BRITISH STANDARD

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546-4:2006

Aluminium and aluminium alloys — Foil —

Part 4: Special property requirements

The European Standard EN 546-4:2006 has the status of a British Standard

ICS 77.150.10

BSI
British Standards

National foreword

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A list of organizations represented on NFE/35 can be obtained on request to its secretary.

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Foreword

This document (EN 546-4:2006) has been prepared by Technical Committee CEN/TC 132 “Aluminium and aluminium alloys”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2007, and conflicting national standards shall be withdrawn at the latest by June 2007.

This document supersedes EN 546-4:1997.

Within its programme of work, Technical Committee CEN/TC 132 entrusted CEN/TC 132/WG 6 "Foil and finstock" to revise EN 546-4:1997.

The following modifications have been made:

— Clause 3: reference to EN 12258-1:1998 has been added, the definition of perforation has been deleted;

— Clause 4: Table 1: limitation of pinholes (6 μm to 20 μm) detection range for light gauge converter double roller (6 μm to 70 μm) has been deleted;

— Clause 6: addition of test by use of Cotton Wool Pad (6.3.4);

— Figure 3 second Figure has been added.

EN 546 comprises the following parts under the general title "*Aluminium and aluminium alloys - Foil":*

— *Part 1: Technical conditions for inspection and delivery*

— *Part 2: Mechanical properties*

— *Part 3: Tolerances on dimensions*

— *Part 4: Special property requirements*

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1 Scope

This document specifies the requirements for special properties of wrought aluminium and wrought aluminium alloy foil and their tests. It applies to flat rolled products.

It does not apply to lacquered, painted, embossed or laminated products.

The technical conditions for inspection and delivery of foil are specified in EN 546-1.

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.

EN 12258-1:1998, *Aluminium and aluminium alloys — Terms and definitions — Part 1: General terms*

EN ISO 20482, *Metallic materials — Sheet and strip — Erichsen cupping test (ISO 20482:2003)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12258-1:1998 and the following apply.

3.1
pinholes (foil)
randomly distributed voids in foil of gauge 6 μm to 20 μm of normally round or oval shape with a maximum diameter $<$ 0,2 mm

3.2
roll holes (foil)
voids with a maximum diameter $>$ 0,2 mm which occur at regular intervals throughout the rolled coil length

4 Application of special property testing

The applicability of tests for special properties of foil products is given in Table 1.

The tests shall only be carried out when agreed between supplier and purchaser and stated on the order.

Table 1 — Applicability of special property tests to product group

Product group and gauge range	Porosity		Wettability	Stickiness	Burst strength	Erichsen cupping test
	Pinholes	Roll holes				
Light gauge converter double rolled (6 μm to 70 μm)	×	×	×	× (6 μm to 50 μm only)	NA	NA
Heavy gauge converter single rolled (35 μm to 200 μm)	NA	×	×	× (35 μm to 50 μm only)	NA	NA
Consumer foil (10 μm to 24 μm)	NA	NA	×	×	×	NA
Container foil single rolled (35 μm to 200 μm)	NA	NA	NA	NA	NA	×
x = test applicable NA = not applicable						

5 Porosity

5.1 Test principle

As rolled foil is examined by using a light box in an area of low illumination, porosity is seen as light points against the dark foil surface.

The light box, consists of translucent glass, lit from below by a luminous source giving an even illumination of 1 000 lux to 1 500 lux. The size of the light box is determined by the dimension of the largest foil sample to be examined.

5.2 Test method

Dim the light in the room in which the test is carried out to 20 lux to 50 lux.

Place the foil test sample on the light box with its matt surface facing the observer. Mask the area of the light box not covered by the test sample. Observe the test sample from a distance of approximately 0,5 m.

The test area shall be selected by one of the following methods:

a) **worst area selection**: a sample of 1 dm^2 is selected from the area exhibiting the highest porosity (worst field);

b) **random selection**: a sample of 1 m^2 is selected at random.

Count the number of pinholes or roll holes in the sample. Ignore pinholes less than 0,020 mm in diameter.

For the worst area selection sample, count the number of voids in 1 dm^2.For the random selection sample, count the number of voids in 1 m^2.

