

INTERNATIONAL STANDARD

**ISO
9653**

Second edition
1998-08-01

Adhesives — Test method for shear impact strength of adhesive bonds

Adhésifs — Essai de tenue au choc par cisaillement du joint adhésif

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Reference number
ISO 9653:1998(E)

ISO 9653:1998(E)**Foreword**

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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 9653 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This second edition cancels and replaces the first edition (ISO 9653:1991). In addition to normative references, requirements have been added for the preparation of plastic-to-plastic specimens prior to bonding (8.1.3), and the requirements for specimen conditioning (9.1) and for the reporting of failure patterns (10.4.3) changed.

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Adhesives — Test method for shear impact strength of adhesive bonds

1 Scope

1.1 This International Standard specifies a method for the determination of the comparative impact value of adhesive bonds in shear, when tested on standard specimens, and using specified conditions of preparation, conditioning and testing.

1.2 The method is intended to be used for wood-to-wood or metal-to-metal bonds, but may be extended to cover plastics-to-plastics bonds as well as bonds between combinations of these materials.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 291:1997, *Plastics — Standard atmospheres for conditioning and testing.*

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

ISO 9142:1990, *Adhesives — Guide to the selection of standard laboratory ageing conditions for testing bonded joints.*

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

ISO 13895:1996, *Adhesives — Guidelines for the surface preparation of plastics.*

3 Definition

For the purposes of this International Standard, the following definition applies.

3.1 impact value: Energy absorbed by a specimen of standard design when sheared by a single blow of a testing-machine hammer. The impact value is expressed in joules per square metre.

4 Principle

The impact value is determined by using a pendulum-type impact machine on a metal-to-metal or wood-to-wood specimen.

5 Apparatus

5.1 Pendulum-type impact machine, with a impact-head velocity of 3,4 m/s, comprising the elements specified in 5.1.1 to 5.1.3.

5.1.1 Impact head, with a flat striking face slightly wider than the specimen and aligned to strike the specimen full-face.

5.1.2 Specimen-holding fixture, as shown in figure 1. The fixture illustrated is not always suitable for use with all impact machines and vices. Dimensions and design of the fixture may be varied as required for adaptation to machines and vices available, provided the following general requirements are met:

The fixture shall be machined from a solid piece of steel and solidly bolted to the base of the testing machine. Corners shall be drilled to ensure that the specimen sets flush against the retaining end of the fixture. The drilled corners are provided to minimize dirt collection at the corners which could hold the end of the specimen away from the face of the fixture. The fixture shall be provided with a screw to tighten the specimen in the fixture to minimize the tendency of the specimen to overturn when struck. A metal plate may be placed between the end of the block and the end of the screw when non-metallic adherends are used. The fixture shall be so located that the specimen will be struck at the point of maximum head velocity.

