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BUREAU OF INDIAN STANDARDS

Draft Indian Standard

PLASTICS — POLY(METHYL METHACRYLATE) (PMMA) MOULDING AND EXTRUSION MATERIALS

PART 1 DESIGNATION SYSTEM AND SPECIFICATIONS

(ICS No. 83.080.20)

Plastics Sectional Committee,
PCD 12

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18 May 2022

FOREWORD

(Formal clause to be added later**)**

Poly(methyl methacrylate) (PMMA) is a transparent thermoplastic. As an alternative to glass, it is often used in sheet form as a lightweight and shatter-resistant material. As well as being used as a casting resin, it can also be used in inks and coatings. Due to its transparency and durability, PMMA has been used in a variety of fields and applications, including rear-lights and instrument clusters for vehicles, appliances, and lenses for glasses. Sheets of PMMA can be used for building windows, skylights, bulletproof security barriers, signs and displays, sanitary ware (bathtubs), LCD screens, furniture, and many other applications.

Considerable assistance has been derived from ISO 24026-1, while preparing this standard. In order to have uniform practice in the designation system of various resins, IS number is designated as block 1.

The composition of the Committee responsible for the formulation of this standard is given in Annex A (to be included).

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: 1960 ‘Rules for rounding off numerical values (revised)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1 SCOPE

1.1 This Standard prescribes the designation system, requirements, methods of sampling and test for Polymethyl methacrylate (PMMA) thermoplastic material.

1.2 The types of PMMA plastic are differentiated by a classification system based on appropriate levels of the designatory property like vicat softening temperature, melt mass-flow rate, viscosity number (optional) and on information about the intended application and/or method of processing, important properties, additives and colourants.

1.3 This standard is applicable to all poly(methyl methacrylate) homopolymers and to copolymers of methyl methacrylate (MMA) containing at least a mass percentage of 80 percent of MMA and not more than a mass percentage of 20 percent of acrylic esters or other monomers.

1.4 This standard applies to materials ready for normal use in the form of beads, granules and pellets and to materials unmodified or modified by colourants, additives, etc. It does not apply to PMMA modified with elastomers.

1.5 This standard is not intended to imply that materials having the same designation give necessarily the same performance. This standard does not provide engineering data, performance data or data on processing conditions which might be required to specify a material for a particular application and/or method of processing. If such additional properties are required, they are, if suitable, determined using the test methods specified in IS XXXXX (Part 2)[PCD/12/19328].

1.6 In order to specify a thermoplastic material for a particular application or to ensure reproducible processing, additional requirements can be given in data block 5.

2 REFERENCES

The Indian standards and other publications listed below contain provisions which, through reference in this text, constitute provision of this standard. At the time of publication, the edition 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 below.

IS/Other Publication	Title
IS 2491 : 2013	Food hygiene — General principles — Code of practice (*third revision*)
IS 2828 : 2019/ISO 472 : 2013	Plastics — Vocabulary (*second revision*)
IS 9833 : 2018	List of colourants for use in plastics in contact with foodstuffs and pharmaceuticals (*second revision*)
IS 9845 : 1998	Determination of overall migration of constituents of plastics materials and articles intended to come in contact with foodstuffs — Method of analysis (*second revision*)
ISO 1043-1 : 2011	Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics
IS XXXXX (Part 2) : 2022 / ISO 24026-2 : 2020 [PCD/12/19328]	Plastics — Poly(methyl methacrylate) (PMMA) moulding and extrusion materials — Part 2: Preparation of test specimens and determination of properties

3 TERMINOLOGY

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

4 DESIGNATION SYSTEM

4.1 General

4.1.1 Designation code for PMMA material shall be done based on five data blocks. The designation shall consist of following information given in the order presented and shall be codified in different blocks as indicated below:

Data Block 1	For Indian Standard
Data Block 2	For the material identification
Data Block 3	For intended application or method of processing, important properties, additives, and supplementary information
Data Block 4	For designatory property
Data Block 5	For additional information

4.1.2 Designation may also include an optional data block mentioning the description, before data block 1.
Example — The designation consists of an optional description block, reading "Thermoplastics".

