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Carbon-fibre-reinforced composites — Determination of the resin, fibre and void contents

Composites renforcés de fibres de carbone — Détermination des teneurs en résine, en fibre et en vide

FDIS stage

Contents

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 document 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*.

This second edition cancels and replaces the first edition (ISO 14127:2008), which has been technically revised.

The main changes are as follows:

— ——the new method: Method C (microscopic method) as means to determinate fibre content by volume and areal void content has been added;

— ——technical details related to the new method have been edited;

— ——procedure A3 has been modified by replacing the heating plate, beaker and watch glass with a heating mantle and round bottom flask;

— ——in Section 4.3, 6.3subclauses 4.3,6.3 and 7.3,7.3, where provisions for the number of test samples per assessment have been newly added.;—;

— ——"m_r""m_r" has been corrected to "φ_r""φ_r" in Formula (4).Formula (4).

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

The constituent contents such as fibre content, resin content as well as void content are parameters characterize physical/structural properties of carbon-fibre-reinforced composites. Such properties are proven to have influence on mechanical performances of carbon-fibre-reinforced composites; thus, the constituent contents are always required as important index for processing quality control.

Microscopic method calculates the fibre volume content/areal void content from measured fibre area/void area and the area of cross-section of a specimen. The principle of this method differs from method A or B, so that method C might be available when some of the types of resin were so hard to remove or in the case of lacking information of the prepregs. Meanwhile, thanks to the development of electronic and information technology, equipment integrated with image analysis functions is commercially available. The microscopic method has multiple advantages of being efficient, safe, commercial and ~~environmental~~environment friendly.

Carbon-fibre-reinforced composites — Determination of the resin, fibre and void contents

1 Scope

This document specifies methods for calculating the resin, fibre and void contents of a carbon-fibre-reinforced composite from the densities of the resin, the fibre and the composite and the mass of fibre in the composite (using method A), for calculating the fibre content from the thickness of the composite (using method B), and for calculating the fibre content by volume and areal void content through microscopic analysis (using method C).

Method A specifies three different resin removal procedures for the determination of the mass of fibre in the composite (viz a combustion procedure, a procedure by digestion in nitric acid and a procedure by digestion in a mixture of sulfuric acid and hydrogen peroxide). The selection of the procedure to be used is made by considering the combustibility of the resin used in the composite, its ability to decompose and the type of resin concerned. Method A is only of limited applicability when filled resins are present that can prevent complete dissolution and/or combustibility of the resin.

Method B (thickness measurement method) is only applicable to composites moulded from prepregs of known fibre mass per unit area.

Method C (microscopic method) is only applicable to carbon-fibre-reinforced composites with unidirectional, orthogonal and multidirectional laminates. It can also be used as reference for determination of the areal void content and fibre volume content of aramid- or glass-fibre-reinforced plastics, but is not applicable to fabric reinforced composites.

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

ISO 1183-1, Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method

ISO 1183-2, Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method

ISO 1183-3, Plastics — Methods for determining the density of non-cellular plastics — Part 3: Gas pyknometer method

ISO 6353-2, Reagents for chemical analysis — Part 2: Specifications — First series

ISO 9344, Microscopes — Graticules for eyepieces

ISO 10119, Carbon fibre — Determination of density

ISO 10934, Microscopes — Vocabulary for light microscopy

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 10934 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/obphttps://www.iso.org/obp

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

3.1
fibre content by mass
ratio of the mass of fibre in a composite to the total mass of the composite

Note 1 to entry: It is expressed as a percentage.

3.2
fibre content by volume
ratio of the volume of fibre in a composite to the total volume of the composite

Note 1 to entry: It is expressed as a percentage.

3.3
void content
ratio of the volume of the voids (hollow spaces) in a composite to the total volume of the composite

Note 1 to entry: It is expressed as a percentage.

3.4
areal void content
ratio of the total area of the voids (hollow spaces) on the whole observed cross-section of the specimen taken from the composite sample

Note 1 to entry: It is expressed as a percentage.

4 Test specimens — General requirements

4.1 The locations from which the test specimens are taken shall be distributed randomly over the sample and be no nearer than 10 mm to any edge.

4.2 Delamination and cracking shall be prevented during the machining process. The edges of the test specimens shall be ground square and smoothed with abrasive paper (6.2.3).(6.2.3).

4.3 At least three test specimens shall be taken unless otherwise specified by the party requesting the test.

5 Conditioning

This conditioning shall be carried out in one of the standard atmospheres specified in ISO 291.