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EUROPEAN STANDARD

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Part 4

EUROPAISCHE NORM

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English version

Aerospace series - Structural adhesives - Test methods - Part 4: Metal-honeycomb core flatwise tensile test

Série aérospatiale - Adhésifs structuraux - Méthodes d'essais - Partie 4: Essai de traction perpendiculaire pour métal-nid d'abeilles

Luft- und Raumfahrt - Strukturelle Klebstoffe - Prüfverfahren - Teil 4: Zugversuch senkrecht zur Deckschicht für Wabenkernverbunde

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This European Standard was approved by CEN on 1991-03-28. 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, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Foreword

This European Standard has been prepared by the European Association of Aerospace Manufacturers (AECMA).

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

According to the Common CEN/CENELEC Rules, the following countries are bound to implement this European Standard :

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom

1 Scope and field of application

This standard specifies the test methods for the determination of the strength of structural adhesives on metal-honeycomb structures flatwise tensile at ambient and other temperatures.

2 References

- EN 2090 Aerospace series - Aluminium alloy 2024-T3 - Clad sheets and strips - $0,4 \leq a \leq 6$ mm ¹⁾
- EN 2334 Aerospace series - Acid chromate pickle for aluminium alloys ²⁾
- EN 2419 Aerospace series - Aluminium alloy 2024-T351 - Plates $6 < a \leq 80$ mm ¹⁾
- EN 2462 Aerospace series - Steel FE-PA13 - Softened - Bars $D_e \leq 100$ mm ¹⁾
- EN 2497 Aerospace series - Dry abrasive blasting of titanium and titanium alloys
- EN 2514 Aerospace series - Aluminium alloy 5052-H191 - Foils for honeycomb ²⁾
- EN 2517 Aerospace series - Titanium alloy Ti-P63 - Annealed - Sheets, strips and plates $a \leq 100$ mm ¹⁾
- EN 2540 Aerospace series - Steel FE-PM62 - Sheets ²⁾.

3 Test samples

3.1 The shape and dimensions of the test piece shall be as given in figure 1.

Two types of test pieces are suitable :

- type A : direct bonding of honeycomb to the facing blocks.
- type B : bonding of honeycomb between the two facing sheets, then bonding of the whole to the facing blocks.

3.2 Materials (general)

The following materials shall be used :

3.2.1 Honeycomb core : aluminium alloy see EN 2514

The honeycomb core shall be without perforations or additional corrosion protection.

3.2.2 Facing sheets : aluminium alloy see EN 2090.

3.2.3 Facing blocks : aluminium alloy see EN 2419.

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

2) In preparation at the date of publication of the present standard.

3.3 Materials (for test temperatures above 150 °C)

One of the following materials shall be used :

3.3.1 Corrosion resisting steel FE-PM62 see by EN 2540.

3.3.2 Titanium alloy see EN 2517.

3.3.3 Facing blocks in titanium alloy (see EN 2517) or in steel (see EN 2462), when type A test piece is used.

4 Surface preparation

The surface preparation prior to bonding shall conform to EN 2334 and EN 2497.

5 Bonding

The application of the adhesive system (adhesive and primer if applicable) and curing shall be carried out according to the instructions of the adhesive manufacturer or the material standard.

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6 Storage of the test samples after bonding

After curing, samples made with elevated temperature curing adhesives shall be exposed and/or tested after a storage period of at least 16 hours under the conditions as given below (unless otherwise specified by the adhesive manufacturer).

Samples with room temperature curing adhesive not exposed and/or tested immediately after curing, shall also be stored under the conditions as given below (unless otherwise specified by the adhesive manufacturer).

Storage conditions :

- Room temperature : (23 ± 2) °C
- Relative humidity : (50 ± 5) %.

7 Cutting and preparation of test pieces

The type B test pieces may be taken from a sandwich panel, cut out and bonded at ambient temperature onto the facing blocks.

The test sample shall be carefully cut into pieces with a suitable tool such as a band saw.

The setting and spacing of the teeth and the operational speed shall be such that the frictional heating of the bond will be kept to a minimum.

The cutting shall be straight and parallel.

For cutting corrosion resisting steel and titanium alloy test samples a suitable cutting fluid may be used.

8 Test conditions

8.1 The test shall be carried out at the temperatures stated in the relevant material standard. If the test temperature is different from the ambient temperature, the heating rate shall be between 6 °C/min to 10 °C/min.

It is not necessary to control the cooling rate.

The application of load for all tests at temperature other than ambient shall be made immediately after the specimen has been held at the specified test temperature range for 10 min unless a longer term of exposure is required.

8.2 For all test temperatures except room temperature (23 ± 2) °C, temperature control of the test pieces shall be carried out by means of a thermocouple to ensure the accuracy of testing temperature and reproducibility of data.

8.3 The number of test pieces for each test shall be as required by the material standard.

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8.4 Each test piece shall be marked in order to ensure identification of the panel from which it was cut.

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9 Test method

9.1 Tensile testing machine

9.1.1 An approved tensile testing machine shall be used. The failing load of the test piece shall be within 10 % and 90 % of the upper limit of the selected loading range of the machine.

9.1.2 The test loads shall be recorded with an accuracy of 1 %.

9.2 Method of fixing

The ends of the test piece shall be firmly and correctly fixed to the testing machine by means of the holes provided for this purpose in the facing blocks. The attachment points of the machine and the test piece have to be aligned in such way that an imaginary straight line can go through the centre of the test piece and the axis of each of the attachment points of the machine.

9.3 Speed of loading

The load shall be applied until failure :

- either with a speed of 2000 N/min to 3000 N/min,
- or with a speed of the pulling grips between 0,5 mm/min to 1,5 mm/min.

10 Evaluation of results

The tensile strength shall be calculated as follows :

$$R = \frac{F}{L_1 \times L_2}$$

where :

- R = tensile strength in MPa,
F = load at failure in N,
L₁ and L₂ = specimen side dimensions in mm.

The L₁ and L₂ dimensions must be measured prior to loading with an accuracy of ± 0,1 mm.

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11 Test report

The test report shall include the following information:
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- 11.1** Complete identification of the adhesive system including the type, supplier's code, date of manufacture, batch number, material standard, etc.
- 11.2** Type of test piece used (A or B).
- 11.3** Complete identification of the materials (honeycomb core, facing sheets, facing blocks) used.
- 11.4** Detailed information about the preparation of the metal surface prior to bonding.
- 11.5** Conditions of application and bonding including chosen method of bonding (autoclave or press), bondline pressure, heat-up rate, curing time and temperature etc.

11.6 In the case of B type specimens indicate the connecting method between the facing sheets and the facing blocks.

11.7 The number of test pieces used.

11.8 The exposure conditions and test temperature.

11.9 The type of testing machine and speed of loading.

11.10 Information about the individual test pieces including actual dimensions, load at failure and tensile strength.

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11.11 The nature of the failure, including the estimated average percentage of failure in cohesion and/or adhesion both of adhesive and, if applicable, adhesive primer.

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11.12 The average, minimum and maximum value of the tensile strength of the test series.

11.13 Any deviation from this test method shall be described in detail.