BS EN 13523-7:2014

BSI Standards Publication

Coil coated metals — Test methods

Part 7: Resistance to cracking on bending (T-bend test)

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National foreword

This British Standard is the UK implementation of EN 13523-7:2014. It supersedes BS EN 13523-7:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee STI/21, Surface preparation of steel.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 13523-7:2014) has been prepared by Technical Committee CEN/TC 139 “Paints and varnishes”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by December 2014, and conflicting national standards shall be withdrawn at the latest by December 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13523-7:2001.

The main technical changes are:

a) details on the brands of the tape used were added;

b) a remark on conditioning was added;

c) in addition to use a × 10 magnifying glass, the evaluation shall be carried out with normal corrected vision.

EN 13523, *Coil coated metals — Test methods*, consists of the following parts:

— *Part 0: General introduction*

— *Part 1: Film thickness*

— *Part 2: Gloss*

— *Part 3: Colour difference — Instrumental comparison*

— *Part 4: Pencil hardness*

— *Part 5: Resistance to rapid deformation (impact test)*

— *Part 6: Adhesion after indentation (cupping test)*

— *Part 7: Resistance to cracking on bending (T-bend test)*

— *Part 8: Resistance to salt spray (fog)*

— *Part 9: Resistance to water immersion*

— *Part 10: Resistance to fluorescent UV radiation and water condensation*

— *Part 11: Resistance to solvents (rubbing test)*

— *Part 12: Resistance to scratching*

— *Part 13: Resistance to accelerated ageing by the use of heat*

— *Part 14: Chalking (Helmen method)*

— *Part 15: Metamerism*

— *Part 16: Resistance to abrasion*

— *Part 17: Adhesion of strippable films*

— *Part 18: Resistance to staining*

— *Part 19: Panel design and method of atmospheric exposure testing*

— *Part 20: Foam adhesion*

— *Part 21: Evaluation of outdoor exposed panels*

— *Part 22: Colour difference — Visual comparison*

— *Part 23: Resistance to humid atmospheres containing sulfur dioxide*

— *Part 24: Resistance to blocking and pressure marking*

— *Part 25: Resistance to humidity*

— *Part 26: Resistance to condensation of water*

— *Part 27: Resistance to humid poultice (Cataplasm test)*

— *Part 29: Resistance to environmental soiling (Dirt pick-up and striping)*

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1 Scope

This part of EN 13523 specifies the procedure for determining the resistance to cracking of an organic coating on a metallic substrate when bent through 135° to 180°. The degree of adhesion may also be evaluated.

Both folding and mandrel methods are considered. The folding method is more often used for practical purposes but where more precise determinations are required, the mandrel method is recommended.

The cylindrical bend method may also be used for a pass/fail decision by using an agreed mandrel.

The choice of the appropriate test method is limited by the thickness and/or the hardness of the substrate.

The feasibility of the test depends on the type and thickness of the substrate. During the procedure, the mandrel should not deform.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13523-0:2014, *Coil coated metals — Test methods — Part 0: General introduction*

EN 23270, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing (ISO 3270)*

EN 60454-2, *Pressure-sensitive adhesive tapes for electrical purposes — Part 2: Methods of test (IEC 60454-2)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13523-0:2014 and the following apply.

3.1
metal thickness
total thickness of the substrate including any metallic coating and excluding any organic coating

4 Principle

The coated test specimen is bent parallel to the direction of rolling through 135° to 180° over a period of 1 s to 2 s around various radii with the coating on the outside of the bend.

Close contact is maintained between the test specimen and either the wedge or mandrel to ensure a uniform bend.

Any bending device allowing the required smooth and uniform bending may be used.

The minimum bending radius to which the specimen can be bent without cracking of the organic coating determines the resistance to cracking on bending through 135° to 180°.

The minimum bending radius to which the specimen can be bent without loss of adhesion determines the resistance to loss of adhesion on bending through 135° to 180°.

