INTERNATIONAL STANDARD

**ISO 14126**

First edition
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# Fibre-reinforced plastic composites — Determination of compressive properties in the in-plane direction

*Composites plastiques renforcés de fibres — Détermination des caractéristiques en compression dans le plan*

Reference number
ISO 14126:1999(E)

## Contents







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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

International Standard ISO 14126 was prepared by ISO/TC 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*.

This first edition cancels and replaces ISO 8515:1991, which dealt only with glass-fibre-reinforced plastic composites.

Annex A forms a normative part of this International Standard. Annexes B to D are for information only.

## Introduction

This standard is based on ISO 8515, with the scope extended to include all fibre-reinforced plastic composites, such as more recent composites based on carbon and aramid fibres, but retains the test conditions relevant for glass-fibre-reinforced systems. Other source documents consulted include ASTM D 3410 (buckling criteria, larger specimen width and longer gauge length), ASTM D 695 (modified version in SACMA SRM1), prEN 2850, CRAG 400, DIN 65380 and JIS K 7076 (see bibliography).

Several different types of jig, different materials and different specimen sizes are covered by these source documents. The table below presents examples, the specimen sizes being given as overall length × gauge length × width × thickness, in millimetres.

| | | | |
|---|---|---|---|
| ISO 8515 (GRP) | Celanese type 110 × 13 × 6,4 × 2 | End block 120 × 20 × 10 × (3 to 10) | |
| prEN 2850 (CFRP) | Celanese type 110 × 10 × 10 × 2 | ASTM D 695 80 × 5 × 12,5 × 2 | Revision includes a machined specimen with co-cured tabs. |
| JIS K 7076 (CFRP) | ASTM D 695 78 × 8 × 12,5 × 2 | Celanese 134 × 8 × 6,5 × 2 | ITTRI 108 × 8 × (6 to 12,5) × (1 to 2) |
| ASTM D 3410 (all fibres) | Celanese 140 × 12 × 6 × variable | ITTRI 140 × (25 to 12) × (12 or 25) × variable | |
| (equations/tables give required thickness for modulus, expected strength and gauge length) | | | |
| DIN 65380 (all fibres) | Celanese 112 × 8 × 6,35 × 2 | ITTRI 112 × 8 × 6,35 × 2 | |
| CRAG 400 (all fibres) | Celanese 110 × 10 × 10 × 2 | | |
| SACMA SRM1 (all fibres) | ASTM D 695 (modified) 80,8 × 12,7 × 4,8 × [1 (unidir.) or 3 (fabric)] | | |

These test methods use aspect ratios (height/thickness and height/width) for the gauge area covering a range of values, which appears undesirable in a test known to be susceptible to buckling failures. Also, new support jigs are still being developed. This International Standard harmonizes and rationalizes the current situation by:

a) concentrating on the quality of the test by limiting the maximum bending-buckling strain allowable at failure (i.e. 10 % as recommended by ASTM — see also 5 % level in prEN 2850), so that it is possible to justify an axial-load analysis;

b) allowing any design of jig to be used that meets this above requirement, using two methods of loading (i.e. shear and end loaded);

c) standardizing on two specimen designs, one principally for unidirectional material and one for other materials (the chosen specimen can be used with either loading method);

d) adding an informative note as annex D, which was proposed by ASTM for harmonization purposes, and is taken from ASTM D 3410 (in a modified form).

# Fibre-reinforced plastic composites — Determination of compressive properties in the in-plane direction



## 1 Scope

**1.1** This International Standard specifies two methods for determining compressive properties, in directions parallel to the plane of lamination, of fibre-reinforced plastic composites.

**1.2** The compressive properties are of interest for specifications and quality-control purposes.

**1.3** Two loading methods and two types of specimen are described. They are:

— Method 1: provides shear loading of the specimen (gauge length unsupported).

— Method 2: provides end loading, or mixed loading, of the specimen (gauge length unsupported).

NOTE For tabbed specimens end-loaded using method 2, some load is transferred into the specimen gauge length by shear through the tabs.

— Type A specimen: rectangular cross-section, fixed thickness, end-tabbed.

— Type B specimen: rectangular cross-section, range of thicknesses, untabbed or end-tabbed (two sizes available).

Any combination of test method and specimen may be used, provided that the requirements of subclause 9.8 are satisfied and that the specimen is representative of the material under test. These alternative test conditions will not necessarily give the same result.

The type A specimen is the preferred specimen for unidirectionally reinforced materials tested in the fibre direction. For other materials, the type A or B specimen may be used. The type B2 specimen is preferred for mat, fabric and other multidirectionally reinforced materials.

**1.4** The methods are suitable for fibre-reinforced thermoplastic and thermosetting plastic composites.

Unreinforced and particle-filled plastics, as well as those reinforced with short fibres (less than 1 mm in length), are covered by ISO 604 (see bibliography).

**1.5** The methods are performed using specimens which may be machined from a test panel made in accordance with ISO 1268 or equivalent methods, or from finished or semi-finished products.

**1.6** The methods specify required dimensions for the specimen. Tests which are carried out on specimens of other dimensions, or on specimens which are prepared under different conditions, may produce results which are not comparable. Other factors, such as the speed of testing, the support fixture used and the condition of the specimens, can influence the results. Consequently, when comparative data are required, these factors must be carefully controlled and recorded.

**1.7** Fibre-reinforced plastics are usually anisotropic. It is therefore often useful to cut test specimens in at least the two main directions of anisotropy, or in directions previously specified (for example a lengthwise direction associated with the production process).

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 291:1997, *Plastics — Standard atmospheres for conditioning and testing*.

ISO 527-1:1993, *Plastics — Determination of tensile properties — Part 1: General principles.*

ISO 527-4:1997, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*.

ISO 1268:1974, *Plastics — Preparation of glass fibre reinforced, resin bonded, low-pressure laminated plates or panels for test purposes* (under revision).

ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*.

ISO 3534-1:1993, *Statistics — Vocabulary and symbols — Part 1: Probability and general statistical terms*.

ISO 5893:1993, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Description*.

ISO 9353:1991, *Glass-reinforced plastics — Preparation of plates with unidirectional reinforcements by bag moulding*.

## 3 Definitions

For the purpose of this International Standard, the following definitions apply:

**3.1**
**compressive stress**
$\sigma_c$
the compressive force experienced by the test specimen at any particular moment divided by the initial cross-sectional area of the parallel-sided portion of the specimen

It is expressed in megapascals.

**3.2**
**compressive strength**
**compressive failure stress**
$\sigma_{cM}$
the maximum compressive stress sustained by the specimen

It is expressed in megapascals.

**3.3**
**compressive strain**
$\varepsilon_c$
the ratio of the decrease in the distance between the gauge marks on the parallel-sided portion of the test specimen (due to a compressive force) to the initial distance between the gauge marks

It is expressed as a dimensionless ratio or in percent.