

English Version

Adhesives - Determination of tensile lap-shear strength of bonded assemblies

Adhésifs - Détermination de la résistance au cisaillement en traction d'assemblages collés à recouvrement simple

Klebstoffe - Bestimmung der Zugscherfestigkeit von Überlappungsklebungen

This European Standard was approved by CEN on 27 December 2008.

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Foreword

This document (EN 1465:2009) has been prepared by Technical Committee CEN/TC 193 “Adhesives”, the secretariat of which is held by AENOR.

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of an identical text or by endorsement, at the latest by August 2009, and conflicting national standards shall be withdrawn at the latest by August 2009.

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 1465:1994.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Safety statement

Persons using this document should be familiar with the normal laboratory practice, if applicable. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any regulatory conditions.

ENVIRONMENTAL STATEMENT — It is understood that some of the material permitted in this standard may have negative environmental impact. As technological advantages lead to acceptable alternatives for these materials, they will be eliminated from this standard to the extent possible.

At the end of the test, the user of the standard shall take care to carry out an appropriate disposal of the wastes, according to local regulation.

1 Scope

This European Standard specifies a method for determining the tensile lap-shear strength of bonded assemblies when tested on a standard specimen and under specified conditions of preparation and testing.

NOTE 1 This test procedure is not applicable for calculations needed for bond design in structural joints.

NOTE 2 This test Test methods for the determination of tensile lap-shear strength of bonded assemblies with wood adhesives are also specified in EN 205 and EN 302-1

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 13887, *Structural Adhesives - Guidelines for surface preparation of metals and plastics prior to adhesive bonding*

EN ISO 291, *Plastics - Standard atmospheres for conditioning and testing (ISO 291:2005)*

EN ISO 527-1, *Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:1993 including Corr 1:1994)*

EN ISO 10365, *Adhesives - Designation of main failure patterns (ISO 10365:1992)*

3 Principle

Adhesive lap-shear bond strength is determined by stressing in shear of a single overlap joint (see Figure 1) between rigid adherends by applying to the adherends a tensile force which is parallel to the bond area and to the major axis of the specimen. The reported result is the observed force or stress at rupture.

4 Apparatus

4.1 Testing machine

It shall comply with a test machine, class 1 and the response time of the machine shall be short enough not to affect the accuracy with which the force applied at the time of rupture can be measured.

NOTE The recorded force shall not differ from the true applied force by more than 1%. The machine shall be capable of applying a tensile force that increases at a steady rate. Where equipment does not allow for constant rate of load application, a rate of jaw separation shall be used which approximates the rate of loading (see EN ISO 527-1). It shall be provided with a suitable pair of self-aligning grips to hold the specimen. The grips and attachments shall be so constructed that they will move into alignment with the test specimen as soon as the load is applied, so that the long axis of the test specimen will coincide with the direction of the applied force through the centre line of the grip assembly to avoid bending moment. Grips that operate by bolting through the adherends shall be avoided since such grips give rise to undesirable stress concentration.

4.2 Jig

for accurately locating adherends during bonding.

5 Specimens

5.1 Unless otherwise specified, test specimens shall conform to the form, dimensions, and alignment as shown in Figure 1. The recommended length (L) of overlap is $(12,5 \pm 0,25)$ mm.

NOTE 1 The choice of dimensions other than those shown in the Figure 1 may result in difficulties in the interpretation of results.

NOTE 2 This overlap is intended for aluminium alloys and materials of similar or higher moduli of elasticity (E) and tensile yield strength.

EXAMPLE For AA 2024-T3 or AECMA AL-P 13 PL (T3) : E = 68 000 MPa

Tensile yield strength at 0,2 % offset = 290 MPa.

5.2 The test joints may be prepared either individually or from slotted or unslotted panels (see Figure 1). Each method is equally suitable either for development or for comparative tests.

