

INTERNATIONAL
STANDARD

ISO
11003-2

First edition
1993-09-15

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

Part 2:

Thick-adherend tensile-test method
(standards.iteh.ai)

*Adhésifs — Détermination du comportement en cisaillement de joints
structuraux —*
Partie 2: Méthode d'essai en traction sur éprouvette épaisse



Reference number
ISO 11003-2:1993(E)

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.

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.

International Standard ISO 11003-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

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

- Part 1: *Torsion test method using butt-bonded hollow cylinders*
- Part 2: *Thick-adherend tensile-test method*

Annex A of this part of ISO 11003 is for information only.

© ISO 1993

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Adhesives — Determination of shear behaviour of structural bonds —

Part 2: Thick-adherend tensile-test method

1 Scope

This part of ISO 11003 specifies a test method for determining the shear behaviour of an adhesive in a single lap joint bonded assembly when subjected to a tensile force.

The test is performed on specimens consisting of thick, rigid adherends, with a short length of overlap, in order to obtain the most uniform distribution of shear stresses possible and to minimize undesired stresses.

This test method may be used to determine:

- the shear properties of an adhesive (stress and strain);
- the shear modulus of the adhesive;
- all other adhesive properties that can be derived from the stress/strain curve (secant moduli, shear stress at a given strain limit, etc.);
- the effect of temperature, environment, testing speed, etc. on these shear properties.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 11003. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 11003 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of

IEC and ISO maintain registers of currently valid International Standards.

ISO 291:1977, *Plastics — Standard atmospheres for conditioning and testing*.

ISO 683-11:1987, *Heat-treatable steels, alloy steels and free-cutting steels — Part 11: Wrought case-hardening steels*.

ISO 1052:1982, *Steels for general engineering purposes*.

ISO 2092:1981, *Light metals and their alloys — Code of designation based on chemical symbols*.

ISO 4588:1989, *Adhesives — Preparation of metal surfaces for adhesive bonding*.

ISO 4995:1991, *Hot-rolled steel sheet of structural quality*.

ISO 6361-2:1990, *Wrought aluminium and aluminium alloy sheets, strips and plates — Part 2: Mechanical properties*.

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

3 Principle

A single lap joint specimen is subjected to a tensile force so that the adhesive is stressed in shear.

The relative displacement of the assembly elements in the direction of the force in the overlap zone is an indication of the shear strain of the adhesive. It is

measured from the start of application of the load until fracture of the specimen. The shear stresses and strains are calculated from the applied force and relative displacement, and are plotted on a curve. The shear modulus of the adhesive is determined using the resulting stress/strain curve.

4 Apparatus

4.1 Tensile testing machine, producing fracture in the specimen at a tensile force between 10 % and 80 % of the full scale range.

4.2 Device for fastening the specimen, so that no torque develops when force is applied to the specimen. For this purpose it is possible to use a fastening device with a cardan mount, the specimen being fastened by means of pins (see figure 1).

4.3 Reference specimen, of the same material and dimensions as the bonded specimen less the thickness of adhesive, but of one piece (so that the deformation of the adherends in the overlap zone can be taken into account when the test results are evaluated).

4.4 Instrument for measuring strain, complying with the following specifications:

- measures strain in the elements to the nearest $1 \mu\text{m}$, in the overlap zone and as close as possible to the bonded joint (for example 1,5 mm away); the instrument shall be fitted with a device such as an extensometer with three measuring points (see note 1);

