*भारतीय मानक*

***Indian Standard***

**IS 16460 : 2023**
**ISO 17555 : 2021**

# प्लास्टिक — फिल्म और चादर — द्विअक्षीय विकसित पॉलीप्रोपाइलीन (पीपी) फिल्म

*( पहला पुनरीक्षण )*

# Plastics — Film and Sheeting — Biaxially Oriented Polypropylene (PP) Films

*( First Revision )*

ICS 83.140.10



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NATIONAL FOREWORD

This Indian Standard (First Revision) which is identical with ISO 17555 : 2021 'Plastics — Film and sheeting — Biaxially oriented polypropylene (PP) films' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Plastics Sectional Committee and approval of the Petroleum, Coal and Related Products Division Council.

This standard was originally published in 2016 which was identical with ISO 17555 : 2003. This revision has been undertaken to align it with latest version of ISO 17555 : 2021.

The major changes in this revision are as follows:

a) The normative references have been updated;
b) The gloss and thickness measurement methods have been added;
c) International Standards for measuring water vapour transmission have been added.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'; and

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standard for which Indian Standard also exist. The corresponding Indian Standard, which is to be substituted in their respective places, is listed below along with their degree of equivalence for the editions indicated:

| *International Standard* | *Corresponding Indian Standard* | *Degree of Equivalence* |
|---|---|---|
| ISO 291 : 2008 Plastics — Standard atmospheres for conditioning and testing | IS 196 : 1966 Atmospheric conditions for testing (*revised*) | Not Equivalent |
| ISO 527-3 : 2018 Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets | IS 13360 (Part 5/Sec 3) : 2022/ ISO 527- 3 : 2018 Plastics — Methods of testing: Part 5 Mechanical properties, Section 3 Determination of tensile properties — Test conditions for films and sheets (*second revision*) | Identical |
| ISO 14782 : 2021 Plastics — Determination of haze for transparent materials | IS 13360 (Part 9/Sec 5) : 1999 Plastics — Methods of testing: Part 9 Optical properties, Section 5 Determination of haze and luminous transmittance of transparent plastics | Not Equivalent |

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*Indian Standard*

# PLASTICS — FILM AND SHEETING — BIAXIALLY ORIENTED POLYPROPYLENE (PP) FILMS

## 1 Scope

This document specifies the requirements for biaxially oriented polypropylene (PP) films, which are mainly used for packaging. The film can be used alone or in laminates with other films.

This document applies only to films composed of more than 95 % (by mass) of polypropylene.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 527-3, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets*

ISO 2813, *Paints and varnishes — Determination of gloss value at 20°, 60° and 85°*

ISO 8296, *Plastics — Film and sheeting — Determination of wetting tension*

ISO 14782, *Plastics — Determination of haze for transparent materials*

ISO 15106-1, *Plastics — Film and sheeting — Determination of water vapour transmission rate — Part 1: Humidity detection sensor method*

ISO 15106-2, *Plastics — Film and sheeting — Determination of water vapour transmission rate — Part 2: Infrared detection sensor method*

ISO 15106-3, *Plastics — Film and sheeting — Determination of water vapour transmission rate — Part 3: Electrolytic detection sensor method*

ISO 15106-4, *Plastics — Film and sheeting — Determination of water vapour transmission rate — Part 4: Gas-chromatographic detection sensor method*

ISO 15106-5, *Plastics — Film and sheeting — Determination of water vapour transmission rate — Part 5: Pressure sensor method*

ISO 15106-6, *Plastics — Film and sheeting — Determination of water vapour transmission rate — Part 6: Atmospheric pressure ionization mass spectrometer method*

ISO 15106-7, *Plastics — Film and sheeting — Determination of water vapour transmission rate — Part 7: Calcium corrosion method*

## 3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

# 4 Classification

Films are classified into two types as shown in Table 1.

**Table 1 — Classification of films**

| | |
|---|---|
| Type 1 | Film subjected to corona discharge, flame or plasma treatment |
| Type 2 | Film not subjected to corona discharge, flame or plasma treatment |

# 5 Requirements

## 5.1 Appearance

Films shall be visibly free of flaws, slackness, wrinkles, stains, foreign matter or marks which can impair their serviceability as agreed upon by interested parties.

