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Buildings and civil engineering works — Sealants — Testing of adhesion properties using a bead peel test

Bâtiments et ouvrages de génie civil — Mastics — Détermination des propriétés d'adhérence par un essai de pelage manuel

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Foreword

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This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 8, *Sealants*.

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.

Buildings and civil engineering works — Sealants — Testing of adhesion properties using a bead peel test

1 Scope

The document specifies a method for evaluating the adhesion of sealants with a minimum elongation at break of 25 % (according to ISO 8339, Method A or B) on various substrates. This test method can be used for one-component and multi component sealants. This method is typically used for elastic sealants but can be also used for plastic sealants. For plastic sealants, the test can be more difficult and needs to be carried out by experienced technicians.

This test is used to judge the adhesion of construction sealants in combination with cleaners, activators and/or primers on various substrates when exposed to a peeling force and also after different aging conditions.

An adhesion test according to this document can also be conducted for process monitoring and quality assurance accompanying production. The test method described in this document is not intended to replace any adhesion cohesion test methods specified in ISO 11600.

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 6927, *Buildings and civil engineering works — Sealants — Vocabulary*

ISO 10365, *Adhesives — Designation of main failure patterns*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6927 apply.

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

Sealant beads are applied onto substrates. After any required conditioning and optional aging the beads are manually peeled from the substrate to determine the adhesion properties.

The failure pattern is then recorded.

5 Sample preparation

5.1 General

Depending on the objective of the test, more than one bead per substrate may be applied.

5.2 Materials, substrates and surface treatment

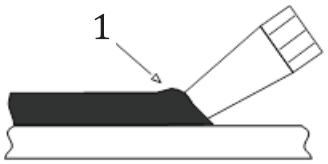
The sealant, substrate and the surface treatment shall be selected according to the requirements of the final application and shall be defined between the concerned parties. For both methods at the starting point a bond breaking tape could be applied on a length of 10 mm to 15 mm in order to have an easier start of the cutting process.

5.3 Sealant application

5.3.1 Method without mold

This method can be used for e.g. non-sagging sealants.

For every test specimen, at least one sealant bead with a minimum length of 80 mm, but with sufficient length for the number of intended ageing steps (each aging step requires about 50 mm), shall be applied onto the substrate.

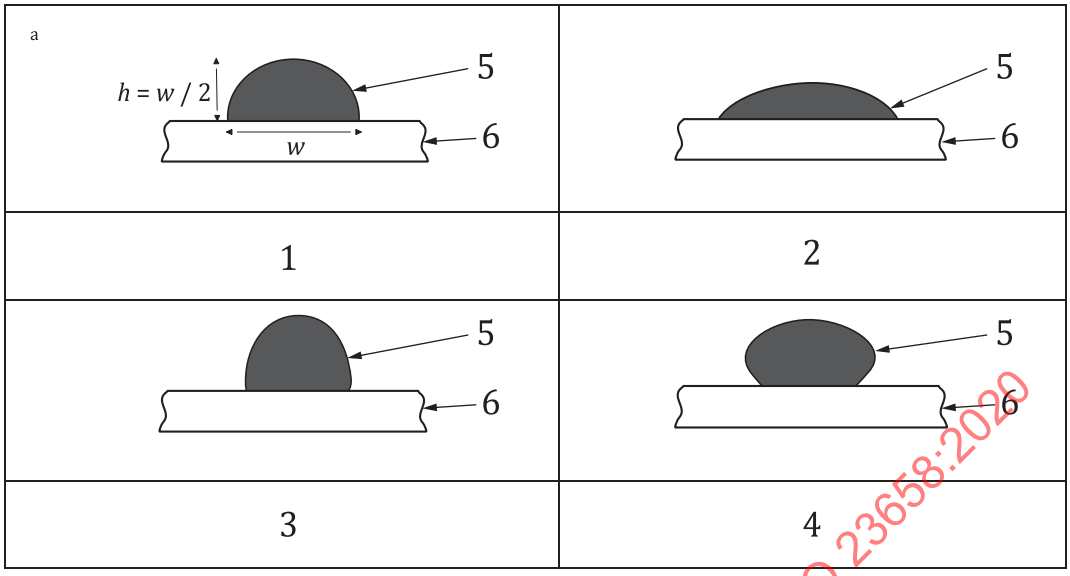


Key

1 bow wave

Figure 1 — Bead application

Usually semicircular beads are applied (Figure 1) by cutting the nozzle to the suitable diameter. The height of the sealant bead should be 5 mm to 8 mm or compacted to this height. Beads that are too thin or too high lead to falsified results during later peeling. During the application, a good wetting of the substrate shall be ensured as well; air entrapment shall be avoided.



