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Composites and reinforcements fibres — Carbon fibre reinforced plastics(CFRPs) and metal assemblies — Determination of the tensile lap-shear strength

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Composites and reinforcements fibres — Carbon fibre reinforced plastics(CFRPs) and metal assemblies — Determination of the tensile lap-shear strength

SAFETY STATEMENT — Persons using this document should be familiar with normal laboratory practice, if applicable. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practice. It is recognized that some of the materials permitted in this document have a negative environmental impact. As technological advances lead to more acceptable alternatives for such materials, they will be eliminated to the greatest extent possible. At the end of the test, care should be taken to dispose of all waste in an appropriate manner in accordance.

1 Scope

This document specifies a method for determining the lap-shear strength of the adhesive joint between carbon fibre-reinforced plastics (CFRPs) and metal adherends, using a standard specimen loaded in tension and under specified conditions of preparation, conditioning and testing. This method is intended for assessing the suitability of adhesives to be used for bonding a carbon fibre reinforced plastic (CFRPs) to a metal.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 472, *Plastics — Vocabulary*

3 Term and definitions

For the purposes of this document, the terms and definitions given in ISO 472.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Principle

Adhesive lap-shear bond strength is determined by stressing a single-overlap joint between a CFRP and a metal adherend in shear by the application of a tensile force parallel to the bond area along the major axis of the specimen.

NOTE Single-lap specimens are economical, practical and easy to make. They are the most widely used specimens for development, evaluation and comparative studies involving adhesives and bonded products, including manufacturing quality control.

5 Apparatus

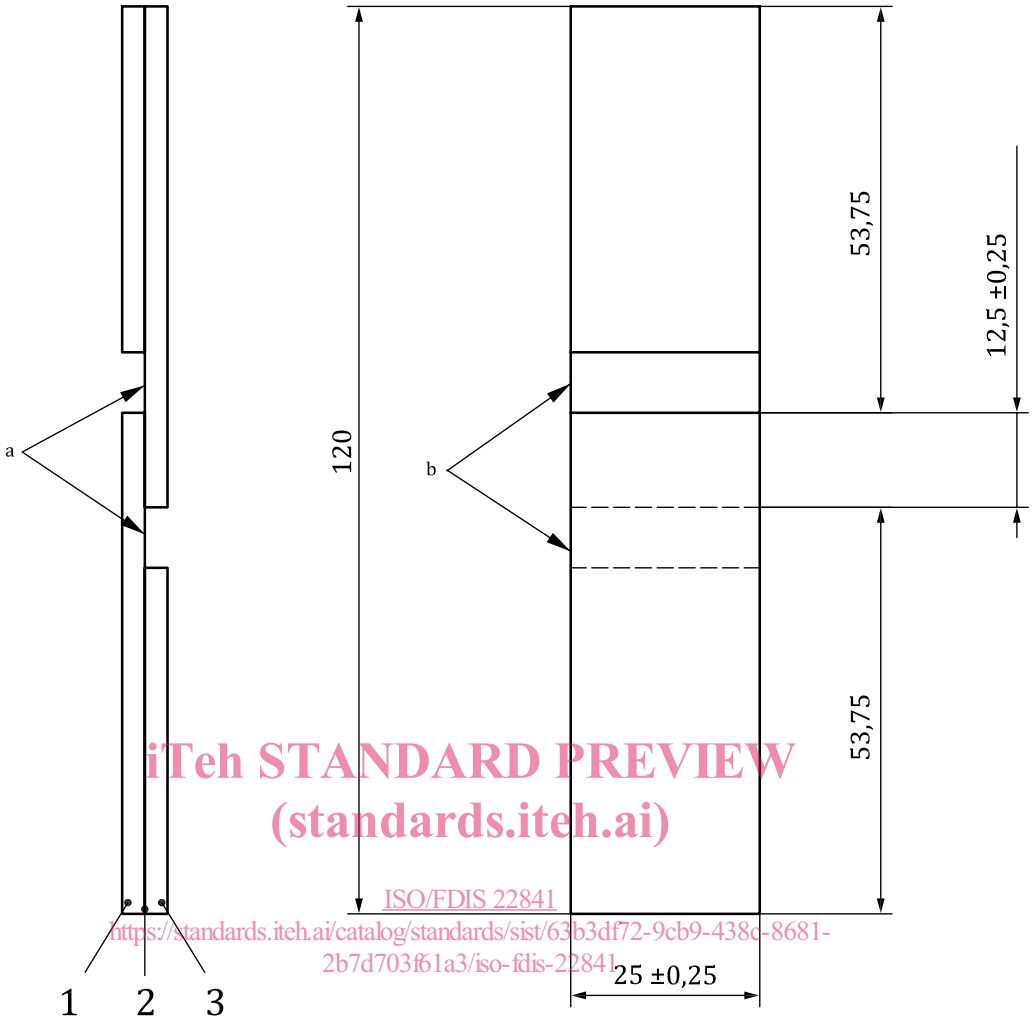
5.1 Linear measuring device, such as vernier calipers or micrometre, capable of measuring the width and thickness of the specimen with an accuracy of at least 0,05 mm.

