BRITISH STANDARD AEROSPACE SERIES

BS EN
2243-4:2005

Non-metallic materials — Structural adhesives — Test method —

Part 4: Metal-honeycomb core flatwise tensile test

The European Standard EN 2243-4:2005 has the status of a British Standard

ICS 49.025.50

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 2243-4:2005. It supersedes BS EN 2243-4:1991 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee ACE/65, Non-metallic materials for aerospace purposes (excluding textiles), to Subcommittee ACE/65/-/63, Structural adhesives, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 10, an inside back cover and a back cover.

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English Version

Aerospace series - Non-metallic materials - Structural adhesives - Test method - Part 4: Metal-honeycomb core flatwise tensile test

Série aérospatiale - Matériaux non-métalliques - Système d'adhésifs structuraux - Méthodes d'essai - Partie 4 : Essai de traction perpendiculaire pour métal-nid d'abeilles

Luft- und Raumfahrt - Nichtmetallische Werkstoffe - Strukturelle Klebstoffsysteme - Prüfverfahren - Teil 4: Zugversuch senkrecht zur Deckschicht für Wabenkernverbunde

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Foreword

This European Standard (EN 2243-4:2005) 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of an identical text or by endorsement, at the latest by April 2006, and conflicting national standards shall be withdrawn at the latest by April 2006.

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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 strength of structural adhesives by testing in tension metal to honeycomb core joints, at ambient or other temperatures.

Two types of test pieces are defined:

Type A: direct bonding of honeycomb to facing blocks;

Type B: bonding of honeycomb between the two facing sheets, then bonding of the whole to the facing blocks.

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 2090, *Aerospace series — Aluminium alloy AL-P2024- — T3 — Clad sheet and strip — 0,3 mm ≤ a ≤ 6 mm.*[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.*[1)]

EN 2497, *Aerospace series — Dry abrasive blasting of titanium and titanium alloys.*

EN 2540, *Aerospace series — Steel FE-PM3902 (X7CrNiAl17-7) — Air melted — Solution treated and precipitation hardened — Sheet and strip – a ≤ 6 mm — 1 240 MPa ≤ R_m ≤ 1 450 MPa.*[1)]

EN 3456, *Aerospace series — Titanium alloy TI-P64001 — Annealed — Sheet and strip, hot rolled — a ≤ 6 mm.*[1)]

EN 3464, *Aerospace series — Titanium alloy TI-P64001 — Annealed — Plate — 6 mm < a ≤ 100 mm.*[1)]

EN 3487, *Aerospace series — Steel FE-PA13 — Softened — 500 ≤ R_m ≤ 700 MPa — Bar for machining — D_e ≤ 100 mm.*[1)]

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

EN 4385, *Aerospace series — Non-metallic materials — General organisation of standardisation — Links between types of standards.*[1)]

EN 4606, *Aerospace series — Aluminium honeycomb core.*[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.

R tensile strength (in mega pascals);

F load at failure (in newtons);

L_i dimensions (in 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

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 10 % and 90 % of the upper limit of the selected loading range of the machine.

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

6.1.2 Recorder

It shall record continuously the displacement relative to the load applied throughout the test until total failure occurs.

6.2 Materials/Reagents

Not applicable

6.3 Qualification of personnel

Not applicable

7 Test samples/Test pieces

7.1 Materials

7.1.1 For test temperatures up to 150 °C

Honeycomb core: see EN 4606.

Aluminium alloy EN 2419 (facing blocks) or EN 2090 (facing sheets).

7.1.2 For test temperatures above 150 °C

Honeycomb core: see EN 4606.

Corrosion resisting steel EN 2540 (facing sheets) or EN 3487 (facing blocks) or titanium alloy EN 3456 and EN 3464.

NOTE 1 These are the preferred (reference) alloys for high temperature test, but aluminium alloys defined in 7.1.1 can also be used.

NOTE 2 The same material has to be used for all the tests if results have to be compared.

7.2 Surface preparation before bonding

EN 2334 or EN 2497 according to the material, or another specified preparation.

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.

7.4 Dimensions of panels (type B test piece)

The test panel shall be of sufficient size to permit the manufacture of at least one test piece (see Figure 1).

7.5 Storage of test panels after bonding

They shall be stored under the following conditions:

— temperature : (23 ± 2) °C;

— relative humidity : (50 ± 5) %.