Key

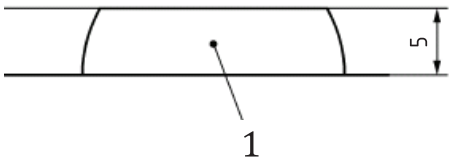
1 correct dimension ($h \approx 5$ mm)
2 too flat
3 too high, too narrow
4 poor wetting
5 sealant
6 substrate
a w = width: 10 mm $w/2$ = height 5 mm to 8 mm.

Figure 2 — Bead dimensions — Semicircular bead

Produce in a specified height and thickness (see Figure 2). The dimension is always the same with and w/o spatula.

Alternatively, the beads can also be pressed to a height of 5 mm to 8 mm (see Figure 3).

Dimensions in millimetres



Key

1 sealant

Figure 3 — Beads pressed to a height of 5 mm to 8 mm

To ensure the dimension of the bead, a spatula with shape of the recommend bead size can be used (see Figure 4).

Figure 4 — Example of a suitable spatula

5.3.2 Method with mold

This method can be used for e.g. self-leveling sealants (for which the method described in 5.3.1 is not applicable)

Non-adhesives spacers e.g. a self-adhesive foam tape is used to form a mold for the product. Depending on the viscosity, the sealant shall be tooled or poured into the mold. The mold shall be applied along all four edges of the later bead (not visible in Figure 5).

When using a foam tape, apply pre-treatments prior to the foam tape. Cleaners, activators or primers that are applied on the foam tape may cause curing problems.

Incompatibility between sealant and mold may cause adhesion failure. Make sure to use appropriate molds only.

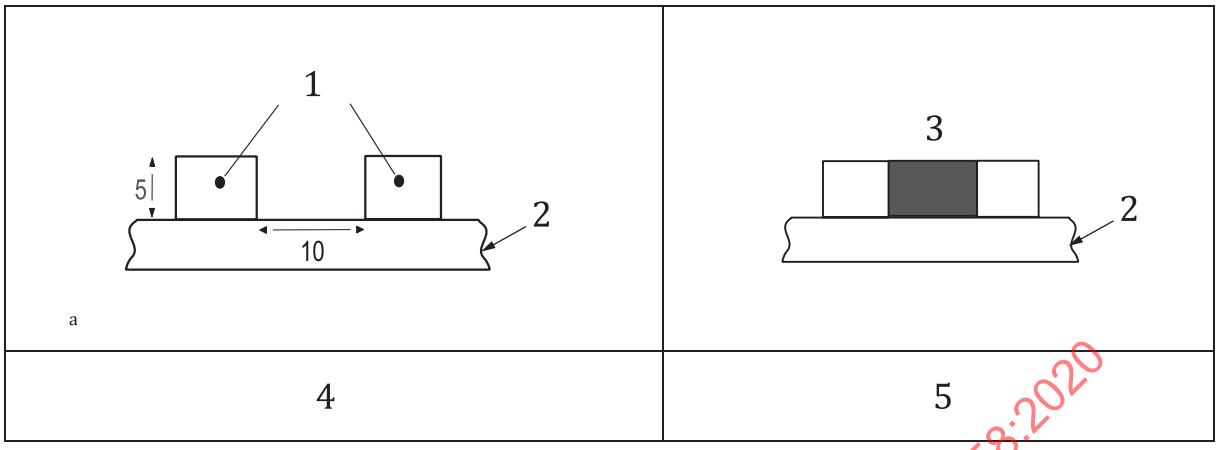
6 Conditioning of the sealants

The curing or setting shall occur as agreed between the concerned parties. See Annex A for typical conditioning.

