
Adhesives — Determination of the bond strength of engineering-plastic joints

*Adhésifs — Détermination de la résistance de joints collés des
plastiques industriels*

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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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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.

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).

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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 second edition cancels and replaces the first edition (ISO 15509:2001), which has been technically revised. The main changes compared to the previous edition are as follows:

- the list of normative references in [Clause 2](#) has been updated;
- the mandatory terms and definitions clause ([Clause 3](#)) has been inserted.

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.

Introduction

Methods of determining the strength of adhesive joints are well known. Several International Standards describe various methods including the lap-shear test or the butt torsion test. However, these methods are either not suitable for the determination of values which can be used for design purposes, or are restricted to metallic substrates. Because the existing International Standards for the measurement of the strength of bonded plastic materials are derived from test methods for metals and are less suitable for plastic materials due to the bending of substrates and varying modulus of elasticity, a new test method and a new test geometry have been developed and are described in this document.

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Adhesives — Determination of the bond strength of engineering-plastic joints

1 Scope

This document describes a test method for measuring the shear and/or tensile strength of an adhesively bonded plastic/plastic specimen of a specific design. This method allows the determination of a combined shear and tensile behaviour of the bond. These shear and tensile values are useful for design purposes.

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

A hollow cylindrical test specimen of specific design is used for the determination of the shear and tensile strengths of adhesively bonded plastic/plastic joints. These values can be used in calculation programmes. The rotationally symmetrical specimen allows testing under tensile, torsional or combined tensile/torsional loads if a suitable test machine is used.

NOTE 1 The shear stress is not uniformly distributed as the stress varies by approximately 15 % from the inner radius to the outer radius. Therefore, the calculated shear strength represents an “average” value.

NOTE 2 The origin of the stress distribution curve is the deformation of the bond line, as the deformation increases with increasing diameter. The superimposition of shear and tensile stresses is negligible in the bondline of rotationally symmetrical specimen compared to lap-shear specimen as described in ISO 4587. There are practically no significant peaks in the stress distribution curve compared with the peaks observed in a lap-shear specimen, since the bond is continuous in the direction of the displacement.

5 Specimen

5.1 Preparation

5.1.1 General

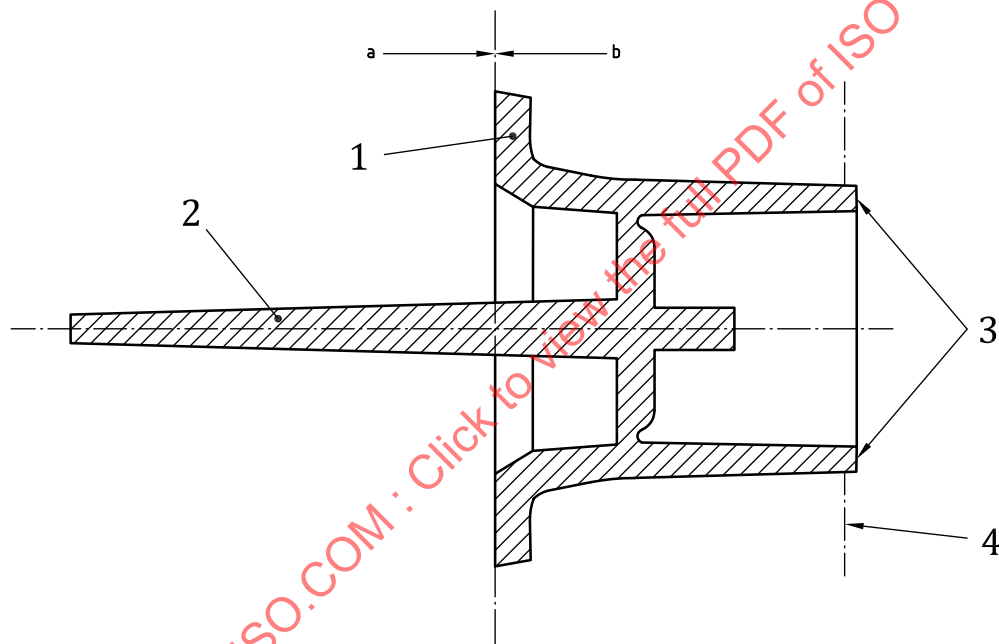
Prepare the adherends by injection moulding as described in [5.1.2](#) to [5.1.5](#).

5.1.2 Mould

The mould used shall be of the ejector-pin type with a limitation of one moulding per shot. The mould cavity shall be filled through a cone gate.

NOTE The use of this type of mould avoids weld lines which can lead to symmetry problems with the moulding after cooling, or to a weakening of the mechanical properties in this area.

A schematic drawing of an injection-moulded adherend is shown in [Figure 1](#).