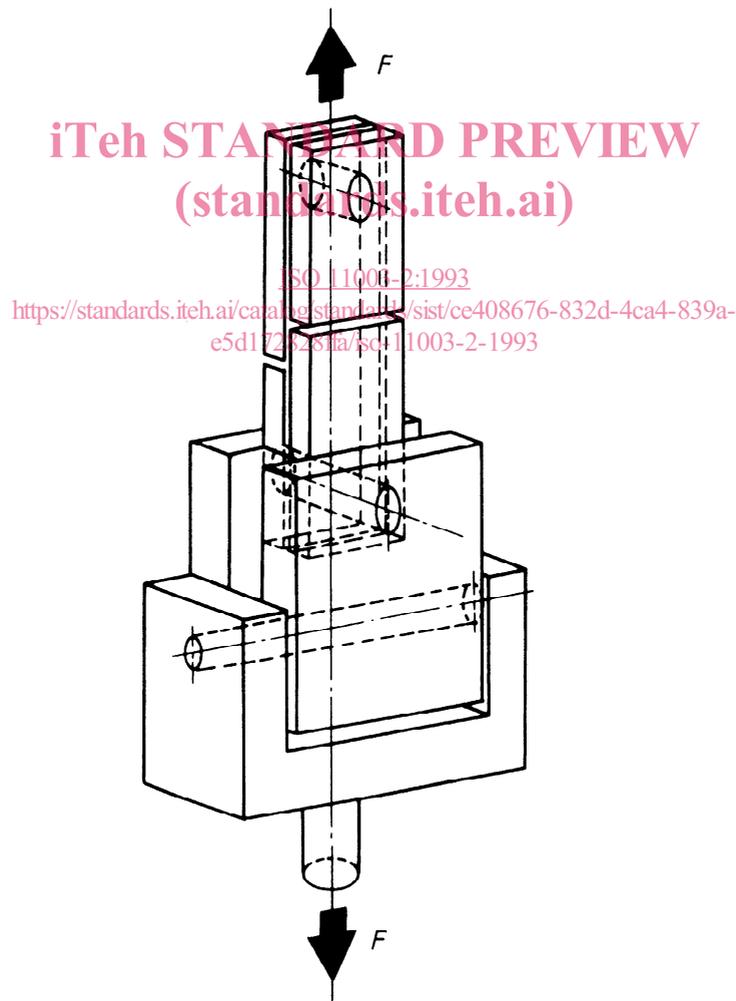


Figure 1 — Device for fastening the specimen on the testing machine (cardan mount)

— continuously records strain values as a function of the load applied.

The use of two extensometers (one on each side of the specimen) is recommended to minimize any symmetry defects in the specimen.

NOTE 1 A range of extensometers with inductive sensors has been developed in Germany by Althof and its collaborators at the DFVLR (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, 3300 Braunschweig). This DFVLR system (see annex A) is very suitable for the present application.

4.5 Recorder, to continuously record the relative displacement of the elements as a function of the load applied, from the start of application of the load until the specimen breaks.

The test load is recorded with an accuracy of $\pm 1\%$ with respect to the load applied.

4.6 Optical microscope, to measure the thickness of the bonded joint d_c with an accuracy of 0,01 mm.

5 Specimens

Prepare the specimens according to the instructions of the adhesive manufacturer. Information on conditioning of the specimens shall be included in the test report.

The specimens may be prepared individually or cut from bonded panels.

The specimens consist of single lap joint bonded assemblies.

5.1 Materials

Machined panels or bars, 6 mm thick (evenness: 2/100 mm), made of steel (in accordance with ISO 683-11, ISO 1052 and ISO 4995) or aluminium alloy (in accordance with ISO 2092 and ISO 6361-2).

NOTE 2 A suitable steel is XC 18 or E 24, grade 1 or 2. A suitable aluminium alloy is 2024 (AU 4 G 1) A5T3.

5.2 Preparation of surfaces before bonding

The surfaces to be bonded shall be prepared in accordance with ISO 4588, unless otherwise specified.

5.3 Bonding of specimens

5.3.1 Panels

The panels from which the specimens are cut shall consist of two sheets with dimensions in accordance with figure 2, bonded together on one side in accordance with the adhesive manufacturer's instructions.

In order to define the thickness of the adhesive, shims or spacers (metal foil) or calibrated metal wires may be incorporated outside the overlap zone.

5.3.2 Pre-cut panels

Proceed as in 5.3.1, using two pre-cut sheets so as to obtain a panel in accordance with figure 3.

Two holes shall be provided in each sheet so that the two sheets can be superposed correctly using an assembly with two centring lugs.

5.3.3 Individual specimens

Bond two bars of dimensions 110 mm \times 25 mm in accordance with the adhesive manufacturer's instructions.

Define the thickness of the adhesive joint as indicated in 5.3.1.

Use a suitable mount to position the two bars correctly on top of each other.

5.4 Dimensions of specimens

The dimensions of the specimens are given in figure 4. The specimen with extensometer is shown in figure 5.

The sides of the specimens and the overlap shall be parallel to the nearest 0,1 mm. The ends of the specimen shall be straight and perpendicular to the major surface.

5.5 Cutting and preparation of specimens

5.5.1 Panels

Cut the bonded panels into specimens using a suitable tool such as a band saw. Then subject the specimens to the required machining. Perform the last pass on the edge of the specimen parallel to the longitudinal direction of the specimen so as to avoid any metal burrs along the bonded joint.

Drill holes at the ends of the specimen for pins for holding the specimen to the tensile testing machine.

