

ISO 22838:2020
NBN ISO 22838:2021

 **NBN**



Composites and reinforcements fibres – Determination of the fracture energy of bonded plates of carbon fibre reinforced plastics (CFRPs) and metal using double cantilever beam specimens (ISO 22838:2020)

Valid from 17-06-2021

ICS: 83.120

INTERNATIONAL
STANDARD

ISO
22838

First edition
2020-12

**Composites and reinforcements
fibres — Determination of the fracture
energy of bonded plates of carbon
fibre reinforced plastics (CFRPs) and
metal using double cantilever beam
specimens**



Reference number
ISO 22838:2020(E)

ISO 22838:2020(E)



COPYRIGHT PROTECTED DOCUMENT

© ISO 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions and symbols	1
3.1 Terms and definitions.....	1
3.2 Symbols.....	2
4 Principle	3
5 Apparatus	3
6 Specimens	4
6.1 Number of specimens.....	4
6.2 Conditioning.....	4
6.3 Manufacture of adhesive joint specimens.....	4
6.3.1 General.....	4
6.3.2 DCB specimen measurements.....	5
6.4 Preparation of specimens.....	5
7 Procedure	6
7.1 Test set-up and data recording.....	6
7.2 Initial loading (precracking stage).....	6
7.3 Re-loading: Testing from the precrack.....	6
7.4 Determination of the thickness ratio of the CFRP and metal beams.....	9
7.4.1 Theoretical prediction of thickness ratios.....	9
7.4.2 Procedure to detect the occurrence of plastic deformation during a DCB adhesive joint test.....	9
7.5 Measurement of machine compliance.....	10
7.6 Measurement of curvature induced by coefficient of thermal expansion difference between metal and composite beams.....	10
8 Data analysis	12
8.1 Determination of the raw data from the load-displacement trace.....	12
8.1.1 General.....	12
8.1.2 Initiation values.....	12
8.1.3 Propagation values.....	13
8.2 Determination of adhesive fracture energy.....	13
8.2.1 General.....	13
8.2.2 DCB test with identical thickness: Corrected beam theory (CBT).....	13
8.2.3 DCB test with dissimilar thicknesses: modified beam theory for DCB specimens with dissimilar thicknesses.....	14
8.2.4 DCB test with identical and dissimilar thicknesses: Area method.....	15
9 Precision	15
10 Test report	16
Annex A (informative) Work flow chart as brief guideline	18
Annex B (informative) Formula for calculating G value using $(EI)_{eq}$ or $E_1I_1 E_2I_2$	19
Annex C (normative) Measurement of test system compliance	20
Bibliography	22

ISO 22838:2020(E)

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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

The potential benefits to the users of CFRP/metal assemblies of implementing the adhesive fracture energy of DCB specimen based on this document are:

- a) expanding CFRP applications to the fields where it could be used in combination 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 as CFRP in aerospace, or in constructions such as steel bridges and industrial applications (e.g. pipework repair, etc.)

Composites and reinforcements fibres — Determination of the fracture energy of bonded plates of carbon fibre reinforced plastics (CFRPs) and metal using double cantilever beam specimens

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. 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 the test method for the determination of adhesive fracture energy of adhesively bonded plates of carbon fibre reinforced plastic (CFRP) and metal using a double cantilever beam (DCB) specimen. The test method is also applicable to bonded joints between metals and other composite materials, such as glass fibre reinforced plastics.

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 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*

ISO 25217, *Adhesives — Determination of the mode 1 adhesive fracture energy of structural adhesive joints using double cantilever beam and tapered double cantilever beam specimens*

3 Terms, definitions and symbols

3.1 Terms and definitions

No terms and definitions are listed in this document.

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/>