5 Apparatus

5.1 Bending device

5.1.1 for the folding method

Vice or **suitable bend forming apparatus** as shown in Figure 1.

5.1.2 for the mandrel method

Bending device, appropriate to the metal thickness, hardness, and panel size:

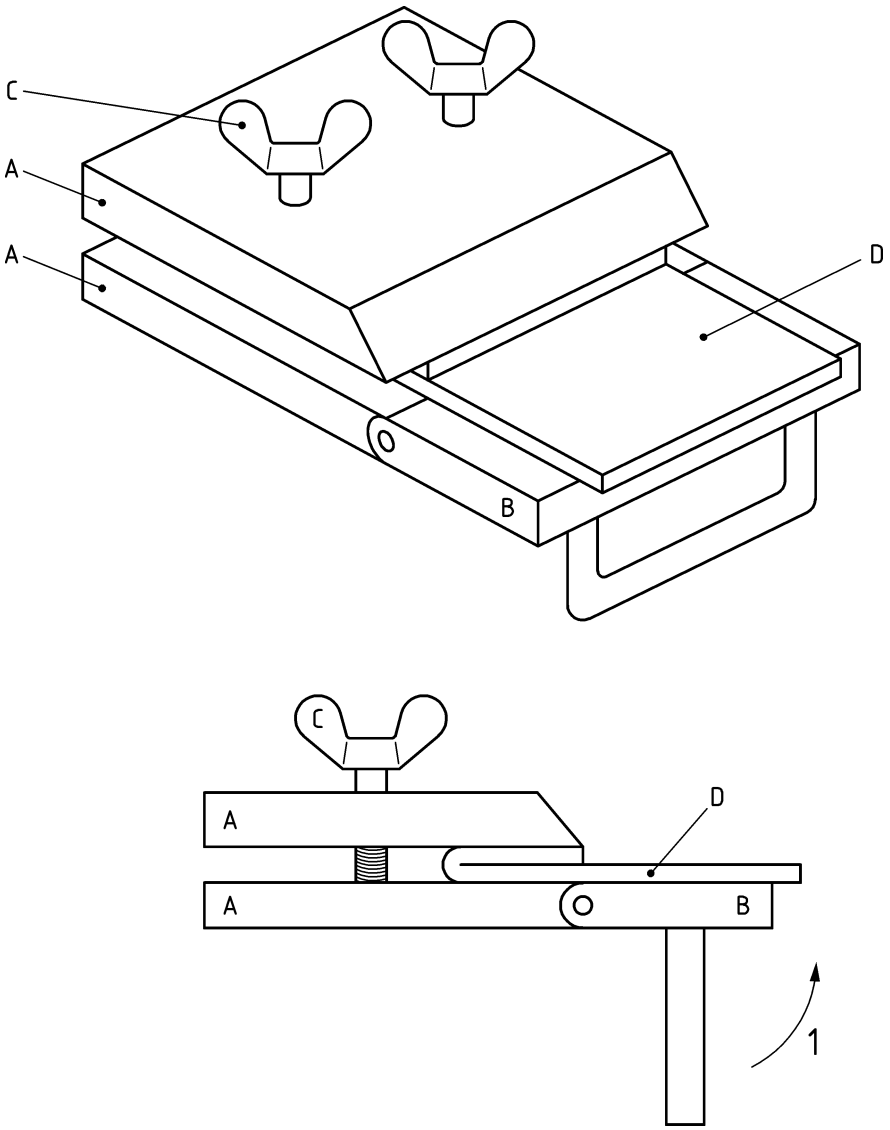
— cylindrical mandrel: see Figure 2;

— conical mandrel: see Figure 3;

— conical wedge mandrel: see Figure 4; the conical wedge mandrel may be driven manually (see Figure 5) or pneumatically (see Figure 6).

5.2 Magnifying glass × 10.

5.3 Transparent pressure-sensitive adhesive tape, 25 mm wide, with an adhesion strength of (10 ± 1) N per 25 mm width when tested in accordance with EN 60454-2.