4.1.3 Each data block shall be separated by space or hyphen.

4.1.4 If a data block is not used, this shall be indicated by double comma (,,).

4.1.5 In case of data block 5, as it is for additional information, if no information is to be specified, double comma (,,) may or may not be used.

4.2 Designation System Codification

4.2.1 *Data Block* 1 — For Indian Standard.

4.2.2 *Data Block* 2 — Code used for the identification of Polymethyl methacrylate is PMMA in accordance with ISO 1043-1.

4.2.3 *Data Block* 3

4.2.3.1 Code used for the intended application and/or method of processing and important properties, additives and colour shall be as per Table 1. Information about intended application and/or method of processing is given in position 1 and information about important properties, additives and colour in positions 2 to 8.

4.2.3.2 If information is given for important properties, additives and colour and no specific information is available for intended application and/or method of processing, the code X shall be used in position 1.

4.2.3.3 If information about important properties, additives and colour in position 2 to 8 is not applicable, then the designation code is not required. In such case, designation code will be of single digit (Position 1) for data block 3.

Table 1 — Code-letters used in data block 2
(*Clause* 4.2.3)

Code-letter	**Position 1**	**Code-**	**Positions 2 to 8**
(1)	(2)	(3)	(4)
		A	Processing stabilized
		C	Coloured[2)]
D	Disc manufacture[1)]	D	Beads[3)]
E	Extrusion of tubes, profiles and	E	Expandable
F	Extrusion of films	F	Special burning
G	General use	G	Pellets, granules[3)]
H	Coating	H	Heat-ageing stabilized
L	Monofilament extrusion	L	Light and/or weather
M	Injection moulding		
		N	Natural (not coloured)
Q	Compression moulding		
R	Rotational moulding	R	Moulding release agent
S	Powder coating or sintering	S	Lubricated
		T	Controlled transparency
X	No indication		
		Z	Antistatic

NOTES :

1 Video disc manufacture.
2 C_1 = coloured but transparent. C_2 = coloured and non-transparent.
3 For the definition of beads, pellets and granules, *see* IS 2828.

4.2.4 *Data Block* 4

4.2.4.1 *General*

4.2.4.1.1 In this data block, the vicat softening temperature is represented by a three-figure code- number, the melt mass-flow rate by a three-figure code-number and the viscosity number by a two-figure code-number (optional).

4.2.4.1.2 If a property value falls on or near a range limit, the manufacturer shall state which range designates the material. If subsequent individual test values lie on, or either side of, the range limit because of manufacturing tolerances, the designation is not affected.

NOTE — Not all the combinations of values of the designatory properties are available with currently offered polymers.

4.2.4.2 *Vicat softening temperature*

The vicat softening temperature is classified by eight cells and coded by three figures as specified in Table 2. The vicat softening temperature shall be determined in accordance with IS XXXXX (Part 2) [PCD/12/19328].

Table 2 — Code-numbers used for Vicat softening temperature in data block 3
(*Clause* 4.2.4.2)

Code-number	**Range of VST (**°C)
(1)	(2)
076	≤ 80
084	> 80 to ≤ 88
092	> 88 to ≤ 96
100	> 96 to ≤ 104
108	> 104 to ≤ 112
116	> 112 to ≤ 120
124	> 120 to ≤ 128
132	> 128

4.2.4.3 *Melt flow rate*

The melt flow rate is classified by six cells and coded by three figures as specified in Table 3. The melt flow rate shall be determined in accordance with IS XXXXX (Part 2) [PCD/12/19328].

Table 3 — Code-numbers used for melt flow rate in data block 3
(*Clause* 4.2.4.3)

Code-	**Range of MFR (**g/10 min)
(1)	(2)
005	≤ 1
015	> 1 to ≤ 2
030	> 2 to ≤ 4
060	> 4 to ≤ 8
120	> 8 to ≤ 16
240	> 16

4.2.4.4 *Viscosity number (Optional)*

The viscosity number is classified by six cells and coded by two figures as specified in Table 4. Viscosity number shall be determined in accordance with IS XXXXX (Part 2) [PCD/12/19328].

