



SLOVENSKI STANDARD SIST EN 2311:2017

01-junij-2017

Nadomešča:
SIST EN 2311:2012

Aeronavtika - Puše s samomazalno oblogo - Tehnična specifikacija

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Ta slovenski standard je istoveten z: EN 2311:2017
SIST EN 2311:2017
http://www.sist.si/standards/standards/2311:2017/daae-44b0-ba84-a5e65352032b/sist-en-2311-2017

ICS:

49.030.99 Drugi vezni elementi Other fasteners

SIST EN 2311:2017

en,fr,de

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 2311:2017](#)

<https://standards.iteh.ai/catalog/standards/sist/718471fc-daae-44b0-ba84-a5e65352032b/sist-en-2311-2017>

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 2311

March 2017

ICS 49.035

Supersedes EN 2311:2012

English Version

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

Série aérospatiale - Bagues avec garniture
autolubrifiante - Spécification technique

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

This European Standard was approved by CEN on 2 January 2017.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre 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 the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

<https://standards.iteh.ai/catalog/standards/sist/718471fc-daac-44b0-ba84-a5e65352032b/sist-en-2311-2017>



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents	Page
European foreword.....	3
1 Scope	4
2 Normative references	4
3 Terms and definitions	5
4 Required characteristics, inspection and test methods	7
5 Quality assurance	11
6 Acceptance conditions	12
7 Packaging	12
8 Certificate of compliance	13
Annex A (normative) Testing of permissible and ultimate static loads	15
A.1 Permissible radial static loads (C_S)	15
A.2 Ultimate radial static loads	15
A.3 Permissible axial static loads (C_a)	16
A.4 Ultimate axial static loads	17
Annex B (normative) Testing of permissible radial dynamic loads (C_{25})	19
B.1 Principle	19
B.2 Method	19
Annex C (normative) Fluids — Essential characteristics	22
C.1 Fuel for turbine aero engine	22
C.2 Fluids for de-icing circuit	22
C.3 Hydraulic fluids	22
C.4 De-icing and anti-icing fluids	23
Annex D (normative) Resistance of the liner to peeling	24
D.1 Principle	24
D.2 Method	24
Annex E (normative) Measurement of friction coefficient for EN 4534-2, EN 4535-2, EN 4536-2 and EN 4537-2 (for inch size only)	25
E.1 Principle	25
E.2 Starting torque under load C_{25} at room temperature	25
Annex F (informative) Permissible unit pressure	27
Annex G (informative) Standard evolution form	28

European foreword

This document (EN 2311:2017) 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 September 2017, and conflicting national standards shall be withdrawn at the latest by September 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 2311:2012.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

[SIST EN 2311:2017](https://standards.iteh.ai/catalog/standards/sist/718471fc-daac-44b0-ba84-a5e65352032b/sist-en-2311-2017)

<https://standards.iteh.ai/catalog/standards/sist/718471fc-daac-44b0-ba84-a5e65352032b/sist-en-2311-2017>

EN 2311:2017 (E)**1 Scope**

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

This standard applies to all bushes when referred to in the respective product standards or in a design documentation.

The liner is designed to be used in the temperature range of -50 °C to 163 °C . Aluminium bushes are limited to -55 °C to 121 °C .

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2285, *Aerospace series — Bushes, plain, aluminium alloy, with self-lubricating liner — Dimensions and loads*

EN 2286, *Aerospace series — Bushes, flanged aluminium alloy, with self-lubricating liner — Dimensions and loads*

EN 2287, *Aerospace series — Bushes, plain corrosion resisting steel, with self-lubricating liner — Dimensions and loads*

EN 2288, *Aerospace series — Bushes, flanged, corrosion resisting steel, with self-lubricating liner — Dimensions and loads*

EN 2755, *Aerospace series — Bearings, spherical plain, in corrosion resisting steel with self-lubricating liner — Elevated loads at ambient temperature — Technical specification*

EN 4534-2, *Aerospace series — Bushes, plain in aluminium alloy with self-lubricating liner, elevated load — Part 2: Dimensions and loads — Inch series*

EN 4535-2, *Aerospace series — Bushes, flanged in aluminium alloy with self-lubricating liner, elevated load — Part 2: Dimensions and loads — Inch series*

EN 4536-2, *Aerospace series — Bushes, plain in corrosion resisting steel with self-lubricating liner, elevated load — Part 2: Dimensions and loads — Inch series*

EN 4537-2, *Aerospace series — Bushes, flanged in corrosion-resisting steel with self-lubricating liner, elevated load — Part 2: Dimensions and loads — Inch series*

EN 9100, *Quality Management Systems — Requirements for Aviation, Space and Defense Organizations*

EN 9133, *Aerospace series — Quality management systems — Qualification procedure for aerospace standard parts*

EN 10204, *Metallic products — Types of inspection documents*

EN ISO 8785, *Geometrical Product Specification (GPS) — Surface imperfections — Terms, definitions and parameters*

ISO 11078, *Aircraft — De-icing/anti-icing fluids — ISO type II, III and IV*

TR 4475, *Aerospace series — Bearings and mechanical transmissions for airframe applications — Vocabulary*¹⁾

3 Terms and definitions

For the purpose of this standard the terms and definitions given in TR 4475 and the following definitions apply.