Key

A apparatus jaws
B bending plate
C clamping screws
D test specimen
1 direction of movement

Figure 1 — Practical test (P) — folding method

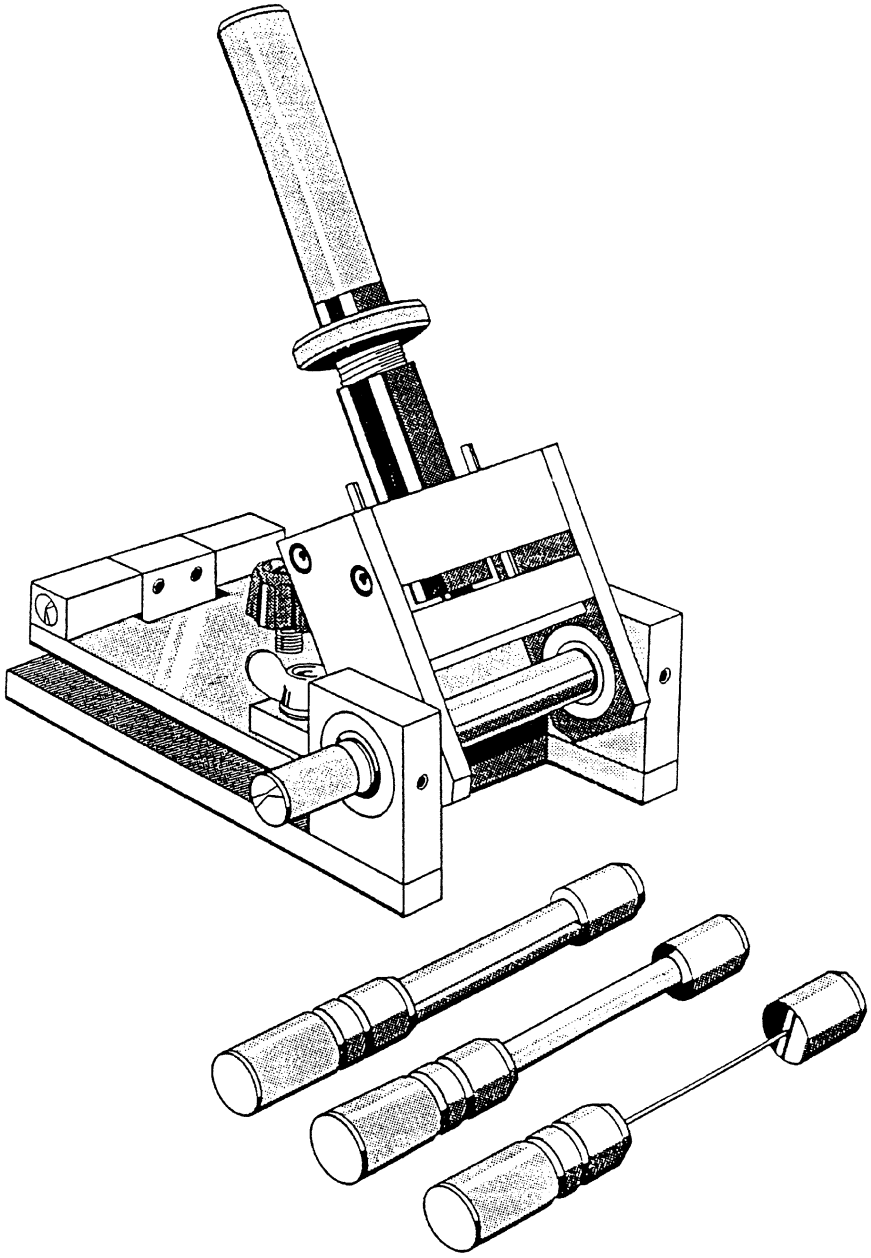


Figure 2 — Laboratory test (L) — cylindrical bend

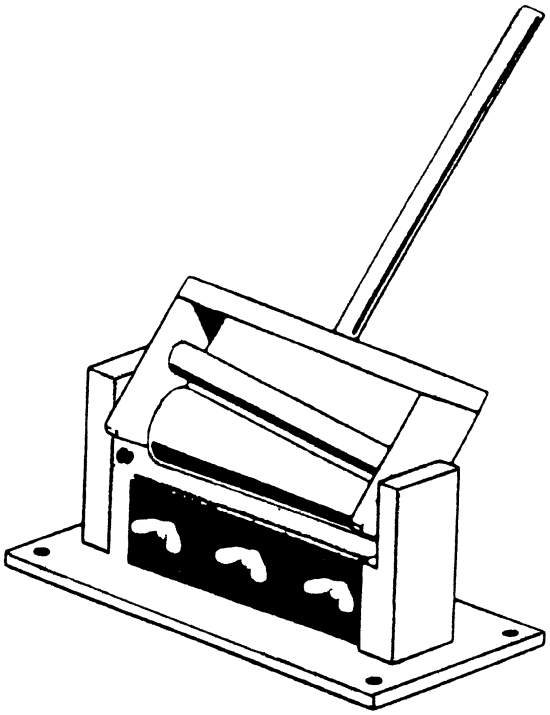
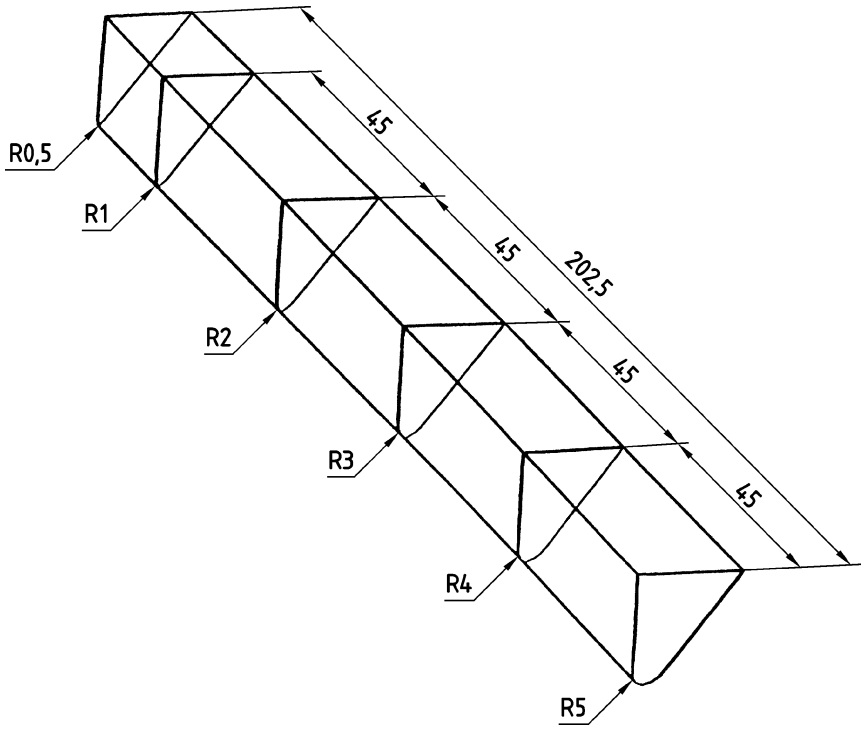


Figure 3 — Laboratory test (L) — conical bend

Dimensions in millimetres



NOTE In this conical wedge mandrel, the distance between each increase of 1 mm radius is 45 mm. This distance should always be equal to or larger than 30 mm so that eventual creep of cracks does not substantially influence the test results.

