
**Composites and reinforcements
fibres — Carbon fibre reinforced
plastics (CFRPs) and metal assemblies
— Determination of the cross tension
strength**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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.

Introduction

This document specifies a method for determining the cross tensional strength of the bonded plates of carbon fibre reinforced plastics (CFRPs) to metal assemblies, with a standard specimen loaded in cross tension and under specified conditions of preparation, conditioning and testing. This method is intended for testing only those bonded plates used in bonding carbon fibre reinforced plastics (CFRPs) to metal assemblies.

The potential benefits to the users of CFRP-metal assemblies of implementing the cross tensional strength of the bonded plates of carbon fibre reinforced plastics (CFRPs) to metal assemblies based on this document are:

- a) expanding CFRP applications to the fields of the combinations with metallic components;
- b) the detection or the prevention of physical properties loss - such as ion migration and time-related degradation in sealant film, injected calking layer and glass fibre reinforced plastics (GFRPs) layer;
- c) demonstrating the conformity to specified conditions for type certification requirements in the engineering such as aircraft developments;
- d) evaluating the procedures for maintenance, repair and overhaul (MRO) in the engineering operations such of CFRP aircrafts.

It is not the intent of this document to imply the need for:

- 1) omitting relevant field tests for CFRP related engineering;
- 2) generally specifying the dimensions of test specimen to represent CFRPs related bonded or fastened structures;
- 3) superimposing test results for specific applications of the parameters that exceed the range of this document.

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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 practices and to ensure compliance with any regulatory conditions. It is recognized that some of the materials permitted in this document might 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.

1 Scope

This document specifies a method for determining the cross tensional strength of the bonded plates of carbon fibre reinforced plastics (CFRPs) to metal assemblies, with a standard specimen loaded in cross tension and under specified conditions of preparation, conditioning and testing. This method is intended for testing those bonded plates used in bonding carbon fibre reinforced plastics (CFRPs) to metal assemblies.

2 Normative reference

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 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*

ISO 10365, *Adhesives — Designation of main failure patterns*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10365 and the following apply.

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 <https://www.electropedia.org/>

3.1

cross tension force

force applied on test specimen during cross tension testing (N)

3.2

cross tension strength

CTS

stress obtained by dividing maximum *cross tension force* (3.1) by bonded area (MPa)

4 Test specimen

The test specimen is composed of two rectangular coupons as shown in [Figure 1](#).

The bonding shall be covered in the lapped area of each coupon in the test specimen.

One method is to bond two rectangular coupons to be a Type A cross specimen. The other is by cutting an adhered sheet of CFRP (thickness: 4 mm) and metal (thickness: 4 mm) laminate in size of 260 mm × 150 mm into cross shaped specimen as shown in [Figure 2](#). Then, notches are introduced in the specimens as shown in [Figures 3](#). The notch of the laminate shall go as far as the adhesive line and care shall be taken that the ply is cut completely, to be cross specimen Type B. A minimum number of 5 valid test results is needed to calculate statistical values.

The bonded area is square shape to be equal to the lapped area with the size of 25 mm × 5 mm. From the viewpoint of reducing the scattering in CTS values, round shape with diameter: 20 mm is recommended for bonded area. [Annex A](#) gives information on the effect of the bonded area shapes (square or round) on the CTS values and its scattering (in detail, see [Annex A](#)).