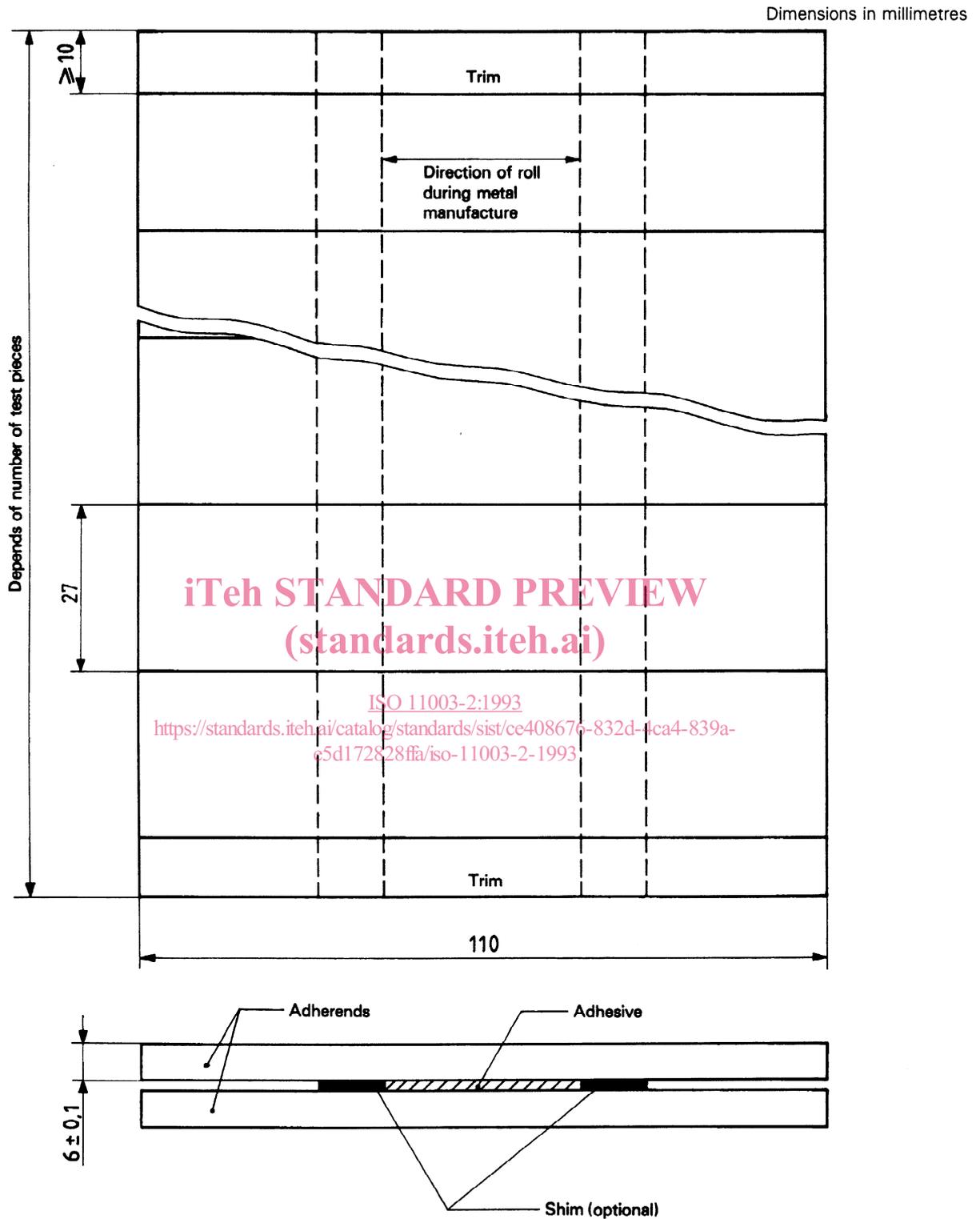


Figure 2 — Test panel for making specimen assemblies

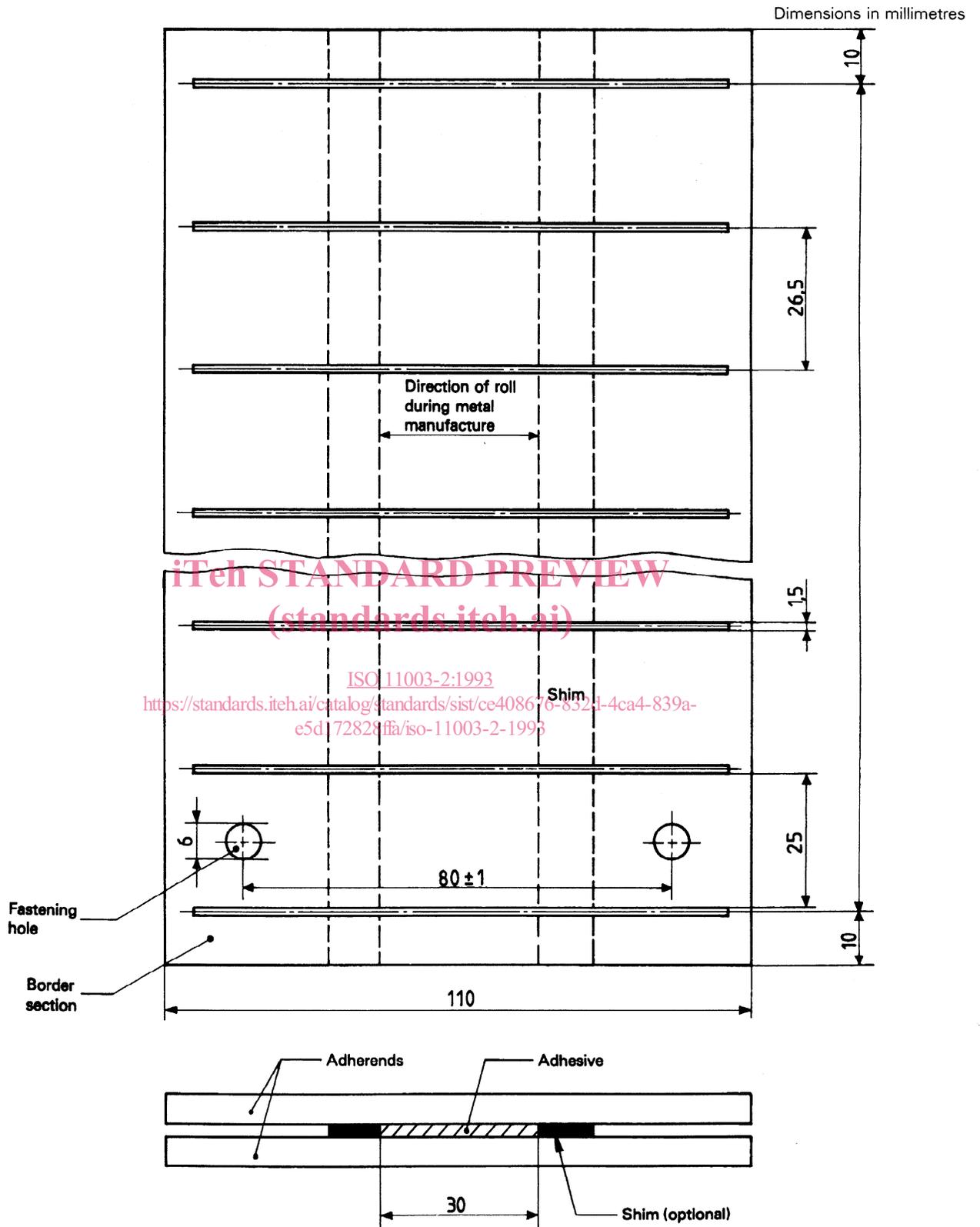


Figure 3 — Pre-cut panel for making specimen assemblies

