
**Adhesives — Determination of shear
behaviour of structural adhesives —**

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

iTeh STANDARD PREVIEW

*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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Contents

| | Page |
|------------------------------|------|
| 1 Scope | 1 |
| 2 Normative references | 1 |
| 3 Principle | 1 |
| 4 Apparatus | 1 |
| 5 Test specimen | 3 |
| 6 Test conditions | 6 |
| 7 Procedure | 6 |
| 8 Calculations | 7 |
| 9 Precision | 7 |
| 10 Test report | 8 |

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 11003 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11003-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This second edition cancels and replaces the first edition (ISO 11003-1:1993), which has been technically revised.

ISO 11003 consists of the following parts, under the general title *Adhesives — Determination of shear behaviour of structural adhesives*:

- Part 1: *Torsion test method using butt-bonded hollow cylinders*
- Part 2: *Tensile test method using thick adherends*

Adhesives — Determination of shear behaviour of structural adhesives —

Part 1:

Torsion test method using butt-bonded hollow cylinders

1 Scope

This part of ISO 11003 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, e.g. in finite element analysis methods.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 11003. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11003 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

[ISO 11003-1:2001](#)

ISO 291:1997, *Plastics — Standard atmospheres for conditioning and testing*

ISO 4588:1995, *Adhesives — Guidelines for the surface preparation of metals*

ISO 10365:1992, *Adhesives — Designation of main failure patterns*

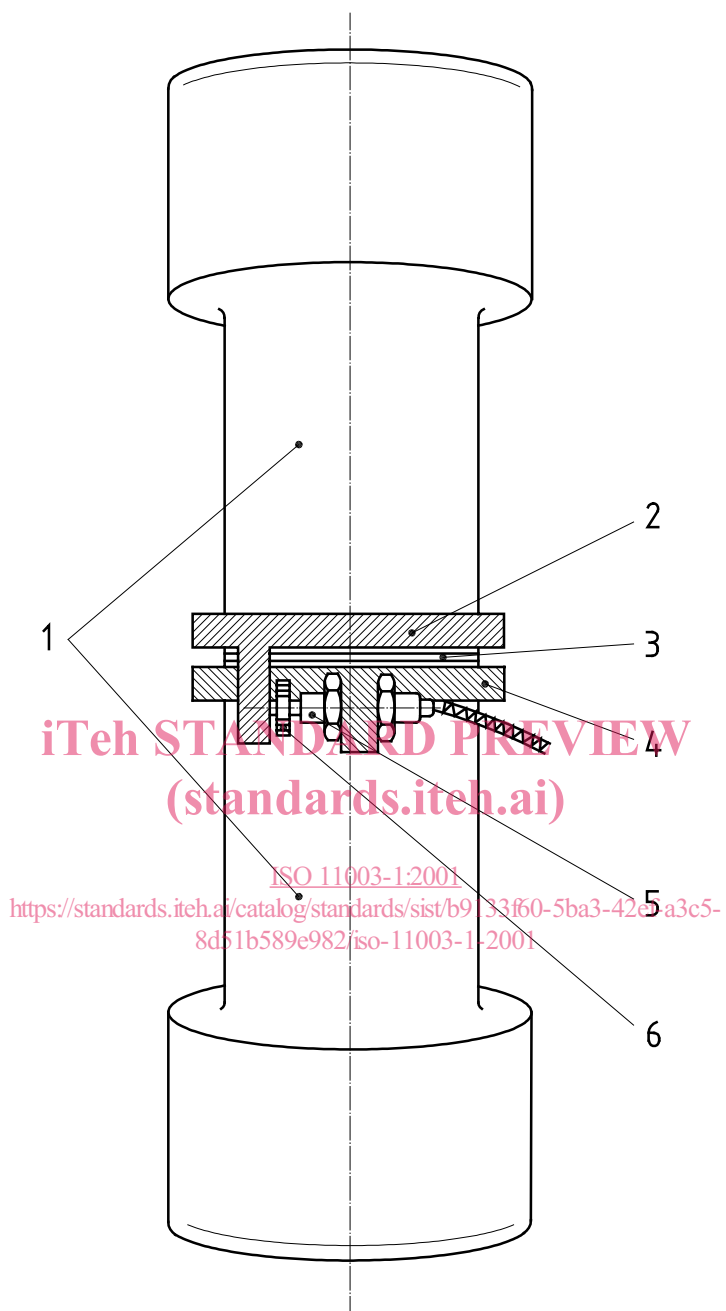
3 Principle

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.

