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Elastic adhesives — Testing of adhesively bonded joints — Bead peel test

Adhésifs élastiques — Essai des assemblages collés — Essai de pelage sur cordon

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Foreword

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

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.

Elastic adhesives — Testing of adhesively bonded joints — Bead peel test

1 Scope

This document specifies a method for evaluating the adhesion of elastic adhesives and sealants [with a minimum elongation at break of 100 % and a modulus of elasticity of maximum 10 MPa[1)]] on various substrates. In this way, the effect of various coatings or the surface pre-treatments of the substrate materials on the adhesion can be compared. It can also be used to evaluate the influence of pre-treatment, substrate and adhesive on the long-term durability of adhesively bonded joints and seals. This test can also be used for process monitoring and quality assurance accompanying production.

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 10365, *Adhesives — Designation of main failure patterns*

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 Principle

Adhesive beads are applied onto substrates. These are then peeled off again after curing and a possible subsequent climate resistance test. If an ageing is performed, the individual steps shall progress in succession with the test specimen, whereby a partial area is peeled off further before the ageing and after every ageing step. The failure pattern is then determined.

5 Sample preparation

5.1 Materials and surface treatment

The bonded joint materials and the surface treatment shall be selected according to the requirements of the application.

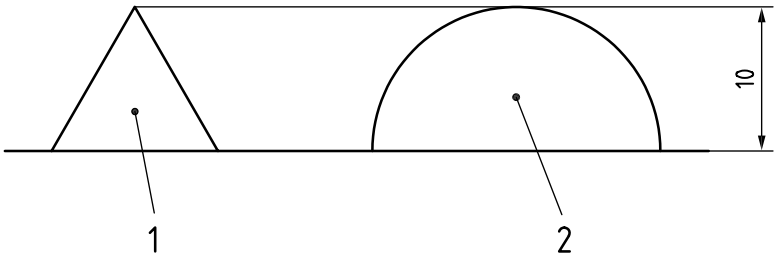
5.2 Adhesive application

For every test specimen, at least one adhesive bead with a length of minimum 80 mm, but with sufficient length for the number of intended ageing levels (each about 50 mm) shall be applied onto the jointing part.

1) The elongation and modulus of elasticity are measured according to ISO 527-2.

The bead geometry shall be defined corresponding to the later process. Alternatively, either semi-circular beads or triangular beads may be applied (see Figure 1).

Dimensions in millimetres



Key

1 triangular bead

2 semicircular bead

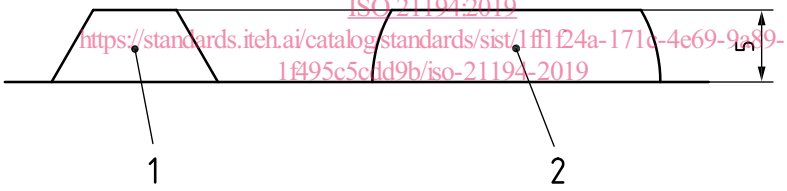
Figure 1 — Schematic representation of the adhesive application

In all cases, the height of the adhesive should be 5 mm. The adhesive component that extends over a height of 5 mm shall be removed (see Figure 2) or compacted to this height. The selected variant shall be listed in the test report (see Clause 9). Beads that are too high lead to falsified results during later peeling.

The width of the bead should be in a range between 10 mm and 15 mm.

During the application, it shall be ensured that the adhesive wets the substrate well.

Dimensions in millimetres



Key

1 triangular bead

2 semicircular bead

Figure 2 — Schematic representation of beads shortened to 5 mm height

6 Curing the adhesive

The curing or setting shall occur in accordance with the conditions specified for the adhesive or corresponding to the process conditions.

7 Ageing

The test specimens may be aged artificially to test the long-term resistance. The choice of ageing conditions shall correspond to the service conditions. Annex A describes, as an example, an ageing process that is often applied in practice. Also, ISO 9142 can be considered for suitable ageing regimes.

8 Implementation

To test the adhesive bonding, the bead shall be cut through with a sharp knife obliquely under about 45° in the direction of peel as far as the bonding surface and pulled off with pointed pliers at the same time (peeling angle 130° to 160°) or peeled off by unrolling. The peeling force shall be increased until a crack begins to progress. If the failure progresses in the adhesive, the bead shall be continuously newly incised during the peeling process. These incisions shall continue in the peak angle between the bead and jointing part surface up to the bonding surface. There should be an interval of about 3 s between each incision, during which the material is subject to further strain. This process shall be repeated until a bead piece of minimum 50 mm per ageing cycle is peeled off.

9 Evaluation

The failure patterns of the peeled beads shall be appraised for the evaluation. The failure patterns shall be evaluated in accordance with ISO 10365. As the failure can also progress in the coatings or their interfaces in the case of a multilayer structure of the jointing part (paint, primer, etc.), this shall be differentiated during the evaluation. The failure patterns shall be evaluated in the following manner:

— Grade 1: More than 95 % cohesion failure (CF) ratio and less than 5 % adhesive detachment (AF) of the adhesive from the contact surface;

— Grade 2: 75 % to 95 % cohesion failure ratio;

— Grade 3: 25 % to < 75 % cohesion failure ratio;

— Grade 4: 5 % to < 25 % cohesion failure ratio;

— Grade 5: less than 5 % cohesion failure ratio.

Other failure patterns than adhesion failure (AF) and cohesion failure (CF) can also occur, especially in the case of multilayer substrates. If an evaluation according to the abovementioned grading is not possible due to the failure patterns, it is not necessary to indicate a grading, but the failure patterns shall be indicated in the evaluation using the following code letters:

— adhesive not cured (NC);

— bubbles in the bulk of the adhesive (BFB);

— bubbles in the adhesion zone (BS);

— foam structure in the adhesion zone (FS);

— cohesion failure in the primer (CPrF);

— adhesion failure between primer and its substrate (SCPrF);

— cohesion failure in the paint (CFPa);

— failure between various paint layers (PaIF);

— adhesion failure between paint and its substrate (PaDF);

— corrosion of the base material (Cor);

— substrate failure in the base material (SF);

— bead tear-off without prior peeling (BF).

10 Test report

The test report shall contain at least the following information:

a) a reference to this document, i.e. ISO 21194:2019;

b) type and designation of the adhesive;

c) curing conditions;

d) jointing part material, including all coatings;

e) bonding surface pre-treatment;

f) variant of the bead application;

g) ageing conditions, if performed;

h) evaluation according to this document, including potential quality defects (see Table B.1 in Annex B);

i) all deviations from this document, including their substantiation;

j) date of the testing.

Annex A
(informative)

Example of an ageing method

Every specimen is subject to the following treatments in succession. After every treatment, the bead test is continued on the aged test specimen, with a further piece of the bead (about 50 mm) being peeled off. The treatment steps are as follows.

— Begin after curing (see Clause 5) (first test);

— 7 days storage in fully demineralised water at 20 °C, conditioning 2 h under ambient conditions (second test);

— 1 day storage at 80 °C, test after conditioning 2 h under ambient conditions (third test);

— 7 days at 70 °C in saturated moisture (so-called cataplasm method), conditioning 2 h under ambient conditions (fourth test). In the cataplasm method, the test specimens are packed moistly and shrink-wrapped into diffusion-tight bags.