Table 4 — Code-numbers used for viscosity number in data block 3
(*Clause* 4.2.4.4)

Code-	**Range of VN (**ml/g)
(1)	(2)
43	≤ 48
53	> 48 to ≤ 58
63	> 58 to ≤ 68
73	> 68 to ≤ 78

83	> 78 to ≤ 88
93	> 88

4.2.5 *Data Block* 5

The indication of additional requirements in this optional data block, in a way transforms a designation into a material's specification for a specific application. This can be accomplished by referring to a relevant Indian Standard.

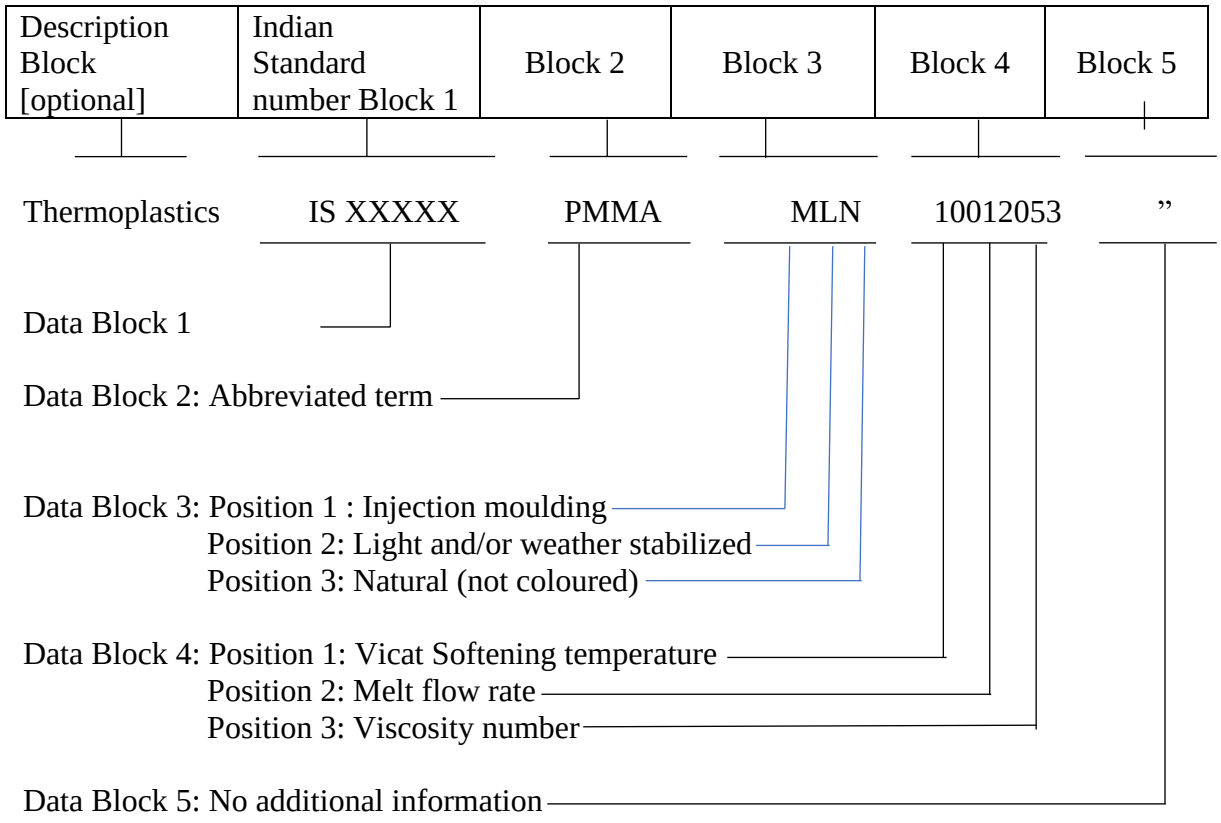
4.3 Coding Example

There will be no space or hyphen between two alphabets/number within a block except data block 1, but each data block will be mentioned and separated by a space or hyphen. Each data block is restricted with maximum number of letter/ numbers as mentioned below.

