
**Aeronavtika ņ Nekovinski materiali ņ Konstrukcijska lepila ņ Preskusna metoda ņ
6. del: Doloņ anje striĥne napetosti in striĥne deformacije**

Aerospace series - Non-metallic materials - Structural adhesives - Test method - Part 6:
Determination of shear stress and shear strain

Luft- und Raumfahrt - Nichtmetallische Werkstoffe - Strukturelle Klebstoffe -
Prüfverfahren - Teil 6: Bestimmung der Schubspannung und Gleitung

Série aérospatiale - Matériaux non métalliques - Systeme d'adhésifs structuraux -
Méthodes d'essai - Partie 6 : Détermination de la contrainte et de la déformation de
cisaillement

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English Version

**Aerospace series - Non-metallic materials - Structural adhesives
- Test method - Part 6: Determination of shear stress and shear
strain**

Série aéronautique - Matériaux non-métalliques - Système
d'adhésifs structuraux - Méthodes d'essai - Partie 6 :
Détermination de la contrainte et de la déformation de
cisaillement

Luft- und Raumfahrt - Nichtmetallische Werkstoffe -
Strukturelle Klebstoffsysteme - Prüfverfahren - Teil 6:
Bestimmung der Schubspannung und Gleitung

This European Standard was approved by CEN on 26 September 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This European Standard (EN 2243-6:2005) has been prepared by the European Association of Aerospace Manufacturers - Standardization (AECMA-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of AECMA, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2006, and conflicting national standards shall be withdrawn at the latest by April 2006.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

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Introduction

This standard is part of the series of EN non-metallic material standards for aerospace applications. The general organization of this series is described in EN 4385. This standard is a level 3 document as defined in EN 4385.

1 Scope

This standard defines the general requirements for the determination of shear stress and shear strain behaviour of structural adhesives by testing in tension metal to metal lap joints, at ambient or other temperatures.

This method can also be used to investigate the influence of environmental exposures on structural adhesives.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system* (ISO 7500-1:2004).

EN 2243-1, *Structural adhesives — Test methods — Part 1: Single lap shear — Aerospace series*.¹⁾

EN 2334, *Aerospace series — Chromic-sulphuric acid pickle of aluminium and aluminium alloys*.

EN 2419, *Aerospace series — Aluminium alloy AL-P2024- — T351 — Plate — 6 mm < a ≤ 80 mm*.²⁾

EN 4385, *Aerospace series — Non-metallic materials — General organisation of standardisation — Links between types of standards*.²⁾

3 Definitions, symbols and abbreviations

3.1 Definitions

Not applicable

3.2 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

1) Published as AECMA Standard at the date of publication of this standard.

2) Published as AECMA Prestandard at the date of publication of this standard.

τ	average shear stress (in megapascals);
γ	angle of measured shear strain (in radians);
d	shear displacement (in millimetres);
t	adhesive thickness (in millimetres);
F	load (in newtons);
L	length of overlap (in millimetres);
W	width of overlap (in millimetres);
G_e	elastic shear modulus (in newtons per square millimetres).

4 Health and safety

This standard does not necessarily include all health and safety requirements, associated with its use.

Persons using this standard shall be familiar with normal laboratory/test house practices.

It is the responsibility of the user to establish satisfactory health and safety practices and to ensure conformity with any European, national or local laws/regulations.

5 Principle/Technique

Not applicable

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6 Resources

6.1 Apparatus

All test equipment shall be calibrated at intervals not exceeding 12 months.

6.1.1 Tensile testing machine

The tensile testing machine shall conform to class 1 of EN ISO 7500-1. The failing load of the test specimen shall be within 20 % and 80 % of the upper limit of the selected loading range of the machine.

6.1.2 Suspension

In order to obtain moment-free load application, a Cardanic suspension is required (see Figure 1).

6.1.3 Extensometers

They shall meet the following requirements:

- accuracy of test piece displacement measurement to within 0,001 mm;
- measurement of test piece overlap displacement (example of three point measurement is shown in Figures 1 and 2);

- continuous recording of the load-displacement curve;
- negligible influence of test piece deformation on test results.

To eliminate the effect of a non-uniform adhesive layer, it is recommended to measure the overlap displacement on both sides of the test piece (see note).

NOTE A correct determination of adhesive characteristics is only possible when properly measuring the adhesive layer shear deformation. Depending on the type of extensometer and its fixing to the test specimen, however, the measured value can include adherent deformations. This should be kept to a minimum. Otherwise, it is necessary to determine with the extensometer used on a dummy specimen (without adhesive layer) the adherent deformation corresponding to the test conditions in order to take it into account in the calculation.

6.1.4 Recorder

It shall record continuously the displacement (see 9.2) relative to the load applied throughout the test until failure occurs.

6.2 Materials/Reagents

Not applicable

6.3 Qualification of personnel

Not applicable

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7 Test samples/Test pieces

7.1 Materials

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7.1.1 For test temperatures up to 150 °C

Aluminium alloy EN 2419

7.1.2 For test temperatures above 150 °C

See EN 2243-1.

7.2 Surface preparation before bonding

EN 2334 unless otherwise specified

7.3 Bonding

The application and curing of the adhesive system (adhesive and primer) shall be carried out according to the material standard unless otherwise agreed with the adhesive system manufacturer.

Shims can be applied outside the overlap to adjust the adhesive thickness (see Figures 2 and 3). Adhesive shall not be applied at the location of the shims.

The entire mating surface of the two panels shall be bonded.

7.4 Dimensions of panels

See Figure 3.

7.5 Storage of test panels after bonding

They shall be stored under the following conditions:

- temperature : $(23 \pm 2) ^\circ\text{C}$;
- relative humidity : $(50 \pm 5) \%$.

7.6 Cutting of panels and preparation of test pieces

The panels shall be cut into test pieces (see Figures 2 and 3).

The panels made with high temperature curing adhesives shall be cut only after a storage period of 16 hours (see note 1).

NOTE 1 For batch acceptance testing, this 16 hours period can be omitted. Nevertheless, for temperature curing adhesive, care shall be taken to cut panels only when their temperature is down to ambient.

Perform the cutting operation so as to avoid overheating ($\leq 50 ^\circ\text{C}$) or mechanical damage to the joint (see note 2).

NOTE 2 A fine-tooth, circular or band-saw has been found suitable for this purpose.

The panels may also be pre-cut outside the area to be bonded.

Cutting shall be straight and parallel. After cutting, the test pieces shall be reworked to the required width by milling and the holes shall be drilled (see Figure 2).

The use of cooling liquids is not permitted, unless otherwise specified.

7.7 Test pieces

7.7.1 Dimensions

See Figure 2.

7.7.2 Number of specimens

See material standard.

7.7.3 Identification

Each test piece shall be marked to identify the panel from which it was cut and its position in the panel.

8 Testing procedure

8.1 Dimensions measurement

Measure the dimensions " L " and " W " (see Figure 2) with an accuracy of $\pm 0,1 \text{ mm}$.

Measure the thickness of the adhesive in the middle of the overlap at both sides of the test piece with an accuracy of $\pm 0,01 \text{ mm}$. The average thickness shall be determined.