7.6 Cutting of panels and preparation of type B test pieces

The panels shall be cut into test pieces (see Figure 1).

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 (≤ 50 °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.

Cutting shall be straight and parallel.

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

Test piece shall be bonded onto blocks by using a cold curing type adhesive.

The application and curing of the adhesive system (adhesive and primer) shall be carried out according to its material standard, and care shall be taken to avoid any mechanical or thermal effect that could damage the joint to be tested.

7.7 Test pieces

7.7.1 Dimensions

See Figure 1.

7.7.2 Number of specimen

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 specimen side dimensions L_1 and L_2 with an accuracy of ± 0,1 mm.

8.2 Fixing

The ends of the test piece shall be carefully 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 a way that an imaginary straight line can go through the centre of the test piece and the axis of the attachment points of the machine.

8.3 Test temperatures

When the test temperature is different from ambient (23 ± 2) °C, then the chamber including jig shall be stabilized within the test temperature tolerance for at least 30 minutes prior to inserting the test piece.

The temperature control of the test piece shall be carried out using a thermocouple.

The junction of the thermocouple shall be firmly attached to the test piece in immediate contact with the metal. It shall be shielded from direct heating.

8.4 Loading

For test temperature different from ambient, and unless otherwise specified, a minimum exposure time of 10 minutes at the required temperature shall be applied prior to loading.

The load shall be applied at a uniform jaws separation of 1 mm/min. (see note 1).

NOTE 1 For test other than qualification, it can be tolerated to apply the load at speed between 0,5 mm/min and 1,5 mm/min, or at rate between 2 000 N/min and 3 000 N/min.

Record the load-displacement curve (see note 2).

NOTE 2 For non-ambient temperature tests, there is a requirement for the test portion of the specimen to be within the specified temperature tolerance throughout the period of loading to failure.

The exposure time of ten minutes is normally sufficient to fulfill this requirement.

Nevertheless, the test laboratory may be required to prove the heat dwell concept (procedure and conditions) by means of temperature/time records on dummy specimen(s) incorporating thermocouple(s) embedded in drilled hole(s) within the test portion of the specimen. These records shall be made available to demonstrate the validity of the heat dwell conditions.

In this case, for tests under non-ambient conditions, the specimen shall be placed in the grips of the test machine and the temperature monitored according to the heat dwell concept previously established. When it reaches the lower (or upper, for temperature below ambient) limit of the test temperature tolerance, allow the specimen to dwell within the tolerance band for a minimum of 3 minutes prior to loading. The test shall be completed within a maximum dwell of 10 minutes.

The heat-up/dwell cycle used shall be given in the test report.

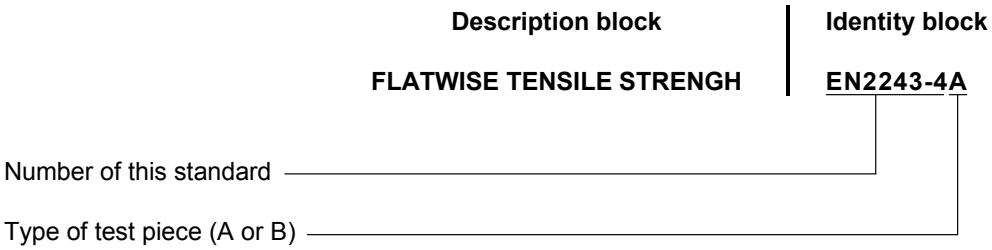
9 Expression of results

The tensile strength shall be calculated as follows:

$$R = F/L_1.L_2$$

10 Designation

EXAMPLE



11 Test report

The test report shall include:

— reference to the test method designation;

— the type of tensile testing machine, the speed of loading, the exposure conditions and test temperature;

— the type of test piece used (A or B);

— complete identification of the adhesive system, including the type, manufacturer, date of manufacture, batch number, material standard or specification number;

— complete identification of the metal and honeycomb core used;

— detailed information about the surface preparation before bonding;

— application and bonding conditions including the bonding method (press, autoclave, ...), pressure on the adhesive joint, heat-up rate, curing time and temperature;

— information about individual test piece including traceability from panel, actual dimensions, sheet thickness and bond line thickness;

— type of recorder;

— expression of individual results, including peel load, nature and location of failure with estimated percentage of failure in cohesion and/or adhesion in adhesive or primer;

— associated diagram;

