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Plastics — Film and sheeting — Biaxially oriented polypropylene (PP) films

Plastiques — Film et feuille — Films en polypropylène (PP) bi-orientés

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This second edition cancels and replaces the first edition (ISO 17555:2003), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the normative references have been updated;

— the gloss and thickness measurement methods have been added;

— further International Standards for measuring water vapour transmission have been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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 mm	Tolerance on width mm
500 + 40*n*	+4 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 m	Length in roll km	Tolerance m
1 000	1	+10

Table 3 *(continued)*

Nominal length m	Length in roll km	Tolerance 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 µm	Thickness of film µm	Tolerance 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.

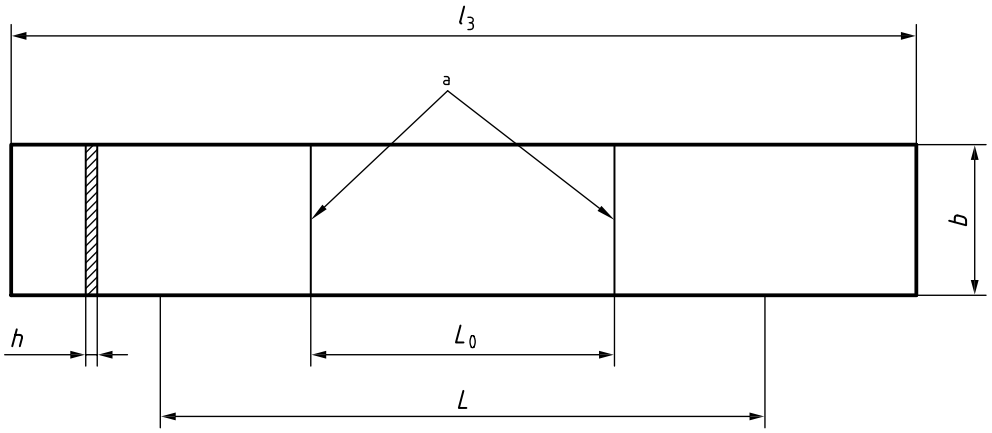
6.4 Tensile strength and tensile strain at break

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):

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

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.