SLOVENSKI STANDARD
SIST EN 6072:2010

01-september-2010

Aeronavtika - Kovinski materiali - Preskusne metode - Preskus utrujanja z nespremenljivo amplitudo

Aerospace series - Metallic materials - Test methods - Constant amplitude fatigue testing

Luft- und Raumfahrt - Metallische Werkstoffe - Prüfverfahren - Ermüdungstest mit konstanter Amplitude

Série aérospatiale - Matériaux métalliques - Méthodes d'essai - Essai de fatigue à amplitude constante

Ta slovenski standard je istoveten z: **EN 6072:2010**

ICS:

49.025.05 Železove zlitine na splošno Ferrous alloys in general

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English Version

Aerospace series - Metallic materials - Test methods - Constant amplitude fatigue testing

Série aérospatiale - Matériaux métalliques - Méthodes d'essai - Essai de fatigue à amplitude constante

Luft- und Raumfahrt - Metallische Werkstoffe - Prüfverfahren - Ermüdungstest mit konstanter Amplitude

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Page

Foreword

This document (EN 6072:2010) 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.

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of an identical text or by endorsement, at the latest by December 2010, and conflicting national standards shall be withdrawn at the latest by December 2010.

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1 Scope

This European Standard defines a method to determine constant amplitude fatigue data of metallic materials and the S-N curve (or Wöhler curve).

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.

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

ISO 965-1, *ISO general-purpose metric screw threads — Tolerances — Part 1: Principles and basic data*

ISO 1101, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ASTM E 466, *Standard practice for conducting force controlled constant amplitude axial fatigue tests of metallic materials* [1)]

ASTM E 1823, *Standard terminology relating to fatigue and fracture testing* [1)]

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ASTM E 1823 and the following apply.

3.1 Direction of test samples

3.1.2
cylindrical specimens
the direction of the sample is identified by the following symbols:
L : Long (grain flow direction);
LT : Long Transverse;
ST : Short Transverse.

The directions of semi-finished products of rectangular cross section for rolled or extruded products and forgings are identified on Figure 1.

The directions of semi-finished products of circular cross section for rolled products and forged rings are identified on Figure 2.

3.1.2
flat specimens
designation for direction of these specimens is identical to ASTM designation:

Two letters separated by a dash:
First letter : direction of load
Second letter : direction of crack propagation

The directions of semi-finished products of rectangular cross section for rolled or extruded products and hand forgings are identified on Figure 3.

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1) Published by: American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103, USA.

The directions of semi-finished products of circular cross section for drawn or extruded products and hand forgings are identified on Figure 4.

4 Principles of the method

See ASTM E 466.

5 Apparatus

See ASTM E 466 (calibrating to ISO 7500-1 is also acceptable).

6 Test specimens

6.1 General

Test specimens shall be prepared according to the requirements of the relevant Process or Material Standard.

6.2 Geometry

The geometry of test specimens is described in Annexes A to D.

6.3 Machining

6.3.1 Dimensional tolerances

Machining tolerances (according to ISO 286-1) on transverse dimensions: ISO js 12.

Form tolerances (according to ISO 1101) = ISO IT9.

Specimens shall be machined cold, without generating surface hardening nor appreciable heating of the metal.

Recommendations for machining procedure of specimens are given in Annex E for each type of specimen.

Final machining to comply with the tolerances and to obtain the surface finish required on the calibrated section (see Annexes A to D).

6.3.2 Specimens to be heat-treated

The heat treatment should preferably be applied to the specimen blanks to avoid distortion, which cannot be corrected by machining.

Final machining after heat treatment, in accordance with 6.3.1.

NOTE For steels treated to obtain a high UTS, it may be necessary to machine the specimens to the final dimensions in the as-delivered condition and then protect them before heat treatment.

In general, the surface of steel and aluminium alloys specimens shall be:

— either protected against corrosion by an appropriate product,

— or machined only shortly before carrying out the test.