— in case of multiple tests:

  — number of test pieces;

  — average, standard deviation, maximum and minimum values of the test series;

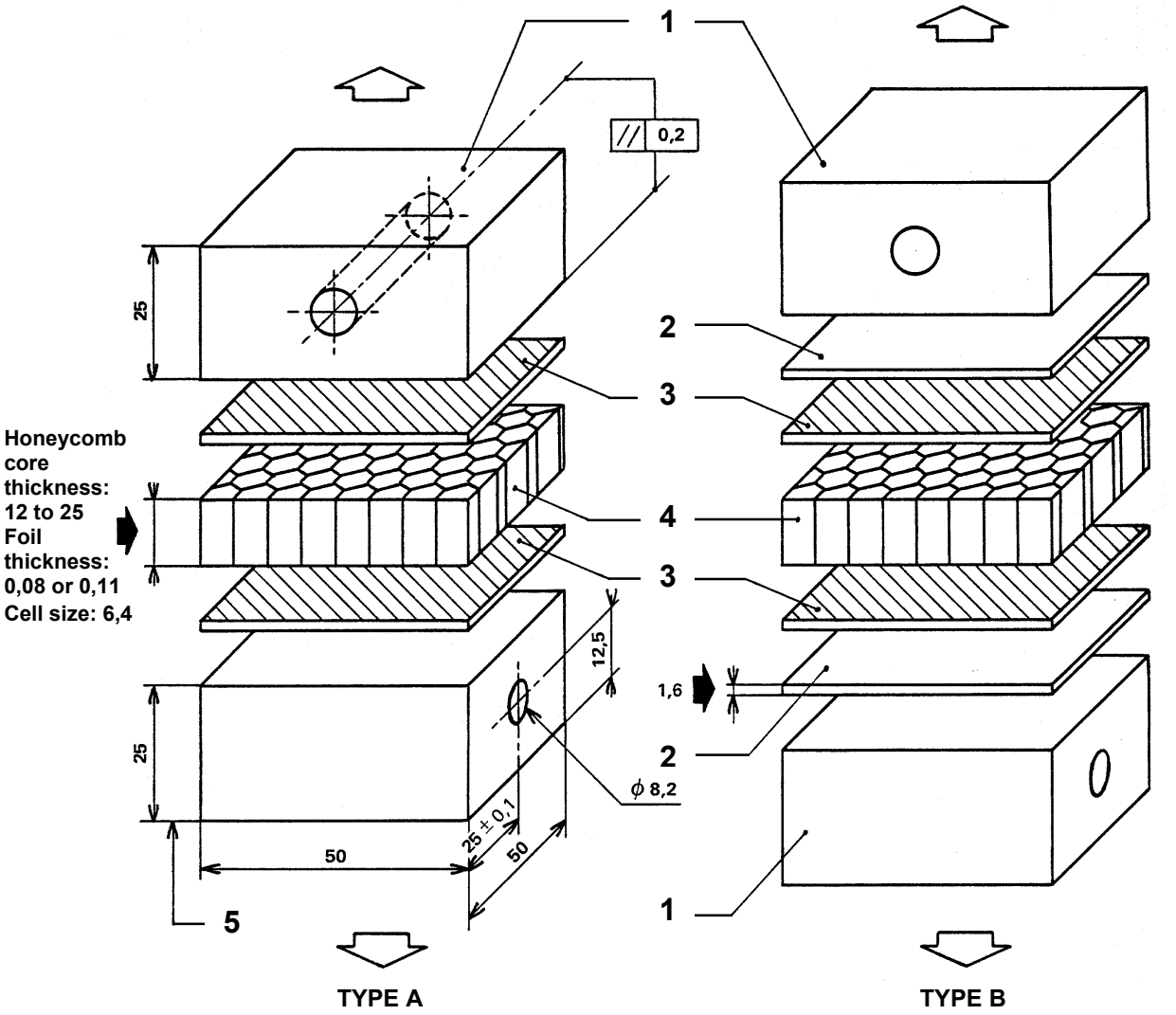
— traceability to personnel performing the test work;

— any incident which may have affected the result;

— any deviation from this standard described in detail;

— date of test.

Dimensions in millimetres



(For honeycomb material: see EN 4606)

Key

1 Facing blocks
2 Facing sheet
3 Adhesive
4 Honeycomb core
5 Face of reference

Figure 1

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