

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

This document is a preview generated by EVS

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN 2311:2012 sisaldab Euroopa standardi EN 2311:2012 ingliskeelset teksti.	This Estonian standard EVS-EN 2311:2012 consists of the English text of the European standard EN 2311:2012.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 14.03.2012.	Date of Availability of the European standard is 14.03.2012.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile [standardiosakond@evs.ee](mailto:standardiosakond@evs.ee).

ICS 49.030.99

### Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:  
Aru 10, 10317 Tallinn, Eesti; [www.evs.ee](http://www.evs.ee); telefon 605 5050; e-post [info@evs.ee](mailto:info@evs.ee)

### The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:  
Aru 10, 10317 Tallinn, Estonia; [www.evs.ee](http://www.evs.ee); phone 605 5050; e-mail [info@evs.ee](mailto:info@evs.ee)

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 23 December 2011.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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

Management Centre: Avenue Marnix 17, B-1000 Brussels

# Contents

Page

Foreword.....	3
<b>1 Scope .....</b>	<b>4</b>
<b>2 Normative references .....</b>	<b>4</b>
<b>3 Terms and definitions .....</b>	<b>5</b>
3.1 Description .....	5
3.2 Loads .....	5
3.3 Friction torque under load at ambient temperature .....	6
3.4 Surface discontinuities .....	6
3.5 Adhesion of the liner .....	7
3.6 Delivery batch .....	7
<b>4 Required characteristics, inspection and test methods.....</b>	<b>8</b>
<b>5 Quality assurance .....</b>	<b>11</b>
5.1 Manufacturer's approval .....	11
5.2 Product qualification .....	11
<b>6 Acceptance conditions .....</b>	<b>11</b>
6.1 Manufacturer's responsibility.....	11
6.2 Inspections and tests to be carried out by the manufacturer.....	11
6.3 Customer quality control .....	11
<b>7 Packaging .....</b>	<b>12</b>
<b>8 Certificate of compliance .....</b>	<b>12</b>
<b>Annex A (normative) Testing of permissible and ultimate static loads .....</b>	<b>15</b>
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 .....	16
<b>Annex B (normative) Testing of permissible radial dynamic loads (<math>C_{25}</math>).....</b>	<b>19</b>
B.1 Principle.....	19
B.2 Method .....	19
<b>Annex C (normative) Fluids — Essential characteristics .....</b>	<b>21</b>
C.1 Fuel for turbine aero engine .....	21
C.2 Fluids for de-icing circuit.....	21
C.3 Hydraulic fluids .....	21
C.4 De-icing and anti-icing fluids.....	21
<b>Annex D (normative) Resistance of the liner to peeling .....</b>	<b>22</b>
D.1 Principle .....	22
D.2 Method .....	22
<b>Annex E (normative) (for inch size only) Measurement of friction coefficient for EN 4534-2, EN 4535-2, EN 4536-2 and EN 4537-2.....</b>	<b>23</b>
E.1 Principle .....	23
E.2 Starting torque under load $C_{25}$ at room temperature .....	23
<b>Annex F (informative) Permissible unit pressure .....</b>	<b>25</b>

## Foreword

This document (EN 2311:2012) 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 2012, and conflicting national standards shall be withdrawn at the latest by September 2012.

This document supersedes EN 2311:1987.

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

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

## 1 Scope

This European Standard 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 respective product standards or in a design documentation.

The liner is designed to be used in the temperature range of  $-50\text{ }^{\circ}\text{C}$  to  $163\text{ }^{\circ}\text{C}$ . Aluminium bushes are limited to  $-55\text{ }^{\circ}\text{C}$  to  $121\text{ }^{\circ}\text{C}$ .

## 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 load at ambient temperature — Technical specification*

EN 4534-2, *Aerospace series — Bushes, plain in aluminium alloy with self-lubricating liner, elevated load — Part 002: Dimensions and loads — Inch series*

EN 4535-2, *Aerospace series — Bushes, flanged in aluminium alloy with self-lubricating liner, elevated load — Part 002: Dimensions and loads — Inch series*

EN 4536-2, *Aerospace series — Bushes, plain in corrosion resisting steel with self-lubricating liner, elevated load — Part 002: Dimensions and loads — Inch series*

EN 4537-2, *Aerospace series - Bushes, flanged, corrosion-resisting steel with self-lubricating liner, elevated load - 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*

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

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

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

### 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 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.

#### 3.2 Loads

##### 3.2.1

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

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

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 and defined as being the highest load the bush will support without failure occurring

##### 3.2.3

**permissible dynamic radial load  $C_{25}$**

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

##### 3.2.4

**cycle**

an angular displacement of the shaft in relation to the lined bush of  $0^\circ$  to  $25^\circ$ , then of  $25^\circ$  to  $-25^\circ$  and finally  $-25^\circ$  to  $0^\circ$

---

<sup>1)</sup> Published as ASD-STAN Technical Report at the date of publication of this standard by Aerospace and Defence Industries Association of Europe-Standardization (ASD-STAN), ([www.asd-stan.org](http://www.asd-stan.org)).