

# INTERNATIONAL STANDARD

**ISO  
4578**

Third edition  
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## **Adhesives — Determination of peel resistance of high-strength adhesive bonds — Floating-roller method**

*Adhésifs — Détermination de la résistance au pelage des assemblages  
à forte cohésion — Méthode des galets mobiles*

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Reference number  
ISO 4578:1997(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 4578 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This third edition cancels and replaces the second edition (ISO 4578:1990), which has been technically revised.

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# Adhesives — Determination of peel resistance of high-strength adhesive bonds — Floating-roller method

## 1 Scope

This International Standard specifies a floating-roller method for the determination of the peel resistance of high-strength adhesive bonds between a rigid adherend and a flexible adherend when tested under specified conditions of preparation and testing.

Note — There are indications that the floating roller may produce more constant numerical data than other peel methods. However, it should not be expected that the flexible adherend will conform to the surface of the roller.

## 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 using the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291:—<sup>1)</sup>, *Plastics — Standard atmospheres for conditioning and testing.*

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

ISO 5893:1993, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Description.*

ISO 7500-1:1986, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tensile testing machines.*

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.*

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1) To be published. (Revision of ISO 291:1977)

### 3 Definition

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

**peel resistance:** The average force per unit test-specimen width, measured along the bond line, required to separate progressively the two members of a bonded test specimen under specified conditions of test. It is expressed in kilonewtons per metre of width.

### 4 Principle

This method consists of measuring the force necessary to peel a flexible adherend from a rigid adherend at a given angle defined by the peel test fixture, using rollers allowing constant alignment of the flexible peeled-off adherend with the grips of the tensile testing machine.

### 5 Apparatus

**5.1 Tensile testing machine,** capable of maintaining a pre-determined constant crosshead rate. The machine shall be capable of determining the maximum load. The measured strength shall be between 15% and 85% of the capacity of the load measuring device. The machine shall enable the applied force to be measured and recorded with an accuracy of 1%.

The machine shall have a suitable self-aligning grip to hold the test specimen. The jaws of this grip shall firmly hold the outer 25 mm of the end of the flexible adherend. The grip and attachment shall be so constructed that they will move into alignment with the test specimen as soon as the force is applied, so that the flexible member of the test specimen will coincide with the direction of the applied pull through the centreline of the grip assembly.

The machine shall be autographic, giving a chart that can be read in terms of millimetres of crosshead movement as one coordinate and applied force as the other coordinate. It is recommended that inertialess equipment be used.

All equipment shall be calibrated regularly in accordance with ISO 7500-1 in the case of metal adherends and with ISO 5893 in the case of rubber and plastic adherends.

**5.2 Peel test fixture** (see figure 1), for supporting the test specimen. The fixture shall be attached to one of the cross-arms of the testing machine (5.1). The 25 mm diameter rollers on the test fixture shall roll freely. The angle determined by the rollers and the use of dual bearings are critical, and the rollers shall therefore be carefully maintained.

### 6 Test specimens

**6.1** An example of a test specimen is shown in figure 2. Test specimens may be prepared individually or cut from bonded panels. The bonded panels and individual test specimens shall consist of two adherends properly prepared and bonded together.

Dimensions in millimetres

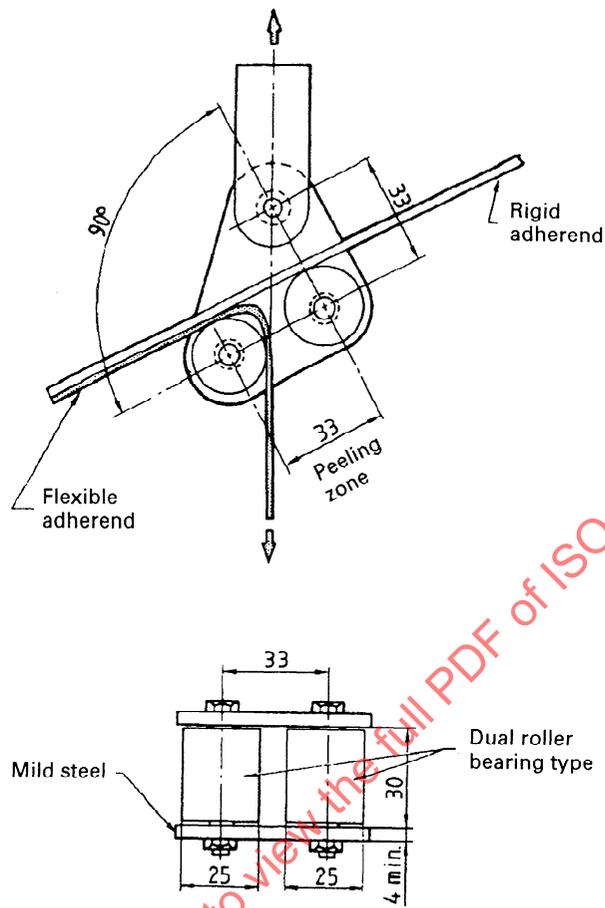


Figure 1 — Peel test fixture

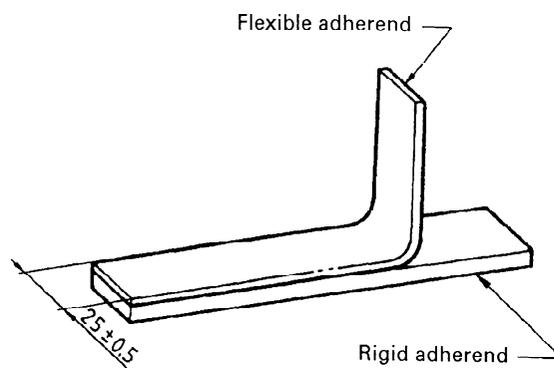
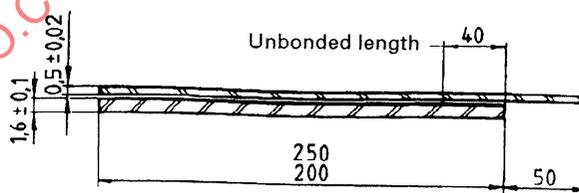