3.1

bush with self-lubricating liner

ring in corrosion resisting steel or aluminium alloy with a self-lubricating liner bonded to the bore

Note 1 to entry: With regards to flanged bushes the self-lubricating material is bonded to the outer face of the flange as well as the bore.

3.2

loads

3.2.1

permissible static load C_s or permissible static axial load C_a (flanged bushes only)

maximum permissible load (without safety factor), which can be applied statically

Note 1 to entry: It is defined as a unit pressure multiplied by the effective projected area (radial or axial) for deformations that are compatible with correct operational behaviour.

3.2.2

ultimate static load (radial or axial)

1,5 times the value of the permissible static load

Note 1 to entry: It is defined as being the highest load the bush will support without failure occurring.

3.2.3

permissible dynamic radial load C_{25}

load that a bush can withstand, when subjected to an oscillating motion for 25 000 cycles at the rate of (12 ± 2) cycles/min

3.2.4

cycle

angular displacement of the shaft in relation to the lined bush of 0° to -25° , then of -25° to $+25^\circ$ and finally $+25^\circ$ to 0° , see Figure 1

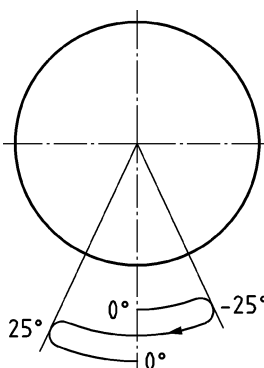


Figure 1 — Cycle

1) Published as ASD-STAN Technical Report at the date of publication of this standard. <http://www.asd-stan.org/>

EN 2311:2017 (E)**3.3
friction torque under load at ambient temperature**

coefficient of friction calculated as follows:

$$\mu = \frac{T}{C_{25} \cdot R}$$

where

μ is the coefficient of friction;

T is the dynamic rotational torque under load, expressed in Newton meters (Nm);

R is the radius of shaft, expressed in metres (m);

C_{25} is the dynamic radial load, expressed in Newton (N).

**3.4
surface discontinuities****3.4.1****crack**

linear recession with a sharp bottom resulting from a disturbance of the integrity of the surface and of the parent material of the workpiece

[SOURCE: EN ISO 8785, modified: figure not included]

3.4.2**scratch
score**

surface imperfection which is a recession of irregular shape and unspecified direction

<https://standards.iteh.ai/catalog/standards/sist/718471fc-daac-44b0-ba84-4665322037b/sist-en-2311-2017>

[SOURCE: EN ISO 8785, modified: synonym "score" added, figure not included]

3.4.3**lap**

tongue-like raising of small thickness, often in the form of a seam, caused by folding over of material and forcing it into the surface when rolling, forging etc.

[SOURCE: EN ISO 8785, figure not included]

3.4.4**seam**

non-welded fold which appears as an open defect in the material

3.5**void**

area where the adhesive bond is broken or non-existent leaving a smooth and clean area on the metallic surface

Note 1 to entry: Used in context of adhesion of the liner.

3.6**delivery batch**

consists of bushes bearing the same identity block although they may originate from different manufacturing batches

4 Required characteristics, inspection and test methods

According to Table 1.

Table 1 — Required characteristics, inspection and test methods (1 of 4)

Clause	Characteristics	Requirements	Inspection and test method	Q ^a	A ^a
4.1	Materials	In accordance with the product standards or design documentation	Chemical analysis and physical properties or a certificate of compliance according to EN 10204, 3.1B issued by the semi-finished product manufacturer.	X	X
4.2	Dimensions and tolerances	In accordance with the product standards or design documentation	Suitable measuring instruments Measurement of the bore^b and of the outer diameter — Rings having a width of < 10 mm: — in the median plane. — Rings having a width of > 10 mm: — in two planes parallel to the outer faces and placed at a distance from these faces twice the maximum chamfer value of these rings. Measurement of widths of rings: — A minimum four point check on the width of each ring (distance between the two faces).	X	X
4.3	Masses	In accordance with the product standards or design documentation	Suitable methods	X	
4.4	Marking	In accordance with the product standards or design documentation	Visual examination	X	X
4.5	Surface appearance	— The bushes shall be free of surface discontinuities liable to have a detrimental effect on the characteristics and durability. — The liner shall not contain contaminant products and shall not show broken or voided areas. — No lubrication allowed.	Visual monitoring using appropriate procedures.	X	X