4 Apparatus

4.1 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.

4.2 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

5 Test specimen

5.1 Preparation

5.1.1 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 ten times higher than that of the adhesive.

5.1.2 Preparation of the surface

The surfaces to be bonded shall be prepared in accordance with ISO 4588 or by any method leading to a cohesive failure within the adhesive layer.

5.1.3 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 may be 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).

5.1.4 Adhesive bond

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

NOTE 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 ten times its thickness.

5.1.5 Dimensions

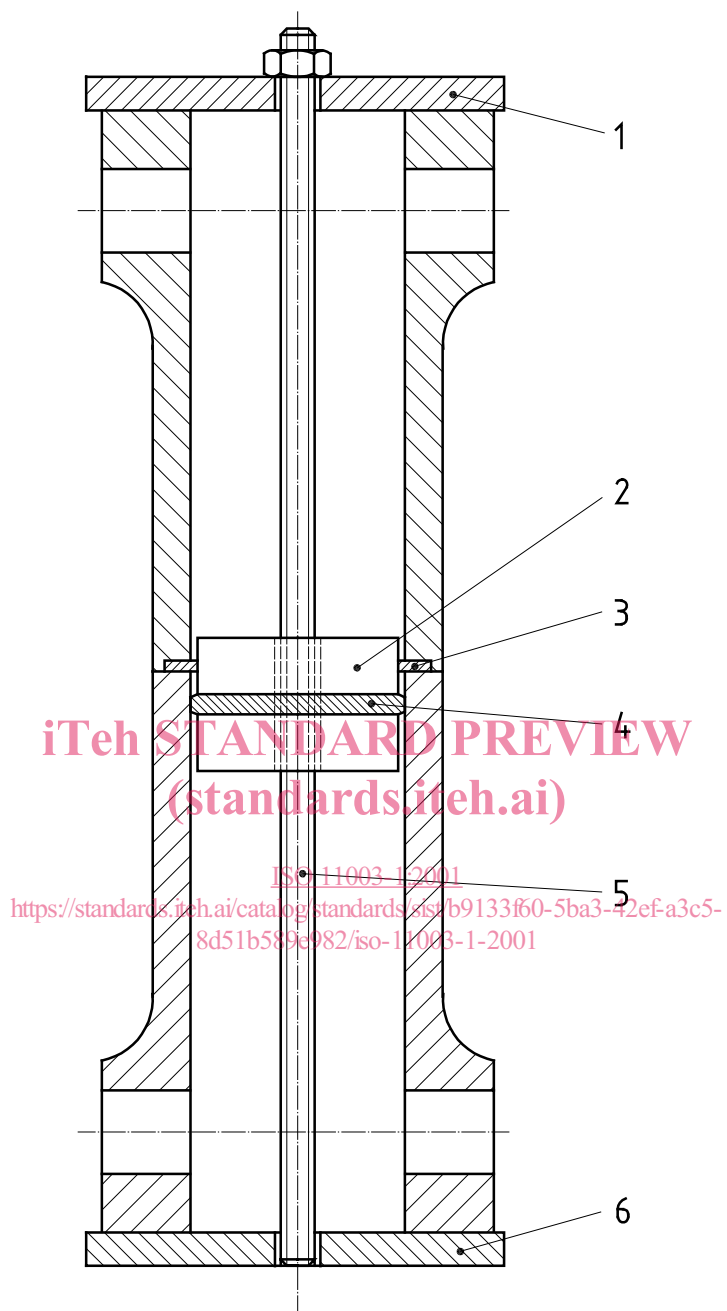
Three sizes of specimen (A, B, C) are recommended (see Table 1), although intermediate sizes are acceptable provided that

$$r_i \geq 0,8 r_o$$

where

r_i is the inner radius of each cylinder;