Key

- 1 base of adherend
- 2 sprue
- 3 bonding areas
- 4 degassing zone
- a Injection direction.
- b Ejection direction.

Figure 1 — Schematic drawing of one of the adherends after moulding

The mould shall be manufactured in accordance with conventional mould-making processes. It shall be of an adequate size so as to allow the preparation of adherends of the dimensions shown in [Figure 2](#).

5.1.3 Injection-moulding parameters

The parameters shall be agreed upon between the user and the plastic material supplier.

NOTE 1 The injection-moulding parameters will depend on the geometry of the mould and the nature of the plastic material.

Dimensions in millimetres

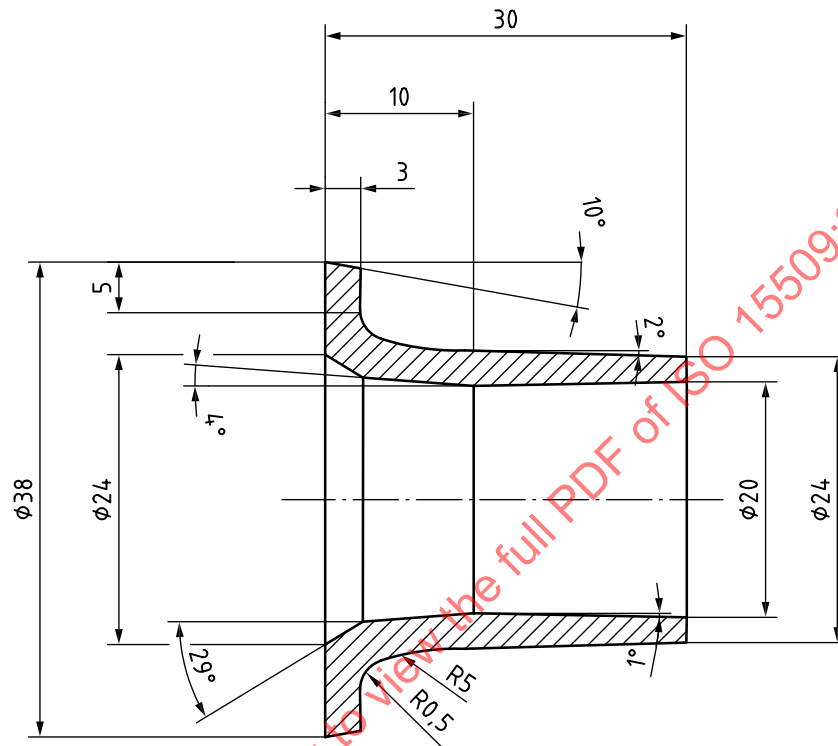


Figure 2 — Dimensions of adherend

The plastic material shall be pre-dried. The temperature and time shall be as agreed upon between the user and the plastic material supplier.

NOTE 2 Temperatures between 100 °C and 150 °C (depending on the type of plastic) over periods of 4 h to 6 h in a vacuum oven are the preferred conditions.

5.1.4 Removal of the sprue

Remove the central part, or sprue, from each of the adherends. A simple method consists of using a chisel while rotating the adherend in a lathe.

Avoid any contact with the bonding area during this operation.

5.1.5 Geometry

The specimen shall consist of two adherends bonded together.

The dimensions of each adherend shall be as given in [Figure 2](#).

