INTERNATIONAL STANDARD

ISO 12815

First edition
2013-03-01

Fibre-reinforced plastic composites — Determination of plain-pin bearing strength

Composites plastiques renforcés de fibres — Détermination de la résistance au matage au moyen d'une goupille ordinaire

Reference number
ISO 12815:2013(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 12815 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*.

Introduction

In preparing this harmonized version, reference was made to similar methods, such as prEN 6037 and ASTM D 5961, harmonization with open-hole tests has been achieved where relevant (e.g. specimen and hole size). The method is applicable to all current and future fibre-reinforced plastic composites meeting the requirements of this International Standard.

The method described in this International Standard uses the maximum load to define the plain-pin laminate bearing strength. This point is well-defined and has been shown to be at a similar level to the less easily defined, initial failure in the similar "torqued bolt" test(s) (see below). In the torqued bolt test, the load can increase after the bearing failure (up to x 2), as the failed material is jammed against the bolt, washers and loading jigs. The property determined applies only to the laminate lay-up tested.

The strength properties of "bolted" joints are dependent on the actual conditions involved for the joint being assessed. This includes initial bolt torque (including any load lost in bolt threads), effect of relaxation due to visco-elastic effects, effect of hot/wet conditioning, washer size/over-size, bolt material/rivet details and chamfer depth/plate thickness. It is recommended that additional tests to the plain-pin test be conducted for the actual joint conditions of interest in the applications, as no standardized configuration can represent all these variations. ASTM D 5961, *Standard test method for bearing response of polymer matrix composite laminates,* can be used as guidance on bolted joint tests.

Fibre-reinforced plastic composites — Determination of plain-pin bearing strength

1 Scope

This International Standard specifies a procedure for determining the plain-pin bearing strength of fibre-reinforced plastic composites.

The method described in this International Standard is applicable to fibre-reinforced plastic composites with either thermoset or thermoplastic matrices.

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.

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

ISO 527-4, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

ISO 472, *Plastics — Vocabulary*

ISO 1268 (all parts), *Fibre-reinforced plastics — Methods of producing test plates*

ISO 2602, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 5893, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification*

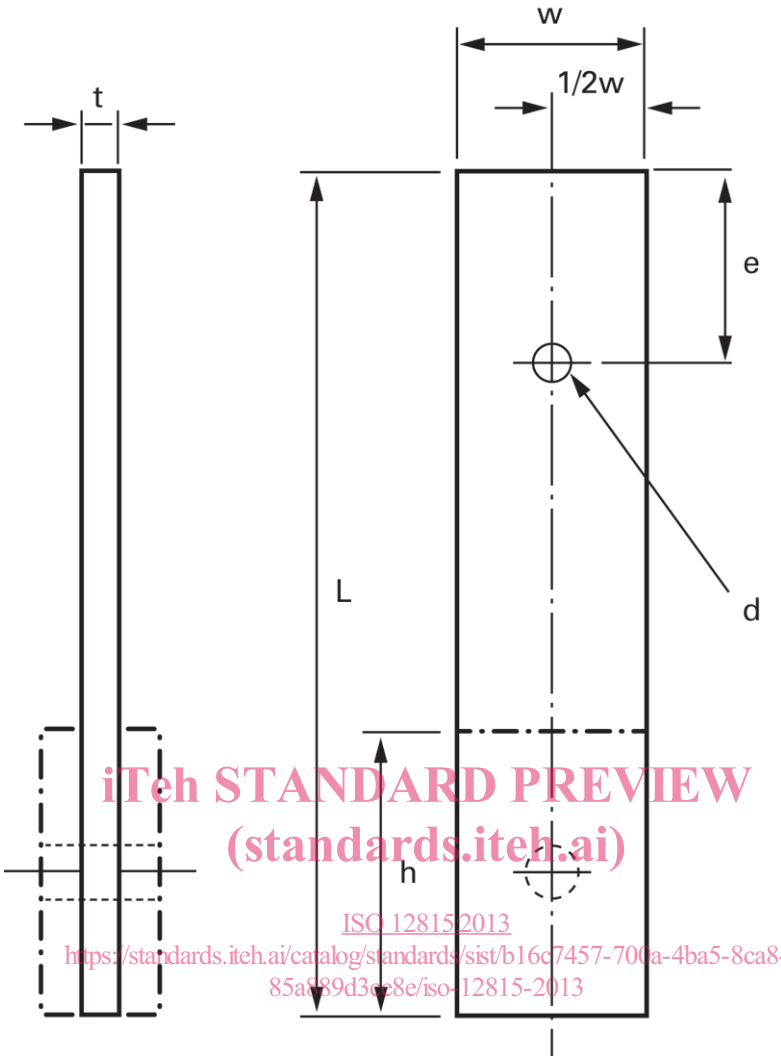
3 Terms and definitions

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

3.1
plain-pin bearing strength
σ_p
stress obtained by dividing the maximum load by the projected cross-sectional area of the pin contact area with the specimen (i.e. d x t)

Note 1 to entry: The result is expressed in megapascals, MPa.