Figure 4 — Conical wedge mandrel

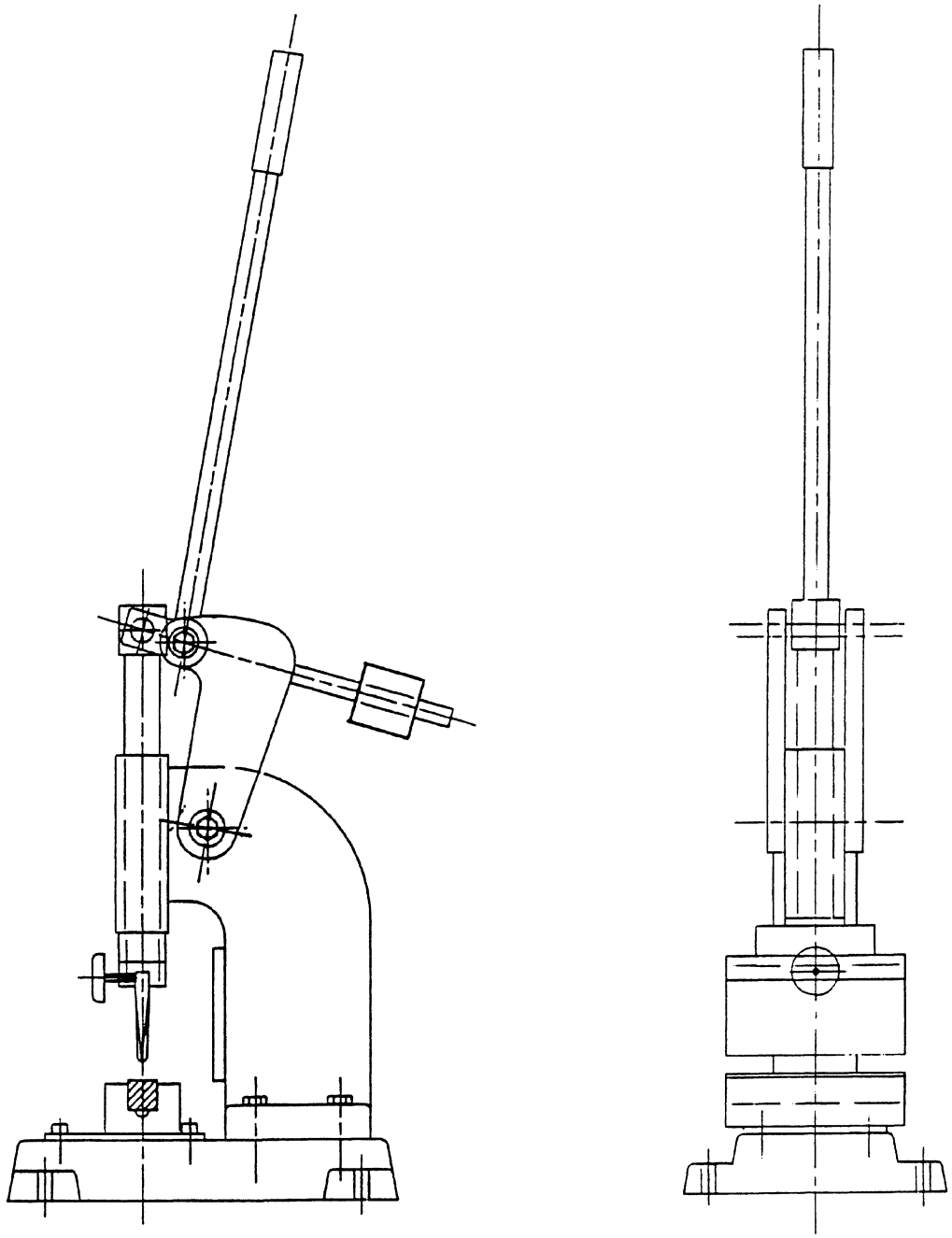