7 Ageing simulation

The test specimens may be aged artificially to test the long-term adhesion properties. The choice of ageing shall be agreed between the concerned parties and depends usually on the intended use or application area of the sealant e.g. joints in water treatment plants have other exposures than a joint sealant for interior use. Annex A describes an example of an ageing method.

Dimensions in millimetres



Key

1 mold e.g. self-adhesive tape
2 substrate
3 sealant
4 barriers
5 the applied product
a W/2 = height typical height 5 mm to 8 mm

Figure 5 — Bead dimensions for self-leveling products

8 Peel test procedure

Grip the substrate in order to immobilize the test specimen prior to the peel test. To test the adhesion of the sealant bead, start by cutting (use of suitable safety gloves is recommended) the end of the sealant bead parallel or by using a bond breaker as described above to the bonding surface to free a tab which can be gripped by hand (~25 mm). Peel the sealant by pulling the cut end away from the bond surface by hand at a peeling angle of 130° to 160°. In case of 100 % adhesive failure only, pull off the bead from the substrate for 50 mm per ageing cycle.

In case of cohesive failure, slowly increase the peeling force until the sealant begins to tear, then, as the failure progresses, cut the sealant again to the bonding surface. Always pull as close as possible to the tensile strength of the applied product. Continue to peel the sealant and cut again after sealant has begun to fail cohesively. There should be an interval of about 3 seconds between each incision, during which the material is subject to further strain. Repeat this process until a bead length of minimum 50 mm per ageing cycle is peeled off. The distance between the cuts should be approximately 3 mm to 6 mm (See Figure 6, Figure 7 and Figure 8).

Figure 6 — Preparation for peeling

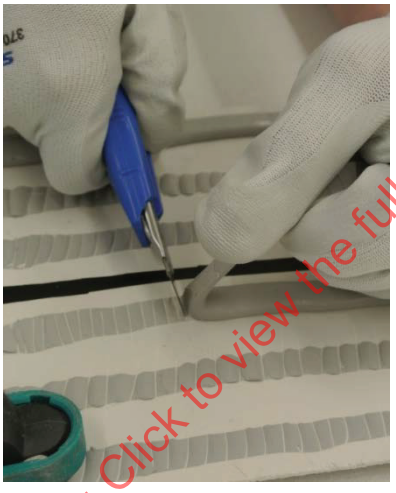
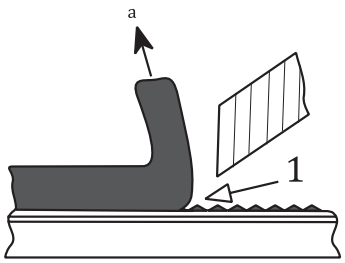


Figure 7 — Testing



Key

1 stress

[a] Pull.

Figure 8 — Peel stress

The bond line shall be kept under maximum stress. Keep this stress maintained for approximately 3 s to 5 s to see if adhesion loss occurs. Slowly increase the load and place a next cut just before the sealant breaks. Cutting too early may hide adhesion weaknesses.

9 Evaluation

The failure patterns of the peeled beads shall be determined 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 paint, primer etc., this shall be differentiated during the evaluation. The failure patterns shall be evaluated in the following manner:

Report the failure close to the nearest 10 %.

Other failure patterns can also occur, especially in the case of multilayer substrates. If an evaluation according to the above-mentioned 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.

Some examples for observations beside cohesive or adhesive failure are as follows:

— sealant not cured;

— bubbles in the sealant;

— bubbles in the adhesion zone;

— foam structure in the adhesion zone;

— cohesion failure in the primer;

— adhesion failure between primer and its substrate;

— cohesion failure in the paint;

— 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);

— adhesion loss without peeling effort (BF).

10 Test report

The test report shall contain at least the following information:

a) reference to this technical report;

b) type name, batch number and color of the sealant;

d) substrates, including coatings;

e) surface pre-treatment (e.g. cleaner, primer etc. including batch number if applicable);

f) details of method used for the bead application;

c) curing conditions (like temperature, humidity, duration etc.);

g) ageing conditions (for examples see Annex A);

h) test results according to this document for each aging condition rounded to nearest 10 %, including potential quality defects;

i) all deviations from this document, including an explanation;

j) date and reference of technician of the testing.