3.2
specimen coordinate axes
coordinate axes for the material under test, the direction parallel to the plate longitudinal axis being defined as the “1” direction, the direction perpendicular to them as the “2” direction and, the direction “3” being perpendicular to the plate (i.e. the through-thickness direction) [SOURCE: ISO 527-4:1997, Clause 4.8]



Key

t thickness
w specimen width
L specimen length
e distance from end of specimen
h length of tabbing (if used)
d pin/hole diameter

Figure 1 — Test specimen for determination of plain-pin bearing strength

4 Principle

A test specimen consisting of a strip of rectangular cross-section with a plain hole, centrally positioned with respect to the width, is loaded in tension by a clearance fit metallic plain-pin. The maximum load sustained by the specimen is used to determine the plain-pin bearing strength, based on the projected area of the pin in contact with the specimen. The test measures a material plain-pin bearing strength under these loading conditions, rather than a load to fail a bolted joint, for the laminate lay-up tested.

5 Apparatus

5.1 Test machine.

5.1.1 General, test machine conforming to ISO 5893 as appropriate to the requirements given in 5.1.2 to 5.1.3.

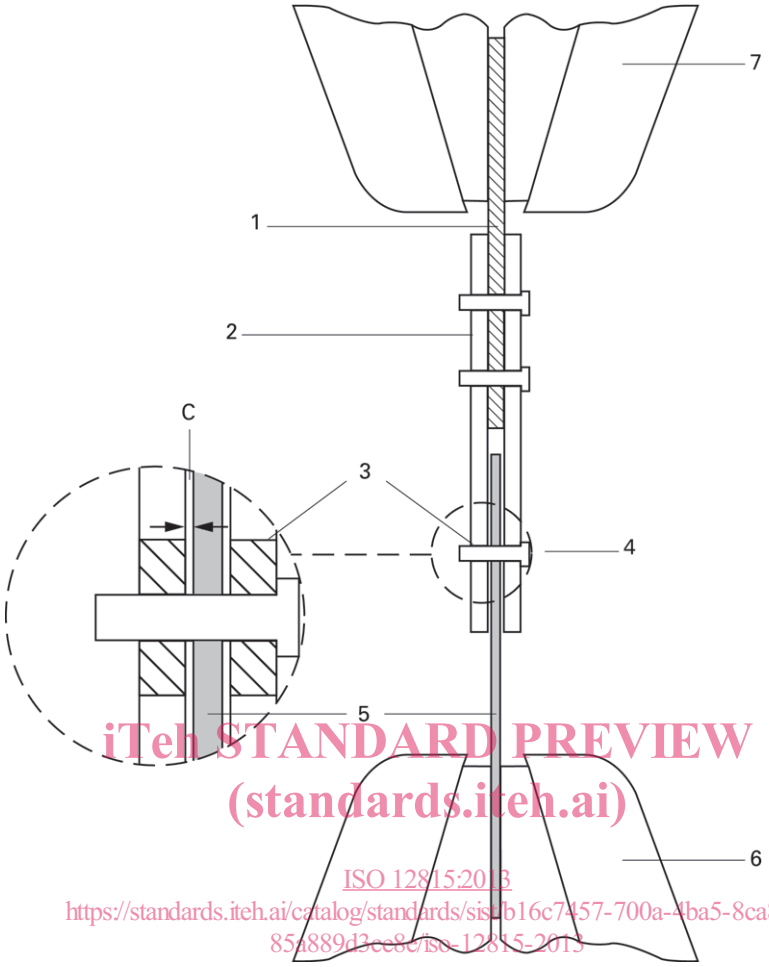
5.1.2 Speed of testing, *v*, shall be kept constant according to ISO 5893.