Data Block 1	IS XXXXX
Data Block 2	Maximum 4 character
Data Block 3	Maximum 8 character
Data Block 4	Maximum 8 character (3 characters for Vicat softening temperature, 3 characters for Melt flow rate and 2 characters for viscosity number)
Data Block 5	Maximum 8 character

5 EXAMPLES OF DESIGNATIONS

A PMMA intended for injection moulding material (M), light stabilized (L), natural (not coloured) (N), with a vicat softening temperature of 101 °C (100), a melt flow rate of 10 g/10 min (120) and a viscosity number of 50 ml/g (53), would be designated:



Designation: Thermoplastics IS XXXXX (Part 1)-PMMA-MLN-10012053-,, or

IS XXXXX (Part 1)-PMMA-MLN-10012053-,, or

IS XXXXX (Part 1)-PMMA-MLN-10012053

6 REQUIREMENTS

6.1 Vicat Softening Temperature

The vicat softening temperature of the material shall be designated as per table 2 when determined in accordance with IS XXXXX (Part 2) [PCD/12/19328].

6.2 Melt Flow Rate

The melt flow rate of the material shall be designated as per table 3 when determined in accordance with IS XXXXX (Part 2) [PCD/12/19328].

6.3 Viscosity Number

The viscosity number of the material shall be designated as per table 4 when determined in accordance with IS XXXXX (Part 2) [PCD/12/19328].

6.4 Special Requirements of Polymer Used for Molding or Extrusion Articles in Contact with Food Stuffs, Pharmaceutical and Drinking Water

6.4.1 When the products are used in contact with foodstuffs, pharmaceuticals and drinking water, its requirements with respect to the material shall also meet the following:

6.4.1.1 *Pigments and Colourants*

In case the coloured material is used for food-packaging applications it shall comply with the list and limits of the pigments and colourants prescribed in IS 9833.

6.4.1.2 *Overall Migration*

The material shall comply with the overall migration limits as detailed below when tested by the method prescribed in IS 9845.

a) 60 mg/kg, *Max* of the foodstuff; in the case of liquid foodstuffs or of simulants, the limit shall be 60 mg/l, *Max*. However, the value of the overall migration limit shall be equal to 10 mg/dm^2 of the surface of the material or article in the following cases:

   i) Containers or articles which are similar to containers or which in any case may be filled to a capacity less than 250 ml provided it is possible to calculate the surface area of contact with the foodstuff.

   ii) Sheets, foils and other non-fillable articles for which ratio between the surface area of the material or article and the quantity of foodstuffs, in contact may not be calculated.

6.4.1.3 *Storage and Control*

6.4.1.3.1 *Storage*

Plastics materials intended for food contact use shall be stored separately from materials in closed, properly identified containers.

6.4.1.3.2 *Control*

An authorized person shall supervise and control the issue of plastics materials to the process or manufacturing area and shall maintain appropriate records of the issue of such materials.

6.4.1.3.3 Adequate standards of hygiene (IS 2491) shall be maintained at all times and plant operators and store men shall be trained in proper hygiene practices.

6.4.2 The requirements mentioned in **6.4.1** shall remain valid as long as the chemical composition and manufacturing process remains the same. In case of any change in chemical composition and/or manufacturing processes, the requirements mentioned in **6.4.1** shall be tested.

7. PACKING AND MARKING

7.1 Packing

The material shall be packed in suitable form of packing, as agreed to between the purchaser and the supplier.

7.2 Marking

7.2.1 Each bag and/or unit package whichever is smallest in size that is being delivered to the customer shall be clearly marked with the following:

a) Name and type of the material;

b) Designation code;

c) Net mass of the material;

d) Batch number/ Lot number;

e) Month and year of manufacture of the material;

> NOTE — Batch number/ Lot number may reflect Month and Year of Manufacture of the material. If not, it has to be printed separately as mentioned in (e).

f) Name of the manufacturer and trademark, if any; and

g) Any other statutory requirements.

7.2.2 *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.

8 SAMPLING

8.1 GENERAL

In drawing, preparing, storing and handling samples, the precautions and directions given in **8.1.1** to **8.1.6** shall be observed.

8.1.1 Samples shall be collected in a closed environment.

8.1.2 The sampling instrument shall be of stainless steel or any other suitable material on which the material shall have no action. The instrument shall be clean and dry.

