface abrasion by the taber abraser |

**ANNEX B**

(*Clause* 6)

**SAMPLING OF POLYCARBONATE *LATHI***

**B-1 SCALE OF SAMPLING**

**B-1.1 Lot**

In a single consignment all the *lathi*’s of identical dimensions belonging to the same batch of manufacture shall be grouped together to constitute a lot.

**B-1.2** For judging conformity to the specified requirements each lot shall be considered separately.

**B-1.3** The number of sample *lathi*’s from a lot for determining the conformity shall be in accordance with col (2) and col (3) of Table 3.

**B-1.4** The sample *lathi*’s shall be taken at random from the lot. In order to ensure randomness of selection, random number tables may be used (*see* also IS 4905).

**B-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY**

**B-2.1** Each of the sample *lathi*’s selected according to **B-1.3** shall be tested for all the requirements of this specification. The lot shall be declared to be in conformity if each sample *lathi* individually meets the specified requirements.

**Table 3 Number of Sample *Lathi***

(*Clause* B-1.3)

|  |  |  |
| --- | --- | --- |
| **Sl No.** | **Number of *Lathi* in a Lot, *N*** | **Number of Sample *Lathi*, *n*** |
| (1) | (2) | (3) |
|  | Up to 25 | 1 |
|  | 26 to 150 | 2 |
|  | 151 to 300 | 3 |
|  | 301 to 500 | 4 |
|  | 501 and above | 5 |

**ANNEX C**

(*Foreword*)

**COMMITTEE COMPOSITION**

Plastics Sectional Committee, PCD 12

|  |  |
| --- | --- |
| *Organization* | *Representative(s)* |
| **Central Institute of Petrochemicals Engineering and Technology (CIPET), Chennai** | **PROF. SHISHIR SINHA (*Chairperson*)** |
| All India Plastics Manufacturers Association, Mumbai | SHRI JAGAT KILLAWALASHRI SHYAM SUNDER (*Alternate*) |
| CSIR - Central Food Technological Research Institute, Mysore | SHRI R. S. MATCHESHRI KESHAVA MURTHY. P (*Alternate*) |
| CSIR - Indian Institute of Toxicology Research, Lucknow | DR V. P. SHARMA DR A.B. PANT (*Alternate*) |
| Central Institute of Petrochemicals Engineering and Technology (CIPET), Chennai | DR S. N. YADAV DR SMITA MOHANTY (*Alternate* I)DR VISHAL VERMA (*Alternate* II) |
| Central Pollution Control Board, New Delhi | MS DIVYA SINHA MS YOGESH CHANDRA (*Alternate*) |
| Chemical and Petrochemicals Manufacturers Association, New Delhi | SHRI UDAY CHAND |
| Coca-Cola India Private Limited, Gurugram | SHRI VIRENDRA LANDGE SHRI RAJENDRA DOBRIYAL (*Alternate*) |
| Department of Chemicals and Petrochemicals, Government of India, New Delhi | SHRI O. P. SHARMADR SANJAY KUMAR CHATTOPADHYAY (*Alternate*) |
| Food Corporation of India (FCI), New Delhi | SHRI KAUSHIK DASSHRI S. VIJAY KUMAR (*Alternate*) |
| GAIL (India) Limited, New Delhi | SHRI KULDEEP NEGISHRI AJIT CHATURVEDI (*Alternate*) |
| HPCL Mittal Energy Limited, Noida | SHRI VINEET KUMAR GUPTASHRI ALAKESH GHOSH (*Alternate*) |
| Haldia Petrochemicals Limited, Kolkata | SHRI SUVOMOY GANGULYMS AMARTYA MAITY (*Alternate* I)MS SUDIPTA GHOSH (*Alternate* II) |
| Huhtamaki India Limited, Mumbai | SHRI MUTHUSAMY CHOCKALINGAMMS AISHWARYA VANAGE (*Alternate*) |
| Indian Centre for Plastics in the Environment, Mumbai | SHRI TUSHAR K. BANDOPADHYAYMS NEHA MAURYA (*Alternate* I)MS POONAM GUPTA (*Alternate* II) |
| Indian Flexible Packaging & Folding Carton Manufacturers Association, Mumbai | SHRI ATIN CHAUDHURI |
| Indian Institute of Technology Delhi, New Delhi | PROF. J. JACOVPROF. SAMPA SAHA (*Alternate*) |
| Indian Institute of Technology Roorkee, Roorkee | SHRI PRASENJIT MONDELDR PRADIP KUMAR MAJI (*Alternate* I)DR KOMAL TRIPATHI (*Alternate* II) |
| Indian Oil Corporation Limited, New Delhi | SHRI SUMIT BASUSHRI RAJA PODDAR (*Alternate* I)SHRI JATINDER DHALIWAL (*Alternate* II) |
| Indian Pharmacopoeia Commission, Ghaziabad | DR JAI PRAKASH DR MANOJ KUMAR PANDEY (*Alternate*) |
| Indian Plastic Institute, Mumbai | SHRI V. B. LALL SHRI MIHIR BANERJI (*Alternate*) |
| Ministry of Environment Forest and Climate Change, New Delhi | DR SATYENDRA KUMARSHRI AMIT LOVE (*Alternate*) |
| National Chemical Laboratory, Pune | DR P R SURESHADR R V GUNDLOORI (*Alternate* I)MS SANGEETA HAMBIR (*Alternate* II) |
| Organisation of Plastics Processors of India, Mumbai | SHRI DEEPAK LAWALE |
| PlastIndia Foundation, Mumbai | SHRI HEMANT MINOCHASHRI RAJU D. DESAI (*Alternate*) |
| Reliance Industries Limited, Mumbai | SHRI S. V. RAJUSHRI AMIT SHAH (*Alternate* I)DR SHREERAM WADEKAR (*Alternate* II) |
| Sabic Innovative Plastics India Private Limited, Bengaluru | DR SUMANDA BANDYOPADHYAYSHRI NAGARAJ DHADESUGUR (*Alternate* I)SHRI SUNIL RAUTO (*Alternate* II) |
| Shivalik Agro Poly Products Ltd., Mohali | SHRI PANKAJ KUMAR MAHAJANDR G. D. TYAGI (*Alternate*) |
| Shriram Institute for Industrial Research,Delhi | DR MANMOHAN KUMAR SHRI SANJAY KUMAR SINGH (*Alternate* I)MS PUSHPLATA (*Alternate* II) |
| Technical Training and Research Centre, Lohia Group, Kanpur | SHRI R. K. DWIVEDI |
| Voluntary Organisation in Interest of Consumer Education (VOICE), New Delhi | SHRI M. A. U. KHANDR RAJIV JHA (*Alternate*) |
| BIS Directorate General | SHRI CHINMAY DWIVEDI, SCIENTIST ‘E’/DIRECTOR AND HEAD (PETROLEUM, COAL AND RELATED PRODUCTS DEPARTMENT) [REPRESENTING DIRECTOR GENERAL (*Ex-Officio*)] |
| *Member Secretary*SHRI SHIVAM DWIVEDISCIENTIST ‘C’/DEPUTY DIRECTOR(PETROLEUM, COAL AND RELATED PRODUCTS DEPARTMENT), BIS |