Report separately the number of pinholes and roll holes per unit area.

5.3 Acceptance values

The maximum acceptable number of pinholes and roll holes shall be agreed between supplier and purchaser.

5.4 Sampling and frequency of testing

One full width test sample at correct nominal gauge measuring approximately 1 m in length along the rolling direction shall be taken and tested from every three rolled coils.

6 Wettability

6.1 Test principle

The test shall apply to aluminium foil in the gauge range 6 μm to 200 μm.

The surface of the fully annealed foil is assessed according to its ability to be wetted by liquids applied under clearly defined conditions.

6.2 General test conditions

6.2.1 General

Carry out the tests at ambient temperature. Remove the outside wraps to reduce the coil build-up by a minimum of 3 mm in order to obtain a representative sample before performing the test. Usually the test is carried out on the matt side of the foil. Precautions shall be taken to prevent the liquids from accidentally coming into contact with edge of reel.

Do not repeat tests on the same area of sample.

6.2.2 Equipment used

Four techniques are recommended:

1) the droplet bottle, to be used for depositing drops of liquid on the surface to be tested (see 6.3.1);

2) a spray bottle, to apply a fine spray mist across the width of the metal surface to be tested (see 6.3.2);

3) a spray bottle, to enable a continuous stream of liquid to be applied to the surface (see 6.3.3);

4) cotton wool soaked in the appropriate liquid to be used for smearing the surface under test (see 6.3.4).

   The cotton wool shall be clean.

   This test should be used as a referee method.

Other tests can be used after agreement between supplier and customer.

6.2.3 Liquid used

The following liquids shall be used for all tests:

— distilled water; or

— distilled water mixed with industrial ethyl-alcohol to a concentration of 10 % or 20 % by volume.

6.3 Test procedures

6.3.1 Test by droplet

6.3.1.1 Test method

Use a droplet bottle to drop 40 mg to 80 mg drops of liquid onto the horizontal metal surface at a rate of one drop every 5 cm to 10 cm across the width of the web. Tilt the surface between 40°and 60°(see Figure 1). Determine the wettability index from the tail left by the movement of the droplets across the surface.

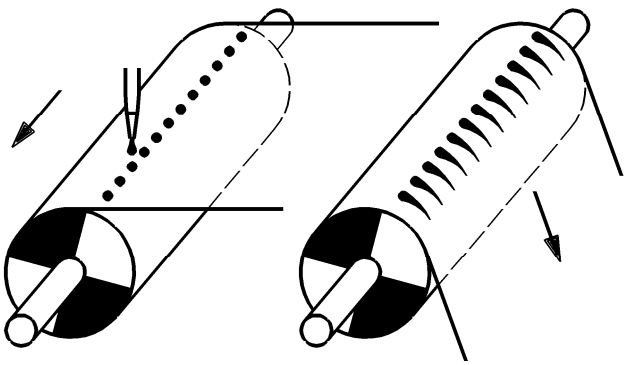
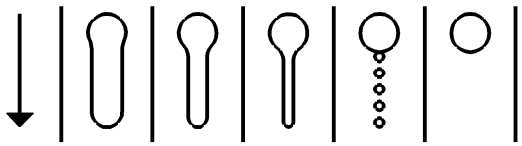


Figure 1 — Test by droplet

6.3.1.2 Test results

If the test is performed with distilled water, the wettability index is shown by the shape of the trace given on the surface taken from the worst area of the foil. The wettability indices are defined from A to G in Figure 2. Wettability indices included between A to C are acceptable.



distilled water	A	B	C	D	E
distilled water mixed with industrial ethyl-alcohol to a concentration of + 10 % volume	B	C	D	E	F
distilled water mixed with industrial ethyl-alcohol to a concentration of + 20 % volume	C	D	E	F	G

Figure 2 — Wettability indices

6.3.1.3 Acceptance criteria

The required wettability shall be agreed between supplier and purchaser.

6.3.2 Test by fine spray

6.3.2.1 Test method

Position the metal surface at an angle, approaching the vertical. Use a spray bottle to apply a fine spray mist across the width of the metal surface.

