INTERNATIONAL STANDARD

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Plastics — Film and sheeting — Biaxially oriented poly(ethylene terephthalate) (PET) films

Plastiques — Film et feuille — Films en poly(éthylène téréphtalate) (PET) bi-orientés

Reference number
ISO 15988:2003(E)

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 15988 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

Plastics — Film and sheeting — Biaxially oriented poly(ethylene terephthalate) (PET) films

1 Scope

This International Standard specifies biaxially oriented transparent polyethylene terephthalate (PET) films, mainly used for packaging.

NOTE Biaxially oriented transparent PET films are used alone and/or as laminated film with other films.

2 Normative references

The following referenced documents are indispensable for the application 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 291:1997, *Plastics — Standard atmospheres for conditioning and testing*

ISO 527-3:1995, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets*

ISO 4593:1993, *Plastics — Film and sheeting — Determination of thickness by mechanical scanning*

ISO 8296:1987, *Plastics — Film and sheeting — Determination of wetting tension*

ISO 14782:1999, *Plastics — Determination of haze for transparent materials*

ISO 15105-1:2002, *Plastics — Film and sheeting — Determination of gas-transmission rate — Part 1: Differential-pressure method*

ISO 15105-2:2003, *Plastics — Film and sheeting — Determination of gas-transmission rate — Part 2: Equal-pressure method*

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*

3 Classification

Films are classified into two groups as follows.

1) Film treated with corona discharge.

2) Film not treated with corona discharge.

4 Requirements

4.1 Appearance

The films shall be visibly free of flaws, slackness, wrinkles, stains, foreign matter or any marks that impair its serviceability.

The splicing of two films in a roll shall be prominently marked in order to provide a visible indication from the side of the roll. The interested parties shall agree upon the method of marking the splice.

NOTE One acceptable method of marking is the use of coloured adhesive tape.

4.2 Dimensions

4.2.1 General

For any individual film selected at random from any delivery, the dimensions listed in 4.2.2 to 4.2.5, including their nominal values, shall be agreed upon among interested parties.

4.2.2 Width

The tolerance of width of the films shall be within $^{+4}_{0}$ mm.

An example of film width with corresponding tolerance is given in Table 1.

Table 1 — Example of a film width and its tolerance

Width mm	Tolerance of width mm
$500 + 40\,n$	$^{+4}_{0}$
NOTE n: integer, 0, 1, 2, ..., in width steps of 40 mm.	

4.2.3 Length of film in a roll

The tolerance of film length in a roll shall be within $^{+1}_{0}$ % of the nominal value.

Examples of film length and corresponding tolerances in a roll are shown in Table 2.

Table 2 — Examples of film length in a roll and their tolerances

Length of film		Tolerance of length of film
Nominal length m	Length in a roll km	m
4 000	4	$^{+40}_{0}$
6 000	6	$^{+60}_{0}$
8 000	8	$^{+80}_{0}$
$>$ 8 000	$>$ 8	1 % of nominal length

4.2.4 Inside diameter of core of a roll

The inside diameter tolerance of a core of a roll shall be within $^{+2}_{0}$ mm of the nominal value.

Examples of inside diameter of core in a roll, and corresponding tolerance are given in Table 3.

Table 3 — Examples of inside diameter of a core in a roll and their tolerances

Inside diameter of core mm	Tolerance on inside diameter of core mm
76	$^{+2}_{0}$
152	$^{+2}_{0}$

4.2.5 Thickness

The thickness tolerance shall be within ± 10 % of the nominal value.

Examples of thicknesses and corresponding tolerances are given in Table 4.

Table 4 — Examples of thickness and their tolerances

Thickness		Tolerance
Nominal thickness No.	Thickness μm	 μm
12	12	± 1,2
16	16	± 1,6
25	25	± 2,5

4.3 Physical properties

Films shall meet the requirements of physical properties listed in Table 5.

Table 5 — Properties of film

Properties	Unit	Test method	Requirements		Testing in accordance with subclause
			Longitudinal[a]	Transverse[b]	
Tensile strength at break	MPa	ISO 527-3	⩾ 150	⩾ 150	5.4
Tensile strain at break	%	ISO 527-3	⩽ 200	⩽ 200	5.4
Dimensional change on heating	%	—	⩽ 3,0	⩽ 3,0	5.5
Coefficient of oxygen transmission[c]	fmol · 100 μm/ $\left(m^2 \cdot s \cdot Pa\right)$	ISO 15105-1 or ISO 15105-2	⩽ 140		5.6
Coefficient of water vapour transmission[d]	g/100 μm/ $\left(m^2 \cdot 24h\right)$	ISO 15106-1, ISO 15106-2 or ISO 15106-3	⩽ 10		5.7
Haze	%	ISO 14782	⩽ 8,0		5.8
Wetting tension[e]	mN/m	ISO 8296	⩾ 40		5.9

[a] Longitudinal: direction parallel to extrusion or “machine direction”.

[b] Transverse: direction perpendicular to extrusion.

[c] 23 °C, 0 % relative humidity.

[d] 40 °C, 90 % relative humidity.

[e] The wetting tension shall only apply to films treated with corona discharge

4.4 Physiological behaviour

For applications involving food contact, the film shall conform to all applicable regulatory requirements.

5 Test methods

5.1 Conditioning and testing of specimens

Testing of tensile properties, haze and wetting tension shall be carried out in a standard atmosphere of (23 ± 2) °C, (50 ± 5) % in accordance with ISO 291, after conditioning the specimens for at least 8 h under the same conditions. Specimens for the testing of dimensional change on heating shall also be conditioned under these conditions.

