भारतीय मानक
Indian Standard

IS 13193 : 2024

संकचन और बहिर्वेधन के लिए थर्मोप्लास्टिक पॉलीएसटर्स (पीईटी और पीबीटी) — विशिष्टि

(पहला पुनरीक्षण)

Thermoplastic Polyesters (PET and PBT) for Moulding and Extrusion — Specification

(First Revision)

ICS 97.200.50

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Plastics Sectional Committee, PCD 12

FOREWORD

This Indian Standard (First Revision) 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.

This standard was originally published in 1992. The major changes in this revision are as follows:

a) Title and scope has been modified; and

b) Two major variants of thermoplastic polyester (PET and PBT) are under the scope of this standard.

Polyethylene terephthalate (PET) and polybutylene terephthalate (PBT) which are the most widely used plastics materials, are made by the esterification of purified terephthalic acid (PTA) or dimethyl terephthalate (DMT) with monoethylene glycol (MEG) in case of PET and with 1,4-butane-diol in case of PBT. Isophthalic acid (IPA) and/or diethylene glycol (DEG) can also be added as comonomers. Due to their chemistry, PET and PBT also fall under the group called ‘saturated or thermoplastic polyesters'.

Due to their high mechanical properties, PET and PBT are grouped under the family of ‘engineering thermoplastics'. Their ability to be modified by the addition of either reinforcing agents or fillers or additives makes them popular for a diverse range of applications in packaging, automotive, electrical, electronic, telecommunications, appliances, business machines, railways and many other industries.

Thermoplastic polyesters (PET and PBT) are converted into a wide variety of products using injection molding/ blow molding/extrusion processes.

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

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 (*first 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

THERMOPLASTIC POLYESTERS (PET AND PBT) FOR MOULDING AND EXTRUSION — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard prescribes the requirements and the methods of sampling and tests for polyethylene terephthalate (PET) and polybutylene terephthalate (PBT) materials for moulding and extrusion.

1.2 This standard is intended to be used for characterization of PET and PBT materials on the basis of basic polymer properties and recommended end-uses.

1.3 This standard is only applicable to virgin PET and PBT.

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 revisions, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

3 TERMINOLOGY

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

4 TYPES

4.1 Two types of thermoplastic polyesters, namely:

a) polyethylene terephthalate (PET) [and its copolymer(s)]; and

b) polybutylene terephthalate (PBT) [and its copolymer(s)].

5 REQUIREMENTS

5.1 Description

5.1.1 *Chemistry*

The virgin material shall be thermoplastic (saturated) polyester, produced by the catalytic condensation at high temperature and reduced pressure of DMT/PTA with monoethylene glycol or 1, 4-butane-diol for making PET or PBT types respectively.

5.1.2 *Form*

The material shall be in granular form.

5.2 Unfilled PET and PBT

5.2.1 Virgin PET and PBT without the intentional addition of any performance enhancers are covered in this section.

5.2.2 Characterization of unfilled PET and PBT shall be done as follows:

a) The basic polymer properties shall comply with the requirements laid down in Table 1 when tested according to the methods mentioned corresponding to each requirements under col (5) of the Table 1;

b) Any residual inorganic content shall be determined by measuring the ash content as per ISO 3451-2;

c) Carboxyl content shall be determined by the applicable titration method as agreed to between purchaser and supplier;

d) Colour of pellets or granules are generally evaluated in reflected light using a colour spectrophotometer or colorimeter. Method of evaluation, reference samples, measuring instrument, tests per sample shall be as agreed to between purchaser and supplier, as per end use application;

For properties at b), c) and d), the requirements shall be as agreed to between the purchaser and the supplier.

5.3 Filled PET and PBT

5.3.1 Virgin PET and PBT having an intentional addition of performance enhancers (reinforcing agents, additives, fillers, colorants, flame retardants, heat stabilizers, lubricating agents, etc,) are covered in this section. Such addition of one or more performance enhancers may be done to achieve desired functionalities in specific applications.

5.3.2 Characterization of filled PET and PBT shall be done as follows:

a) The basic polymer properties (of the starting unfilled PET and PBT) shall be tested according to the methods mentioned corresponding to each requirement under col (5) of Table 1;

b) Any residual inorganic content shall be determined by measuring the ash content as per ISO 3451-2;

c) Carboxyl content shall be determined by the applicable titration method as agreed to between purchaser and supplier; and

d) Colour of pellets or granules are generally evaluated in reflected light using a colour spectrophotometer or colorimeter, etc, Method of evaluation, reference samples instrument used and tests per sample shall be as agreed to between purchaser and supplier, as per end use application.

