Doc. No. PCD 27 (24011) WC
October 2023

**BUREAU OF INDIAN STANDARDS**
DRAFT FOR COMMENTS ONLY



*Draft Indian Standard*

# PLASTICS — METHODS OF TESTING
# PART 1 INTRODUCTION

(*First revision of* IS 13360 (Part 1))

(ICS 83.080.01)

Methods of Sampling and test for Plastics Sectional Committee, PCD 27

Last date for receipt of comment is **30 December 2023**

## FOREWORD

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

Number of standards in the area of plastics comprising raw materials and products have been published. The practice had been to include most of the test methods in the product standard itself. Consequently, a number of test methods like impact strength, cross-breaking strength, melt flow index, vicat softening point, etc, have been repeated in them. The committee, therefore, decided that an appropriate classified and unified series of Indian standards on these common test methods for plastics may be prepared and aligned as far as possible with Standards published by International Organization for Standardization (ISO).

This Indian Standard was originally published 1992. This revision has been undertaken to update this introductory standard in view of standards revised/new standards formulated under this series.

A realistic classification of test methods has been decided upon comprising of the following 11 parts:

Part 1 Introduction

Part 2 Sampling and preparation of test specimen

Part 3 Physical and dimensional properties

Part 4 Rheological properties

Part 5 Mechanical properties

Part 6 Thermal properties

Part 7 Electrical properties

Part 8 Permanence / Chemical properties

Part 9 Optical properties

Part 10 Resin properties (thermosets)

Part 11 Special properties

Total plan of streamlining test methods and standards is given in Annex A.

Test method standards for individual plastics like PVC, polyethylene, cellular materials, phenolic moulding materials, etc. would be retained as such. IS 13360 describes test methods currently used by the plastics industry for determining the quality of its products. It is intended that appropriate methods be specified in all Indian Standards for plastics materials and products. In many of the methods, the test procedures are identical with the standards published by International Organization for Standardization (ISO).

These methods have been published as dual-numbered standards. Where the methods are generally similar but not identical to the ISO method this has been mentioned in the foreword to the method.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision)'*.

## 1 SCOPE

This Indian Standard gives a general introduction to IS 13360, which describes a range of methods for testing plastics. It covers standard atmospheres for conditioning and testing plastics. The individual methods published/ being prepared are listed in Annex A.

## 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 No.* | *Title* |
|---|---|
| IS 196 : 1966 | Atmospheric conditions for testing (*revised*) |
| IS 1070 : 2023 | Reagent Grade Water — Specification (*fourth revision*) |
| IS 2828 : 2019 / ISO 472 : 2013 | Plastics — Vocabulary (*second revision*) |
| IS/ISO 80000 (all parts) | Quantities and units |

## 3 TERMINOLOGY

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

**3.2** It is the custom in the plastics industry to refer to the "property of moulding material" as "the property of a test moulding made from the moulding material".

## 4 CONTENTS AND USAGE OF IS 13360 (Part 1)

IS 13360 **(**Part 1) provides a rationalized collection of methods for testing plastics materials and includes tests that are applied to moulding and extrusion compounds, synthetic resins, reinforced plastics, semi-fabricated products such as sheet, film, rod and tube and finished articles in the form of moulding and extrusion. Many of the methods are restricted to one set of conditions and many of the methods are not suitable for cellular plastics. Where there is no material or product standard it is recommended that use be made, as far as practicable of the methods in IS 13360. For particular materials some variation in a method may be necessary and details of the variation are to be stated in the material or product standard where this exists. The variation should be referred to, or detailed, in the test report.

## 5 UNITS

**5.1** Numerical values in Indian Standard are normally expressed in units of International System of Units (SI) as described in IS/ISO 80000 (all parts).

## 6 APPARATUS AND REAGENTS

Wherever possible, apparatus used should comply with the requirements of the appropriate Indian Standard. Reagents should be of recognized analytical reagent quality unless otherwise stated and distilled or demineralized water should be used wherever water is specified (*see* IS 1070).

## 7 SAMPLING

Sampling procedure is normally specified in product standards and sampling should be carried out according to the method specified for that product.

## 8 NUMBER OF TEST PIECES

It is recognized that specifications for test programs may sometimes require use of different numbers of test pieces from those given in Indian Standard. For example, in production, a more informative and accurate result may be obtained if fewer test pieces are taken from one article. It should be noted, however, that in general, the use of fewer test pieces yields less reliable results.

