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Fibre-reinforced plastic composites — Shear test method using a shear frame for the determination of the in-plane shear stress/shear strain response and shear modulus

Composites plastiques renforcés de fibres — Méthode d'essai de cisaillement à l'aide d'un châssis de cisaillement pour la détermination de la contrainte de cisaillement /déformation au cisaillement dans le plan et du module de cisaillement

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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).

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For an explanation on 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 the following URL: 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.

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Introduction

The test method described in this document uses a shear frame fixture in order to introduce a pure shear loading throughout the free area of the test specimens. The edges of the test specimens are uniformly clamped during the test procedure avoiding fibre rotation and load re-distribution effects. This allows for the ultimate shear strength of high shear-elongation materials to be obtained even at shear strains higher than 5 % which is a limitation when using ISO 14129 or other standards regarding in-plane shear test methods for fibre reinforced plastic composites.

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Fibre-reinforced plastic composites — Shear test method using a shear frame for the determination of the in-plane shear stress/shear strain response and shear modulus

1 Scope

This document specifies a method using a shear test apparatus for measuring the in-plane shear stress/shear strain response, shear modulus and shear strength of continuous-fibre-reinforced plastic composite materials with fibre orientations of 0° and 0°/90°.

This method is applicable to thermoset and thermoplastic matrix laminates made from unidirectional layers/non-woven fabrics and/or fabrics including unidirectional fabrics, with the fibres oriented at 0° and 0°/90° to the specimen axis, where the lay-up is symmetrical and balanced about the specimen mid-plane.

The method is suitable for determining shear properties in both the linear and nonlinear load-deformation range even at shear strains greater than 5 %.

Short and long fibre-reinforced plastic composites can also be tested using this document.

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

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

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

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 12781-1, *Geometrical product specifications (GPS) — Flatness — Part 1: Vocabulary and parameters of flatness*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 http://www.electropedia.org/

3.1
plane
plane spanned by coordinate axes 1 and 2

Note 1 to entry: See Figure 2.

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3.2
in-plane shear stress
τ_{12}
stress obtained by dividing the instantaneous tensile load acting on the shear frame by the specimen cross-sectional area

Note 1 to entry: See also 8.1.

Note 2 to entry: The in-plane shear stress is expressed in MPa.

3.3
in-plane shear strength
τ_{12M}
maximum value for the shear stress

Note 1 to entry: See also 8.2.

Note 2 to entry: The in-plane shear strength is expressed in MPa.

3.4
shear strain
γ_{12}
sum of the individual components of the total shear strain of the test specimen

Note 1 to entry: See also 8.3.

3.5
in-plane shear modulus
in-plane chord modulus
G_{12}
shear stress difference τ''_{12} and τ'_{12} divided by the corresponding shear strain difference $\gamma''_{12} = 0{,}005$ and $\gamma'_{12} = 0{,}001$

Note 1 to entry: See also 8.4 and Figure 4.

Note 2 to entry: The in-plane shear modulus is expressed in MPa.

3.6
direction of coordinate axis 1
<test specimen> direction parallel to the loading axis of the test machine

Note 1 to entry: The fibres oriented at an angle of 0° are in this direction.

Note 2 to entry: See Figure 2 and Figure 3.

3.7
direction of coordinate axis 2
<test specimen> direction orthogonal to the loading axis of the test machine

Note 1 to entry: The fibres oriented at an angle of 90° are in this direction.

Note 2 to entry: See Figure 2 and Figure 3.

4 Principle

A square test specimen with recessed corners and reinforcing fibres oriented at 0° and 0°/90° to the specimen axis is held in a shear frame and subjected to pure shear loading. In order to determine the shear modulus and the shear strength, the tensile load acting on the shear frame and the associated shear strain are measured.

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