For properties at b), c) and d), the requirements shall be as agreed to between the purchaser and the supplier.

5.4 Requirement for Material for Stretch Blow-Moulding

5.4.1 The material shall be of PET type.

5.4.2 *Relative Viscosity*

The relative viscosity shall be as agreed to between purchaser and the supplier and shall be tested as per ISO 1628-5.

5.4.3 *Intrinsic Viscosity* (*IV*)

The intrinsic viscosity shall be as agreed to between purchaser and the supplier. ISO 1628-5 shall be used for testing the parameter.

5.4.4 *Moisture*

As per the processing requirement, the moisture content shall be ≤ 0.4 percent. In general, ISO 15512-2019 (Method A and Method C) is followed for determination of moisture content, however appropriate method for determination of moisture content may also be considered as per agreement between the purchaser and supplier.

5.5 Requirement for Material for Making Films, Monofilaments Strappings, Sheet, etc

5.5.1 The material shall be of PET type. PBT may also be used.

5.5.2 *Relative Viscosity*

The relative viscosity shall be as agreed to between the purchaser and the supplier and shall be tested as per ISO 1628-5.

5.5.3 *Intrinsic Viscosity* (IV)

The intrinsic viscosity shall be as agreed to between purchaser and the supplier, which shall be tested as per ISO 1628-5.

5.5.4 *Moisture*

The material shall also conform to the requirement as mentioned in **5.4.4**.

5.6 Special Requirement for Material for Flame Retardant Applications

The material shall conform to ratings FV-0, FV-1, FV-2, etc, and to oxygen index values as per the end-use requirements and agreements between the purchaser and the supplier when tested in accordance with the method prescribed in Annex B and IS 13360 (Part 6/Sec 6) respectively.

NOTE — There may be other requirements necessary for specific applications. These may be specified by agreement between the purchaser and the supplier.

6 PACKING AND MARKING

6.1 Packing

The material shall be packed in bags/containers with suitable liner as agreed to between the purchaser and the supplier, in a manner so as to provide protection against ingress of moisture and to facilitate easy handling.

6.2 Marking

6.2.1 Each package shall be clearly marked with the following information:

a) Name and type of the material;

b) Net mass of the material;

c) Indication of the source of manufacture and recognized trademark, if any;

d) Batch number in code or otherwise to enable a lot of manufacture to be traced from records;

e) Month and year of the manufacture;

f) Recycling symbol as per IS 14534; and

g) Any other statutory requirements.

6.2.2 *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 products may be marked with the Standard Mark.

7 SAMPLING

The method of drawing representative sample of the material from a lot and the criteria for conformity of the material to the requirement of this standard shall be as prescribed in Annex C.

8 TEST SPECIMENS

Specimens for testing shall be prepared by injection moulding prescribed in IS 13360 (Part 2/Sec 3).

Table 1 Requirements for Polyethylene Terephthalate (PET) and Polybutylene Terephthalate (PBT) (Unfilled Natural Colour)

(*Clauses* 5.2.2 *and* 5.3.2)

Sl No.	Characteristic	Requirement for Type		Method of Test, Ref to
		PET	PBT	
(1)	(2)	(3)	(4)	(5)
i)	Density, g/cm^3	1.35 ± 0.05	1.30 ± 0.02	IS 13360 (Part 3/Sec 10)/ IS 13360 (Part 3/Sec 11)
ii)	Melting point, °C	240 to 265	223 to 225	IS 13360 (Part 6/Sec 10)
iii)	a) Relative viscosity at 25 °C ± 0.1 °C	1.34 to 1.67	1.34 to 1.75	ISO 1628-5
	b) Intrinsic viscosity at 25 °C ± 0.1 °C	0.56 to 1.10	0.60 to 1.30	—
iv)	Heat distortion, temperature, °C, *Min*			Annex H of IS 13411
	a) at 18.5 kg/cm^2	60	60	
	b) at 4.6 kg/cm^2	70	165	
v)	Vicat softening point at 1 kg, °C, *Min*	75	210	IS 13360 (Part 6/Sec 1)
vi)	Tensile strength at break, MPa, *Min*	55	52	IS 13360 (Part 5/Sec 1)
vii)	Elongation at break, percent	50 to 200	50 to 200	IS 13360 (Part 5/Sec 1)
viii)	Impact strength, izod (notched), kJ/m^2, *Min*	2.0	2.0	Annex E of IS 13411
ix)	Cross breaking strength, at maximum load, MPa, *Min*	80	75	Annex F of IS 13411

