SLOVENSKI STANDARD
SIST EN 1337-2:2001

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Konstrukcijska leģiģļ a - 2. del: Drsni elementi

Structural bearings - Part 2: Sliding elements

Lager im Bauwesen - Teil 2: Gleitteile

Appareils d'appui structuraux - Partie 2: Eléments de glissement

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EUROPEAN STANDARD
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EN 1337-2

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English version

Structural bearings - Part 2: Sliding elements

Appareils d'appui structuraux - Partie 2: Eléments de glissement

Lager im Bauwesen - Teil 2: Gleitteile

This European Standard was approved by CEN on 18 November 2000.

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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 Management Centre has the same status as the official versions.

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

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Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 167 "Structural bearings", the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by June 2001, and conflicting national standards shall be withdrawn at the latest by June 2001.

This European Standard EN 1337 “Structural bearings”, consists of the following 11 Parts:

Part 1: General design rules

Part 2: Sliding elements

Part 3: Elastomeric bearings

Part 4: Roller bearings

Part 5: Pot bearings

Part 6: Rocker bearings

Part 7: Spherical and cCylindrical PTFE bearings

Part 8: Guide bearings and restrain bearings

Part 9: Protection

Part 10: Inspection and maintenance

Part 11: Transport, storage and installation

Further to CEN/TC 167’s decision Part 1and 2 form a package of standards and they come into force together, while the other parts come into force separately after the publication of parts 1 and 2.

Annexes A, B, C and L are informative. Annexes D, E, F, G, H, J and K are normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This standard considers a minimum operating temperature of –35°C.
An extension down to –40°C will be considered in a future amendment.
Applications beyond the range of temperature given in clause 1 need special consideration not covered by this standard. Characteristics and requirements given in this standard do not apply in such cases.

1 Scope

This European Standard specifies the characteristics for the design and manufacture of sliding elements and guides which are not structural bearings but only parts of them for combination with structural bearings as defined in other Parts of this European Standard.

Suitable combinations are shown in Table 1 of EN 1337-1:2000.

Sliding surfaces with a diameter of the circumscribing circle of single or multiple PTFE sheets less than 75 mm or greater than 1500 mm, or with effective bearing temperatures less than –35°C or greater than 48°C are outside the scope of this European Standard.

Sliding elements for use as temporary devices during construction, for example during launching of the superstructure, are also outside the scope of this European Standard.

In this standard the specification is also given for curved sliding surfaces which are not part of separate sliding elements but which are incorporated in cylindrical or spherical PTFE bearings as per EN 1337.

NOTE The general principles detailed in this European Standard may be applied for sliding elements outside this scope, but their suitability for the intended use should be proven.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 1337-1:2000	Structural bearings - Part 1: General design rules
prEN 1337-3:1996	Structural bearings - Part 3: Elastomeric bearings
EN 1337-7	Structural bearings - Part 7: Spherical and cylindrical PTFE bearings
EN 1337-9	Structural bearings – Part 9: Protection
prEN 1337-10:1998	Structural bearings - Part 10: Inspection and maintenance
EN 1337-11:1997	Structural bearings - Part 11: Transport, storage and Installation
ENV 1992-1-1	Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for building

ENV 1993-1-1	Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for building
EN 10025:1990/A1:1993	Hot rolled products of non-alloy structural steels –Technical delivery conditions (includes amendment A1:1993)
EN 10088-2	Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip for general purposes
EN 10113-1	Hot-rolled products in weldable fine grain structural steels - Part 1: General delivery conditions
EN 10137-1	Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions – Part 1: General delivery conditions
EN 10204	Metallic products - Types of inspection documents
ISO 527-2:1993	Plastics - Determination of tensile properties - Part 2: Testing conditions for moulding and extrusion plastics
ISO 1083	Spheroidal graphite cast iron - Classification
ISO 1183	Plastics - Methods for determining the density and relative density of non-cellular plastics
ISO 2039-1	Plastics - Determination of hardness - Part 1: Ball indentation method
ISO 2137	Petroleum products - Lubricating grease and petrolatum - Determination of cone penetration
ISO 2176	Petroleum products - Lubricating grease - Determination of dropping point
ISO 2409	Paints and varnishes - Cross-cut-test
ISO 3016	Petroleum products - Determination of pour point
ISO 3522	Cast aluminium alloys - Chemical composition and mechanical properties
ISO 3755	Cast carbon steels for general engineering purposes
ISO 4287	Geometrical product Specifications (GPS) – Surface textute: Profile method – Terms, definitioons and surface texture parameters
ISO 6158	Metallic coatings - Electroplated coatings of chromium for engineering purposes
ISO 6506	Metallic materials – Brinell hardness test
ISO 6507-1	Metallic materials – Vickers hardness test - Part 1: Test method
ISO 6507-2	Metallic materials - Vickers hardness test - Part 2: Verification of testing machine

3 Terms and definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1.1
backing plate
metallic component which supports sliding materials

3.1.2
coefficient of friction
ratio of lateral force (resisting force) to the normal force.