Dimensions in millimetres

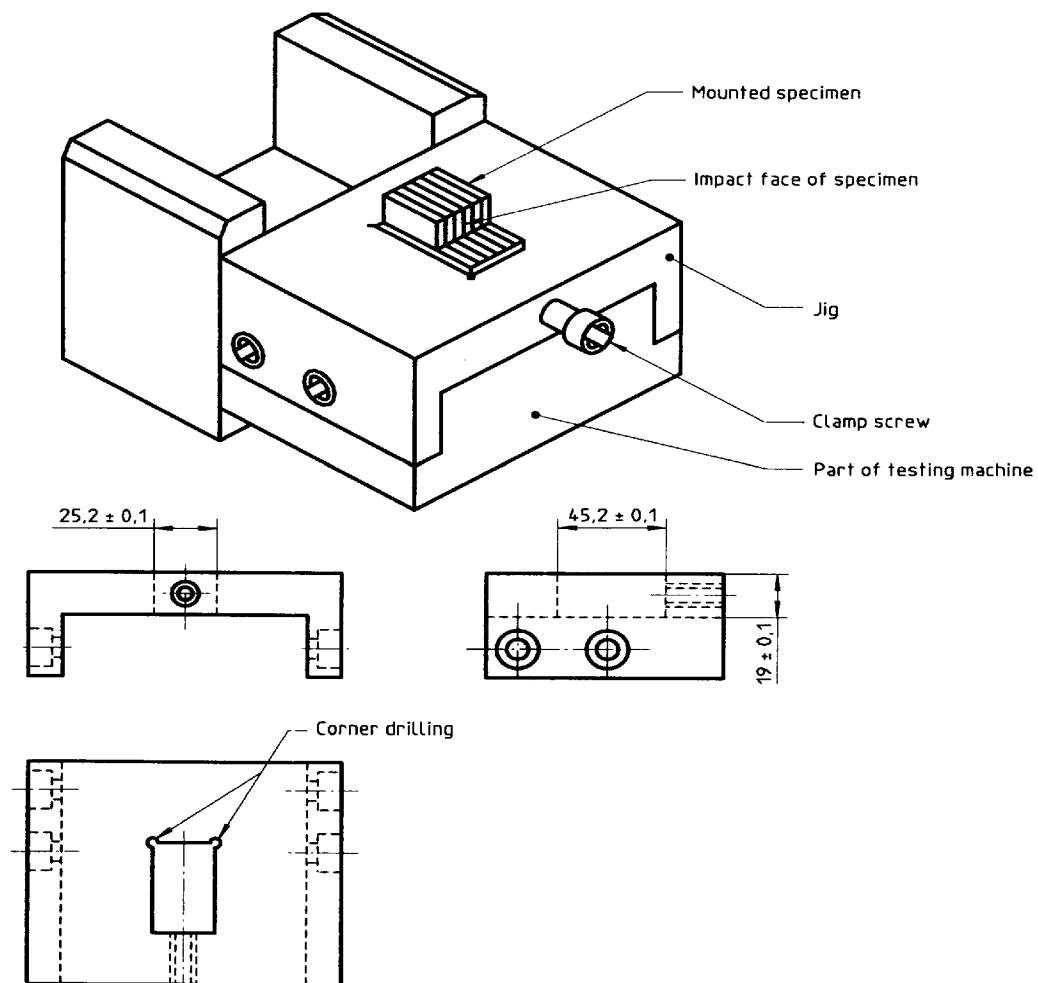


Figure 1 — Adapter fixture for impact machines

5.1.3 Vice or bolts, to hold the fixture firm and immobile under the stress of the testing-machine hammer. The total height of the vice fixture and specimen shall be such that the lower edge of the striking face of the impact head strikes the specimen as near the adhesive line as possible, preferably within 0,80 mm. Ordinarily, the distance between the top of the jaws of the vice of the machine and the bottom of the striking face of the head is 22 mm. The proper height of the specimen may be obtained by adjusting its height in the fixture.

NOTE — Additional information on impact-testing machines and their calibration may be found in ISO 178:1993, *Plastics — Determination of flexural properties*, and ISO 179 (both parts), *Plastics — Determination of Charpy impact properties*.

5.2 Conditioning chamber, capable of maintaining a relative humidity of $(50 \pm 5) \%$ at $23 \text{ °C} \pm 2 \text{ °C}$.

NOTE — A saturated solution of calcium nitrate will give approximately 51 % relative humidity at the test temperature.