6.3.2.2 Test results

The whole surface under the liquid spray shall remain uniformly wetted by the applied liquid:

— distilled water : wettability A;

— distilled water mixed with industrial ethyl alcohol to a concentration of 10 % by volume : wettability B;

— distilled water mixed with industrial ethyl alcohol to a concentration of 20 % by volume : wettability C.

6.3.2.3 Acceptance criteria

Minimum values shall be agreed between supplier and purchaser.

6.3.3 Test by liquid stream

6.3.3.1 Test method

Position the metal surface at an angle of between 40° and 60°. Using a spray bottle, apply a continuous stream of test liquid across the width (see Figure 3).

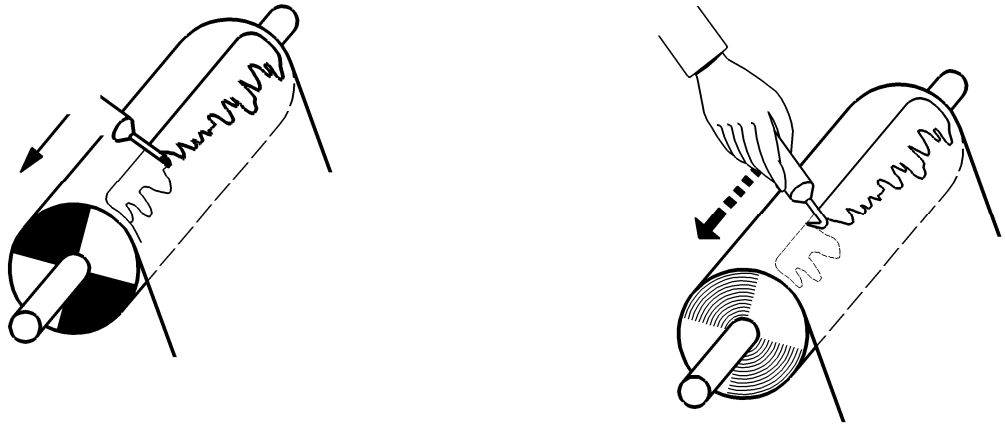


Figure 3 — Test by liquid stream

6.3.3.2 Test results

The whole surface under the stream of liquid and its subsequent spread downwards shall remain uniformly wetted:

— distilled water : wettability A;

— distilled water mixed with industrial ethyl alcohol to a concentration of 10 % by volume : wettability B;

— distilled water mixed with industrial ethyl alcohol to a concentration of 20 % by volume : wettability C.

6.3.3.3 Acceptance criteria

Minimum values shall be agreed between supplier and purchaser.

6.3.4 Test by use of Cotton Wool Pad

6.3.4.1 Test method

A clean and dry piece of cotton wool is carefully dipped in the required liquid. It is brought into contact with the metal surface on one edge and moved towards the other edge. The surface is usually horizontal (see Figure 4).

6.3.4.2 Test results

The whole surface moistened by the cotton wool shall remain uniformly wetted:

— distilled water : wettability A;

— distilled water mixed with industrial ethyl alcohol to a concentration of 10 % by volume : wettability B;

— distilled water mixed with industrial ethyl alcohol to a concentration of 20 % by volume : wettability C.

6.3.4.3 Acceptance criteria

The whole surface moistened by the cotton wool shall remain wet:

Minimum values shall be agreed between supplier and purchaser.

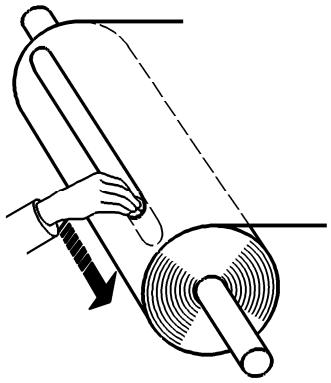


Figure 4 — Cotton Wool Pad Test

6.4 Frequency of testing

Random testing of sufficient frequency to verify control capability, to the satisfaction of the purchaser shall be carried out.

