SLOVENSKI STANDARD
SIST EN 2667-2:2018

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Aeronavtika - Nekovinski materiali - Penjenje konstrukcijskih lepil - Preskusne metode - 2. del: Tlačna strižna cev

Aerospace series - Non-metallic materials - Foaming structural adhesives - Test methods - Part 2: Compressive tube shear

Luft- und Raumfahrt - Nichtmetallische Werkstoffe - Strukturelle Expansionsklebstoffe - Prüfverfahren - Teil 2: Abscherung von Rohren unter Druck

Série aérospatiale - Matériaux non-métalliques - Adhésifs structuraux expansibles - Méthodes d'essai - Partie 2 : Cisaillement sur tube en compression

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49.025.50	Lepila	Adhesives

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English Version

Aerospace series - Non-metallic materials - Foaming structural adhesives - Test methods - Part 2: Compressive tube shear

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

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European foreword

This document (EN 2667-2:2018) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-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 ASD, 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of an identical text or by endorsement, at the latest by July 2018, and conflicting national standards shall be withdrawn at the latest by July 2018.

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1 Scope

This European Standard defines the test method for determining the bond strength of structural foaming adhesive films or pastes by means of the tube test method.

This test method is suitable for determining bond strength in relation to the density after curing of the adhesive foam by means of compressive tube shear specimens.

It preferably applies to high expansion ratios, i.e. > 50 % measured according to the method EN 2667-3.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

EN 2388, *Aluminium alloy 2024-T351 — Tubes for structures 0,6 mm ≤ a ≤ 12,5 mm — Aerospace series* [1)]

EN 2667-3, *Aerospace series — Non-metallic materials — Foaming structural adhesives films — Test methods — Part 3: Expansion ratio and volatile content* [2)]

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

3 Apparatus and auxiliary equipment

3.1 Tensile testing machine

The test machine shall be approved to ISO 7500-1 and so designed that the breaking load lies between 10 % and 90 % of the selected full-scale capacity.

The loads shall be recorded to an accuracy of 1 %.

3.2 Auxiliary equipment

— air circulating oven with an accuracy of ± 5 °C;

— balance with an accuracy to the nearest 0,01 g;

— band saw;

— thermoelectric couple;

— mounting device per Figure 1.

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1) Published as ASD-STAN Standard at the date of publication of this standard by AeroSpace and Defence industries Association of Europe - Standardization (ASD-STAN) (www.asd-stan.org)

2) Published as ASD-STAN Prestandard at the date of publication of this standard by AeroSpace and Defence industries Association of Europe - Standardization (ASD-STAN) (www.asd-stan.org)

4 Test tubes, test specimens

4.1 Test tubes

The shape and the dimensions of the concentric tubes shall be in conformity with Figure 2.

4.1.1 Materials

The following materials are normally to be used:

— aluminium alloy 2024 - T351, in accordance with EN 2388, or;

— aluminium alloy 5052-0, in tubes for structures 0,6 mm ≤ a ≤ 12,5 mm.

For test temperature exceeding 150 °C, the same aluminium alloys shall be used after verification of their test temperature capability.

4.1.2 Surface preparation

Surface preparation before bonding shall be in accordance with EN 2334.

4.1.3 Bonding and weighing of test tubes

Bonding of the test tubes shall take place within 4 h after completion of the preliminary surface treatment. The test tubes may require application of a primer to ensure cohesive failure, i.e. failure within the adhesive.

The application of the foaming adhesive system (adhesive and primer, if necessary) as well as the curing shall be carried out in accordance with the adhesive manufacturer's instructions and the material standard.

The tubes shall be weighed to the nearest 0,01 g: m_1, m_2.

A mass m_3 of adhesive [3)] defined in the material standard, or in line with the manufacturer's recommendation, shall be rolled or spread evenly over the entire surface of the inner tube.