6 Specimens

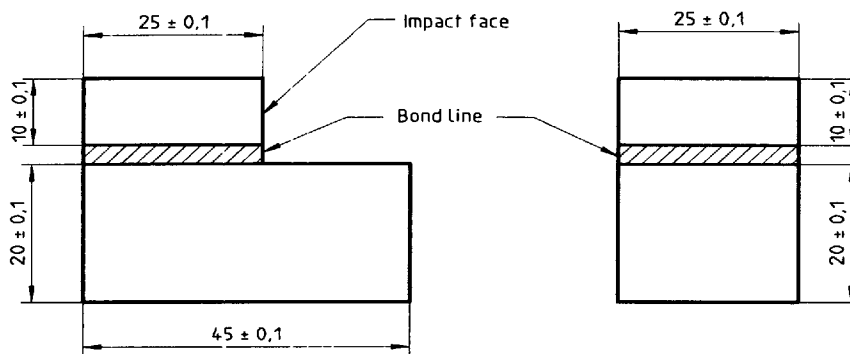
6.1 The specimen for metal-to-metal adhesives shall conform to the dimensions given in figure 2a) whenever possible. In cases where this specimen cannot be fractured in the testing machine available, the dimensions of the 25 mm by 25 mm block may be reduced to a smaller square, keeping the dimensions of the 25 mm by 45 mm block constant. The dimensions of the specimen and bonded area shall be clearly stated in the test report (clause 13). In any case, it is desirable that the specimen size be such as to give impact strengths that fall somewhere near the middle range of the testing machine, since readings in the highest and lowest ranges are often unreliable. The specimen shall be assembled in such a way that the face receiving the impact load is at the point of maximum velocity of the impact head. The impact face of the specimen shall be square and flat, perpendicular to the plane of the bond, and parallel to the striking face of the pendulum.

Tests on adhesives with high impact strength should be conducted on steel to minimize deformation. Specimens may be re-used after testing, provided that the face receiving the impact is not deformed.

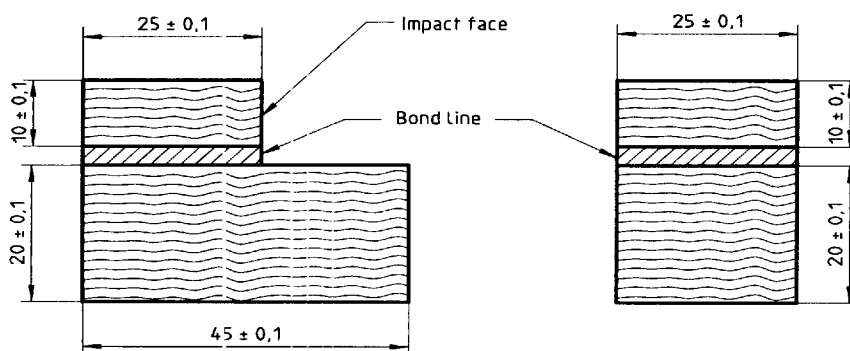
6.2 Specimens for wood-to-wood adhesives shall conform to the dimensions shown in figure 2b). The specimens shall be prepared by bonding blocks 10 mm thick by 25 mm wide, of convenient length, to blocks 20 mm thick by 45 mm wide, of the same convenient length, where the 25 mm and 45 mm dimensions, in each case, are those in the direction of the grain. Specimens, each 25 mm in width, may then be cut from the bonded assembly by cutting across the long dimension, in the grain direction. Wood having a minimum specific gravity of 0,65 based on oven-dry mass and volume shall be selected (see the note). These blocks shall be of straight grain and free from defects, including knots, birdseye, short grain, decay, and any unusual discolorations within the test area. The blocks shall be at the equilibrium moisture content recommended by the manufacturer of the adhesive. In the absence of such recommendation, the moisture content shall be from 10 % to 12 %, based on oven-dry mass as determined on representative samples (see the note). Just prior to bonding, the blocks shall be surfaced, preferably with a hand-feed jointer, and then weighed and assembled in pairs so that blocks of approximately the same specific gravity are bonded together. The surfaces shall remain unsanded and shall be free from dirt. Blocks shall be bonded as described in clause 8, after which specimens conforming to figure 2b) shall be prepared.

NOTE — Suitable woods are listed in annex B of ISO 6237:1987, *Adhesives — Wood-to-wood adhesive bonds — Determination of shear strength by tensile loading*. In this annex, the moisture content determination process is described as well.

Dimensions in millimetres



a) Metal-to-metal specimen



b) Wood-to-wood specimen showing grain direction

Figure 2 — Block shear impact specimen

7 Number of specimens

7.1 At least 10 specimens shall be tested for each adhesive in the case of metal-to-metal specimens.

7.2 At least 20 specimens shall be tested, representing at least four different joints, in the case of wood-to-wood specimens.