7 Stickiness

7.1 Test principle

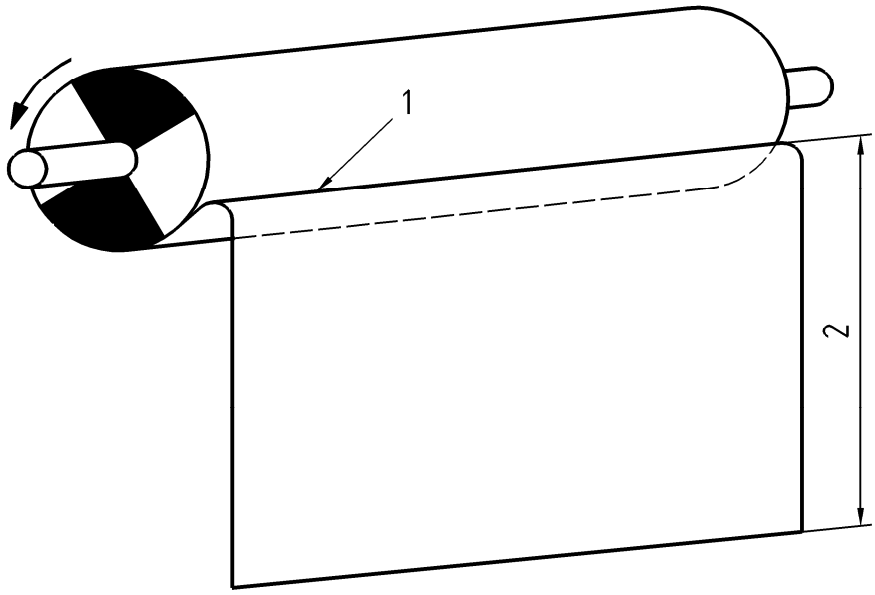
The test applies to fully annealed aluminium foil in the gauge range 6 μm to 50 μm.

The ease of unwind is evaluated by assessing the stickiness between laps.

7.2 Test method

Carry out the test at room temperature. Remove a minimum of 3 mm from the build up on the coil to obtain a representative sample. Place the reel onto a horizontal axis, enabling it to be easily moved by hand.

Wind the foil back on itself with the web falling freely under gravity (see Figure 5).



Key

1 Line of unwind
2 Length of foil

Figure 5 — Stickiness test

The line of unwind (1) shall lie in the same horizontal plane as the axis of the reel.

Unwind a few centimetres of the reel by hand to see if the material is free fall.

If the foil does not unwind, increase the length of foil hanging until it unwinds under its own weight.

7.3 Acceptance criteria

If the material is free fall, the foil is assessed as zero stickiness.

The length of foil (2) necessary to cause it to unwind, expressed in metres is the value used in expressing stickiness.

The maximum length of foil shall be 2 m.

7.4 Frequency of testing

Random testing of sufficient frequency to verify control capability, to the satisfaction of the purchaser shall be carried out.

8 Burst strength

The test shall be applied only to consumer foil in the "O" condition. The material is submitted to a uniform pressure distributed over a known surface area and the bursting pressure is measured to give an indication of the suitability of the material for packaging or wrapping applications.

NOTE 1 There is no standard for testing the burst strength of aluminium foil.

ISO 2758 may be used to give a measure of burst strength. However, other methods exist and the test procedure shall be agreed between supplier and purchaser.

NOTE 2 Results of burst strength testing are dependent on alloy, gauge, process history and method of test. Accordingly, acceptance criteria should be agreed between supplier and purchaser.

9 Erichsen cupping test

9.1 Test principle

This test shall be applied only to container foil.

The material is submitted to increasing penetration by a spherically-ended punch, and the depth of the cup so formed at the point of rupture is measured (based on the movement of the punch). This indicates the formability of the material.

9.2 Test method

The test shall be carried out according to EN ISO 20482.

9.3 Acceptance criteria

Minimum values shall be agreed between supplier and purchaser.

9.4 Frequency of testing

Random testing of sufficient frequency to verify control capability, to the satisfaction of the purchaser shall be carried out.

Bibliography

[1] EN 546-1, *Aluminium and aluminium alloys — Foil — Part 1: Technical conditions for inspection and delivery*

[2] ISO 2758, *Paper — Determination of bursting strength*

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