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 24153 : 2015/ISO : 2009	Random sampling and randomization procedures (*first revision*)
IS 12252 : 2017	Polyalkylene terephthalates (PET & PBT), their copolymers and list of constituents in raw materials and end products for their safe use in contact with foodstuffs and pharmaceuticals (*first revision*)
IS 13360	Plastics — Methods of testing:
(Part 2/Sec 3) : 2019/ISO 294-1 : 2017	Sampling and preparation of test specimens, Section 3 Injection moulding of test specimens of thermoplastic materials — General principles and moulding of multipurpose and bar test specimens (*first revision*)
(Part 3)	Physical and dimensional properties,
(Sec 10) : 2021/ ISO 1183-1 : 2019	Determination of density of non-cellular plastics — Immersion method, liquid pyknometer method and titration method (*first revision*)
(Sec 11) : 2021/ ISO 1183-2 : 2019	Determination of density of non-cellular plastics — Density gradient column method (*first revision*)
(Part 5/Sec 1) : 2021/ISO 527-1 : 2019	Mechanical properties, Section 1 Determination of tensile properties — General requirements (*second revision*)
(Part 6)	Thermal properties,
(Sec 1) : 2018/ ISO 306 : 2013	Determination of vicat softening temperature of thermoplastics materials (*second revision*)
(Sec 6) : 2019/ ISO 4589-1 : 2017	Flammability by oxygen index — General requirements (*second revision*)
(Sec 10) : 2023/ ISO 3146 : 2022	Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods (*second revision*)
IS 13411 : 1992	Glass reinforced polyester dough moulding compound — Specification
IS 16630	Plastics — Post-consumer poly (ethylene terephthalate) (PET) bottle recyclates:
(Part 1) : 2018	Designation system and basis for specifications
(Part 2) : 2024	Preparation of test specimens and determination of properties
ISO 1628-5 : 1998	Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers — Part 5: Thermoplastic polyester (TP) homopolymers and copolymers
ISO 15512 : 2019	Plastics — Determination of water content

ANNEX B

(*Clause* 5.6)

DETERMINATION OF THE BURNING BEHAVIOUR OF VERTICAL PLASTICS SPECIMENS IN CONTACT WITH A SMALL FLAME IGNITION SOURCE

B-1 GENERAL

B-1.1 This is a small-scale laboratory screening procedure for comparing the relative burning behavior of vertically oriented plastic specimens exposed to a low energy level ignition.

B-1.2 This method of test determines the after-flame/after-glow times and damaged length of specimens. It is applicable to solid and cellular materials having an apparent density of not less than 250 kg/m^3. This method is not applicable for materials that spring away from the applied flame without igniting.

B-1.3 The classification system described is intended for quality assurance and the preselection of component materials for products. This system is not intended to assess the fire behaviour of building materials, furnishings, complete items of equipment or finished parts.

B-2 OUTLINE OF THE METHOD

A test specimen bar is supported vertically by one end and the free end is exposed to a specified gas flame. The burning behaviour of the bar is assessed by measuring the after-flame/afterglow times.

B-3 SIGNIFICANCE OF TEST

B-3.1 Test made on a material under the conditions specified may be of considerable value in comparing the relative burning behaviour of different materials, in controlling manufacturing processes or in assessing any change in burning characteristics prior to, or during, use. The results obtained from this method are dependent upon the shape, orientation and environment surrounding the specimen and the conditions of ignition. Correlation with performance under actual service conditions is not implied.

B-3.2 Results obtained in accordance with this method shall not be used to describe or appraise the fire hazard presented by a particular material or shape under actual fire conditions, unless used as one element of a fire risk assessment that takes into account all of the factors that are pertinent to the assessment of the fire hazard in a particular end use for the material. Assessment for fire hazard requires consideration of such factors as fuel contribution, intensity of burning (rate of heat release), products of combustion and environmental factors such as the intensity of source, orientation of exposed material and ventilation conditions.