3.1.3
composite material
sliding material used in guides.

3.1.4
guide
sliding element which restrains a sliding bearing from moving in one axis.

3.1.5
hard chromium surface
steel backing element plated with a hard chromium layer.

3.1.6
lubricant
special grease used to reduce the friction and wear in the sliding surfaces.

3.1.7
mating surface
hard smooth metallic surface against which the PTFE or composite materials slide.

3.1.8
polytetrafluoroethylene (PTFE)
a thermoplastic material used for its low coefficient of friction.

3.1.9
sliding surface
combination of a pair of flat or curved surfaces of different materials which allow relative displacements.

3.1.10
sliding materials
materials which form sliding surfaces.

3.2 Symbols

The most frequently occurring symbols are defined below. Those that are local, and unique to a particular clause, are defined at their first appearance.

3.2.1 Latin upper case letters

A	contact area of sliding surface	mm^2
E	modulus of elasticity	GPa
F	action; force	N; kN
G	permanent action	N; kN
L	diameter of the circumscribing circle of single or multiple PTFE sheets (see Figures 3, 4 and 5); length of PTFE or composite materials sheets of guides (see Figure 6)	mm
M	bending moment	N x mm; kN x m
N	axial force; force normal to principal bearing surface	N; kN
R_{y5i}	average surface roughness	µm
S	shape factor	
T	temperature	°C
V	transverse or shear force	N; kN

3.2.2 Latin lower case letters

a	smallest dimension of PTFE sheets; minor side of rectangular plates or sheets	mm
b	major side of rectangular plates or sheets	mm
c	cleareance between sliding components (difference in width between key and keyway)	mm
d	diameter, diagonal	mm
e	eccentricity	mm
f	nominal compressive strength	MPa
h	protrusion of PTFE sheet from its recess	mm
n	number of cycles	
s	sliding distance	mm
t	thickness, time	mm; s; h
u	perimeter of PTFE sheet	mm
v	sliding speed	mm/s
w	deformation	
x	longitudinal axis	
y	transverse axis	

z	axis normal to the principle bearing surface

3.2.3 Greek letters

α	angle ..... rad
γ	partial safety factor
δ	elongation at break ..... %
Δz	maximum deviation of plane or curved sliding surfaces from theoretical surface ..... mm
λ	ratio, coefficient
μ	coefficient of friction
μ_1	initial coefficient of friction; i.e. the maximum coefficient of friction occurring during the first movement at the start or restart of any test
μ_T	maximum coefficient of friction during a given temperature phase
ρ	mass density ..... kg/m^3
σ	normal pressure ..... MPa

3.2.4 Subscripts

a	average
b	backing plate
c	concrete
CM	composite materials
d	design
dyn	dynamic
G	permanent action
g	geometrical
k	characteristic
M	material
max	maximum
min	minimum
n	cycle number
p	PTFE
pl	preload
Q	variable action
R	resistance
r	reduced
S	internal forces and moments from actions
s	static
t	tension
T	temperature
u	ultimate
x, y, z	coordinates

3.3 Abbreviations

CM Composite Material

PTFE Polytetrafluoroethylene

4 Functional requirements

NOTE Sliding elements and guides permit movements in plane or curved sliding surfaces with a minimum of friction. Specific verification of frictional resistance is required, as verification of mechanical and physical properties alone is not sufficient to ensure that these components will have the required characteristics. The performance of the sliding elements and guides is deemed to be satisfactory if standardized specimens shown in annex D of specified material combinations meet the requirements of this clause when tested as specified in specific friction tests described in annex D

4.1 Sliding elements and guides incorporating sliding surfaces with PTFE sheets

4.1.1 Requirements in short term friction tests

The coefficients of friction in each phase of friction testing shall not exceed the values given in Table 1.