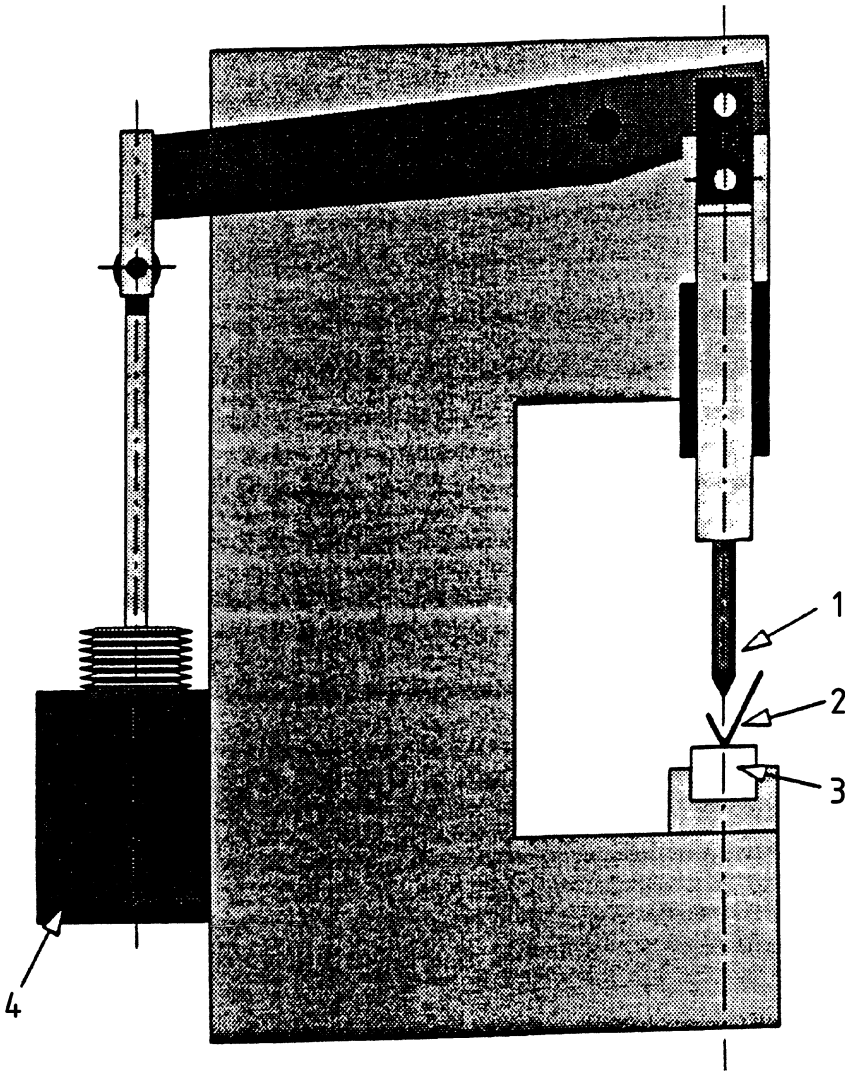