5.3 The adherend surface shall be properly treated to obtain an optimum bond. Surface treatments shall be in accordance with manufacturer's instructions or EN 13887 unless otherwise specified. The adhesive shall be applied and cured according to the recommendations of the manufacturer of the adhesive. In the absence of such recommendations, the procedure shall be such as to achieve an optimum bond with minimum variations. In any case, the use of a jig to ensure the correct overlap and accurate alignment of the adherends is recommended.

Special care shall be taken in preparing individual specimens to ensure proper alignment and that bond thicknesses are as uniform and constant as possible.

The thickness should orient itself to the intended use. A typical thickness is 0,2 mm. Thicknesses can be controlled by inserting a calibrated wire spacer or small glass spheres in the bond area. If a wire spacer is used, the wire shall lie parallel to the direction of application of the load as this minimizes the effect of the wire on the joint.

The surfaces shall be prepared according to EN 13887 unless otherwise specified. For all adherends the method used for surface preparation shall be reported.

5.4 The number of test specimens will depend on the precision required, but reliance should not be placed on fewer than 5 observations.

6 Conditioning and testing atmosphere

The test specimens shall be conditioned and tested in one of the standard laboratory atmospheres specified in EN ISO 291.

7 Procedure

Locate the test specimen symmetrically in the grips, with each grip (50 ± 1) mm from the nearest edge of the overlap. A shim may be used in the grips so that the applied force will be in the plane of the adhesive bond.

Operate the machine so that the stress or strain on the test joint increases at a constant (i.e. steady) rate. This rate shall be such that the average joint will be broken in a period of (65 ± 20) s.

Record the highest force during rupture as the breaking force of that specimen. Results from test specimens that rupture in the adherend shall be discarded except for routine testing and noted in the test report.

8 Expression of results

Express the results of the tests as the arithmetic mean and coefficient of variation of the breaking force in newtons or the breaking stress in megapascals of the valid test specimens.

The tensile lap-shear strength, in megapascals, is calculated by dividing the breaking force, in newtons, by the shear area, in square millimeters.

NOTE It is suggested that the following criteria for repeatability and reproducibility should normally be observed for test results obtained using this European Standard:

