International Standard

ISO 4591

Plastics — Film and sheeting — Determination of average thickness of a sample and average thickness and yield of a roll, by gravimetric techniques (gravimetric thickness)

Plastiques — Film et feuille — Détermination de l'épaisseur moyenne d'un échantillon, et de l'épaisseur moyenne d'un rouleau, ainsi que de sa surface par unité de masse, par mesures gravimétriques (épaisseur gravimétrique)

First edition — 1979-10-15

ISO 4591-1979 (E)

Price based on 3 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4591 was developed by Technical Committee ISO/TC 61, *Plastics*, and was circulated to the member bodies in May 1977.

It has been approved by the member bodies of the following countries :

Australia	Hungary	Poland
Austria	India	Portugal
Belgium	Iran	Romania
Brazil	Ireland	South Africa, Rep. of
Bulgaria	Israel	Spain
Canada	Italy	Sweden
Chile	Japan	Switzerland
Czechoslovakia	Korea, Rep. of	Turkey
Finland	Netherlands	United Kingdom
France	New Zealand	USA
Germany, F. R.	Peru	USSR

No member body expressed disapproval of the document.

Plastics — Film and sheeting — Determination of average thickness of a sample and average thickness and yield of a roll, by gravimetric techniques (gravimetric thickness)

Section one : Determination of gravimetric thickness of a sample

1 Scope and field of application

Section one of this International Standard specifies a method for the determination of the gravimetric thickness of a sample of plastics film or sheeting.

The method is applicable to all plastics films and sheeting, and has special value when mechanical scanning is not sufficiently precise, particularly for measuring the thickness of embossed sheeting.

2 Principle

Calculation of the thickness of a sample from measurements of its mass, area, and density.

3 Reference

ISO/R 1183, *Plastics — Methods for determining the density and relative density (specific gravity) of plastics, excluding cellular plastics.*

4 Apparatus

4.1 Knife-edged punch, square or circular, having an area of 100 ± 0,5 cm^2, or

4.2 Square template, having an area of 100 ± 0,5 cm^2.

4.3 Balance, accurate to 0,000 1 g.

5 Test specimens

Test specimens of area 100 ± 0,5 cm^2 shall be cut at positions approximately equally spaced across the width of the sample in each of two bands approximately 1 m apart in the longitudinal direction.

The minimum number of test specimens taken from each band across the film or sheeting shall be dependent on width as follows :

— widths up to and including 1 000 mm : 3

— widths above 1 000 mm and up to 1 500 mm : 5

— widths above 1 500 mm : 10

In the case of very thin film, when the mass of a specimen of area 100 ± 0,5 cm^2 is less than 1 g, two test specimens located very close together on the film in the longitudinal direction (extrusion/calender direction) shall be used for one measurement.

6 Procedure

6.1 Determine the mass, in grams, of the test specimen to at least three significant figures and its density as described in ISO/R 1183, at a temperature of 23 ± 1 °C.

NOTE — Take care to prevent the formation of static charges which could affect the reproducibility of this mass determination.

6.2 For moisture-sensitive films or sheeting, the conditioning requirements of time and relative humidity shall be agreed between buyer and seller.

7 Expression of results

Calculate the gravimetric thickness of each test specimen, t_s, in micrometres or millimetres, from formula (1) or (2) respectively, when one test specimen is used :

$$t_s = \frac{100\, m_s}{\varrho}\, [\mu m] \qquad \ldots (1)$$

$$t_s = \frac{m_s}{10\, \varrho}\, [mm] \qquad \ldots (2)$$

where

m_s is the mass, in grams, of the test specimen;

ϱ is the density, in grams per cubic centimetre, of the test specimen.

When two test specimens are used, use formula (3) or (4) :

$$t_s = \frac{50\, m_s}{\varrho}\, [\mu m] \qquad \ldots (3)$$

$$t_s = \frac{m_s}{20\, \varrho}\, [mm] \qquad \ldots (4)$$

8 Test report

The test report shall include the following particulars :

a) reference to this International Standard;

b) full identification of the sample;

c) gravimetric thickness of each test specimen, in micrometres or millimetres;

d) arithmetic mean of the test results, to the nearest 1 μm or 0,001 mm, reported as the average gravimetric thickness of the sample.

Section two : Determination of average gravimetric thickness and yield of a roll

9 Scope and field of application

Section two of this International Standard specifies a method for the determination of the average gravimetric thickness and, if required, the yield (area per unit mass) of a roll of plastics film or sheeting.

The method is applicable to all plastics films and sheeting, and has special value when mechanical scanning is not sufficiently precise, particularly for measuring the thickness of embossed sheeting.

10 Principle

Calculation of the average thickness and, if required, the yield of a roll from measurements of the length, average width and net mass of the roll and of the density of the film or sheeting.

11 References

ISO/R 1183, *Plastics — Methods for determining the density and relative density (specific gravity) of plastics, excluding cellular plastics.*

ISO 4592, *Plastics — Film and sheeting — Determination of length and width.*[1]

12 Apparatus

Weighing device, the accuracy of which is at least 0,5 % of the reading.

13 Procedure

13.1 Length and average width of film or sheeting in a roll

Determine the length and average width of the roll, in metres, by the method specified in ISO 4592.

13.2 Net mass of roll

Place the roll of material centrally on the pan or other supporting arrangement of the weighing device. Ensure that the roll of material and the pan are free from contact with other bodies.

Determine the gross mass to an accuracy of 0,5 %. Deduct the mass of the tube or other member upon which the film or sheeting has been rolled from the gross mass to give the net roll mass, with the same accuracy.

Report the net roll mass, in kilograms, to the nearest significant figure corresponding to an accuracy of 0,5 %.

13.3 Density

Determine the density at 23 ± 1 °C of the film or sheeting as described in ISO/R 1183.

14 Expression of results

14.1 Average gravimetric thickness of roll

Calculate the average gravimetric thickness of the roll, t_r, in micrometres or millimetres, from formula (5) or (6) respectively :

$$t_r = \frac{1\,000\,m_r}{Lb\,\varrho}\ [\mu m] \qquad \ldots (5)$$

$$t_r = \frac{m_r}{Lb\,\varrho}\ [mm] \qquad \ldots (6)$$

where

m_r is the net mass, in kilograms, of the roll;

L is the length, in metres, of the roll;

b is the average width, in metres, of the roll;

ϱ is the density, in grams per cubic centimetre, of the film or sheeting.

Express the result to the nearest 1 µm or 0,001 mm respectively.

14.2 Yield

If required, calculate the yield, in square metres per kilogram, from the formula

$$\text{yield} = \frac{\text{area of roll (in square metres)}}{\text{net mass of roll (in kilograms)}} = \frac{Lb}{m_r}\left[\frac{m^2}{kg}\right]$$

where L, b and m_r are as defined in 14.1.

15 Test report

The test report shall include the following particulars :

a) reference to this International Standard;

b) full identification of the material;

c) average gravimetric thickness of the tested roll;

d) yield of the roll (if required).

---

1) At present at the stage of draft.