6.3.3 Grinding

Grinding of steel and titanium specimens shall only be carried out when a process is available which guarantees no detrimental effects to the specimen surface, for example contamination.

6.4 Straightening

It is strictly forbidden to straighten a distorted specimen.

Such distortion can arise from heat treatment on specimens machined to their final dimensions.

The surface hardening generated by the mechanical equipment used to straighten the specimens affects the mechanical properties and gives unrepresentative results.

7 Procedure

7.1 Number of specimens

A minimum of 10 fatigue specimens with valid results is necessary to determine a Wöhler curve.

Upon request, a static loaded specimen shall be performed.

7.2 Measurements of specimen dimensions

The dimensions of the test specimens shall be measured before testing and the results reported in the test report (see Clause 9).

7.3 Test procedure

Load ratio R and K_t factor are given in the relevant Process or Material Standard.

The test frequency shall be not more than 170 Hz. For frequency greater than 50 Hz, it is advisable to carry dynamic calibrations on test work.

The choice of load levels shall be done in order that test results can be regularly positioned on the S-N curve between at least 10^4 and 3.10^6 cycles, so that a Wöhler curve can be raised. For qualification of materials, cycling must not be stopped before 3.10^6 cycles, unless other conditions are specified. In case of non-failure at 3.10^6 cycles (or more), specimen can be tested again at a higher load level that will lead to failure before 10^5 cycles. Test results must mention that specimen has been tested after a non-failure so that analysis can take it into account.

NOTE For load ratio $R < 0$, it is recommended to use anti buckling equipment.

The breaking near the grip and the associated number of cycles shall be mentioned in the test report (see Clause 9). In this case the specimen should be clamped again (if possible) and the test should be continued at the same load level.

In order to check the reproducibility and friability of test machine, an example of inspection card is given in Annex I.

8 Analysis of test results

8.1 Failure of specimens

After testing, specimens shall be examined. Failure type and sites shall be indicated (see Annex F).

8.2 Presentation of fatigue data

All the values measured and calculated from the specimens shall be reported in a table (see Annex G).

The cross section of the specimen, which has been used for calculation, shall be indicated.

8.3 Plot of the Wöhler curve

All the individual results shall be represented in a log (or semi-log) scale scheme: max. stress in MPa, σ, versus Fatigue life, number of cycles, N (see Annex H).

The analysis of the test results shall generate a mean Wöhler curve with 50 % probability of failure, in addition two curves for minimum and for maximum probability of failure.

9 Test report

The test report shall refer to the test method and shall include the following:

— Complete identification of the tested material including the manufacturers Name, Designation, and Batch Number.

— All details relating to the preparation of the specimens.

— All relevant dimensions of the specimens.

— Date of test and traceability to the individual performing the test work.

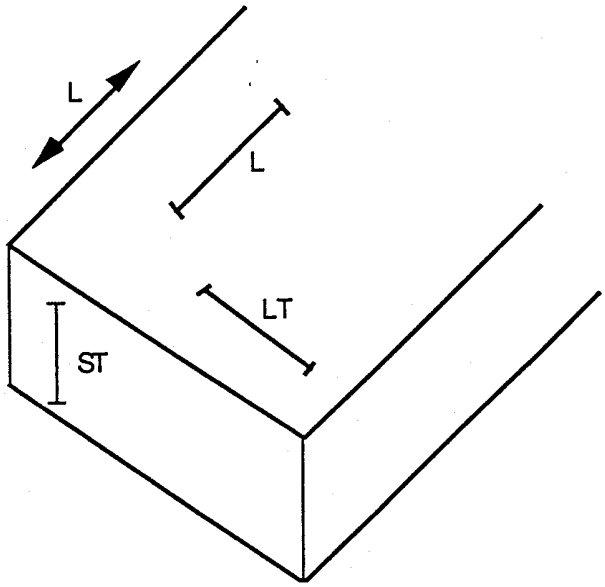
— Conditioning.

