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BSI Standards Publication

Aerospace series — Metallic materials — Test method — Shear test for wires and rivets

National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 3238:2010) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-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 ASD, prior to its presentation to CEN.

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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 shear testing rivet wire and rivets in metallic materials 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 4259, *Aerospace series — Metallic materials — Definition of general terms* [1)]

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 (ISO 7500-1:2004)*

ISO 286-1:1988, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits*

3 Terms, definitions, parameters and symbols

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

3.1 General terms

See EN 4259.

3.2 Other terms

3.2.1 Shear strength

Shear strength (R_c) is given by:

$$R_c = \frac{F_m}{2\,S_o} \qquad \text{or} \qquad R_c = 2\frac{F_m}{\pi {d_o}^2}$$

where

d_0 is the original diameter of the test piece;

F_m is the maximum force;

S_o is the original cross-sectional area of the test piece.

1) Published as ASD Pre-Standard at the date of publication of this standard.

3.2.2 Parameters and symbols

See Table 1.

Table 1 — Parameters and symbols

Symbol	Unit	Parameter
d_0	mm	Original diameter of the test piece
d_1	mm	Inside diameter of the inner shearing device
d_2	mm	Outside diameter of the inner shearing device
F_m	N	The maximum force which the test piece withstands during the test
h	mm	Distance between bottom of housing and lower part of inner shearing device
l_1	mm	Length of the outer shearing device
l_2	mm	Length of the inner shearing device
$L_{min.}$	mm	Minimum length of the test piece
R_c	MPa	Shear strength – The maximum force (F_m) divided by twice the original cross-sectional area (S_0) of the test piece
S_0	mm^2	Original cross-sectional area of the test piece

4 Health and safety

Resources, test pieces, test samples, test materials, test equipment and test procedures shall comply with the current health and safety regulations/laws of the countries where the test is carried out.

Where equipment, materials and/or reagents which may be hazardous to health are specified, appropriate precautions in conformity with local regulations/laws shall be taken.

5 Principle

The shear test consists in subjecting a wire, rivet or test piece of circular cross-section to shearing in double shear.

6 Testing requirements

6.1 Resources

6.1.1 Equipment/plant

a) Tensile or compression testing machines verified in accordance with EN ISO 7500-1;

b) shearing device for compression testing machine (see Figures 1 and 3);

c) shearing device for tensile testing machine (see Figures 2 and 3);

d) shearing devices shall consist of the following components:

1) housing (1);

2) housing socket (2);

3) slide (3);

4) slide socket (4).

The dimensions are shown in Table 2.

Shearing device sockets (2) and (4) of Figure 3 shall have a hardness of:

5) for aluminium and aluminium alloys, 500 HV minimum;

6) for other alloys, 700 HV minimum.

The shearing devices need not conform to the pictorial representation but the dimensions specified and surface roughness shall be maintained.

Table 2 — Dimensions

Shearing devices	d_1	Tol.	**Shearing device corresponding to tolerance zone** [a]	d_2	h min.	L_1	L_2	**Test piece** d_0	Tol.	L min.
1	2	+ 0,100 0	H12	30	35	15	20	2	– 0,020 – 0,370	50
	3							3		
	4	+ 0,120 0						4	– 0,030 – 0,390	
	5							5		
	6	+ 0,075 0	H11					6	– 0,030 – 0,345	
	8	+ 0,090 0						8	– 0,040 – 0,370	
2	10	+ 0,022 0	H8	45	50	30	50	10	– 0,013 – 0,186	110
	12	+ 0,027 0						12	– 0,016 – 0,193	
	14							14		
	16							16		
3	18	+ 0,033 0	H8	45	50	40	50	18	– 0,016 – 0,193	130
	20							20	– 0,020 – 0,212	
	25							25		

[a] According to ISO 286-1:1988.

NOTE If the actual size of wire (d_0) is different from dimensions given in Table 2, a shearing device with an appropriate inside diameter (d_1) consistent with other parameters of Table 2 should be used.

6.1.2 Materials/reagents

— Degreasing fluids;

— test record sheet or test log book or equivalent.

6.1.3 Qualification of personnel

Testing to the requirements of this test method shall only be undertaken and/or supervised by personnel who have demonstrated their competence by a suitable education and appropriate training and experience.

6.2 Test samples/test pieces – Test piece dimensions

Unless otherwise specified by the technical or material standard, drawing or order, cylindrical test pieces (wire or rivets) with an original diameter (d_0) and length ($L_{\text{min.}}$) according to Table 2 shall be used.

Where possible, products shall be tested in full section, however for materials with a tensile strength exceeding 1 000 MPa, it is permissible for test pieces of diameter (d_0) within the range 2 mm to 16 mm taken from the product to be used. The test piece axis shall be $d_0/2$.

NOTE There are currently no rivet wire standards in the ASD-STAN series specifying greater than 10 mm diameter.

6.3 Testing procedure

6.3.1 Temperature of test

The test shall be carried out at 10 °C $\leq \theta \leq$ 35 °C, unless otherwise specified.

In cases of dispute, the test shall be performed at $\theta = (23 \pm 5)$ °C.

6.3.2 Method of test

6.3.2.1 Place the shearing device with sockets corresponding to the original test piece diameter (d_0) in the machine so that the vertical axis of the device coincides with the line of action of the test force.