5.1.3 Indicator for load, such that the error in the indicated force is less than ±1 % of the full scale (see ISO 5893).

5.2 Micrometer, or equivalent, capable of reading to 0,01 mm, or less, and suitable for measuring the thickness, *t* and width, *w* of the test specimen; and the pin/hole diameter, *d* and position. The micrometer shall have faces appropriate to the surface being measured (i.e. flat faces for flat, polished surfaces and hemispherical faces for irregular surfaces).

5.3 Loading jig and pin, the plain-pin is loaded by a double-shear metal plate assembly, as shown in Figure 2. The loading jig shall include clearance, *c*, of at least 0.5 mm on both sides of the specimen and shall not distort under the applied load. The pin should be manufactured in a hardened steel. The loading pin shall similarly not distort during the test and should be an clearance fit in the hole in the specimen, unless specified otherwise. The loading pin shall have a diameter of 6 mm (tolerance 0 to −0.05 mm).

NOTE Hardened plates are acceptable as an alternative to the use of the hardened bushes shown in Figure 1.



Key

1 grip plate
2 side plate
3 hardened bushes
4 hardened loading pin
5 specimen
6, 7 machine grips
c clearance = 0.5 mm (minimum)

Figure 2 — Loading plates and test arrangement

6 Test specimens

6.1 Shape and dimensions

6.1.1 Preferred specimen size

The specimen shall have a width, *w*, of 36 mm ± 0,5 mm and a length, *L* of 100 to 180 mm. In cases of dispute the specimen length shall be 180 mm. For specimen thickness reference shall be made to the international standard for the material or the appropriate part of ISO 1268 for test panel manufacture, otherwise a minimum of 4 mm shall be used for the pin hole size given in 6.1.2. The width of individual specimens shall be parallel to within 0,2 mm. The configuration of the specimen is shown in Figure 1.

A hole, 6 mm (tolerance 0 to + 0,05 mm), in diameter is machined within 0,1 mm of the specimen centre line and a distance, *e*, of 36 mm (i.e. 6 × the hole diameter) from the end of the coupon. Providing that an acceptable bearing failure (c.f. shear-out) is still obtained, the end distance, *e*, can be reduced to 18 mm.

6.1.2 Alternative specimen size

Alternative specimens shall maintain a specimen width/hole diameter and an end distance/hole diameter ratio of 6; and a plain-pin diameter/specimen thickness of 1,5.

NOTE For existing applications, a 6,35 mm (0,25") hole at 38,1 mm (1,5") from the end of a 38,1 mm (1,5") wide coupon meets these requirements.

6.2 Preparation of specimens

6.2.1 General

A test plate shall be prepared in accordance with ISO 1268 (all parts) or another specified/agreed procedure. Individual specimens or groups of specimens shall be cut to the required size. Some parameters for machining are specified in ISO 2818. Further guidance on cutting specimens is given in Annex A of ISO 527-4.

The plate configuration shall be, if not given by the materials specification or as agreed by the interested parties, in a pseudo isotropic configuration. The 0°, x or axial direction in the plate shall be marked (see ISO 1268-4).

NOTE For 0,125mm thick unidirectional plies, the quasi- isotropic configuration lay-up for a 4 mm thick panel is given by [+45°, 90°, −45°, 0°]$_{4S}$ (i.e. 8 repeats of the stacking unit).

6.2.2 End tab material (if required)

Providing failure does not occur at or within the grip, unbonded tabs or no tabs may be used. If tabs are used, they shall be constructed from a cross-ply or fabric glass-fibre/resin laminate, or from the material under test. The tab material thickness shall be between 0,5 mm and 2 mm thick, with a tab angle of 90° (i.e. not tapered). See ISO 527-4.

6.2.3 Application of end tabs

Bonded end tabs, if used, shall be applied to the specimen with a high elongation adhesive, as described in Annex A of ISO 527-4.

NOTE A similar procedure can be used for individual specimens or for a group of specimens.

6.2.4 Machining the test specimens

The test specimen shall be cut and the hole drilled without causing damage.

6.3 Checking the test specimens

The specimens shall be flat and free of twist. The surfaces and edges shall be free from cracks, scratches, pits, sink marks and flashes. The drilled hole should not be damaged. The specimens shall be checked for conformity to these requirements by visual observation against straight-edges, squares and flat plates, and by measuring with micrometer callipers. Specimens showing measurable or observable departure from one or more of these requirements shall be rejected or machined to the required size and shape before testing. The pin shall be a clearance fit in the hole.