Table 1 - Maximum coefficients of friction in short term tests of PTFE sheets in combination with hard chromium plating, austenitic steel or aluminium alloy used for curved or plane sliding surfaces.

Test See annex D	Temperature	Hard chromium or austenitic steel				Aluminium alloy			
		$\mu_{s,1}$	$\mu_{dyn,1}$	$\mu_{s,T}$	$\mu_{dyn,T}$	$\mu_{s,1}$	$\mu_{dyn,1}$	$\mu_{s,T}$	$\mu_{dyn,T}$
C	+ 21 °C	0,012	0,005	–	–	0,018	0,008	–	–
D	- 35 °C	0,035	0,025	–	–	0,053	0,038	–	–
E	0 °C	0,018	0,012	–	–	0,027	0,018	–	–
E	- 35 °C	–	–	0,018	0,012	–	–	0,027	0,018

NOTE $\mu_{s,1}$ is the static coefficient of friction at the first cycle.
$\mu_{dyn,1}$ is the dynamic coefficient of friction at the first cycle.
$\mu_{s,T}$ is the static coefficient of friction at subsequent cycles.
$\mu_{dyn,T}$ is the dynamic coefficient of friction at subsequent cycles.
(see also annex D, Figures D.4 and D.6)

4.1.2 Requirements in long term friction tests

The coefficients of friction of the sliding material combinations shall not exceed the values listed in Tables 2 and 3.

4.2 Guides incorporating composite materials CM1 and CM2

4.2.1 Requirements in short term friction test

The maximum static or dynamic coefficient of friction shall not exceed 0,15.

Table 2 - The coefficients of friction in long term tests of PTFE sheets in combination with austenitic steel used for plane sliding surfaces.

Temperature	Total slide path			
	5 132 m		10 242 m	
	$\mu_{s,T}$	$\mu_{dyn,T}$	$\mu_{s,T}$	$\mu_{dyn,T}$
-35°C	0,030	0,025	0,050	0,040
-20°C	0,025	0,020	0,040	0,030
0°C	0,020	0,015	0,025	0,020
+21°C	0,015	0,010	0,020	0,015
NOTE $\mu_{s,T}$ and $\mu_{dyn,T}$ are the static and dynamic coefficient of friction respectively at the relevant temperatures.				

Table 3 - Maximum coefficients of friction in long term tests of PTFE sheets in combination with hard chromium plating, austenitic steel or aluminium alloy used for curved sliding surfaces.

Temperature	Total slide path 2 066 m			
	Austenitic steel or hard chromium		Aluminium alloy	
	$\mu_{s,T}$	$\mu_{dyn,T}$	$\mu_{s,T}$	$\mu_{dyn,T}$
-35°C	0,030	0,025	0,045	0,038
-20°C	0,025	0,020	0,038	0,030
0°C	0,020	0,015	0,030	0,022
+21°C	0,015	0,010	0,022	0,015

4.2.2 Requirements in long term friction test

Maximum static or dynamic coefficients of friction shall not exceed the values listed in Table 4.

Table 4 - Maximum static or dynamic coefficients of friction μ_T in long term tests of composite material CM1 and CM2 in combination with austenitic steel used for plane sliding surfaces in guides

Temperature	Total slide path 2 066 m
	μ_T
-35°C	0,200
-20°C	0,150
0°C	0,100
+21°C	0,075

5 Material properties

In the absence of specific Standards, material testing shall be in accordance with the procedures given in annexes D to H.

5.1 PTFE sheets

5.1.1 Material specification

The raw material for PTFE sheets shall be pure polytetrafluoroethylene free sintered without regenerated or filler materials.

5.1.2 Mechanical and physical properties

The characteristics of PTFE shall be in accordance with Table 5.

Table 5 - Mechanical and physical properties of PTFE.

Property	Testing Standard	Requirement	
mass density	ISO 1183	ρ_p = 2140 to 2200	kg/m^3
tensile strength	ISO 527-2	f_{ptk} = 29 to 40	MPa
elongation at break	ISO 527-2	$\delta_p \geq 300$	%
ball hardness	ISO 2039-1	H132/60 = 23 to 33	MPa

The test specimens shall be prepared from fully finished sheet but without impressed dimples. They shall be tested at 23°C ± 2°C.
Mass density shall be determined on three specimens.

Tensile strength test and elongation at break shall be conducted on five specimens type 1 (in accordance with Figure 1 of ISO 527-2:1993). The thickness of the specimens shall be 2 mm ± 0,2 mm and the speed of testing shall be 50 mm/min (speed E as defined in ISO 527-2).