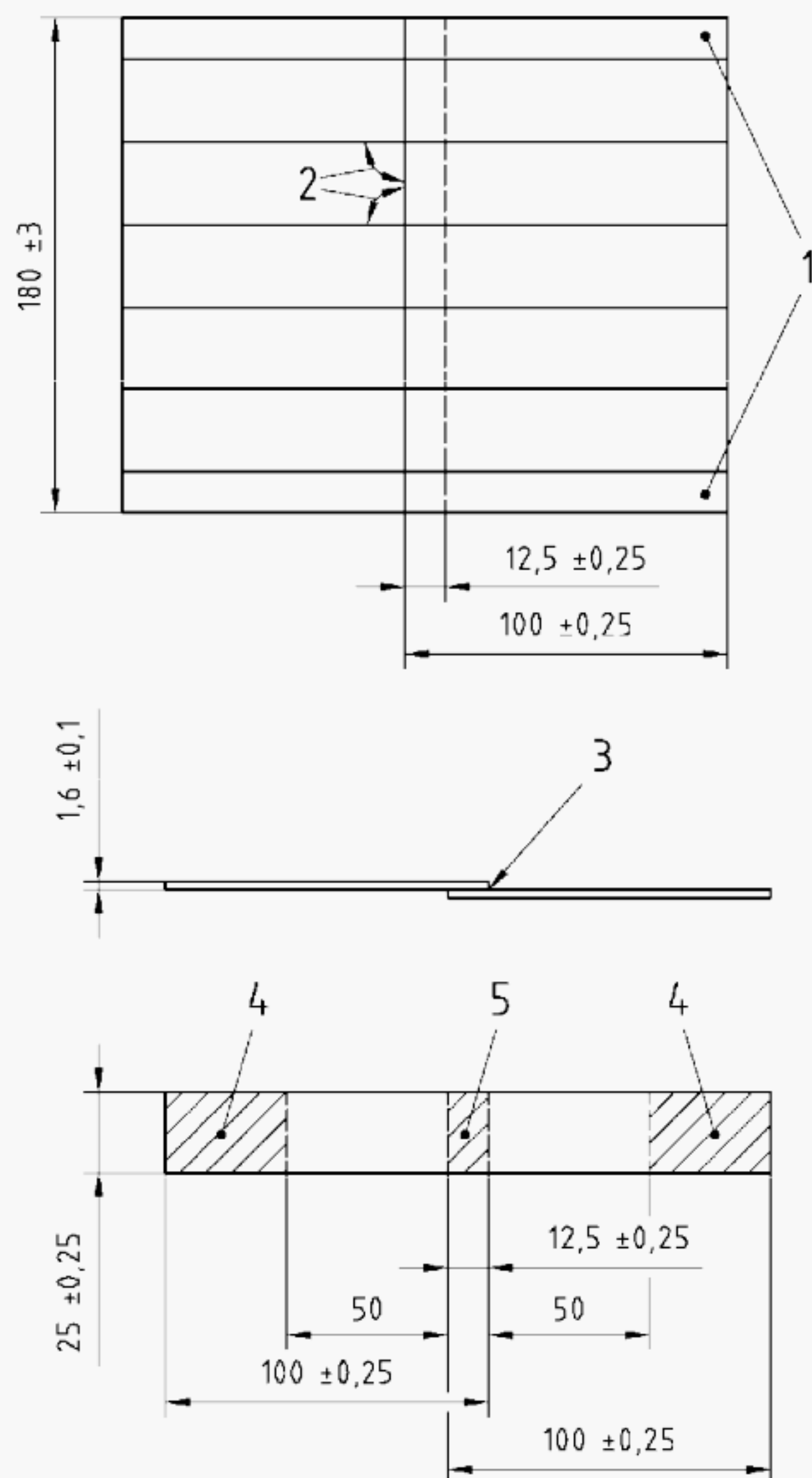
- a) the repeatability (see ISO 3534-1) (i.e. the difference between any two breaking forces obtained with one sample of adhesive by the same operator in a given test room or laboratory) should be less than 2,5 times the standard deviation.
- b) the reproducibility (see ISO 3534-1) (i.e. the difference between the mean breaking forces obtained with one sample of adhesive on the same system in different test rooms or laboratories) should be less than 20 % of the arithmetic mean of the individual mean values.

It is stressed that these criteria are offered for guidance; failure to meet one or other of the requirements does not of itself imply failure to comply with this European Standard.