8.1.3 Precautions shall be taken to protect the samples, the materials being sampled, the sampling instrument and the containers for samples from adventitious contamination.

8.1.4 The samples shall be placed in a suitable clean, dry, air-tight, plastic/metal/glass container on which the material has no action. The sample container shall be of such a size that it is almost completely filled by the sample.

8.1.5 Each sample container shall be sealed air-tight with a stopper after filling and marked with full details of sampling, such as the date of sampling, the month and year of manufacture of the material, etc.

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

8.2 Scale of Sampling

8.2.1 *Lot/Batch*

8.2.1.1 For continuous chemical processes like polymer production, the sampling shall be done from sealed bags/packages or other representative sampling points after proper homogenization of the material.

8.2.1.2 To get the representative samples from the entire lot/batch, random sampling to be done from the entire lots / batches irrespective of the size of lot/batch. The number of sampling to be done as per Table 5 based on the quantity of the lot / batch.

Table 5 Number of Containers to be Selected for Sampling
(*Clause* 8.2.1)

Lot Size (MT) **(1)**	**Number of the Sealed Bag / Package for Sampling** **(2)**
Up to 600	3
> 600 to 1000	4
> 1000	5

8.2.1.3 Approximately 1 kg (or higher quantity required for testing) of sample collected from each of the above sealed bag into a clean plastic bag to have approximately 3 kg composite sample. Proper mixing to be done for homogenisation of composite sample before testing.

8.2.1.4 Based on the requirement of testing, the portion of the composite sample shall be stored properly in two containers as mentioned in **8.1.4**. Sample of the one container shall be used for testing in front of inspection authority at manufacturer site/laboratory. The other sample container shall be stored (maximum 6 months) and properly labelled as a reference sample for testing in future if it is required in case of any dispute or other requirement.

8.3 Sampling Instrument

8.3.1 The sampling instrument made of stainless steel shall be as shown in Fig. 1. It shall be capable of taking samples from all points when inserted into the container / bag. In case of multilayer film sack (FFS bag) sampling may be done by opening the bag and collect the sample.

8.3.2 From each of the containers / bags selected, portions of the material shall be drawn with the help of the sampling instrument. The total quantity of the material collected from each container/bag shall be sufficient to conduct tests for the determination of the various characteristics as required.

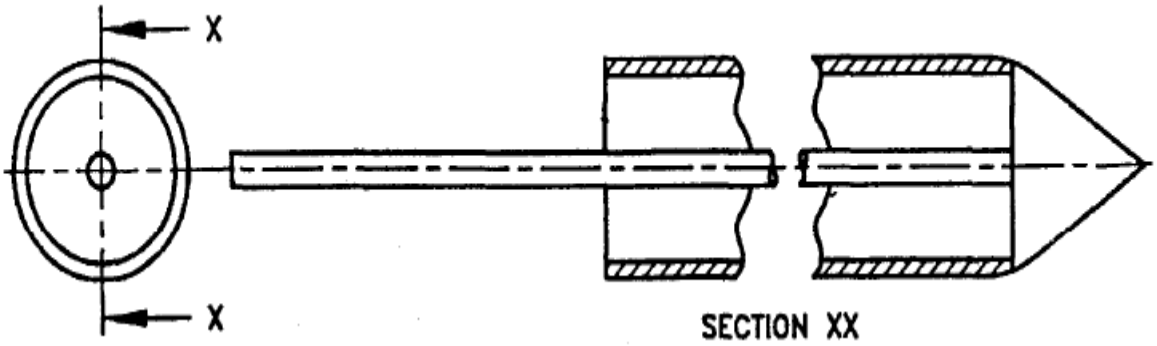


FIG. 1 SAMPLING INSTRUMENT

8.4 Number of Tests

8.4.1 Tests for the determination of vicat softening temperature, melt flow rate and viscosity number shall be conducted individually from a portion of composite samples, kept in the bottle/container.

8.5 Criteria for Conformity

a) Each of the test results for vicat softening temperature, melt flow rate and viscosity number (*optional*) shall satisfy the corresponding requirements given in **6.1, 6.2** and **6.3**.