A total of 10 ball hardness tests shall be conducted using at least three specimens with a minimum of three tests per specimen ; the thickness of the specimens shall be at least 4,5 mm.

All specimens shall pass all the tests conducted on them.

5.1.3 Geometrical properties

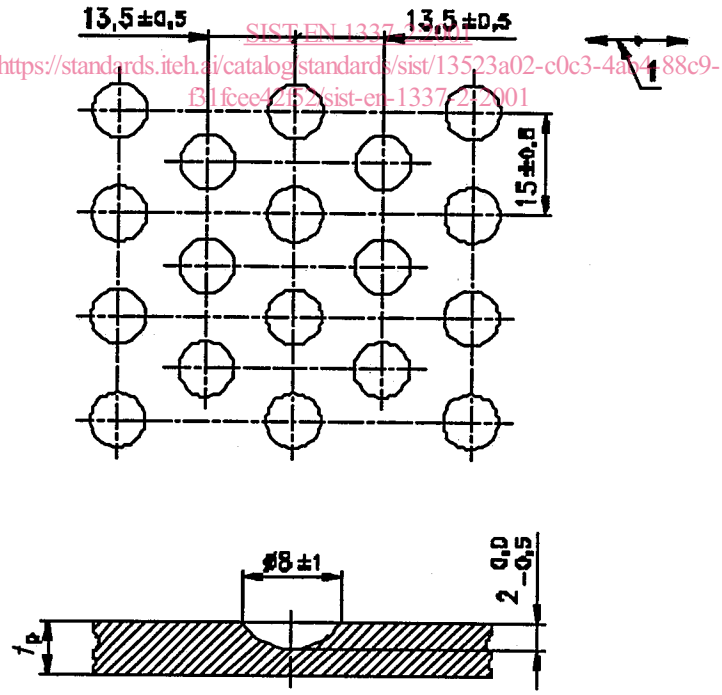
5.1.3.1 Tolerance on thickness

The admissible tolerance on thickness of single PTFE sheets or associated multiple sheets is $^{+0,3}_{0}$mm or sheets with a diameter L less than 1200 mm and $^{+0,4}_{0}$mm for larger sheets.

5.1.3.2 Dimple pattern

Dimples and dimple pattern shall be in accordance with Figure 1.
Where dimples are produced by hot pressing, the temperature during the pressing process shall not exceed 200°C.

Dimensions in millimetres



Key

1 main direction of sliding

Figure 1 - Pattern of dimples in recessed PTFE sheets

5.1.4 Suitability as sliding material

PTFE shall be tested in accordance with annex D and shall meet the requirements of 4.1.1 and 4.1.2.
Lubricant shall be in accordance with 5.7.
The mating surfaces for the short term friction test shall be austenitic steel or hard chromium and for the long term friction test austenitic steel in accordance with 5.3 and 5.4.

5.2 Composite materials

5.2.1 Composite material CM1

This is a composite material consisting of three layers: a bronze backing strip and a sintered interlocking porous matrix, impregnated and overlaid with a PTFE / lead mixture.
The material shall conform to the characteristics listed in Table 6.
In addition, the condition of the material and its surface finish shall be checked visually.

Table 6 - Characteristics of CM1.

Bronze backing	material: CuSn 6			
	composition by mass	Sn	5 to 7,50	%
		P	≤ 0,35	%
		Pb	≤ 0,10	%
		Fe	≤ 0,10	%
		Zn + Ni	≤ 0,30	%
		Remainder Cu		
	thickness		(2,1 ± 0,15)	mm
	hardness HB - ISO 6506		80 to 160	
Bronze interlayer	material: CuSn 10			
	composition by mass	Sn	10 to 12	%
		Pb	≤ 1,00	%
		P	0,25 to 0,4	%
		Si	≤ 0,17	%
		Fe	≤ 0,15	%
		Ni	≤ 0,15	%
	saturation with PTFE - Pb		≥ 25	%
	thickness		$0{,}25\,^{+0{,}15}_{0{,}0}$	mm
Surface layer	material: PTFE/Pb			
	composition by volume	Pb 20 %, remainder PTFE		
	thickness		$0{,}01\,^{+0{,}02}_{0{,}0}$	mm
	total thickness		$2{,}4\,^{+0{,}1}_{0{,}0}$	mm
	overlay adhesion - ISO 2409		GT 2	