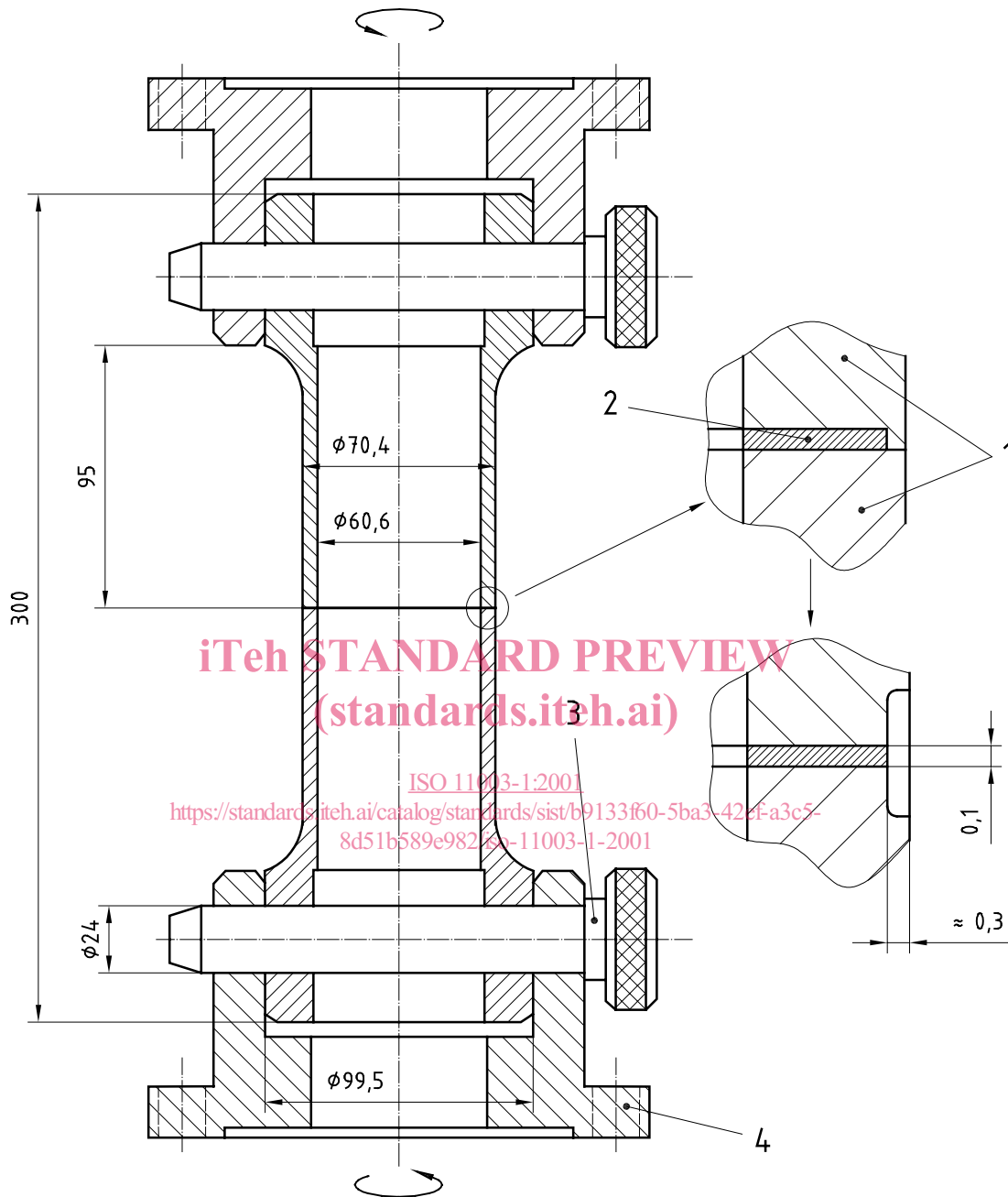
r_o is the outer radius of each cylinder.



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



Key

- 1 Adherends
- 2 Adhesive
- 3 Bolt
- 4 Fixture

NOTE The rim spacer that controls the thickness of the bond is shown in the upper detail view. Before testing, the spacer is removed, as shown in the lower detail view.

Figure 3 — Dimensions of the specimen and specimen holders