B-3.3 Burning behaviour as measured by this test method, is affected by such factors as density, any anisotropy of the material and the thickness of the specimen.

B-3.4 Certain materials may shrink from the applied flame without igniting. In this event, test results are not valid and additional test specimens are required to obtain ten valid tests. If the test specimens continue to shrink from the applied flame without igniting, these materials are not suitable for evaluation by this method of test.

B-3.5 The burning behaviour of some plastic materials may change with time. It is accordingly advisable to make tests before and after ageing by an appropriate procedure. The preferred ageing conditions shall be 7 days at 70 °C. However, other ageing times and temperatures may be used by agreement between the interested parties and shall be noted in the test report.

B-4 APPARATUS

B-4.1 Laboratory Fume Hood (Cupboard) — having an inside volume of at least 0.5 m^3, shall be used when testing the specimens. The chamber shall permit observation and shall be draught-free while permitting normal thermal circulation of air past the specimen during burning. For safety and convenience, it is desirable that this enclosure (which may be completely closed) be fitted with an evacuation device, such as an exhaust fan, to remove products of combustion which may be toxic. However, it is important to note that the device shall be turned off during the actual test and started again immediately after the test to remove the products of combustion.

NOTE — The amount of oxygen available to support combustion is naturally important for the conduct of these flame tests. For tests conducted by this method when burning times are protracted, chamber sizes less than 1 m^3 may not provide accurate results.

B-4.2 Laboratory Burner — a Bunsen burner having a tube length of 80 mm to 100 mm and an inside diameter of $9.4^{+1.6}_{-0.0}$ mm. The tube shall not be equipped with an end-attachment such as a stabilizer.

B-4.3 Ring Stand, With Clamps or the Equivalent — adjustable for positioning of the specimen.

B-4.4 Timing Device — accurate to 1 s

B-4.5 Measuring Scale — graduated in mm

B-4.6 Supply of Technical Grade Methane Gas — with regulator and meter for uniform gas flow. Other gas mixtures having a heat content of approximately 37 MJ/m^3, have been found to provide similar results.

B-4.7 Desiccator — containing anhydrous calcium chloride or other drying agent.

B-4.8 Conditioning Room or Chamber — capable of being maintained at 27 °C ± 2 °C and a relative humidity of 65 percent ± 5 percent.

B-4.9 Complementary Apparatus — (*see* Fig. 1).

B-4.10 Dry Absorbent Surgical Cotton

B-4.11 Full-Draught Air-Circulating Oven — minimum of 25 air changes/hour, capable of being maintained at 70 °C ± l °C or other agreed temperature.

B-5 SPECIMENS

B-5.1 All specimens shall be cut from a representative sample of the material (sheets or from end-products), or shall be cast or injection, compression or transfer moulded to the necessary form. After any cutting operation, care shall be taken to remove all dust and any particles from the surface; cut edges shall have a smooth finish.

B-5.2 Standard bar specimens shall be 125 mm ± 5 mm long, 13.0 mm ± 0.3 mm wide and 3.0 mm ± 0.2 mm thick. Other thicknesses may be used by agreement between the interested parties and, if so, shall be noted in the test report.

NOTE — Tests made on specimens of different thicknesses or density are not comparable and tests made in different directions of anisotropy may also not be comparable.

B-5.3 A minimum of 26 bar specimens shall be prepared. It is advisable to prepare additional specimens in the event that the situation described in **B-3.4** is encountered.

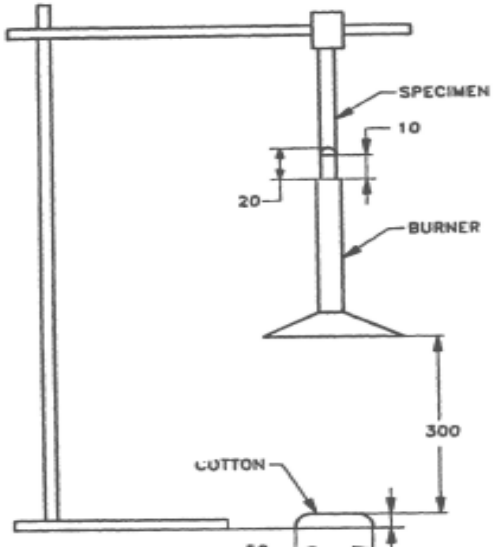
B-6 CONDITIONING

B-6.1 Unless otherwise required by the material specification, the following shall apply.