Figure 2 — Example of a test specimen

**6.2** The surface treatment shall be such as to obtain optimum strength in the bonded assembly. The preparation of the surface shall be in accordance with either ISO 4588 in the case of metals or ISO 13895 in the case of plastics or in accordance with the adhesive manufacturer's instructions, and shall be stated in the test report.

The adhesive shall be applied in accordance with the manufacturer's recommendations to obtain an optimum bond with minimum variation.

Note — Direct comparison of different adhesives can only be made when test specimen construction, adherend materials, adherend dimensions and test conditions are identical.

**6.3** The thickness of the flexible adherend shall be  $0,5 \text{ mm} \pm 0,02 \text{ mm}$  in the case of metal adherends, or thicker if other adherends are used, in order to reduce the deformation of the rigid adherend. The thickness of the rigid adherend shall be  $1,6 \text{ mm} \pm 0,1 \text{ mm}$ . The lengths of the adherends shall be as shown in figure 2.

**6.4** If test specimens are cut from bonded panels, this shall be done by a means that is not deleterious to the bond.

The width shall be either

a)  $25 \text{ mm} \pm 0,5 \text{ mm}$  (the preferred width)

or

b) any other convenient width, provided that the test equipment can accommodate it and the width is stated in the test report.

Note — The method used to cut the test specimens from a bonded panel will depend upon the adherend material, the adhesive composition and the tolerance required on the width (see figure 2). Milling and band-sawing are two methods commonly used for this purpose.

**6.5** The unbonded end of the flexible adherend shall be bent perpendicular to the rigid adherend so that it can be clamped in the grip of the testing machine.

**6.6** The number of specimens to be tested shall be as specified in the material specification or, if not so specified, the number shall be not less than five.

**6.7** The average bond thickness shall be determined for each specimen by measuring the total thickness of the pair of bonded adherends and subtracting the thickness of the two adherends.

**6.8** If specimens are aged prior the testing, select ageing conditions given in ISO 9142.

## 7 Conditioning and testing atmosphere

The test specimens shall be conditioned and tested in one of the standard laboratory atmospheres specified in ISO 291, unless otherwise agreed between the adhesive user and the adhesive manufacturer.

## 8 Procedure

**8.1** Insert the test specimen into the peel fixture (5.2) as shown in figure 1, with the unbonded end of the flexible adherend gripped in the free jaw of the testing machine (5.1). Peel the specimen at a constant crosshead separation rate of  $100 \text{ mm/min} \pm 5 \text{ mm/min}$ , unless otherwise specified. If the rigid adherend bends or is distorted during the test, redesign the specimen with a rigid adherend stiff enough to ensure even peeling.

**8.2** During the peel test, make an autographic recording of force versus crosshead movement (i.e. force versus distance peeled) over a length of at least 115 mm of the bond line, disregarding the first 25 mm of peel.

**8.3** Disregard the results if failure occurs outside the peeling zone as defined in figure 1.

## 9 Expression of results

Determine from the autographic curve, for at least 115 mm of peeling (disregarding the first 25 mm and the last 20 mm), the average peeling force, in kilonewtons per metre of test specimen width, required to separate the adherends. This average force may be determined from the curve by one of the following methods:

- a) By using a planimeter.
- b) A gravimetric method, as follows:

Cut out the area of the chart paper enclosed by the curve and the baseline (abscissa) and weigh it. Determine the surface area by dividing the mass of the area cut out by the previously determined mass per unit surface area of the chart paper. Divide the area thus determined by the length of the baseline (corresponding to 80 mm peeling length) to obtain the average height of the curve (and hence the average peeling force).

- c) By drawing the best straight line through the peeling curve, using a straight edge.
- d) By any other method, such as the use of a computer.

Also record the maximum and minimum forces for each individual specimen.

## 10 Precision

The precision of this 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.

## 11 Test report

The test report shall include the following information:

- a) a reference to this International Standard;
- b) all details necessary for complete identification of the adhesive tested, including type, source, manufacturer's code number, batch or lot number, form, etc.;
- c) all details necessary for complete identification of the adherends, including material, thickness, width and surface preparation;
- d) a description of the bonding process, including the method of application of the adhesive, the drying or pre-curing conditions (where applicable), and the curing time, temperature and pressure;
- e) the average thickness (as precisely as practical) of the adhesive layer after formation of the bond;
- f) a complete description of the specimen: whether individually prepared or cut from a panel, including the dimensions and construction of the specimen, the number of test panels represented and the number of individual specimens (when edge specimens are tested, they shall be designated "edge specimens");
- g) the conditioning procedure used prior to testing and the test conditions used;
- h) the crosshead separation rate, if other than 100 mm/min;
- i) the method used to determine the average peeling force;
- j) the average, maximum and minimum peeling-force values, in kilonewtons per metre of specimen width, for each individual specimen (edge samples shall be reported separately);
- k) the type of failure, in accordance with ISO 10365.

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