5.2 Tensile-testing machine, selected so that the rupture of the specimen occurs between 10 % and 80 % of the full-scale capacity of the load cell. The response time of the machine shall be short enough so as to enable the force applied at the time of rupture to be measured accurately. The recorded force shall not differ from the true applied force by more than 1 %. The machine shall be capable of maintaining the constant speeds of testing specified in Clause 10. A machine which allows a constant rate of load application may be used. The machine shall be provided with a suitable pair of grips to hold the specimen. The grips and attachments shall be constructed so that they move into alignment with the specimen as soon as the load is applied, so that the long axis of the specimen will coincide with the direction of the applied force through the centreline of the grip assembly.

6 Test specimen specification

The test specimen shall be constructed from two adherends: one CFRP and one metallic. It shall conform to the form and dimensions shown in Figures 1 and 2. Six test specimens shall be cut from test panels prepared as described in this clause and Clause 7. Arrows labelled B need to be aligned with narrowed cuts.

Dimensions in millimetres

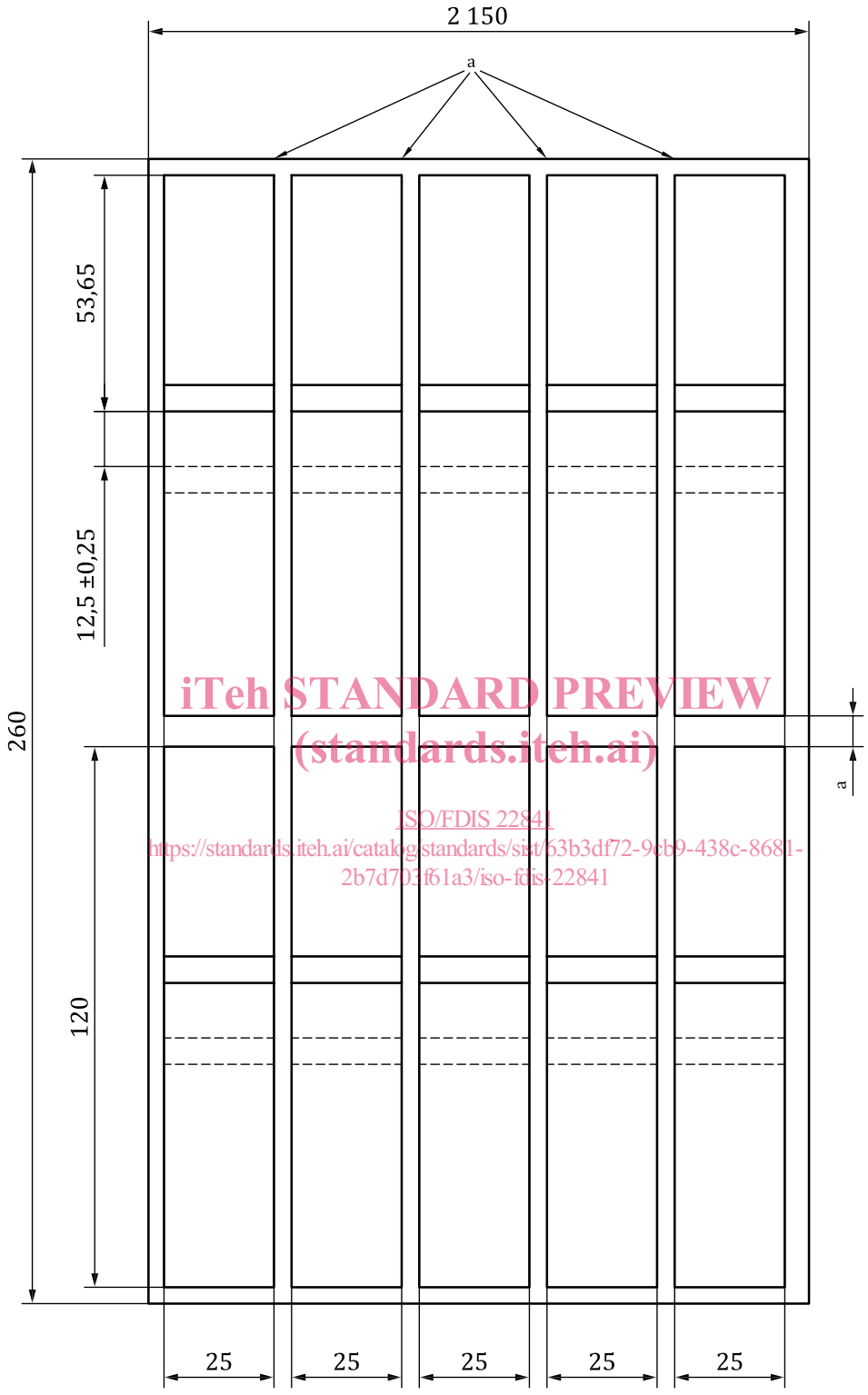


Key

1 CFRPs t=3,0 ± 0,3 mm
2 adhesive layer
3 metal t=3,0 ± 0,25 mm
a Cut up to but not beyond adhesive line.
b Width of sawcut.

Figure 1 — Test specimens

Dimensions in millimetres



a Width of sawcut.

Figure 2 — Suggested arrangement of specimens

7 Preparation of test panels

Cut the metal and CFRP into suitable sizes and assemble in a group of two sheets, taking one from each material.

Prepare the adhesive in accordance with the procedure specified by the manufacturer of the adhesive.

The surface to be bonded may or may not be abraded, as agreed between the interested parties. Apply the adhesive to the metal or CFRP as specified by the manufacturer of the adhesive. After the specified time has elapsed, assemble the metal and CFRP into two-ply panels as described in Clause 6. Then press the panel under the specified conditions. Cure time and conditions shall be those specified by the manufacturer of the adhesive or as agreed between client and testing agency and that they have to be recorded.

