



SLOVENSKI STANDARD
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Aerospace series - Bushes with self-lubricating liner - Technical specification

Aerospace series - Bushes with self-lubricating liner - Technical specification

Luft- und Raumfahrt - Buchsen mit selbstschmierender Beschichtung - Technische Lieferbedingungen

Série aérospatiale - Bagues avec garniture autolubrifiante - Spécification technique

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ICS:

49.030.99 Drugi vezni elementi Other fasteners

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EUROPEAN STANDARD
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English version

**Aerospace series
Bushes with self-lubricating liner
Technical specification**

Série aérospatiale	Luft- und Raumfahrt
Bagues avec garniture autolubrifiante	Buchsen mit selbstschmierender Beschichtung
Spécification technique	Technische Lieferbedingungen

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to CEN Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat : Rue Bréderode 2, B-1000 Bruxelles

Brief history

This European Standard has been prepared by the European Association of Aerospace Constructors (AECMA).

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

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According to the Common CEN/CENELEC Rules, following countries are bound to implement this European Standard:

Belgium, France, Germany, Italy, Netherlands, Spain, United Kingdom

REPUBLIKA BULGARIJA
 БЪЛГАРСКО УПРАВЛЕНИЕ ЗА СТАНДАРТИ
 ДИРЕКЦИОНАЛЕН ОФИС - СОФИЯ
 АНАЛИЗ

.....TET
 БУЛГАРСКИ СЪЮЗ НА ТЕХНИЦИ

1 Scope

This standard specifies the required characteristics, inspections and tests, qualification, acceptance and delivery conditions for bushes designed to be subjected under load, to slow sliding movements, rotations and small oscillations only.

2 Field of application

This standard applies to bushes defined by EN2285, EN2286, EN2287 and EN2288 standards used between fixed and/or moving components of the aircraft structure such as control surfaces, flaps, doors etc, and their control mechanisms. They are designed to be used in the temperature range of -55 to +150 °C.

3 References

- EN2000, Aerospace series - Quality assurance requirements for the manufacture and procurement of EN aerospace standard products
- EN2030, Steel FE-PM 43 - Hardened and tempered - Bars $D \leq 150$ mm - Aerospace series
- EN2064, Bearings spherical plain in corrosion resisting steel with self-lubricating liner - Technical specification - Aerospace series
- EN2285, Bushes, plain, aluminium alloy with self-lubricating liner - Dimensions - Aerospace series
- EN2286, Bushes, flanged, aluminium alloy with self-lubricating liner - Dimensions - Aerospace series
- EN2287, Bushes, plain, corrosion resisting steel with self-lubricating liner - Dimensions - Aerospace series
- EN2288, Bushes, flanged, corrosion resisting steel with self-lubricating liner - Dimensions - Aerospace series

4 Definitions

4.1 Description

Bushes with self-lubricating liner are composed of a ring in corrosion resisting steel or aluminium alloy with a self-lubricating liner bonded to the bore. As regards flanged bushes, the self-lubricating material is bonded to the outer face of the flange as well as the bore.

4.2 Loads

Permissible static load

This is the maximum permissible load (without safety factor), which can be applied statically.

This is defined as a unit pressure multiplied by the effective projected area (radial or axial), for deformations that are compatible with correct operational behaviour.

Permissible static radial load C_s

This corresponds to a unit pressure of 430 MPa for corrosion resisting steel and 206 MPa for aluminium alloy.

Permissible static axial load C_a (Flanged bushes only)

This corresponds to a unit pressure of 340 MPa for corrosion resisting steel and 160 MPa for aluminium alloy.

Ultimate static load (radial or axial)

This is 1,5 times the value of the permissible static load and is defined as being the highest load the bush will support without failure occurring.

Permissible dynamic radial load C_{25}

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This is the load that a bush can withstand, when subjected to an oscillation of + 25 degrees, (total amplitude 50 degrees) for 25000 cycles, at the rate of 10 cycles per minute, without the wear on the self-lubricating liner exceeding the value quoted in clause 6.3.5. It equals :

$$\frac{C_s}{2,5} \text{ for corrosion resisting steel} \quad \text{and} \quad \frac{C_s}{1,2} \text{ for aluminium alloy}$$

4.3 Starting torque

The starting torque at zero load is the maximum torque recorded when the shaft starts to revolve, whilst the bush remains stationary.

5 Materials and surface treatment

The materials and surface treatment shall comply with the requirements of the material standard specified in the dimensional standards, see 7.3.

6 Required characteristics

6.1 Dimensions, tolerances and masses

These shall comply with the values quoted in the dimensional standards. See 7.2.

6.2 Physical characteristics

6.2.1 Physical appearance

6.2.1.1 The bush

It shall be free from scoring, cracks, splits, burrs and any other defects likely to impair its characteristics and endurance. See 7.1.1.

6.2.1.2 The self-lubricating liner

It shall be free from all traces of contaminating products and shall not show signs of any tearing or stripped portions. See 7.1.2.

6.2.2 Surface roughness

This shall comply with the values quoted in the dimensional standards.

6.2.3 Lubrication

No lubrication shall be permitted.

6.2.4 Starting torque at zero load

6.2.4.1 Ambient temperature

The value of this torque is required for checking the characteristics specified in clauses 6.2.4.2 and 6.2.4.3. See 7.4.2.1.

6.2.4.2 Low temperature

The starting torque shall not be greater than twice that recorded at ambient temperature. See 7.4.2.2.

6.2.4.3 High temperature

The starting torque shall not be less than 60 % of that recorded at ambient temperature. See 7.4.2.3.

6.3.4 Ultimate static axial loads (flanged bushes only)

These loads shall be 1,5 times the permissible static axial loads C_a .