## 9 PREPARATION OF TEST PIECES

Preparation of test pieces is often one of the most critical stages of the test procedure, and the specified conditions of preparation should be closely adhered to. In general, the procedure adopted enables a test piece representative of the material under test to be obtained with minimal effect on the properties of the material. Test piece preparation is normally referred to in each method described in IS 13360 (Part 2), in some instances by references to standards for the materials or products. IS 13360 (Part 2) describes general methods of preparation. It should be noted that where no Indian Standard exists, the procedure should be as agreed to between the purchaser and the supplier.

## 10 DIRECTION OF TESTING

The properties of certain types of sheet material may vary with direction in the plane of the sheet. In practice it is usual to cut two groups of test pieces with their major axes respectively parallel and perpendicular to the direction of some feature of the sheet that is either visible or inferred from a knowledge of the method of its manufacturer.

## 11 REPORT

**11.1** When referring to a test procedure, it is necessary to quote the full reference by giving the number of this Indian Standard, Part, Section and date.

**11.2** The test piece dimensions and test conditions specified in IS 13360 (Part 2) have often been adopted on an arbitrary basis and if they are not strictly observed, the test results are liable to be affected. If the dimensions of the test pieces or the test conditions be varied for any reason, it is essential to give details of the variation(s) in the test report.

## 12 STANDARD ATMOSPHERES FOR CONDITIONING AND TESTING

**12.1** The properties of plastics may alter considerably with changes in temperature and relative humidity. To improve the reproducibility of test results, it is usually necessary to condition test pieces before testing in addition to controlling the atmosphere during testing. As large a surface as possible of each test pieces should be exposed to the conditioning atmosphere.

### 12.2 Conditioning

**12.2.1** Where appropriate, the test method specifies the conditioning procedure. The standard atmospheres for conditioning and testing given in IS 196 are to be used, wherever possible.

**12.2.2** Standard atmospheres are to be used only when the properties of samples or test specimens are influenced by both temperature and humidity. If humidity has no influence on the properties being examined, the relative humidity may be uncontrolled. Similarly, if neither temperature nor humidity has any influence on the properties being examined, the temperature and relative humidity may be uncontrolled.

**12.2.3** The period of conditioning shall be stated in the relevant specification for the materials. When the periods are not stated in the appropriate standards, the following shall be adopted:

a) a minimum of 88 h for atmosphere 27/65 (27°C temperature, 65 percent relative humidity and 860 to 1 060 m bar pressure); (1 bar = $10^5$ Pa)
b) a minimum of 4 h for atmosphere 27 (27°C temperature and 860 to 1 060 m bar pressure) (1 bar = $10^5$ Pa)

**NOTE**: For particular tests and for plastics or test specimens that are known to reach temperature and humidity equilibrium either very rapidly or very slowly, a shorter or longer time for the conditioning period may be specified in the appropriate standards.

**12.3** Attainment of equilibrium moisture absorption by plastics in a conditioning atmosphere.

**12.3.1** The amount of moisture absorbed and its rate of absorption by a test specimen conditioned in a humid atmosphere vary significantly according to the nature of the plastic material being examined.

**12.3.2** The normal condition for conditioning stated in this standard (**12.1** and **12.2**) are generally satisfactory, with the following exceptions:

a) materials that are known to reach equilibrium with their conditioning atmosphere only after a long period of time (for example, certain polyamides); and

b) new materials or those of unknown structure, for which neither the capacity for absorbing moisture nor the time required for reaching equilibrium can be estimated beforehand.

**12.3.3** In the two latter cases one may either:

a) dry the material at a high temperature; or
b) condition the test specimen at 27 °C and 65 percent relative humidity until equilibrium is reached.

**NOTES:**

**1.** Procedure (a) has the disadvantage that certain property values, in particular mechanical ones are different in the dry state for those obtained after conditioning in the atmosphere 27/65.

**2.** In the case procedure (b), one of the following criteria may be suitable:

i) Constant mass is attained within 0.1 percent for two determinations made at an interval of $d^2$ weeks (d being the thickness in millimetres of the test specimen);
ii) For certain polymers it is sufficient to prepare a mass/time curve with intervals of time much less than $d^2$ weeks and to consider that a practical equilibrium is reached when the slope of the curve, expressed as a percentage is equal to 0.1.

**12.4 Testing**

Unless otherwise specified, the specimens shall be tested in the same atmosphere in which they have been conditioned. In all cases, the test shall be made immediately after the removal of the test specimens from the conditioning enclosure.