B-6.1.1 Two sets of 5 bar specimens shall be preconditioned for at least 48 h at 27 °C ± 2 °C and 65 percent ± 5 percent relative humidity.

B-6.1.2 Two sets of 5 bar specimens shall be preconditioned for 168 h at 70 °C ± 1 °C and then cooled in a desiccator (**B-4.7**) for at least 4 h at ambient temperature.

B-6.1.3 All specimens shall be tested in a standard laboratory atmosphere of 27 °C ± 2 °C and 65 percent ± 5 percent relative humidity.



All dimensions in millimetres.

FIG. 1 VERTICAL BURNING-BEHAVIOUR TEST APPARATUS

B-7 PROCEDURE

B-7.1 Clamp the specimen from the upper 6 mm of its length with the longitudinal axis vertical so that the lower end of the specimen is 300 mm above a horizontal layer of dry absorbent surgical cotton (50 mm × 50 mm) thinned to a maximum uncompressed thickness of 6 mm (*see* Fig. 1).

B-7.2 Adjust the burner to produce a blue flame 20 mm ± l mm high. The flame shall be obtained by adjusting the supply and air ports of the burner until an approximate 20 mm yellow-tipped blue flame is produced. Increase the air supply until the yellow tip disappears. Measure the height of the flame again and adjust it, if necessary.

B-7.3 Place the flame of the burner centrally under the specimen, so that the top of the burner is 10 mm below the lower end of the specimen and allow it to remain there for 10 s. Withdraw the burner to a distance at least 150 mm away and simultaneously start the timing device. Note the after-flame time t_1, in seconds. If the specimen drips molten or flaming material during flame application, the burner may be tilted to an angle of 45° to avoid material dripping into the tube of the burner. However, the 10 mm distance shall be maintained between the major portion of the specimen and the tilted burner.

B-7.4 When after flaming of the specimen ceases, immediately place the flame of burner again under the specimen. After 10 s, turn off the burner and note the after-flame t_2 and afterglow t_3 times of the specimen.

B-7.5 The test procedure shall be conducted on at least five specimens.

B-8 EXPRESSION OF RESULTS

B-8.1 Calculate the total after flame time t_{fi} in seconds, for an individual specimen, using the formula:

$$t_{fi} = t_1 + t_2$$

where

t_1 = in s, first after-flame time;

t_2 = in s, second after-flame time; and

i = specimen number.

B-8.2 For each set of five specimens from a given preconditioning treatment, calculate the total set after-flame time t_{fs} in seconds, using the formula;

$$\sum_{i=1}^{i=5} t_{fi}$$

where

i and t_{fi} are as defined in **B-8.1**.

B-8.3 Calculate the combustion time t_{ci} in seconds, for an individual specimen, using the formula:

$$t_{ci} = t_2 + t_3$$

where

i and t_2 are as defined in **B-8.1**; and

t_3 = in s, afterglow time.

B-9 CATEGORIES OF BURNING BEHAVIOUR

The behaviour of the specimens shall be classified in one of the categories given in Table 2 (FV = flaming vertical specimen) determined by selecting the appropriate column, using test results to answer the conditional questions posed.

B-10 TEST REPORT

The test report shall include the following particulars:

a) Complete identification of the product tested, including the manufacturer's name, number or code;

b) The thickness to the nearest mm, of the test specimen;

c) The direction of any anisotropy relative to the test specimen dimensions;

d) Conditioning treatment;

e) Any prior treatment before testing, other than cutting, trimming and conditioning;

f) Classification according to the category code designation specified in **B-9**.