There shall be no evidence of any crack, split portion or separation of the constituent components having occurred after these loads have been applied in the test conditions specified in clause 7.5.4.

6.3.5 Permissible dynamic radial loads C_{25}

When the loads have been applied in the test conditions specified in clause 7.5.5 wear shall not exceed :

- 0,13 mm after tests at ambient temperature : see 7.5.5.1
- 0,13 mm after tests at extreme temperature : see 7.5.5.3
- 0,20 mm after tests at low temperature : see 7.5.5.2

7 Inspections and tests

7.1 Visual inspection

7.1.1 The bush

An inspection of the external condition shall confirm that :

- . there are none of the defects specified in clause 6.2.1.1
- . there is no lubrication, as specified in clause 6.2.3
- . the marking conforms with the provisions described in clause 10.1

7.1.2 The self-lubricating liner

The self-lubricating liner shall not reveal any of the defects described in clause 6.2.1.2.

7.2 Dimensions, tolerances and mass

They shall comply with those shown in the dimensional standards.

The measurement of the bore shall be carried out with an instrument suited to the hardness and surface roughness of the liner material.

7.3 Chemical characteristics of the material

The method used to check the chemical analysis shall be left to the discretion of the manufacturer.

7.4 Physical roughness

7.4.1. Surface roughness

The surface roughness, measured with conventional instruments shall comply with the values specified in the dimensional standards.

7.4.2 Starting torque at zero load

The bush shall be mounted in a test device as shown in the figure of Annex D.

7.4.2.1 Ambient temperature

The test is carried out at 20 ± 2 °C with the bush stationary, whilst the shaft is rotated about its axis. The maximum starting torque necessary to cause the shaft to rotate shall be recorded.

7.4.2.2 Low temperature

The bush shall be subjected to a temperature of $- 55 \pm 2$ °C for four hours.

Immediately after, the starting torque shall not exceed twice the value recorded at ambient temperature.

7.4.2.3 Extreme temperature

The bush shall be subjected to ten successive tests, each test comprising a period of 1 hour at $- 55 \pm 2$ °C followed by one hour at 150 ± 2 °C.

Four hours after this series of tests, the starting torque, measured in accordance with 7.4.2.1, shall correspond to the values shown in 6.2.4.3.

7.4.3 Tests on compatibility with fluids

- at $+ 70 \pm 3$ °C

This test shall be performed with the hydraulic fluids specified in clause 6.2.5 and with artificial sea water.

- at $+ 45 \pm 3$ °C

This test shall be performed with aircraft engine fuel and with de-icing fluid specified in clause 6.2.5.

7.4.3.1 The bushes shall be immersed in the fluid, which has been raised to the listed temperature, for 24 hours.

The test shall be performed on the bush half an hour after the immersion period over 25000 cycles (10 cycles per minute at ± 25 degrees total amplitude 50 degrees) with a permissible dynamic radial load, as defined in clause 7.5.5.1.

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The wear measured after this test shall be less than the value quoted in 6.3.5.

7.4.3.2 Bond integrity check of the liner after compatibility with fluids tests.

After tests on compatibility with fluids, the bond integrity of the liner (as defined in 6.2.6) shall be checked.

The bushes shall be sectioned and the halves, which have not been subjected to the load, shall be used for checking on the bond integrity of the bush as shown in 7.4.4.

7.4.4 Check on adherence of the liner

Peel the liner away from the metallic bush and evaluate the bond ; a blade or scribe may be used to initiate this removal. An evaluation of the bond shall enable to determine the location and size of any voids.

A void is an area where the adhesive bond breaks, separating the liner from the metallic substrate and leaving a smooth and clean space, where the liner has not adhered.

In the event of the liner not being able to be removed without chipping, scraping or abrasive techniques, the portions of the liner which cannot be removed should be considered as having been properly bonded and free of voids.

7.5 Mechanical tests

7.5.1 Performance when subjected to the permissible static radial load C_s

The bush assembled to the requirements of Annex D shall be mounted on a test device similar to that shown in figure 2.

A pre-load equivalent to 5 % of the permissible static radial load C_s , shall be applied radially to the bush for three minutes, the comparator is then set to zero.

The static radial load shall then be increased gradually (1 % per second) up to the permissible static radial load value C_s , at which it shall be maintained for three minutes.

The maximum total deformation of the bush, when subjected to this load, shall not exceed the values quoted in table 1.

The load shall then be gradually reduced (1 % per second) to the value of the initial pre-load. The value indicated on the comparator, which is a measurement of the residual deformation, shall not exceed the values quoted in table 2.

7.5.2 Performance when subjected to the ultimate static radial load

After the load C_s has been evaluated, the load shall be increased gradually (1 % per second) until a load of 1,5 C_s has been reached. The bush shall not reveal any crack, split portion or separation of its constituent elements after this test.

7.5.3 Performance when subjected to the permissible static axial load C_a (flanged bushes only)

The bush shall be fitted to a test device (see figure 3).

A pre-load equivalent to 5 % of the permissible static axial load C_a , shall be applied axially to the flange for three minutes, the comparator is then set to zero.

The static axial load shall then be increased gradually (1 % per second) up to the permissible static axial load value C_a , at which it shall be maintained for 3 minutes.

The maximum total deformation of the bush, when subjected to this load shall not exceed the values quoted in table 1.

The load shall then be gradually reduced (1 % per second) to the initial pre-load value. The value indicated on the comparator, which is a measure of the residual deformation shall not exceed the value quoted in table 2.

7.5.4 Performance when subjected to the ultimate static axial load (flanged bushes only)

After the load C_a has been evaluated, the load shall be increased gradually (1 % per second)^a, until a load of 1,5 C_a has been reached. The bush shall be inspected after this test to ensure^a that there are no cracked or split portions or any separation of its constituent components.