The splicing of two films in a roll should preferably be prominently marked to provide a visible indication when the roll is viewed from the end. The method of marking the splice should be agreed upon between the interested parties. Gloss measurement for film for end-use application point of view shall be performed in accordance with ISO 2813.

NOTE One acceptable method of doing this is to use coloured adhesive tape.

## 5.2 Dimensions

### 5.2.1 General

For any individual film selected at random from any delivery, the following dimensions, including their nominal values, shall be as agreed upon between the interested parties.

### 5.2.2 Width

The film width shall lie between the nominal width and a value 4 mm wider than the nominal width. Examples of possible widths are shown in Table 2.

**Table 2 — Examples of nominal widths of films and associated tolerances**

| **Nominal width**<br>mm | **Tolerance on width**<br>mm |
|---|---|
| 500 + 40*n* | +4<br>0 |
| NOTE *n* is an integer, 0, 1, 2, ..., giving width steps of 40 mm. | |

### 5.2.3 Length of film in roll

The length of film in a roll shall lie between the nominal length and a value 1 % longer than the nominal length. Examples of possible lengths are shown in Table 3.

**Table 3 — Examples of nominal lengths of film in a roll and associated tolerances**

| **Nominal length**<br>m | **Length in roll**<br>km | **Tolerance**<br>m |
|---|---|---|
| 1 000 | 1 | +10 |

**Table 3** *(continued)*

| Nominal length<br>m | Length in roll<br>km | Tolerance<br>m |
|---|---|---|
| 2 000 | 2 | +20 |
| 4 000 | 4 | +40 |
| 6 000 | 6 | +60 |
| 8 000 | 8 | +80 |
| >8 000 | >8 | +1 % of nominal length |

### 5.2.4 Inside diameter of core of roll

The inside diameter of the core of the roll should preferably be $76_{0}^{+2}$ mm or $152_{0}^{+2}$ mm.

### 5.2.5 Thickness

The average film thickness shall be within ±10 % of the nominal value. Examples of possible thicknesses are shown in Table 4.

**Table 4 — Examples of thicknesses and associated tolerances**

| Nominal thickness<br>µm | Thickness of film<br>µm | Tolerance<br>µm |
|---|---|---|
| 12 | 12 | ±1,2 |
| 15 | 15 | ±1,5 |
| 20 | 20 | ±2,0 |
| 25 | 25 | ±2,5 |
| 30 | 30 | ±3 |
| 40 | 40 | ±4 |
| 50 | 50 | ±5 |
| 60 | 60 | ±6 |

## 5.3 Properties

The properties of films shall meet the requirements specified in Table 5 and Table 6.

**Table 5 — Properties of film dependent on direction**

| Property | | Unit | Requirements | | Testing in accordance with subclause |
|---|---|---|---|---|---|
| | | | Longitudinal[a] | Transverse[b] | |
| Tensile strength at break | | MPa | ≥100 | ≥100 | 6.4 |
| Tensile strain at break | | % | ≤270 | ≤150 | 6.4 |
| Dimensional change on heating | 120 °C for 15 min | % | ≤10,0 | ≤8,0 | 6.5 |
| | 130 °C for 5 min | % | ≤10,0 | ≤8,0 | 6.5 |
| Coefficient of water vapour transmission[c] | | g/100 µm/(m²·d) | ≤2,0 | | 6.6 |

[a] Longitudinal: direction parallel to extrusion direction.

[b] Transverse: direction perpendicular to extrusion direction.

[c] At 40 °C, 90 % relative humidity.

**Table 6 — Properties of film dependent on type of film**

| Property | Unit | Requirements | | Testing in accordance with subclause |
|---|---|---|---|---|
| | | Type 1 | Type 2 | |
| Haze[a] | % | ≤5,0 | ≤4,0 | 6.7 |
| Wetting tension | mN/m | ≥36 | <35 | 6.8 |
| [a] Only relevant to transparent films. | | | | |

### 5.4 Physiological behaviour

For applications involving food contact, it is presupposed that all applicable regulatory requirements are followed.