Figure 5 — Practical test (P) – hand operated apparatus



NOTE Schematic diagram of mechanical test equipment.

Key

1 wedge
2 test specimen
3 rubber
4 pneumatic cylinder approximately 6 bar

Figure 6 — Practical test (P) — pneumatically driven

6 Sampling

See EN 13523-0.

Use only flat strip of such a size that the required procedure can be executed and the results obtained are representative of the end use of the material.

7 Test panels

See EN 13523-0.

Because of possible burrs, up to 5 mm on extreme edges shall be ignored during evaluation.

The coating surface shall be free of oil and other foreign matter that might influence the flexibility of the coating or interfere with the observation for cracking or loss of adhesion.

8 Procedure

8.1 General

Measure the resistance of the organic coating to cracking at ambient temperature. For more accurate measurements, as required for instance in the case of dispute, the temperature shall be (23 ± 2) °C and the relative humidity (50 ± 5) %, in accordance with EN 23270. Conditioning is carried out in accordance with EN 13523-0:2014, Clause 6.

The coating under test shall always be at the outside of the bend.

The bending shall be carried out over a period of 1 s to 2 s.

The bends shall be examined using normal corrected vision and the magnifying glass (5.2) immediately after bending.

If necessary, a second inspection may be agreed after a specified ageing (see, for example, EN 13523-13) of either the flat material before bending or the bend itself.

The adhesion may also be evaluated as follows: Remove two complete laps from a reel of the adhesive tape (5.3) and discard. Remove an additional length at a steady rate and cut a piece, approximately 75 mm long.

Place the centre of the tape along the length of the bend and smooth the tape into place over for a distance of at least 20 mm either side with a finger.

To ensure good contact with the coating, rub the tape firmly with a fingertip. The colour of the coating seen through the tape is a useful indication of overall contact.

Within 5 min of applying the tape, remove the tape by holding the free end and pulling it off steadily in 0,5 s to 1 s at an angle that is as close as possible to 60° to the panel.

In cases of dispute, one of the following test methods shall be agreed between the interested parties.

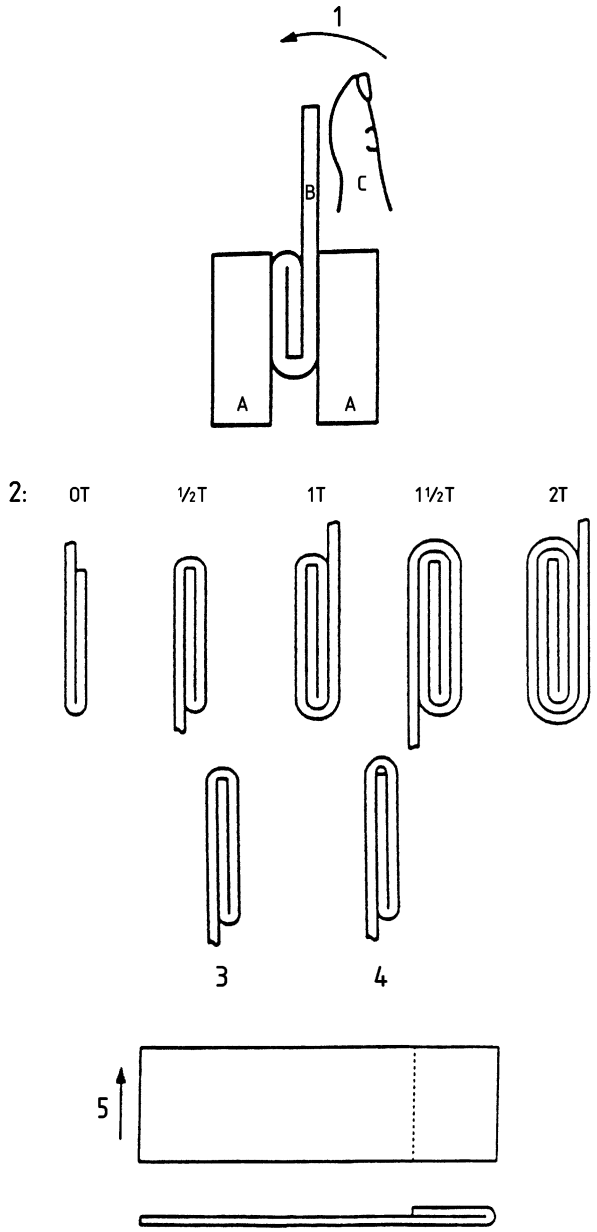
8.2 Methods for practical (industrial) use

8.2.1 Folding method

The apparatus (5.1.1) shall be firmly secured near the edge of a bench, so that the handle can be operated freely.

The test specimen shall be firmly clamped between the jaws of the device or vice, with the painted surface to be evaluated facing downwards, or, in the case of the vice, facing the operator. The handle operating the bending plate shall be lifted smoothly over a period of 1 s to 2 s. This operation shall be repeated with the test specimen being examined immediately after each bend, with normal corrected vision and the magnifying glass (5.2). In the instance of a vice being used where no bending plate is available, even pressure shall be applied with both thumbs, to ensure a smooth and uniform bending operation (see Figure 7).