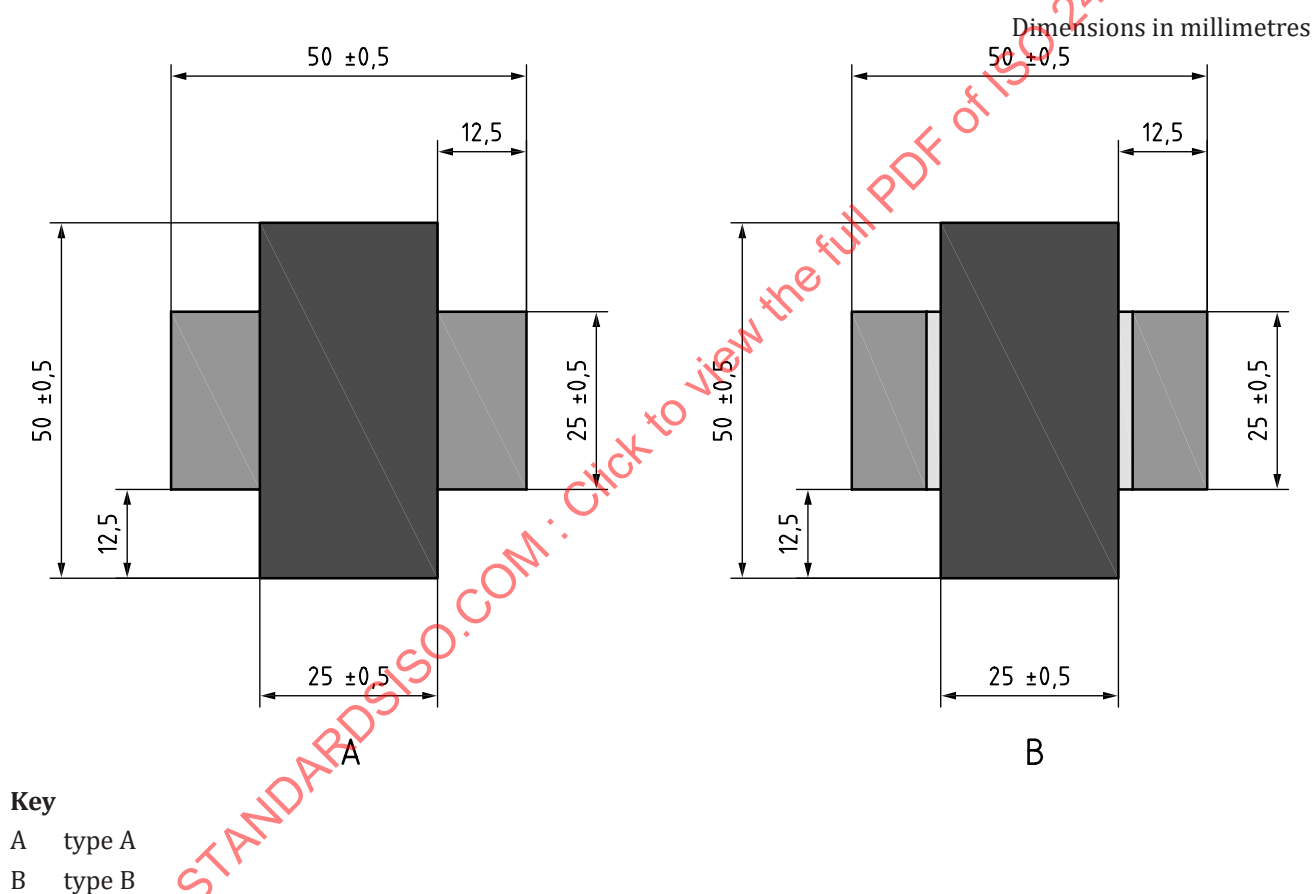
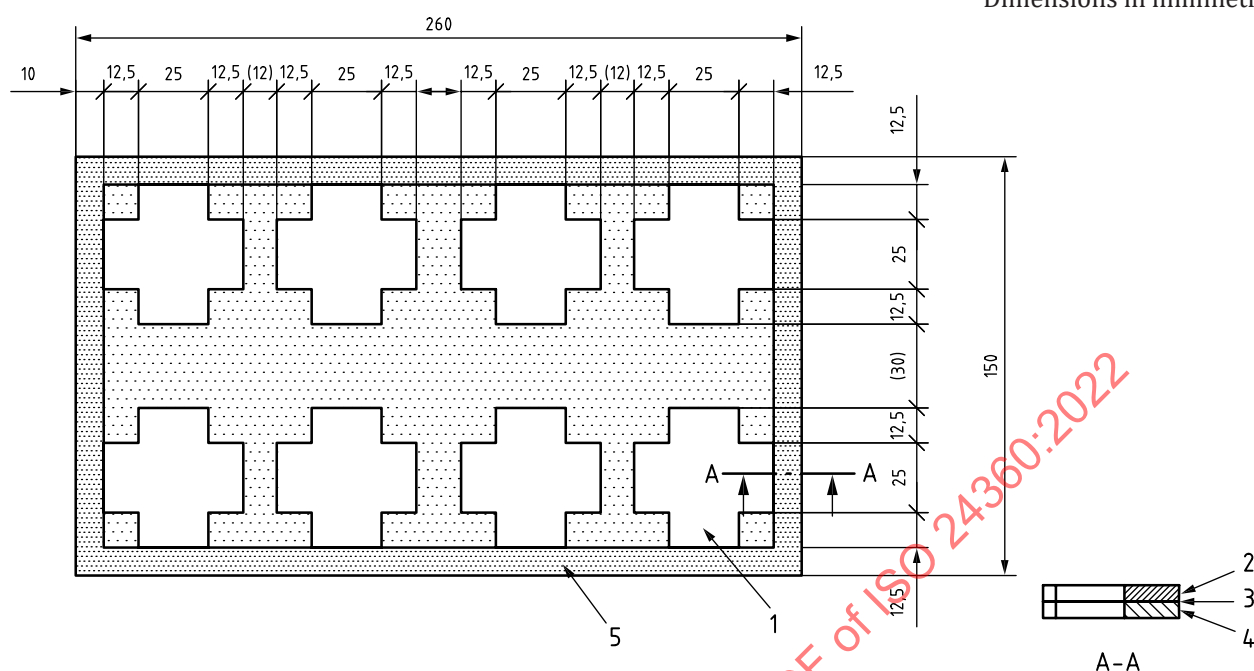