Dimensions in millimetres

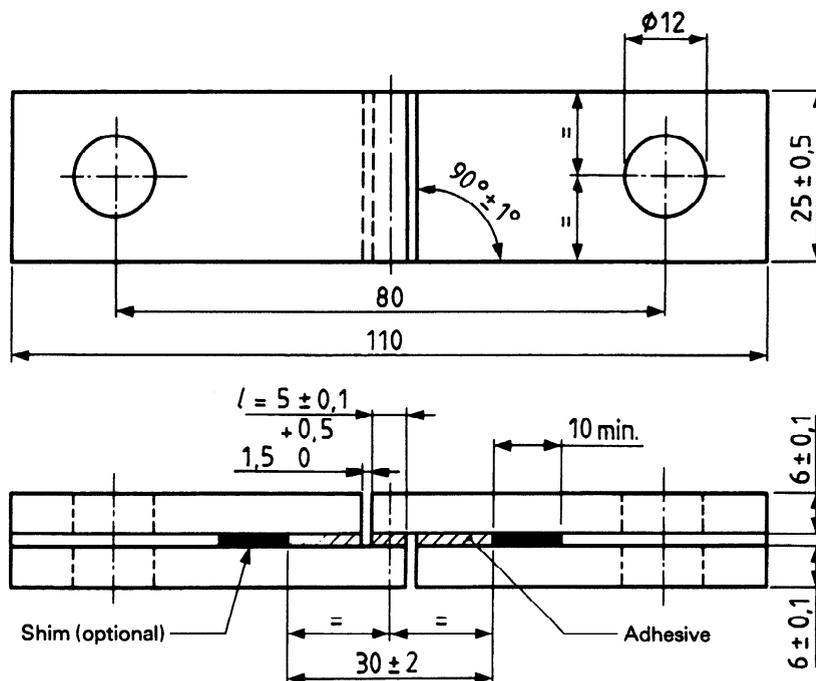


Figure 4 — Specimen
(standards.iteh.ai)

Delineate the overlap zone by milling two grooves as shown in figure 4.

