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Adhesives — Determination of shear behaviour of structural adhesives —

Part 1: Torsion test method using butt-bonded hollow cylinders

Adhésifs — Détermination du comportement en cisaillement d'adhésifs structuraux —
Partie 1: Méthode d'essai en torsion de cylindres creux collés bout à bout

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 11003-1:2001), which has been technically revised. The main changes compared to the previous edition are as follows:

— correction of the formula for angular displacement in 7.2;

— updated references.

A list of all parts in the ISO 11003 series can be found on the ISO website.

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.

Adhesives — Determination of shear behaviour of structural adhesives —

Part 1:
Torsion test method using butt-bonded hollow cylinders

1 Scope

This document specifies a shear test for the characterization of adhesives in a bond. The shear stress/strain properties of the adhesive (including the shear modulus) are useful for advanced design work, such as in finite element analysis methods.

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 291, *Plastics — Standard atmospheres for conditioning and testing*

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

ISO 17212, *Structural adhesives — Guidelines for the surface preparation of metals and plastics prior to adhesive bonding*

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/

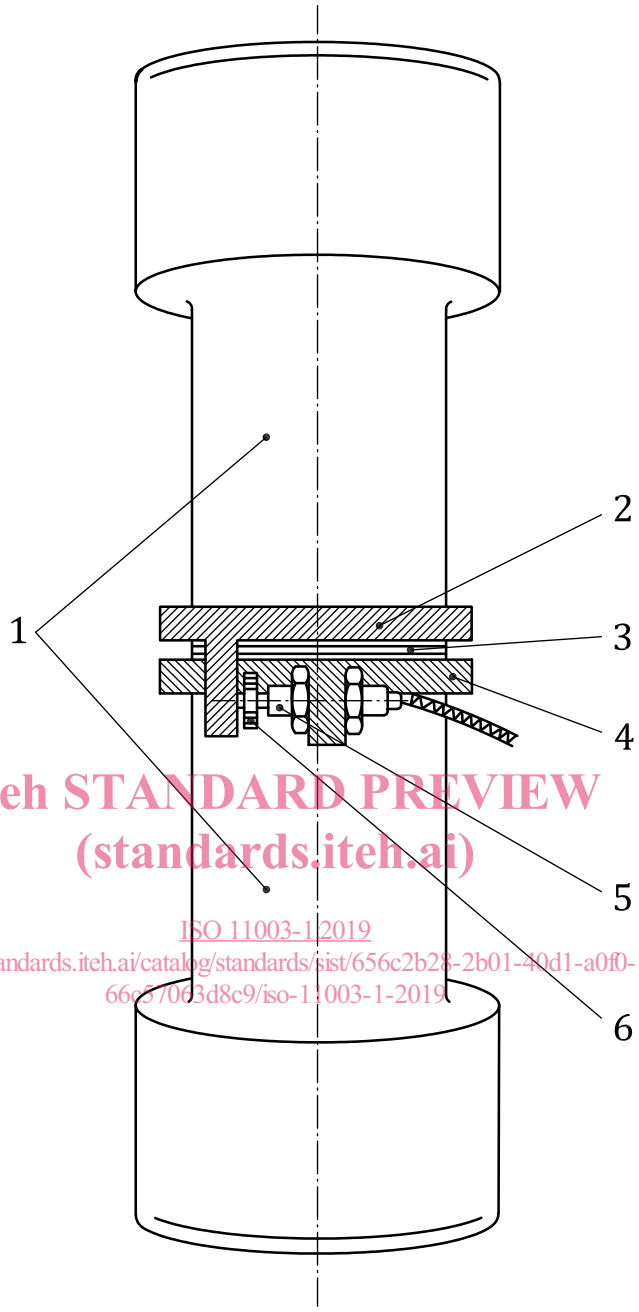
4 Principle

The shear deformation of the adhesive in an annular bond between two hollow cylinders, and the corresponding torque, are measured and recorded up to failure of the joint.

5 Apparatus

5.1 Torsion-testing machine, with a capacity of at least 300 N·m and preferably of 1 000 N·m. Alternatively, a suitably adapted tensile-testing machine may be used. The machine shall include equipment for recording the torque instantaneously with an error of less than 1 %. The gripping heads shall be accurately aligned and, if no hydraulic gripping mechanism is available, all bolts and holes shall be precisely machined so that the specimens are mounted in the apparatus and tested free of uncontrolled loads. The machine shall be equipped with an adequately thermostatted chamber if tests are to be carried out at temperatures different from the ambient temperature.

5.2 Displacement sensor (see Figure 1), capable of measuring, as near as possible to the bond line, the displacement of the two adherends relative to each other and hence the deformation of the adhesive. The sensor and its associated target shall be rigidly mounted on the two adherends as shown in Figure 1. The range of the displacement-measuring equipment shall be adjustable to permit the full-scale reading to be varied between 2 µm and 1 000 µm. The equipment shall be capable of measuring displacements to an accuracy of ±1 µm. The sensor shall be of lightweight and robust construction since it is subjected to high accelerations on failure of the specimen.