Figure 1 — Test specimens for cross tension test

Dimensions in millimetres

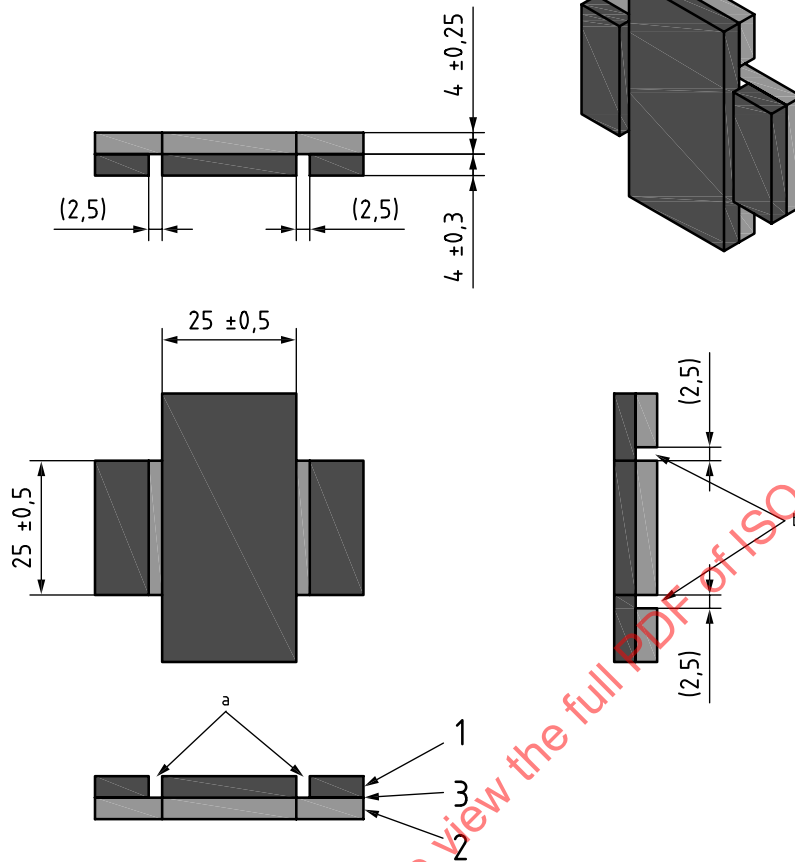


Key

- 1 test specimen
- 2 CFRPs t=4 mm
- 3 adhesive layer
- 4 metal t=4 mm
- 5 cutting area
- A-A cross section

Figure 2 — Example of a preparation method for Type B cross tension test specimens

Dimensions in millimetres

**Key**

- 1 CFRP beam
- 2 metal beam
- 3 adhesive layer
- a Cut up but not beyond adhesive line to be notch.
- b With of saw cut.