Table 2 Categories of Burning Behaviour

(*Clause* B-9)

Sl No.	Conditions	Category (*see* Note 1)			
(1)	(2)	(3)	(4)	(5)	(6)
i)	If : Any individual specimen total after flame time t_{fi}	≤ 10 s	≤ 30 s	≤ 30 s	> 30 s
ii)	And : Total set after flame time t_{fs}	≤ 50 s	≤ 250 s	≤ 250 s	> 250 s
iii)	And : Any individual specimen combustion time after the second flame application t_{ci}	≤ 30 s	≤ 60 s	≤ 60 s	> 60 s
iv)	And : After flame or after glowing up to the specimen holding clamp	No	No	No	Yes
v)	And : Cotton indicator ignited by flaming particles or drops	No	No	Yes	Yes or no
vi)	Then : The category is	FV-0	FV-1	FV-2	(*see* Note 2)

NOTES

1 If only one specimen from a set of five specimens for a given preconditioning treatment does not comply with the requirement for a category, another set of five specimens subjected to the same preconditioning shall be tested. All specimens from the second set shall comply with the appropriate requirements for the category.

2 The material may not be categorized by this method.

ANNEX C

(*Clause* 7)

SAMPLING OF POLYETHYLENE TEREPHTHALATES (PET) AND POLYBUTYLENE TEREPHTHALATE (PBT)

C-1 GENERAL

C-1.1 In drawing, preparing, storing and handling samples, the following precautions and directions shall be observed.

C-1.2 Samples shall not be taken in an exposed place.

C-1.3 The sampling instrument, wherever applicable, shall be made of stainless steel or any other suitable material on which the material shall have no action. The instrument shall be clean and dry.

C-1.4 Precautions shall be taken to protect the samples, and material being sampled, the sampling instrument and the containers for samples from adventitious contamination.

C-1.5 The sample shall be placed in suitable, clean, dry, and airtight metal containers on which the material has no action. The sample containers shall be of such a size that they are almost completely filled by the sample.

C-1.6 Each sample container shall be sealed airtight with a stopper after filling and marked with full details of sampling, such as type of sample, date of sampling, and the month and year of manufacture of material.

C-1.7 Samples shall be stored in such a manner that the temperature of the material does not vary unduly from the normal temperature.

C-2 SCALE OF SAMPLING

C-2.1 Lot

In a single consignment all the packages of the same class, same type, same form and belonging to the same batch of manufacture shall be grouped together to constitute a lot. If a consignment is known to consist of packages belonging to different batches of manufacture or different forms, the packages

belonging to the same batch of manufacture and same form shall be grouped together and each such group shall constitute a lot.

C-2.2 For ascertaining the conformity of the material to the requirements of this specification, samples shall be tested from each lot separately. The number of packages to be sampled shall depend on the size of the lot and shall be in accordance with col (2) and col (3) of Table 3.

These packages shall be selected at random from the lot and in order to ensure the randomness of selection, procedure given in IS 4905 may be followed.

C-3 PREPARATION OF TEST SAMPLES

From each of the packages of material selected, small portions of material shall be drawn with the help of suitable sampling instrument. The total quantity of material collected from each package shall be sufficient to test all the requirements given in **5**.

C-4 NUMBER OF TESTS

Tests for determining all the requirements given in **5** shall be carried out on the individual test samples.

C-5 CRITERIA FOR CONFORMITY

The lot shall be declared as conforming to the requirements of this specification if all the test results on individual samples meet the relevant specification requirements.

Table 3 Scale of Sampling

(*Clause* C-2.2)

Sl No.	Number of Packages in the Lot	Sample Size
(1)	(2)	(3)
i)	Up to 50	3
ii)	51 to 150	4
iii)	151 to 300	5
iv)	301 to 500	7
v)	501 and above	10

ANNEX D

(*Foreword*)

COMMITTEE COMPOSITION

Plastics Sectional Committee, PCD 12

Organization	*Representative(s)*
Central Institute of Petrochemicals Engineering and Technology (CIPET), Chennai	DR SHISHIR SINHA **(*Chairperson*)**
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Central Pollution Control Board, New Delhi	MS DIVYA SINHA MS YOGESH CHANDRA (*Alternate*)
Chemical and Petrochemicals Manufacturers Association, New Delhi	SHRI UDAY CHAND
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Ministry of Environment Forest and Climate Change, New Delhi	DR SATYENDRA KUMAR SHRI AMIT LOVE (*Alternate*)
National Chemical Laboratory, Pune	DR P. R. SURESHA DR R. V. GUNDLOORI (*Alternate* I) MS SANGEETA HAMBIR (*Alternate* II)
Organisation of Plastics Processors of India, Mumbai	SHRI DEEPAK LAWALE
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