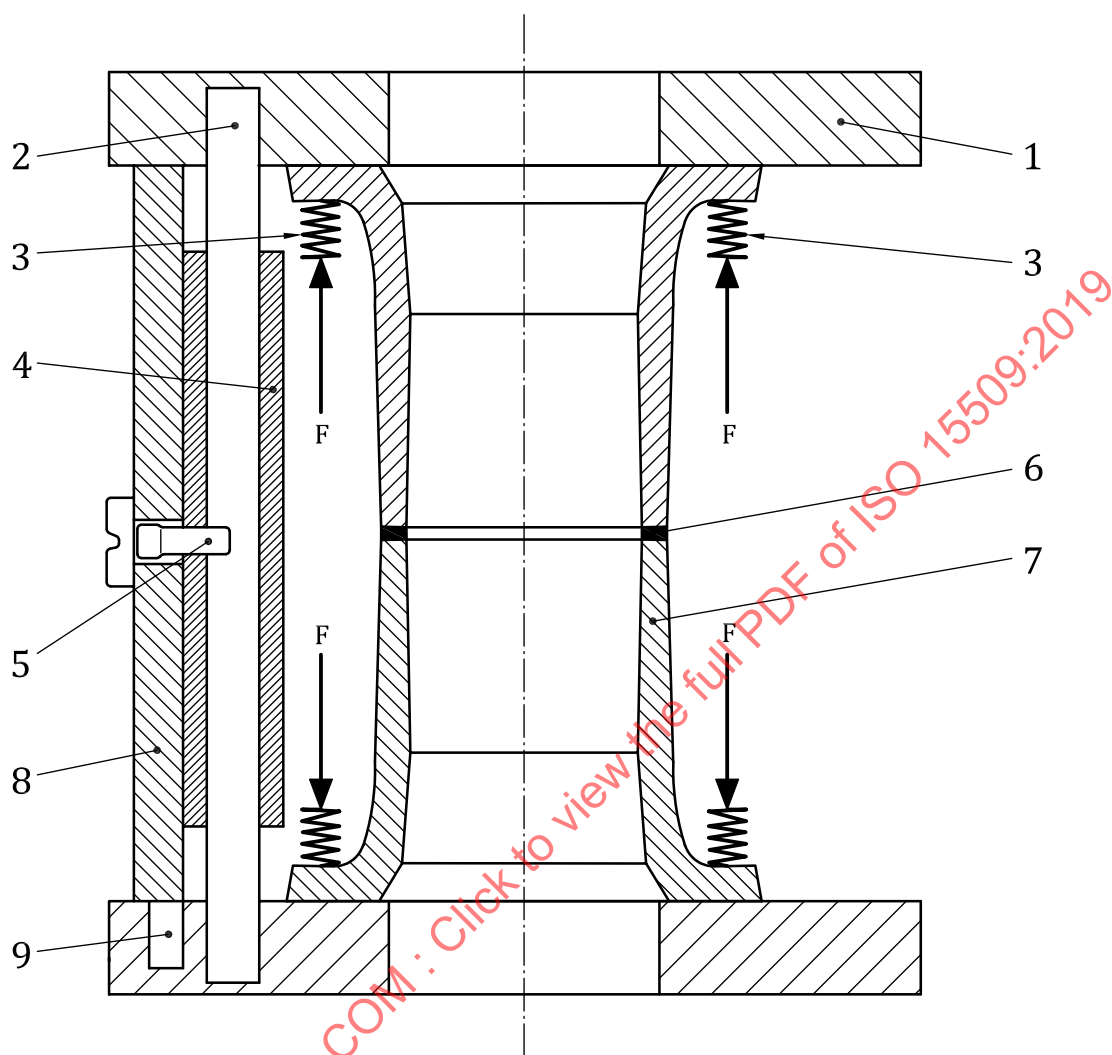
5.2 Surface preparation

Prepare the bonding surfaces of the adherends in accordance with ISO 17212.

Corona discharge at ambient pressure is the preferred method.

5.3 Assembly of the specimen in the mounting jig

Assemble the specimen using the mounting jig shown in [Figure 3](#).



Key

- 1 baseplate
- 2 guide pin
- 3 fixation holding the adherend on the baseplate (three fixation points round the circumference, using springs exceeding a force higher than the weight of the adherend)
- 4 metal sleeve
- 5 screw for fixing spacers on the metal sleeve
- 6 gap for adhesive bond
- 7 adherend
- 8 spacer used to define the bond gap thickness (three pairs of spacers round the circumference, manufactured from the same material as the adherends)
- 9 adjustment screw (for adjusting bond gap)

Figure 3 — Schematic drawing of the specimen during the assembly process

NOTE 1 The mounting jig allows a small amount of movement of the adherends. This compensates for deformations which are caused by the shrinkage or thermal expansion of the adhesive and the adherends during curing.

The spacers shall be made of the same material as the adherends in order to eliminate differences in thermal expansion between the spacers and the adherends.

The spacers shall be linked to the metal sleeves which shall be freely movable along the guide pins.

The alignment of the adherends in the two halves of the mounting jig shall be ensured by a metal centering cone on each baseplate. Each cone shall be freely rotating and have a spring (strong enough to prevent the adherend sliding) which presses the adherend against the centering cone. When contact is established between the adherends and the centering cones, fix the adherends in place at the fixation points.

Assemble both baseplates (with the adherends but without adhesive) by introducing the guide pins into the sleeves and verify the gap between them (for the adhesive bond). The gap can be adjusted by means of the adjustment screws.

NOTE 2 The adjustment is usually made in order to achieve a bond thickness of 0,1 mm.

5.4 Application of the adhesive

Apply the adhesive using the application device as shown in [Figure 4](#), as follows.

Place a baseplate carrying one of the adherends under the dispenser.

Adjust the dispenser so that the nozzle is located exactly above the application area. Apply the adhesive.

NOTE An automated rotating device coupled with the dispenser has been shown to give good results.

Assemble the two halves of the mounting jig and cure the adhesive in accordance with the manufacturer's instructions.

5.5 Conditioning and testing atmosphere

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

6 Apparatus

5.1 Test machine, equipped with a temperature-controlled enclosure for tests carried out at temperatures other than ambient.