NOTE For specimens, the length and thickness of the specimen can be determined in accordance with the clamp's configuration.

Figure 3 — Example of Type B cross tension test specimen

5 Test equipment and testing procedure

The assembled specimen shall be held in the clamps as indicated in [Figure 4](#) for tensile and [Figure 5](#) for compressive mode. In tensile mode, after clamping, the test specimen shall be pulled apart, while in compressive mode, the specimen shall be pushed using testing machine which satisfies the requirements of ISO 7500-1. The force measurement system shall comply with class 1 as defined in ISO 7500-1.

The cross tension force shall be measured during testing. The cross tension strength (CTS) shall be determined by dividing the maximum cross tension force value by the bonded area. All tests shall be carried out at room temperature.

The cross tension strength values obtained in accordance with this test shall be recorded, including type of failure mode for each specimen in accordance with ISO 10365. If failure behaviour not specified in ISO 10365 is observed, it shall be remarked in the test report. See also [Clause 6](#).

A load-displacement diagram shall be created to give information about the deformation of the test specimen. An example of such a diagram is shown in [Figure 6](#).

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Dimensions in millimetres

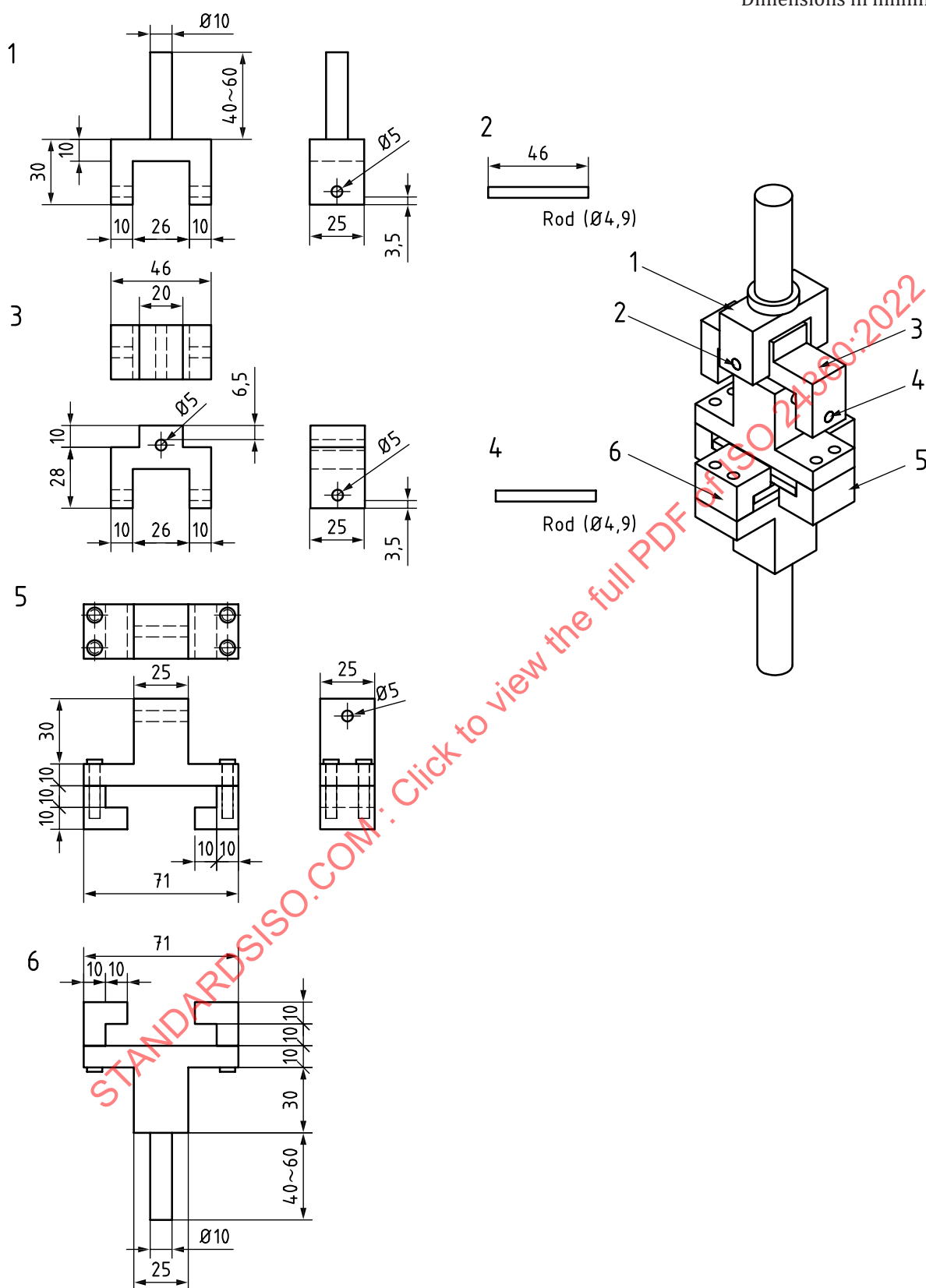
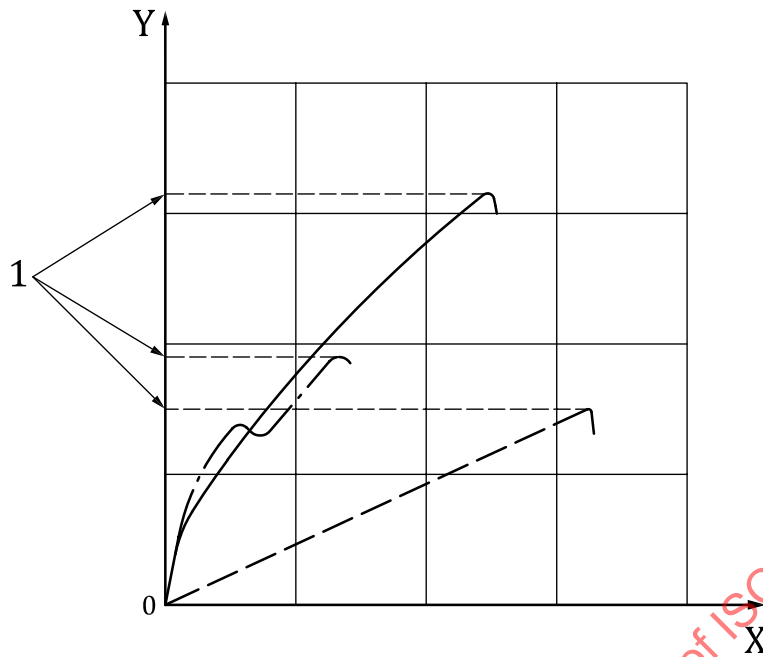


Figure 4 — Example of testing clamps for test specimen in tensile mode





Key

- X crosshead displacement
- Y force/load
- 1 maximum cross tension force

Figure 6 — Examples of load — Displacement curve of adhesive joints (Not to scale)

6 Test report

The test report shall contain at least the following information:

- a) a reference to this document, i.e. ISO 24360:2022;
- b) the bonding process employed;
- c) the bonding conditions and equipment;
- d) the materials and its condition;
- e) the dimensions of the test specimens;
- f) the size and the shape (square or round) of the bonded area;
- g) individual values, mean value and standard deviation of the cross tension strength in MPa;
- h) failure description of the two adherends in accordance with ISO 10365. If other failure behavior is observed, it is remarked;
- i) individual values, mean value and standard deviation of the adhesive area;
- j) special remarks, if any.