When the specimens are machined, care shall be taken to ensure that the assembly is not heated above 50 °C. No liquid shall be used for cooling.

5.5.2 Pre-cut panels

Proceed in the same manner and order as specified in 5.5.1.

5.5.3 Bars

Machine specimens to the required size.

Drill holes for applying the load.

Make two grooves by milling to delineate the overlap.

Take the same precautions as in 5.5.1.

5.6 Number of specimens

At least three specimens shall be tested for a given adhesive.

6 Procedure

The temperature of the test shall be one of the standard temperatures specified in ISO 291.

Measure the length of the overlap l and the width of the specimens b to the nearest 0,1 mm.

Measure the thickness of the adhesive joint in the overlap zone at both ends and on each side of the specimen with an accuracy of 0,01 mm. Use the average value of the four measurements. If the difference between the end values is greater than 20 % of the average value, eliminate the specimen.

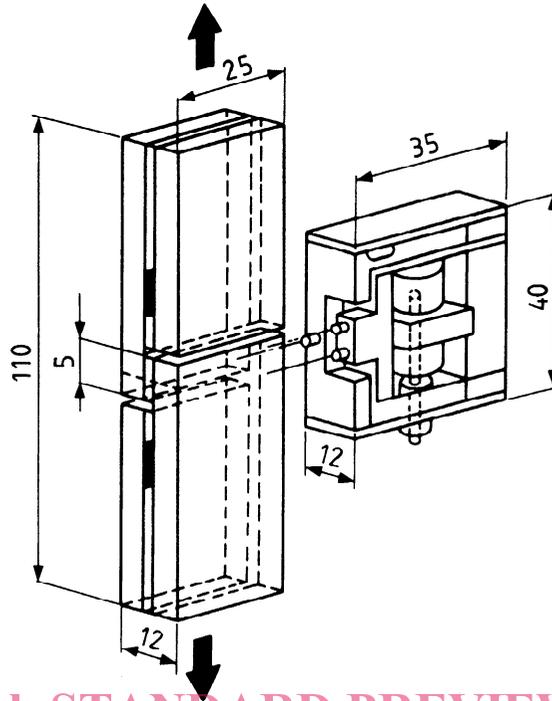
Place an extensometer on the edge of each side of the specimen (see figure 5), positioning the three reference points A, B and C as indicated in figures 6 and 7.

Test the specimen on the tensile testing machine at a constant machine speed of 0,5 mm/min.

Record the force/strain curve to fracture.

Similarly, test the reference specimen (4.3) at the same speed and record the force/strain curve to the fracture force measured for the specimen.

Dimensions in millimetres



iTeh STANDARD PREVIEW

Figure 5 — Specimen for shear test with example of extensometer mounting
(standards.iteh.ai)

ISO 11003-2:1993
<https://standards.iteh.ai/catalog/standards/sist/ce408676-832d-4ca4-839a-e5d172828ffa/iso-11003-2-1993> Adhesive

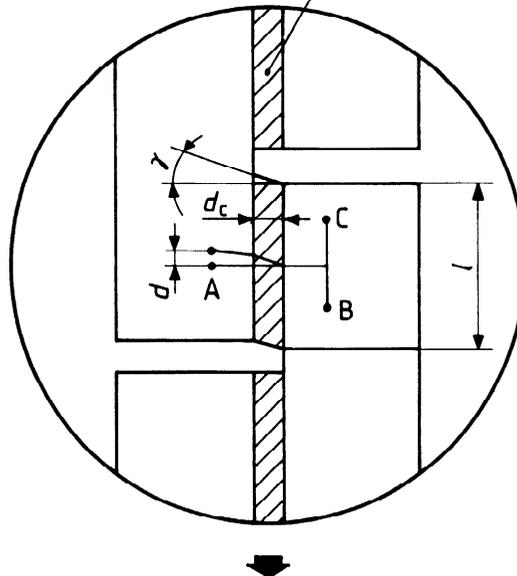


Figure 6 — Shearing of an adhesive joint in the specimen