**ANNEX A**
**(***Clause* 1**)**
**SCHEME FOR STREAMLINING OF INDIAN STANDARDS ON METHODS OF TEST FOR PLASTICS**

**IS 13360 PLASTICS — METHODS OF TESTING**

**PART 1 INTRODUCTION**

**PART 2 SAMPLING AND PREPARATION OF TEST SPECIMENS**

| **Section** | **Subject** | **ISO/Overseas *Standard on the Subject to be Adopted for Revision / Streamlining*** |
|---|---|---|
| (1) | (2) | (3) |
| Sec 1 | Plastics — Compression moulding of test specimens of thermoplastics materials (*first revision*) | ISO 293 |
| Sec 2 | Compression moulding of test specimens of thermosetting materials (*first revision*) | ISO 295 |
| Sec 3 | Injection moulding of test specimens of thermoplastic materials — General principles and moulding of multipurpose and bar test specimens (*first revision*) | ISO 294-1 |
| Sec 4 | Preparation of test specimens by machining (*second revision*) | ISO 2818 |
| Sec 5 | Multipurpose test specimens (*second revision*) | ISO 3167 |
| Sec 7 | Injection moulding of test specimens of thermoplastic materials — Small plates (*third revision*) | ISO 294-3 |
| Sec 9 | Injection moulding of test specimens of thermoplastic materials — Small tensile bars (*first revision*) | ISO 294-2 |
| Sec 10 | Injection moulding of test specimens of thermosetting Powder Moulding Compounds (PMCs) — General principles and moulding of multipurpose test specimens | ISO 10724-1 |
| Sec 11 | Injection moulding of test specimens of thermosetting Powder Moulding Compounds (PMCs) — Small plates | ISO 10724-2 |

**PART 3 PHYSICAL AND DIMENSIONAL PROPERTIES**

| **Section** | **Subject** | **ISO/Overseas *Standard on the Subject to be Adopted for Revision / Streamlining*** |
|---|---|---|
| (1) | (2) | (3) |
| Sec 2 | Determination of apparent density of material that can be poured from a specified funnel | ISO 60 |
| Sec 3 | Determination of apparent density of moulding material that cannot be poured from a specified funnel | ISO 61 |
| Sec 4 | Determination of bulk factor of moulding materials | ISO 171 |
| Sec 5 | Thermosetting moulding materials — Determination of shrinkage (*first revision*) | ISO 2577 |
| Sec 6 | Film and sheeting — Determination of average thickness of a sample, and average thickness and yield of a roll by gravimetric techniques (gravimetric thickness) | ISO 4591 |
| Sec 7 | Liquid resins — Determination of density by the pyknometer method | ISO 1675 |

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| Sec 9 | Determination of moisture in plastics by Coulometric regeneration of phosphorus pentoxide | ASTM D 4019 |
| Sec 10 | Determination of density of non-cellular plastics — Immersion method, liquid pyknometer method and titration method (*first revision*) | ISO 1183-1 |
| Sec 11 | Determination of density of non-cellular plastics — Density gradient column method (*first revision*) | ISO 1183-2 |
| Sec 12 | Determination of density of non-cellular plastics — Gas pyknometer method | ISO 1183-3 |

**PART 4 RHEOLOGICAL PROPERTIES**

| **Section** | **Subject** | **ISO/Overseas *Standard on the Subject to be Adopted for Revision / Streamlining*** |
|---|---|---|
| (1) | (2) | (3) |
| Sec 1/ Subsec 1 | Determination of melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics, Subsection 1 Standard method (*first revision*) | ISO 1133-1 |
| Sec 1/ Subsec 2 | 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*) | ISO 1133-2 |
| Sec 2 | Cup flow of phenolic and alkyd moulding materials | BS 2782 : Part 7, Method 720B |
| Sec 3 | Determination of spiral flow of low-pressure thermosetting moulding compounds | ASTM D 3123 |
| Sec 4 | Determination of properties of polymeric materials by means of a capillary rheometer | ASTM D 3835 |
| Sec 5 | Determination of the fluidity of plastics using capillary and slit-die rheometers (*first revision*) | ISO 11443 |