8 Conditioning of test panels

The specimens shall be conditioned and tested in one of the standard conditioning atmospheres specified in ISO 291 or as agreed between client and testing agency.

9 Preparation of test specimens

Cut the test specimens as shown in Figure 1, taking care that a margin to exclude manufacturing edge effects is removed first. This is accomplished by first cutting the notches to the proper width, depth and location in the test panel using a hollow-ground grooving saw or any other method that will give equally satisfactory results. Notch the specimens as shown in Figures 1 and 2. The notch of the two-layer specimen shall go as far as the adhesive line and care shall be taken that the ply is cut completely. When the panel has been notched, cut the individual specimens from the panel. Number them consecutively from one end of the panel to the other and identify them with regard to their origin in the panel. Select the specimens to be tested so that an even and equal number of specimens is taken from each test panel. The dimensions of the adhesive shear area as machined shall be reported.

10 Procedure

Place the test specimen in the jaws of the grips in the test machine so that the notches are approximately 5 mm from the end of the jaws. The specimen shall be perfectly aligned, and the pairs of jaws shall be directly above each other and in such a position that an imaginary straight vertical line would pass through the centre of the core ply and through the points of suspension of the grips. Test the specimens from each panel in numbered sequence and place them in the jaws alternately so that in one case the upper notch is to the left and in the other case to the right. The rate of separation of the jaws shall be such that the failure occurs within (60 ± 20) s, unless other speeds are agreed upon. The rate of separation shall be reported in the test report.

11 Precision data

Precision data is not available at the time of publication.

12 Calculation and expression of results

Express the results of the tests of the arithmetic mean of the breaking force, in newtons, or the breaking stress, in megapascals, of the valid specimens. The lap shear strength, in megapascals, is calculated by dividing the breaking force, in newtons, by the shear area, in square millimetres.