This method can result in peaking of the bend. Therefore, for more precise results one of the other methods should be used.



Key

A vice jaws
B test specimen
C thumb
1 direction of movement
2 T bends ECCA
3 correct
4 incorrect
5 rolling direction of coil

Figure 7 — T-bend test

8.2.2 Mandrel method

The test specimen shall be placed on an appropriate thick and flexible rubber mat, the painted surface facing towards the rubber. Either by hand or pneumatically, either the cylindrical mandrels in decreasing radius-order

or the conical wedge mandrel (see Figures 4, 5 and 6) shall be pressed deep enough into the rubber to ensure the proper deformation of the test specimen, with the bending parallel to the direction of rolling.

For cylindrical bends mandrels having radii from 0,5 mm to 5 mm, with steps of 0,5 mm, shall be used.

For a 0T-bend a mandrel of radius 0,5 mm shall be used, and the resulting bend totally bent flat.

8.3 Method for laboratory purposes

The coated panel shall be inserted in the apparatus in such a way that a smooth cylindrical or conical bending through 135° to 180° can be achieved.

Any device that allows such a smooth and uniform bending within a period of 1 s to 2 s may be used. A few examples are given in Figures 1, 2 and 3.

For cylindrical bends mandrels having radii from 0,5 mm to 5 mm, with steps of 0,5 mm, shall be used.

For a 0T-bend a mandrel of radius 0,5 mm shall be used, and the resulting bend totally bent flat.

The cylindrical bend method may also be used for a pass/fail decision by using an agreed mandrel.

The feasibility of the test depends on the type and thickness of the substrate. During the procedure the mandrel should not deform.

9 Expression of results

The result shall be the minimum bending radius to which the test specimen can be bent without cracking or without loss of adhesion, expressed in T, rounded upwards to the nearest half T, for example “½T no loss of adhesion” or “1T no cracking”. See Figure 7.

For cylindrical bendings:

$$T_{\text{cyl}} = \frac{\text{Minimum mandrel radius}}{\text{Metal thickness}}$$

For conical bendings:

$$T_{\text{con}} = \frac{\text{Minimum mandrel radius}}{\text{Metal thickness}}$$

NOTE The T-expression as defined in this part of EN 13523 differs from that explained in ASTM D 4145 where values are twice as high. For correlation between rating systems, see EN ISO 17132:2007, Annex A.

10 Precision

No precision data are currently available.

11 Test report

The test report shall contain at least the following information:

a) all details necessary to identify the product tested, including substrate used, type of paint used, coating thickness;

b) a reference to this part of EN 13523 (EN 13523-7);

c) the method used: cylindrical (cyl.) or conical (con.), practical (P) or laboratory (L) test;

d) the bending device used;

e) the results of the test, as indicated in Clause 9, specifying cracking or loss of adhesion as appropriate;

f) any deviation from the test method specified;

g) any unusual features (anomalies) observed during the test;

h) the date of the test.

Bibliography

[1] EN 1396, *Aluminium and aluminium alloys — Coil coated sheet and strip for general applications — Specifications*

[2] EN 10169, *Continuously organic coated (coil coated) steel flat products — Technical delivery conditions*

[3] EN 13523-13, *Coil coated metals — Test methods — Part 13: Resistance to accelerated ageing by the use of heat*

[4] EN ISO 1519, *Paints and varnishes — Bend test (cylindrical mandrel) (ISO 1519)*

[5] EN ISO 6860, *Paints and varnishes — Bend test (conical mandrel) (ISO 6860)*

[6] EN ISO 17132:2007, *Paints and varnishes — T-bend test (ISO 17132:2007)*

[7] ASTM D 4145, *Standard Test Method for Coating Flexibility of Prepainted Sheet*

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