The two tubes (length between 100 mm and 230 mm) shall then be assembled using centering caps (see Figure 3) with the interposition at both ends of a temperature resistant washer made out of knitted fabric (stitches of approximately 100 µm) to retain the adhesive while allowing air and reaction gases to escape.

The curing process shall be carried out with the tube in a horizontal position and according to the material standard. The heat-up rate of the test tubes shall range from 1 °C/min to 6 °C/min and shall be monitored and recorded using a thermoelectric couple placed in the adhesive at the end of the test tubes.

After the end of the cure, cool the test assembly until it reaches ambient temperature. Then remove the curing assembly described in Figure 3 and disassemble to obtain the test tubes.

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3) The determination of this mass m_3 depends on the density, on thickness and on the expansion ratio of the adhesive as well as on the length of test tubes.

The test tubes shall be weighed to the nearest 0,01 g: m_4.

4.1.4 Storage of test tubes after curing

The final test tubes shall be conditioned and tested after a storage period of at least 16 h after curing and under the following conditions:

— temperature : (23 ± 2) °C;

— relative humidity : (50 ± 5) %.

4.2 Test specimens

4.2.1 Cutting test specimens

The cutting of the test tubes into test specimens shall be done with an appropriate tool such as a band saw, in accordance with Figure 2.

The number of teeth and the set of the saw as well as the feed and cutting speed shall be chosen so to minimize thermal and mechanical stressing.

The cuts shall be plane and perpendicular to the tube axis and no cooling fluid shall be used. It is possible to obtain five test specimens per test tube of 100 mm and fifteen test specimens per test tube of 230 mm, while discarding a minimum of 10 mm at each end.

Each test specimen shall be identified with an individual reference mark so as to locate the number of the test tube from which it originated as well as its position in this tube.

4.2.2 Quantity

There shall be a minimum of five individual test specimens for each test.

5 Procedure

Tests shall be performed at the temperatures specified in the material standard.

For all tests carried out at a temperature other than ambient the heat-up rate or the cooling rate of the test specimen shall be less than 10 °C/min. Load shall be applied after stabilization at the specified temperature for a minimum of 10 min and a maximum of 30 min (unless otherwise specified by the supplier).

For all temperatures, with the exception of ambient temperature (23 ± 2) °C, the temperature of the test specimen shall be measured by means of a thermoelectric couple, fixed to the outer surface of the test specimen in accordance with Figure 1.

The test set-up (see Figure 1) comprises a cylindrical ram and a base acting as spacers.

The supports shall be vertically centred in respect to the test specimen so that the external ring rests fully on the support base.

Bond strength shall be determined by shearing the inner tube downward with the test set up as shown in Figure 1.

The load of the test specimen shall be applied at a constant rate ranging from 2 000 N/min to 5 000 N/min until failure.

6 Expression of results

Calculate the bond strength for each test specimen as follows:

$$\tau = \frac{F_{\max.}}{\pi \bullet d_1 \bullet h}$$

where

τ is the shear strength on tubes, in megapascals;

$F_{\max.}$ is the maximum load, in newtons;

d_1 is the outside diameter of the inner tube, in millimetres;

h is the height of the test piece, in millimetres.

Dimensions d and h shall be measured to within ± 0,1 mm.

Calculate the average bond strength of the series of test specimens.

Calculate the density of the foam adhesives to the nearest 0,01 g/cm^3 as follows:

$$D = \frac{4\,000 \bullet [(m_4 - (m_1 + m_2)]}{L \bullet \pi \bullet \left(d_2^2 - d_1^2\right)}$$

where

D is the tube density, in grams per cubic centimetre;

m_1 is the outer tube mass, in grams;

m_2 is the inner tube mass, in grams;

m_4 is the mass of test tubes, in grams;

L is the length of the tubes, in millimetres;

d_1 is the outside diameter of the inner tube, in millimetres;

d_2 is the inner diameter of the outside tubes, in millimetres.