7.3 Specimens that break at some obviously fortuitous flaw remote from the bond line shall be discarded and retests made, unless such flaws constitute a variable the effect of which it is desired to study.

8 Bonding

8.1 Bonding shall be in accordance with the procedure outlined by the manufacturer of the adhesive.

8.1.1 For metal-to-metal specimens, preparation of areas that are to be bonded shall be in accordance with the recommendations of the manufacturer of the adhesive and with ISO 4588.

8.1.2 For wood-to-wood specimens, the grain of the wood shall be parallel in the two pieces and parallel to the bond line, as shown in figure 2b). If wood with a slight taper in the grain must be used, the pieces shall be assembled in such a way that the grain runs towards the bond line towards the back of the specimen. Thus, failures that start in the wood will be directed towards the bond line. Squeeze-out shall be removed when necessary to ensure proper positioning of the specimen in the fixture.

8.1.3 For plastic-to-plastic specimens, preparation of areas that are to be bonded shall be in accordance with the recommendations of the manufacturer of the adhesive and with ISO 13895.

8.2 Excess adhesive at the impact face [see figure 2a) and figure 2b)] shall also be removed carefully to ensure proper striking of the impact head.

9 Conditioning

9.1 Specimens shall be conditioned in accordance with ISO 291. If specimens are aged prior to testing, use ISO 9142.

9.2 All wood specimens shall be conditioned at a relative humidity of $(50 \pm 5) \%$, and at a temperature of $23 \text{ °C} \pm 2 \text{ °C}$ for a period of 7 days, or until specimens reach equilibrium as indicated by no progressive changes in mass, whichever is the shorter period.

9.3 Special conditioning procedures may be used by agreement between the manufacturer and the purchaser.

10 Procedure

10.1 Test in an atmosphere such that the moisture content of the wood specimens developed under the conditions prescribed in 9.2 is not noticeably altered during testing, and test as soon as possible after the conditioning period prescribed in 9.2.

10.2 Place the specimen in the fixture in the vice of the impact machine in such a way that the specimen butts squarely against the retaining end of the fixture. Rest the impact head of the machine gently against the specimen and adjust the fixture so that the head fits squarely against the impact face of the specimen.

10.3 Raise the impact head to a predetermined height and release the safety catch. The impact energy absorbed by the specimen may be read directly.

10.4 Record the following information:

10.4.1 Record, in joules, the energy absorbed in producing failure of the specimen.

10.4.2 Record the bonded area of the specimen.

10.4.3 Record the failure pattern, determined in accordance with ISO 10365.

10.4.4 In the case of wood-to-wood adhesives, record the percentages of wood failure, adhesive failure and contact failure. This will be based on visual inspection.

11 Expression of results

Calculate the impact value of the specimen as the energy absorbed in producing failure of the specimen divided by the bonded area of the specimen, and express in joules per square metre. Report the values to the nearest 100 J/m^2 . Unit results cannot be extended to surfaces different from those tested.

12 Precision

The precision of this test method is not known because inter-laboratory data are not available. When inter-laboratory data are obtained, a precision statement will be added at the following revision.

13 Test report

The test report shall include the following:

- a) a reference to this International Standard;
- b) complete identification of the adhesive tested, including type, source, manufacturer's code numbers, form, etc.;
- c) the method used to prepare the specimens, the dimensions of the specimens and the materials bonded;
- d) the average thickness of the adhesive layer after formation of the joint, within 0,03 mm (the method of obtaining the thickness of the adhesive layer shall be described, including the procedure, location of measurements and range of measurements);
- e) the conditioning procedure used;
- f) the atmospheric conditions in the test chamber;
- g) the number of specimens tested;
- h) the actual bonded area;
- i) the failure pattern;
- j) the maximum, minimum and average value of the impact strength, plus the average value of the percentages of wood, adhesive and contact failures for the wood specimens, or cohesion, adhesion and contact failures for the metal specimens.

ICS 83.180

Descriptors: plastics, adhesives, adhesive bonded joints, tests, adhesion tests, impact tests, shear tests, determination, shear strength.

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