— Equipment used and test parameters (R ratio, test frequency, orientation ...).

— Recorded plots/graphs (with all the points).

— Individual test results and type of failure (see Annex F and Annex G).

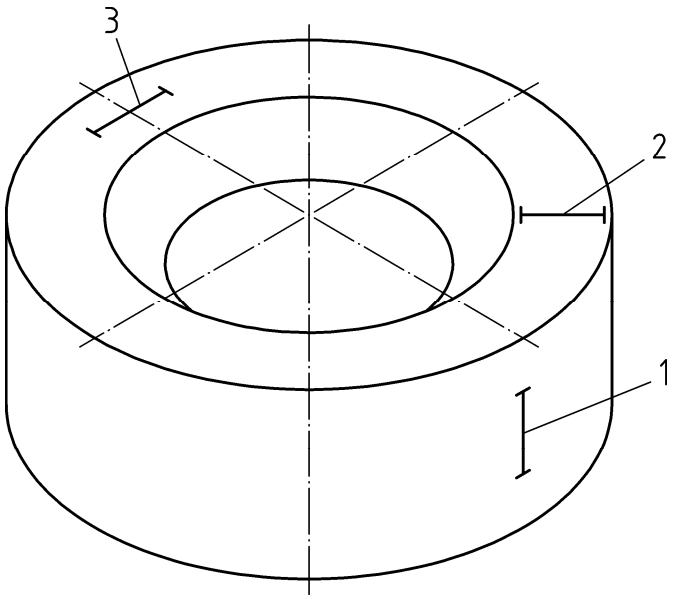
— Any incident which may have affected the results, and any deviation from the test method.



Key

L : Long (grain flow direction)
LT : Long Transverse
ST : Short Transverse

Figure 1 — Cylindrical specimens - Direction of semi-finished products of rectangular cross section

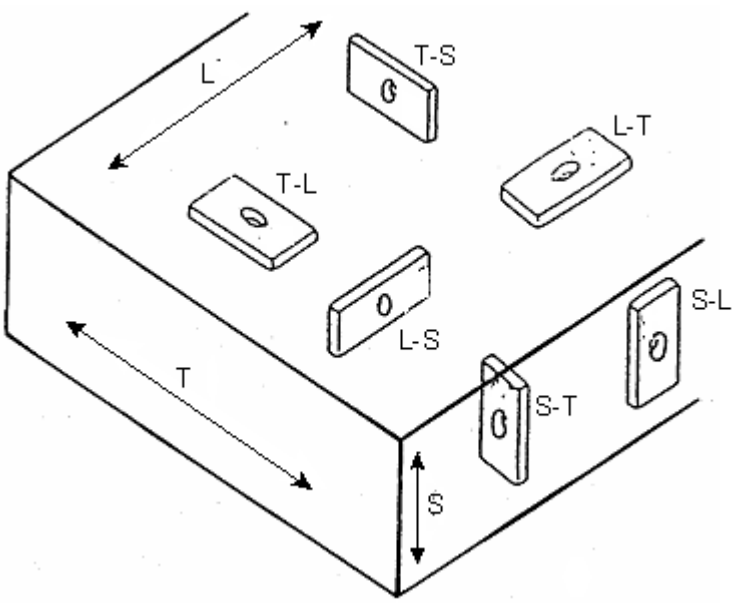


Key

1 Axial: corresponds to LT direction
2 Radial: corresponds to ST direction
3 Tangential: corresponds to L direction (grain flow direction)

Depending on the forging axis, the LT and ST directions can change.

Figure 2 — Cylindrical specimens - Direction of semi-finished products of circular cross section



Key

L : Long (grain flow direction)
LT : Long Transverse
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Two letters separated by a dash:
First letter : direction of load
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Figure 3 — Flat specimens - Direction of semi-finished products of rectangular cross section