Key

1 adherends
2 target support (on upper adherend)
3 butt joint
4 transducer support (on lower adherend)
5 displacement transducer
6 target

Figure 1 — Adhesive-layer specimen with displacement transducer mounted in the test apparatus

6 Test specimen

6.1 Preparation

6.1.1 Substrate material

Aluminium alloy or steel are suitable materials for the adherends. Other materials are acceptable provided the material (including pre-treated surface layers) has a shear modulus at least 10 times higher than that of the adhesive.

6.1.2 Preparation of the surface

The surfaces to be bonded shall be prepared in accordance with ISO 17212 or by any method leading to a cohesive failure within the adhesive layer.

6.1.3 Bonding

Prepare the specimens in accordance with the instructions of the manufacturer of the adhesive. Information about conditioning of the specimen shall be included in the test report.

A joint completely filled with adhesive is essential for the reliability of the test. The two adherends shall be bonded coaxially, with a maximum lateral displacement between their two axes of 0,002 r_o (r_o = outer radius), and a maximum angular deviation so that the bond line thickness varies by no more than 5 % of the recommended thickness. The joining device shall prevent the adhesive from running out of the joint and any displacement of the two adherends during curing.

NOTE To achieve this, the two hollow cylinders are aligned with the help of a plug made of polytetrafluoroethylene (PTFE) or any other suitable device. A temperature-resistant O-ring, inserted into the PTFE plug and placed just below the bond, stops the adhesive from running out of the joint. At the other ends of the adherends, two plates fastened to a threaded rod passing through the PTFE plug prevent any displacement during curing (see Figure 2).

6.1.4 Adhesive bond

The preferred thickness of the bond is 0,2 mm.

For special adhesives, a thickness in the range from 0,05 mm to 0,5 mm may be used.

The thickness of the bond is defined by a rim which is machined along the outer perimeter of one adherend. The rim acts as spacer between the two adherends. The adhesive is applied to the machined adherend to fill the space adjacent to the rim, prior to joining the two adherends. The rim is removed on the lathe after the adhesive is cured (see Figure 3). The resulting adhesive layer shall have a width at least 10 times its thickness.

6.1.5 Dimensions

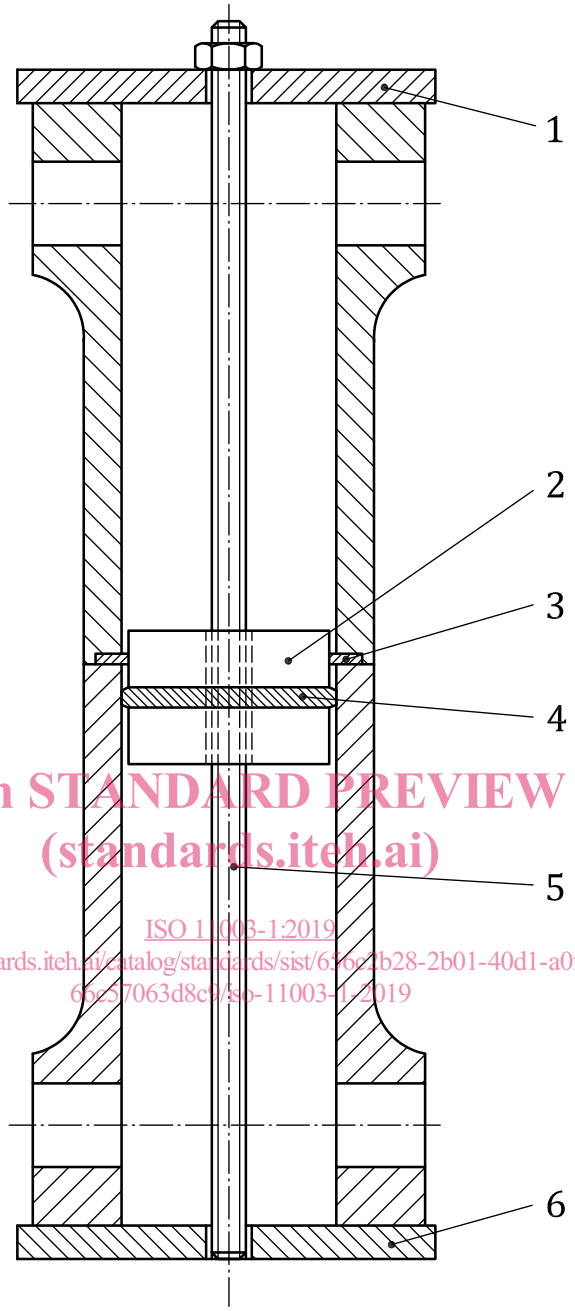
Three sizes of specimen (A, B, C) are recommended (see Table 1), although intermediate sizes are acceptable provided that [see Formula (1)]:

$$r_i \geq 0{,}8 r_o \quad (1)$$

where

r_i is the inner radius of each cylinder;

r_o is the outer radius of each cylinder.



Key

1 top plate
2 polytetrafluoroethylene plug
3 adhesive layer
4 o-ring
5 rod with screw thread
6 bottom plate

Figure 2 — Coaxially aligned hollow cylinders in a suitable joining device