## 6 Test methods

### 6.1 Conditioning of specimens and test conditions

Determine the tensile properties, haze and wetting tension at (23 ± 2) °C and (50 ± 5) % R.H., after conditioning the specimens for at least 4 h under the same conditions. Condition specimens for the determination of dimensional change on heating under the same conditions.

### 6.2 Appearance examination

Check the appearance of the film with the naked eye. Gloss measurement according to ISO 2813 using the three geometries of 20°, 60° or 85° shall be performed for film for end-use application point of view.

### 6.3 Dimensions

#### 6.3.1 Width

Measure the width of the film using a graduated metal ruler.

#### 6.3.2 Inside diameter of core of roll

Measure the inside diameter of the core of a roll using vernier calipers.

#### 6.3.3 Thickness

Thickness of film is an important parameter to ensure better quality. Thickness of the film shall be measured in accordance with ISO 4593, using a dial gauge or equivalent, at points equally spaced along the length of the film specimen as follows:

a) For samples less than 300 mm wide – 10 points;

b) Between 300 mm wide and 1 500 mm wide – 20 points;

c) More than 1 500 wide – 30 points.

The arithmetic mean of the individual measurements to the nearest 1 pm or 0,001 mm is reported as the average mechanically measured thickness of the film.

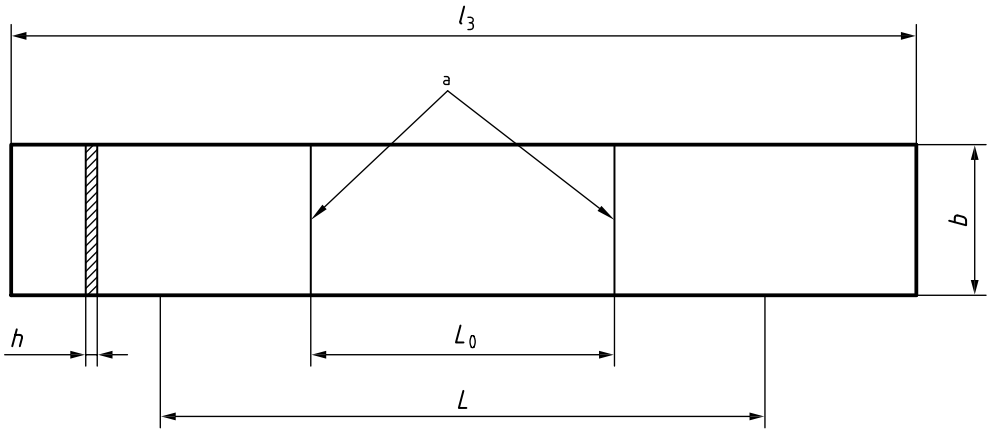
### 6.4 Tensile strength and tensile strain at break

Determine the tensile strength and tensile strain at break in accordance with ISO 527-3. Test five specimens of dimensions as shown in Figure 1. The test speed shall be (100 ± 10) mm/min, (200 ± 20) mm/min or (300 ± 30) mm/min as agreed upon by interested parties.

## 6.5 Dimensional change on heating

### 6.5.1 Preparation of specimens

Prepare five specimens of 20 mm in width and 150 mm in length for both the longitudinal direction and the transverse direction. Mark off a 100 mm gauge length in the central portion of the specimen, each mark being approximately 25 mm from the end.




**Key**

$b$ width: 10 mm to 25 mm

$h$ thickness: ≤ 1 mm

$L_0$ gauge length: (50 ± 0,5) mm

$L$ initial distance between grips: (100 ± 5) mm

$l_3$ overall length: ≥ 150 mm

[a] Gauge marks.