**PART 5 MECHANICAL PROPERTIES**

| **Section** | **Subject** | **ISO/Overseas *Standard on the Subject to be Adopted for Revision / Streamlining*** |
|---|---|---|
| **(1)** | **(2)** | **(3)** |
| Sec 1 | Determination of tensile properties — General requirements (*second revision*) | ISO 527-1 |
| Sec 2 | Determination of tensile properties — Test conditions for moulding and extrusion plastics (*first revision*) | ISO 527-2 |
| Sec 3 | Determination of tensile properties — Test conditions for films and sheets (*second revision*) | ISO 527-3 |
| Sec 4 | Determination of izod impact strength (*second revision*) | ISO 180 |
| Sec 5 | Determination of charpy impact properties — Non-instrumented impact test (*first revision*) | ISO 179-1 |
| Sec 6 | Determination of impact resistance by the free-falling dart method – Staircase methods | ISO 7765-1 |
| Sec 7 | Determination of flexural properties (*second revision*) | ISO 178 |
| Sec 8 | Determination of compressive properties (*first revision*) | ISO 604 |
| Sec 10 | Determination of tear resistance of plastics films and sheeting — Trouser tear method (*first revision*) | ISO 6383-1 |

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|---|---|---|
| Sec 11 | Determination of indentation hardness by means of durometer (shore hardness) (*first revision*) | ISO 868 |
| Sec 12 | Determination of hardness — Ball indentation method (*first revision*) | ISO 2039-1 |
| Sec 13 | Determination of rockwell hardness | ISO 2039-2 |
| Sec 14 | Determination of indentation hardness of rigid plastic by means of barcol impresser | ASTM D2583 |
| Sec 19 | Determination of resistance of plastic materials to abrasion | ASTM D1242 |
| Sec 22 | Determination of resistance to wear by abrasive wheels (*first revision*) | ISO 9352 |
| Sec 23 | Determination of tear resistance of plastics film and sheeting – Elmendorf method | ISO 6383-2 |
| Sec 24 | Determination of impact resistance by the free-failing dart method – Instrumented puncture test | ISO 7765-2 |
| Sec 25 | Determination of tensile properties — Test conditions for isotropic and orthotropic fibre-reinforced plastic composites | ISO 527-4 |
| Sec 26 | Determination of tensile properties — Test conditions for unidirectional fibre-reinforced plastic composites (*first revision*) | ISO 527-5 |
| Sec 27 | Determination of tensile-impact strength | ISO 8256 |

**PART 6 THERMAL PROPERTIES**

| **Section** | **Subject** | **ISO/Overseas *Standard on the Subject to be Adopted for Revision / Streamlining*** |
|---|---|---|
| *(1)* | *(2)* | *(3)* |
| Sec 1 | Determination of vicat softening temperature of thermoplastic materials (*second revision*) | ISO 306 |
| Sec 3 | Determination of temperature of deflection under load — General test method (*third revision*) | ISO 75-1 |
| Sec 6 | Flammability by oxygen index ― General requirements (*second revision*) | ISO 4589-1 |
| Sec 9 | Determination of density of smoke from the burning or decomposition of plastics | ASTM D 2843 |
| Sec 10 | Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing — Microscope methods (*first revision*) | ISO 3146 |
| Sec 11 | Determination of the brittleness temperature by impact | ISO 974 |
| Sec 14 | Standard test method for coefficient of linear thermal expansion of plastics between –30°C and 30°C with a vitreous silica dilatometer | ASTM D 696 |
| Sec 17 | Determination of temperature of deflection under load — Plastics and ebonite (*second revision*) | ISO 75-2 |
| Sec 18 | Determination of temperature of deflection under load — High-strength thermosetting laminates and long-fibre-reinforced plastics (*first revision*) | ISO 75-3 |
| Sec 19 | Flammability by oxygen index ― Ambient temperature test (*first revision*) | ISO 4589-2 |
| Sec 20 | Flammability by oxygen index ― Elevated temperature test (*first revision*) | ISO 4589-3 |
| Sec 21 | Determination of ignition temperature using a hot-air furnace | ISO 871 |
| Sec 22 | Determination of time-temperature limits after prolonged exposure to heat | ISO 2578 |
| Sec 23 | Determination of burning behaviour of thin flexible vertical specimens in contact with small-flame ignition source | ISO 9773 |

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|---|---|---|
| Sec 24 | Cellular plastics — Determination of horizontal burning characteristics of small specimens subjected to a small flame of cellular plastic | ISO 9772 |

**PART 7 ELECTRICAL PROPERTIES**

| **Section** | **Subject** | **ISO/Overseas *Standard on the Subject to be Adopted for Revision / Streamlining*** |
|---|---|---|
| (1) | (2) | (3) |
| Sec 1 | Measurement of resistivity of conductive plastics | ISO 3915 |