5.2 Visual examination

The appearance of the film shall be checked with the naked eye.

5.3 Dimensions

5.3.1 Width

The width of film shall be measured using a calibrated metal rule.

5.3.2 Inside diameter of core of roll

The Inside diameter of the core of a roll shall be measured using a vernier calliper.

5.3.3 Thickness

The average thickness of films shall be measured to the nearest 1 μm using a dial gauge or equivalent in accordance with ISO 4593. Five piles of films shall be used for thicknesses over 16 μm and ten piles of films shall be used for film thicknesses not more than 16 μm The thickness of films shall be measured at ten equidistant points across the film width. The thickness shall be reported as the arithmetic average of these measurements.

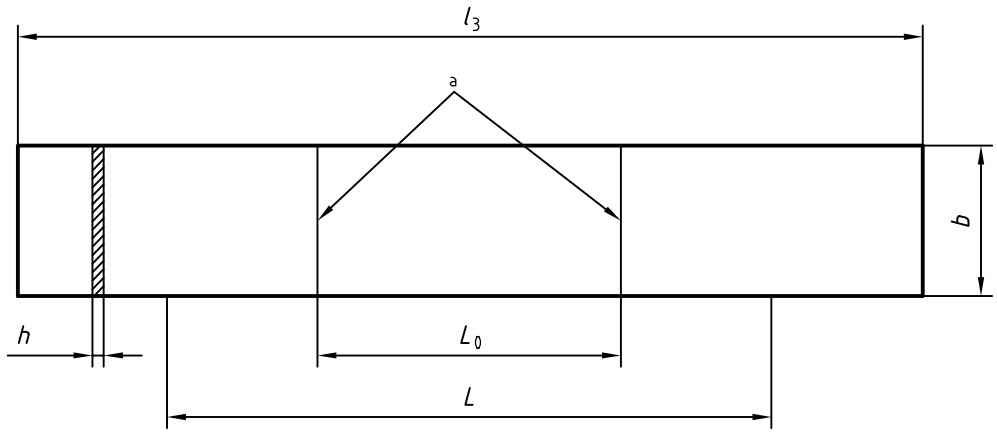
5.4 Tensile strength and tensile strain at break

Tensile strength and tensile strain at break shall be determined by tensile testing at least five specimens in accordance with ISO 527-3. The specimen dimensions are shown in Figure 1. The test speed shall be (200 ± 20) mm/min.

5.5 Dimensional change on heating

5.5.1 Preparation of specimen

Prepare 5 specimens, 20 mm in width and approximately 150 mm in length for both the longitudinal direction and the transverse direction. Mark off a 100 mm gauge length centred in the specimen (each mark approximately 25 mm from the end).



b Width: 10 mm to 25 mm

h Thickness: $\leqslant$ 1 mm

L_0 Gauge length: 50 mm $\pm$ 0,5 mm

L Initial distance between grips: 100 mm $\pm$ 5 mm

l_3 Overall length: $\geqslant$ 150 mm

[a] Gauge marks

Figure 1 — Tensile test specimen

5.5.2 Procedure

Suspend the specimens vertically in a circulating air oven which is kept at (150 ± 3) °C for 30 min. After removal from the oven, allow them to cool for 30 min to room temperature. Measure the length between marks. Calculate an arithmetic mean of 5 specimens using the following equation:

$$S = \frac{L_1 - L_2}{L_1} \times 100$$

where

S is the numerical value of the dimensional change on heating, expressed as a percentage;

L_1 is the numerical value of the length between marks before heating, expressed in millimetres;

L_2 is the numerical value of the length between marks after heating, expressed in millimetres.

5.6 Coefficient of oxygen transmission

The coefficient of oxygen transmission shall be determined in accordance with ISO 15105-1 or ISO 15105-2. The result is calculated by the following equation expressed per 100 μm thickness:

$$P\mathrm{O}_2 = \mathrm{O}_2\mathrm{GTR} \times (d/0{,}1)$$

where

$P\mathrm{O}_2$ is the numerical value of the coefficient of oxygen transmission, expressed in fmol 100 μm per square metre second pascal;

O_2GTR is the numerical value of the transmission rate of oxygen, expressed in fmol per square metre second pascal;

d is the numerical value of the thickness of specimen, expressed in millimetres.

5.7 Coefficient of water vapour transmission

The coefficient of water vapour transmission shall be determined based on the transmission rate of water vapour in accordance with ISO 15106-1, ISO 15106-2 or ISO 15105-2. The result is calculated using the following equation expressed per 100 μm thickness:

$$P\text{WV} = \text{WVTR} \times (d/0{,}1)$$

where

PWV is the numerical value of the coefficient of water vapour transmission, expressed in grams per 100 μm per square metre day;

WVTR is the numerical value of the transmission rate of water vapour, expressed in grams per square metre day;

d is the numerical value of thickness of specimen, expressed in millimetres.

5.8 Haze

Haze shall be determined in accordance with ISO 14782.

5.9 Wetting tension

Wetting tension shall be determined in accordance with ISO 8296.

6 Packaging

Packaging and size of unit packaging shall be agreed upon between interested parties taking into account conditions of transportation and storage.

7 Marking

7.1 Marking on products

If applicable, the surface of the film with corona discharge shall be clearly identified.

7.2 Marking on packaging

The following shall be clearly marked on the package:

a) name of products or symbol: PET;

b) classification of film, whether treated with corona discharge or not;

c) nominal thickness, width and length of a roll;

d) year and month of manufacture;

e) name of manufacturer or symbol.

ICS 83.140.10

Price based on 6 pages