6.3.2.2 Set the force indicator to zero before inserting the test piece in the shearing device. Check that during motion of the slide (3) frictional forces are sufficiently low as to cause negligible deviation of the force indicator.

6.3.2.3 Measure the original test piece diameter (d_0) of the test piece to an accuracy of 0,01 mm.

6.3.2.4 Place the test piece in the shearing device and increase the force slowly until failure. Record the maximum force and determine the shear strength in accordance with 3.2.1.

6.3.2.5 After testing remove the sheared parts of the test piece taking care that no fragments remain in the sockets (2) and (4).

6.4 Expression of results

Results shall be expressed as specified in the relevant technical standard, drawing or order.

7 Test report

All results shall be in written form and the test report shall include, when relevant, at least the following information:

— reference to this test method;

— any other information relevant to the test method(s) (e.g. test condition, test equipment, test procedure, verification, etc.);

— identification and traceability of the semi-finished product to be tested in accordance with the technical specification;

— identification and traceability of test samples taken from the semi-finished product (e.g. location, orientation, size);

— identification and traceability of test pieces taken from test samples (e.g. number, preparation, method, condition).

In certain cases the test piece may be the test sample:

— expression of results (e.g. individual values or mean values, units, etc.);

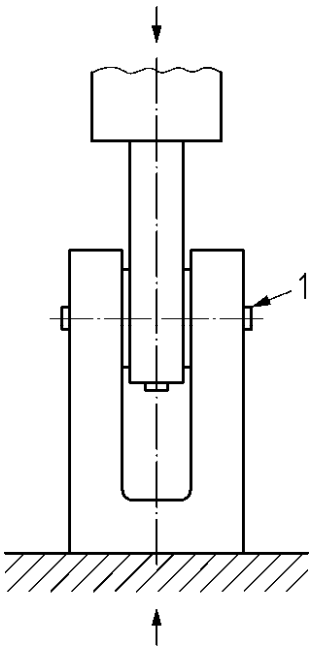
— recorded plots/graphs, when necessary;

— date of test;

— traceability to individual performing the test work;

— any incident which may have affected the results;

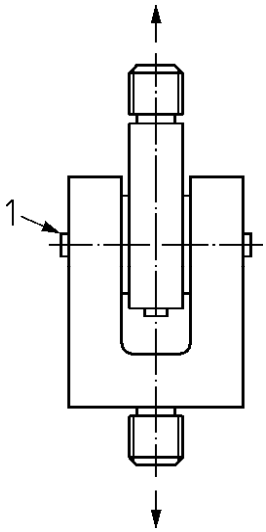
— any deviation from the test method standard.



Key

1 Test piece

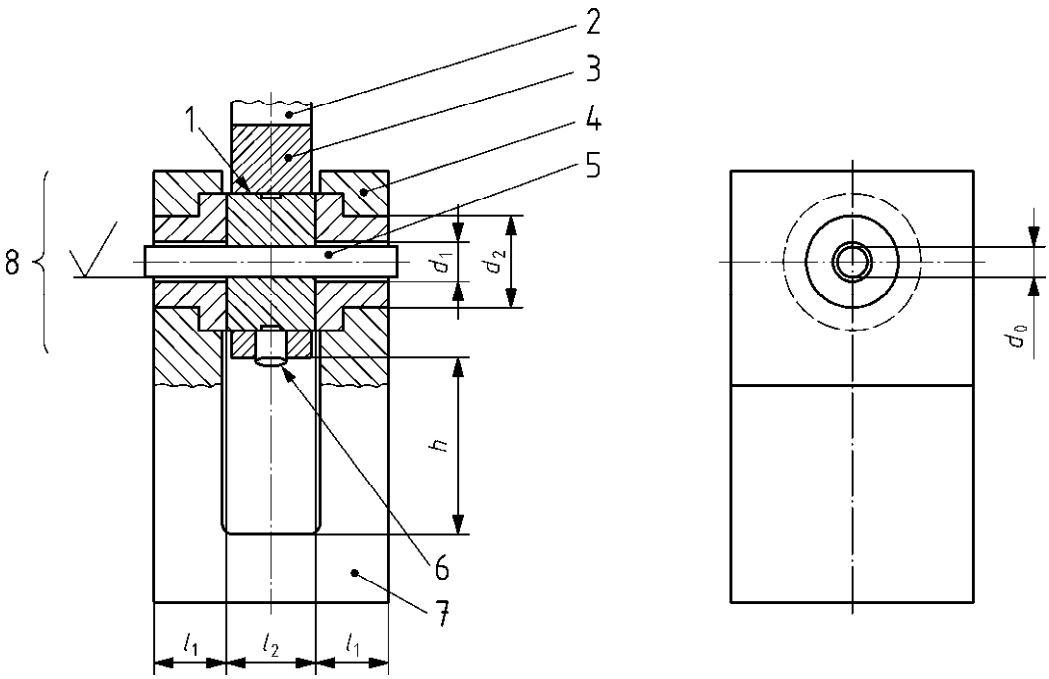
Figure 1 — Shearing device for compression testing machine



Key

1 Test piece

Figure 2 — Shearing device for tensile testing machine



Key

1 One hardened socket in slide
2 Slide
3 Only points to section through slide
4 Only points to section through housing
5 Test piece
6 Lock screw
7 Housing
8 Two hardened sockets in housing

Figure 3 — Assembly of shear test device

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