**Figure 1 — Specimen for tensile testing**

### 6.5.2 Procedure

Suspend the specimens vertically in a circulating-air oven kept at (120 ± 3) °C for 15 min or (130 ± 3) °C for 5 min. After removal from the oven, allow the specimens to cool for 30 min to room temperature. Measure the length between the marks. Calculate the dimensional change of each of the five specimens using Formula (1):

$$S = \frac{L_1 - L_2}{L_1} \times 100 \quad (1)$$

where

$S$ is the dimensional change on heating, in percent;

$L_1$ is the length between the marks before heating, in millimetres;

$L_2$ is the length between the marks after heating, in millimetres.

Report the arithmetic mean of the five results.

### 6.6 Coefficient of water vapour transmission

Determine the water vapour transmission rate in accordance with ISO 15106-1, ISO 15106-2, ISO 15106-3, ISO 15106-4, ISO 15106-5, ISO 15106-6 or ISO 15106-7. From the result, calculate the coefficient of water vapour transmission, expressed per 100 µm of thickness, using Formula (2):

$$P_{WV} = T_{R(WV)} \times \frac{h}{100} \quad (2)$$

where

$P_{WV}$ is the coefficient of water vapour transmission, in grams per 100 µm thickness per square metre day [g/100 µm/(m$^2$·d)];

$T_{R(WV)}$ is the water vapour transmission rate, in grams per square metre day [g/(m$^2$·d)];

$h$ is the thickness of the specimen, in micrometres.

### 6.7 Haze

Determine the haze in accordance with ISO 14782.

### 6.8 Wetting tension

Determine the wetting tension in accordance with ISO 8296.

## 7 Packaging

The packaging and the size of the unit package shall be as agreed between the interested parties, taking into account the conditions of transportation and storage.

## 8 Marking

### 8.1 Marking on products

If applicable, the fact that the surface of the film has been subjected to corona discharge, flame or plasma treatment shall be clearly indicated.

### 8.2 Marking on packaging

The following shall be marked on the package:

a) the name of the product;

b) the classification, i.e. whether the film has been treated or not (see Table 1);

c) the nominal thickness, width and length of the film in the roll;

d) the year and month of manufacture;

e) the manufacturer's name or trademark.

# Bibliography

[1] ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

[2] ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method*

[3] ISO 1183-2, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method*

[4] ISO 2286-2, *Rubber- or plastics-coated fabrics — Determination of roll characteristics — Part 2: Methods for determination of total mass per unit area, mass per unit area of coating and mass per unit area of substrate*

[5] ISO 4593, *Plastics — Film and sheeting — Determination of thickness by mechanical scanning*

[6] ISO 6383-1, *Plastics — Film and sheeting — Determination of tear resistance — Part 1: Trouser tear method*

[7] ISO 6383-2, *Plastics — Film and sheeting — Determination of tear resistance — Part 2: Elmendorf method*

[8] ISO 7765-2, *Plastics film and sheeting — Determination of impact resistance by the free-falling dart method — Part 2: Instrumented puncture test*

[9] ISO 8295, *Plastics — Film and sheeting — Determination of the coefficients of friction*

[10] ISO 11502, *Plastics — Film and sheeting — Determination of blocking resistance*

## National Annex A
(*National Foreword*)

### A-1 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.

(*Continued from second cover*)

The technical committee has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

| *International Standard* | *Title* |
|---|---|
| ISO 4593 : 1993 | Plastics — Film and sheeting — Determination of thickness by mechanical scanning |
| ISO 8296 : 2003 | Plastics — Film and sheeting — Determination of wetting tension |
| ISO 15106 - 1 : 2003 | Plastics — Film and sheeting — Determination of water vapour transmission rate — Part 1: Humidity detection sensor method |
| ISO 15106 – 2 : 2003 | Plastics – Film and sheeting — Determination of water vapour transmission rate — Part 2: Infrared detection sensor method |
| ISO 15106 – 3 : 2003 | Plastics — Film and sheeting — Determination of water vapour transmission rate — Part 3: Electrolytic detection sensor method |

The standard also makes a reference to the BIS Certification Marking of the product, details of which are given in National Annex A.

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.

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**Review of Indian Standards**

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.

This Indian Standard has been developed from Doc No.:PCD 12 (19874).

## Amendments Issued Since Publication

| Amend No. | Date of Issue | Text Affected |
|---|---|---|
| | | |
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