5.2 Clamping jig (see [Figure 5](#)), consisting of an adapter, and two jaws with hinge, screw and locknut.

NOTE This special clamping jig allows easy and quick fixing of the specimen in the test machine.

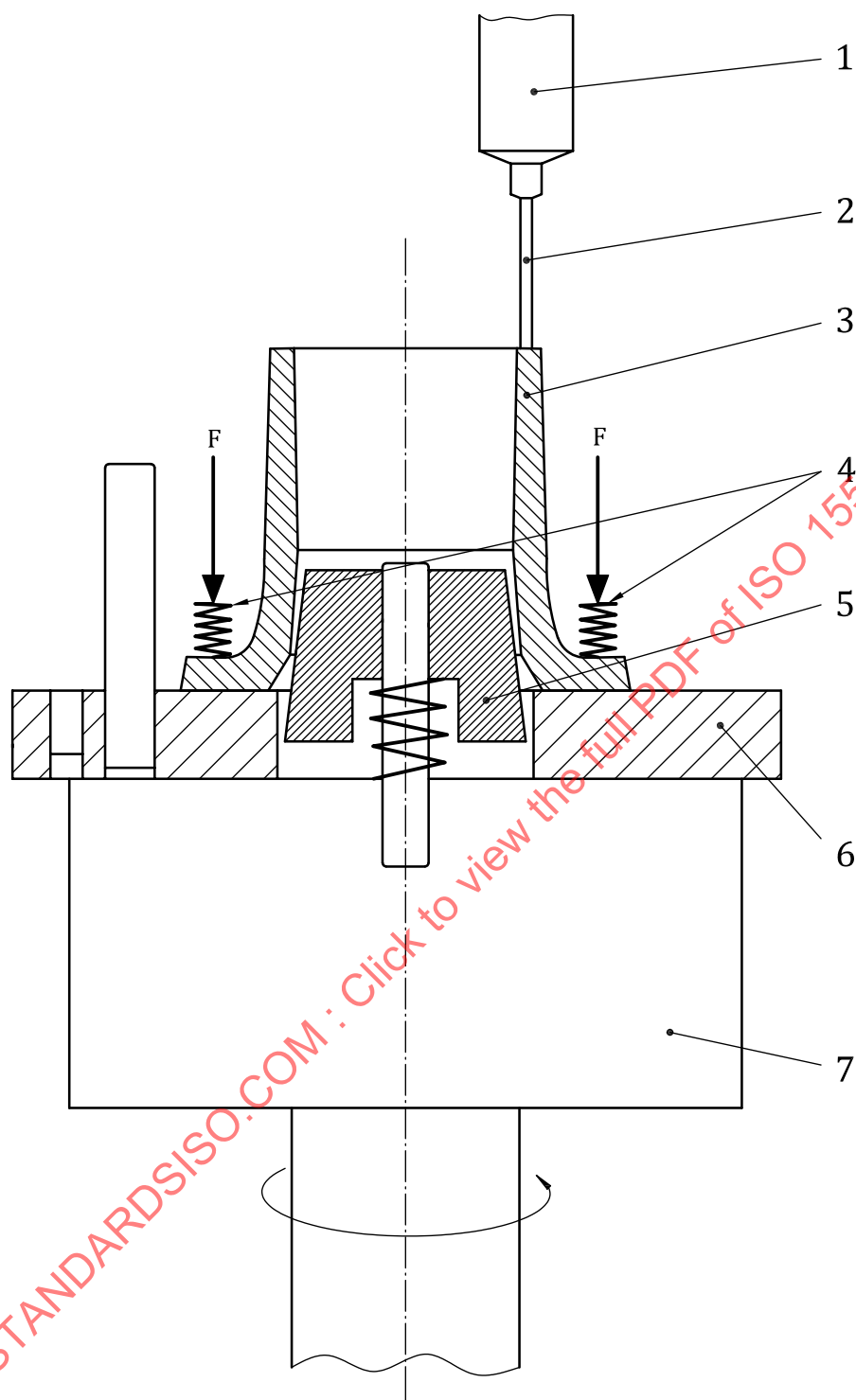
7 Procedure

Place the adapter and the specimen in the jaws. Secure them with the screws. Draw in the locknut to hold the specimen by its flange.

Insert the clamping jigs in the test machine, ensuring that no load is applied to the bonded joint.

Apply a tensile force at a crosshead speed of 1 mm/min and/or a torsional force at a speed of 5°/min until the joint fails. Record the ultimate force reached during the test.

Examine the surface of the bonded parts after failure, and record the failure pattern in accordance with ISO 10365.



Key

- 1 dispenser
- 2 dispenser nozzle
- 3 adherend
- 4 fixation holding the adherend on the baseplate
- 5 centering cone
- 6 baseplate
- 7 rotating support

Figure 4 — Application of the adhesive