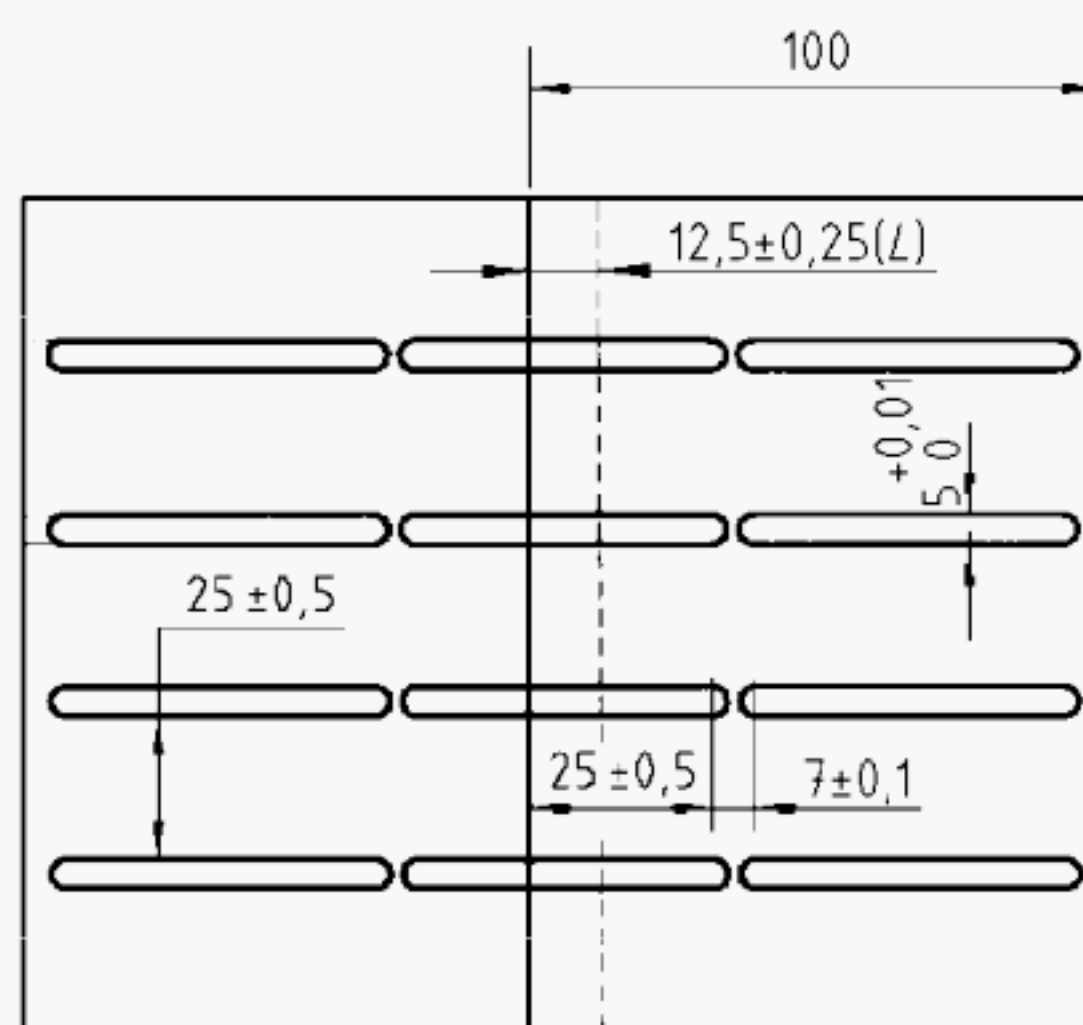
9 Test report

The test report shall include, at least, the following:

- a) reference to this European Standard (EN 1465);
- b) identification of the adhesive tested, including type, source, manufacturer's code number, batch or lot number, form, etc.;
- c) identification of adherends, including material thickness, width and surface preparation;
- d) description of bonding process, including method of application of adhesive, drying or curing conditions (where applicable), and curing or setting time, temperature and pressure;
- e) average thickness (as precisely as practicable) of the adhesive layer after formation of the bond, as well as the method used for controlling the bond thickness;
- f) complete description of the test specimen, including dimensions and construction of the test specimen, with nominal overlap of the joint, whether individual or of panel construction, whether slotted or unslotted panels, conditions used for cutting individual test specimens, number of test panels represented, and number of individual test specimens;
- g) conditioning procedure and applied parameters prior to testing, and test atmosphere;
- h) the rate of loading or rate of jaw separation;
- i) the individual breaking force or stress test results, the arithmetic mean and the coefficient of variation of the mean, together with information about the spread of results;
- j) type of failure according to EN ISO 10365;
- k) result from test specimens that rupture in the adherends;
- l) any operating deviations or difficulties that may have affected the results.



Standard test panel



Optional panel (slotted)

Key

- | | | | |
|---|------------------------------|---|--------------------|
| 1 | discard | 4 | area in test grips |
| 2 | typically $(90 \pm 1)^\circ$ | 5 | shear area |
| 3 | adhesive line | | |

Figure 1 — Forms and dimensions of test panels

Bibliography

- [1] ISO 3534-1, Statistics - Vocabulary and symbols - Part 1: General statistical terms and terms used in probability