**PART 8 PERMANENCE/CHEMICAL PROPERTIES**

| **Section** | **Subject** | **ISO/Overseas *Standard on the Subject to be Adopted for Revision / Streamlining*** |
|---|---|---|
| *(1)* | *(2)* | *(3)* |
| Sec 1 | Determination of water absorption (*first revision*) | ISO 62 |
| Sec 3 | Determination of the effects of the immersion in liquid chemicals (*first revision*) | ISO 175 |
| Sec 4 | Determination of loss of plasticizers — Activated carbon method (*first revision*) | ISO 176 |
| Sec 5 | Determination of migration of plasticizers (*first revision*) | ISO 177 |
| Sec 6 | Determination of the gas transmission rate of films and thin sheets under atmospheric pressure — Manometric method | ISO 2556 |
| Sec 8 | Determination of ash — General methods (*second revision*) | ISO 3451-1 |
| Sec 9 | Determination of resistance to environmental stress cracking (ESC) — Bent strip method (*first revision*) | ISO 22088-3 |
| Sec 11 | Determination of environmental stress cracking (ESC) — Constant-tensile load method (*first revision*) | ISO 22088-2 |
| Sec 13 | Determination of changes in colour and variations in properties after exposure to glass-filtered solar radiation, natural weathering or laboratory radiation sources (*second revision*) | ISO 4582 |
| Sec 14 | Determination of the effects of exposure to damp heat, water spray and salt mist (*first revision*) | ISO 4611 |

**PART 9 OPTICAL PROPERTIES**

| **Section** | **Subject** | **ISO/Overseas *Standard on the Subject to be Adopted for Revision / Streamlining*** |
|---|---|---|
| (1) | (2) | (3) |
| Sec 1 | Determination of refractive index | ISO 489 |
| Sec 5 | Determination of haze and luminous transmittance of transparent plastics | ASTM D 1003 |
| Sec 7 | Determination of specular gloss of plastic films and solid plastics | ASTM D2457 |
| Sec 8 | Determination of transparency of plastic sheeting | ASTM D1746 |
| Sec 9 | Optical properties section 9 determination of yellow index of plastics | ASTM D1925 |
| Sec 10 | Qualitative evaluation of the bleeding of colorants | ISO 183 |

**PART 10 RESIN (THERMOSETTING PROPERTIES)**

| Section | Subject | ISO/Overseas *Standard on the Subject to be Adopted for Revision / Streamlining* |
|---|---|---|
| (1) | (2) | (3) |
| Sec 4 | Determination of gel time and peak exothermic temperature of reacting thermosetting resins | ASTM D2471 |
| Sec 5 | Phenol-formaldehyde mouldings — Determination of free phenols — Iodometric method | ISO 119 |
| Sec 6 | Phenol-formaldehyde mouldings — Determination of free ammonia and ammonium compounds — Colorimetric comparison method | ISO 120 |
| Sec 7 | Phenol-formaldehyde mouldings — Determination of acetone-soluble matter (apparent resin content of material in the unmoulded state) | ISO 308 |

**PART 11 SPECIAL PROPERTIES**

| Section | Subject | ISO/Overseas Standard on the Subject to be Adopted for Revision / Streamlining |
|---|---|---|
| (1) | (2) | (3) |
| Sec 1 | Film and sheeting — Determination of coefficients of friction | ISO 8295 |
| Sec 3 | Film and sheeting — Determination of blocking resistance (*first revision*) | ISO 11502 |
| Sec 4 | Determination of gel count of plastics film | ASTM D3351 |
| Sec 5 | Determination of white point temperature and minimum film-forming temperature | ISO 2115 |
| Sec 7 | Determination of matter extractable by organic solvents (conventional method) (*first revision*) | ISO 6427 |
| Sec 9 | Determination of the viscosity of polymers in dilute solution using capillary viscometers — General principles (*first revision*) | ISO 1628-1 |
| Sec 10 | Resins in the liquid state or as emulsions or dispersions — Determination of apparent viscosity using a singular cylinder type rotational viscometer method (*first revision*) | ISO 2555 |
| Sec 11 | Polymers/resins in the liquid state or as emulsions or dispersions — Determination of viscosity using a rotational viscometer with defined shear rate | ISO 3219 |
| Sec 13 | Film and sheeting — Determination of cold-crack temperature | ISO 8570 |
| See 14 | Film and sheeting — Determination of dimensional change on heating | ISO 11501 |
| Sec 15 | Determination of viscosity using a falling-ball viscometer — Inclined-tube method (*first revision*) | ISO 12058-1 |