

Metallic materials — Test methods —

Part 1: Tensile testing at ambient temperature

The European Standard EN 2002-1:2005 has the status of a
British Standard

ICS 49.025.05; 49.025.15

National foreword

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The UK participation in its preparation was entrusted by Technical Committee ACE/61, Metallic materials for aerospace purposes, to Subcommittee ACE/61/-/1, Mechanical testing of metallic materials, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;
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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 22, an inside back cover and a back cover.

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English Version

Aerospace series - Metallic materials - Test methods - Part 1: Tensile testing at ambient temperature

Série aérospatiale - Matériaux métalliques - Méthodes
d'essais applicables - Partie 1 : Essais de traction à
température ambiante

Luft-und Raumfahrt - Metallische Werkstoffe -
Prüfverfahren - Teil 1: Zugversuch bei Raumtemperatur

This European Standard was approved by CEN on 19 September 2005.

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Foreword

This European Standard (EN 2002-001:2005) has been prepared by the European Association of Aerospace Manufacturers - Standardization (AECMA-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of AECMA, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2006, and conflicting national standards shall be withdrawn at the latest by May 2006.

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Introduction

This standard is part of the series of EN metallic material standards for aerospace applications. The general organization of this series is described in EN 4258.

1 Scope

This standard specifies the requirements for the tensile testing of metallic materials at ambient temperature for aerospace applications.

It shall be applied when referred to in the EN technical specification or material standard unless otherwise specified on the drawing, order or inspection schedule.

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.

EN ISO 7500-1, *Metallic materials – Verification of static uniaxial testing machines – Part 1: Tension/compression testing machines – Verification and calibration of the force-measuring system.*

EN ISO 9513, *Metallic materials – Calibration of extensometers used in uniaxial testing.*

EN 4258, *Aerospace series – Metallic materials – General organization of standardization – Links between types of EN standards and their use.*

EN 4259, *Aerospace series – Metallic materials – Definition of general terms.* ¹⁾

ASTM E-1012, *Standard practice for verification of specimen alignment under tensile loading.* ²⁾

3 Terms, definitions and symbols

For the purposes of this standard, the terms, definitions and symbols given in EN 4259 and the following given in Table 1 apply.

1) Published as AECMA Prestandard at the date of publication of this standard.

2) This standard is published by: American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA.

Table 1 — Terms, definitions and symbols

Symbol	Unit	Term	Definition
—	—	Test piece	The portion of the test sample on which the tensile test is carried out
—	—	Proportional test pieces	A test piece with an original gauge length (L_0) having a specified relationship to the square root of the cross-sectional area (S_0). The proportionality coefficient, K , has the internationally recognized value of 5,65 for test pieces of circular cross-section. The gauge length of a proportional test piece is therefore equal to $5,65 \sqrt{S_0}$. Certain material standards use proportional test pieces with other than the 5,65 proportionality coefficient. In this case, see A_x for the percentage elongation symbol used.
—	—	Non-proportional test piece	A test piece where the original gauge length is independent of the cross-sectional area
—	mm	Extension	The increase of the extensometer gauge length (L_e) at any moment during the test
—	MPa	Limit of proportionality	The stress at which the stress-strain (or force-extension) relationship deviates from a straight line
A	%	Percentage elongation (proportional test piece) NOTE For non-standard proportional test piece, see A_x .	Elongation after fracture expressed as a percentage of the original gauge length (L_0) for a proportional test piece with an original gauge length of $L_0 = 5,65 \sqrt{S_0}$. $A = \frac{L_u - L_0}{L_0} \times 100$
A_{L0}	%	Percentage elongation (non-proportional test piece)	Elongation after fracture expressed as a percentage of the original gauge length (L_0) for a non-proportional test piece with an original gauge length of L_0 . For a non-proportional test piece, the original gauge length is given in millimetres, e.g. $A_{50\text{mm}}$. $A_{L0} = \frac{L_u - L_0}{L_0} \times 100$
A_x	%	Percentage elongation (non standard proportional test piece)	Elongation after fracture expressed as a percentage of original gauge length (L_0) for a non-standard proportional test piece with an original gauge length of $L_0 = x$ (e.g.: A_{40}). A non-standard proportional test piece is one in which the proportionality coefficient has a value other than 5,65. In the example above the gauge length is four times the diameter, equivalent to a proportionality coefficient of 4,51.
a	mm	Test piece thickness	Thickness of a test piece of rectangular cross-section or wall thickness of a tube
b	mm	Test piece width	Width of test pieces of rectangular cross-section, average width of the longitudinal strip taken from a tube or width of a flat wire
D	mm	Tube external diameter	External diameter of a tube
d	mm	Test piece diameter	Diameter of the parallel length of a circular test piece or diameter of round wire or internal diameter of a tube

continued

Table 1 — Terms, definitions and symbols (concluded)

Symbol	Unit	Term	Definition
E	GPa	Young's modulus of elasticity	The value of the increment in stress divided by the corresponding increment in strain for the straight portion of the stress-strain (or force-extension) diagram
F_m	N	Maximum force	The greatest force which the test piece withstands during the test
L	mm	Gauge length	The length of the cylindrical or prismatic portion of the test piece on which elongation is measured
L_c	mm	Parallel length	The length of the reduced section of the parallel portion of the test piece. The concept of parallel length is replaced by the concept of distance between grips for non-machined test pieces.
L_e	mm	Extensometer gauge length	The length of the parallel portion of the test piece used for the measurement of extension by means of an extensometer at any moment during the test. This length may differ from L_0 but can be of any value greater than b , d or D (see above) but shall be less than the parallel length (L_c). It is recommended that the extensometer gauge length is as large as possible.
L_0	mm	Original gauge length	The gauge length before the application of force
L_t	mm	Test piece length	Total length of test piece
L_u	mm	Final gauge length	The gauge length after fracture of the test piece
$L_u - L_0$	mm	Elongation	Elongation after fracture. The permanent increase in the original gauge length (L_0) after fracture.
R_m	MPa	Tensile strength	The maximum force (F_m) divided by the original cross-sectional area (S_0) of the test piece
R_p	MPa	Proof stress	The stress at which a non-proportional extension is equal to a specified percentage of the extensometer gauge length (L_e) (see Figure 1). The symbol used is followed by a suffix giving the prescribed percentage of the original gauge length for example: $R_{p0.2}$
r	mm	Test piece transition radius	Radius at ends of parallel length
S_0	mm ²	Original cross-sectional area	Original cross-sectional area of the parallel length
S_u	mm ²	Minimum cross-sectional area	Minimum cross-sectional area of test piece after fracture
Z	%	Percentage reduction of area after fracture	The maximum decrease of the cross-sectional area ($S_0 - S_u$) expressed as a percentage of the original cross-sectional area (S_0) i.e. $Z = \frac{S_0 - S_u}{S_0} \times 100$
ε	—	Strain	The extension of any moment during the test divided by the original gauge length (L_0) of the test piece
σ	MPa	Stress	The force at any moment during the test divided by the original cross-section area (S_0) of the test piece
θ	°C	Specified temperature	The temperature at which the test is to be carried out