Table 1 — Required characteristics, inspection and test methods (2 of 4)

Clause	Characteristics	Requirements	Inspection and test method	Q ^a	A ^a
4.6	Surface roughness	Shall conform to product standards	Suitable measuring instruments or visual tactile samples.	X	X
4.7	Static loads:	Shall conform to product standards	According to Annex A.	X	
	— radial: C_s	With permissible static loads no maximum total deformations greater than those indicated in Table A.1.			
	— axial: C_a	After removal of the loads, no permanent deformations greater than those indicated in Table A.1.			
4.8	Ultimate loads — radial — axial	After removal of the loads, no rupture, or crack.	According to Annex A.	X	
4.9	Dynamic load and friction coefficient	iTeh STANDARD PREVIEW (standards.iteh.ai)		X	
4.9.1	Dynamic radial load C_{25}	Shall conform to product standards. After removal of the loads: These shall be:	According to Annex B.		
	— at ambient temperature	— no metal to metal contact between the shaft and bush.			
	— at low temperature	— wear of the liner shall not exceed the values indicated in Table B.1.			
	— at high temperature	— liners resistance to peeling and adhesion shall meet the requirements of 4.11 and 4.12.			
4.9.2	Friction coefficient ^c	After dynamic test and before removal of load, torque to rotate shaft shown in Figure B.1 shall be measured and the value of μ calculated. The value shall not exceed 0,05 at ambient temperature	According to Annex E.		

Table 1 — Required characteristics, inspection and test methods (3 of 4)

Clause	Characteristics	Requirements	Inspection and test method	Q ^a	A ^a
4.10	Compatibility between the liner and fluids	<p>The bushes shall meet the requirements of 4.9 at ambient temperature after immersion in the specified fluids.</p> <p>Wear of the liner shall not exceed the values indicated in Table B.1.</p>	<p>Check one bush per fluid:</p> <ul style="list-style-type: none"> — the bush shall be immersed for 24 h in the fluids stated in Annex C at the following temperatures: <ul style="list-style-type: none"> — (45 ± 3) °C for those defined in C.1 and C.2, — (70 ± 3) °C for those defined in C.3, — ambient temperature for those defined in C.4. <p>Within ½ h after this test, proceed to the test defined in B.2.4.</p>	X	
4.11	Resistance of the liner to peeling	<p>The requirements of this test shall only be applied when there is an indication from the manufacturer that the liner is susceptible to peeling.</p> <p>Bushes smaller than 15 mm diameter shall be exempt from this requirement.</p> <p>It shall present a mean peeling resistance of > 0,35 N/mm of width of the outer ring reduced by 2 mm to eliminate the effects of edges and chamfers. Mean resistance shall be such that at least 75 % of the recording curve lies above 0,35 N/mm.</p>	<p>According to Annex D.</p> <p>For acceptance, this test shall be carried out immediately after assembly and curing.</p>	X	X

Table 1 — Required characteristics, inspection and test methods (4 of 4)

Clause	Characteristics	Requirements	Inspection and test method	Q ^a	A ^a
4.12	Bond integrity	For peelable liners, the liner: <ul style="list-style-type: none"> — Shall not contain any contamination substances. — Shall adhere tightly to the outer ring over at least 90 % of the contact area. No void shall be allowed which cannot be described within a circle of diameter equal to: <ul style="list-style-type: none"> — 25 % of outer ring width; — 6 mm. whichever is smaller.	According to Annex D. After the peel strength test, evaluate the location and size of any voids.	X	X
		For non-peelable liners, a sectioned bush shall be examined for bond integrity. The liner: <ul style="list-style-type: none"> — Shall adhere tightly to the outer ring over at least 90 % of the contact area. No void shall be allowed which cannot be circumscribed within a circle of diameter equal to: <ul style="list-style-type: none"> — 25 % of outer ring width; — 6 mm. whichever is smaller.	Destructively examine the liner by chipping, scraping, abrasion, or other appropriate means to determine the bond integrity.	X	X
4.13	Surface treatment	In accordance with the product standard or design documentation	Visual examination	X	X

^a Q: Qualification test; A: Acceptance test.
^b Measurement of the bore could be carried out by "Go" and "NoGo" plug gauges.
^c Not applicable for the standards: EN 2285, EN 2286, EN 2287 and EN 2288.