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SIST EN 1337-3:2005

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Konstrukcijska leģiģļ a ï 3. del: Elastomerna leģiģļ a

Structural bearings - Part 3: Elastomeric bearings

Lager im Bauwesen - Teil 3: Elastomerlager

Appareils d'appui structuraux - Partie 3: Appareils d'appui en élastomere

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Structural bearings - Part 3: Elastomeric bearings

Appareils d'appui structuraux - Partie 3: Appareils d'appui en élastomère

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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 Central Secretariat has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
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Contents

Foreword

This document (EN 1337-3:2005) 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of an identical text or by endorsement, at the latest by September 2005, and conflicting national standards shall be withdrawn at the latest by December 2006.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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 cylindrical PTFE bearings

Part 8 Guide bearings and restrain bearings

Part 9 Protection

Part 10 Inspection and maintenance

Part 11 Transport, storage, and installation

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

1 Scope

This part of EN 1337 applies to elastomeric bearings with or without complementary bearing devices to extend their field of use such as flat sliding elements covered by EN 1337-2 or sliding surface described in 4.4.4, as used in bridge structures or any other structure with comparable support conditions.

This part of EN 1337 applies to elastomeric bearings with dimensions in plan up to (1200 x 1200) mm and does not cover elastomeric bearings made with other elastomers materials than those specified in 4.4.1. It applies to laminated bearings types A, B, C, laminated sliding bearings types E and D, plain pad and strip bearings type F.

This part deals with bearings for use in operating temperatures ranging from – 25 °C to + 50 °C and for short periods up to + 70 °C.

It is recognised that the air temperature in some regions of Northern Europe is lower than –25 °C.

In this case of very low operating temperature (down to – 40 °C), it is essential that bearing characteristics comply also with the shear modulus at very low temperature (see 4.3.1.3. and annex F)

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.

EN 1337-1:2000, *Structural bearings - Part 1: General design rules.*

EN 1337-2:2004, *Structural bearings - Part 2: Sliding elements.*

prEN 1337-8, *Structural bearings - Part 8: Guide bearings and restrain bearings.*

EN 1337-9:1997, *Structural bearings - Part 9: Protection.*

EN 1337-10; *Structural Bearings - Part 10: Inspection and maintenance.*

EN 1337-11; *Structural bearings - Part 11: Transport, storage and installation.*

EN 10025-1, *Hot rolled products of structural steels - Part 1: General technical delivery conditions.*

EN 10025-2, *Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels*

ISO 34-1, *Rubber, vulcanized or thermoplastic - Determination of tear strength - Part 1: Trouser, angle and crescent test pieces.*

ISO 37, *Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties*.

ISO 48, *Rubber, vulcanized or thermoplastic - Determination of hardness (hardness between 10 IRHD and 100 IRHD).*

ISO 188, *Rubber, vulcanized or thermoplastic - Accelerated ageing and heat resistance tests.*

ISO 815, *Rubber, vulcanized or thermoplastic - Determination of compression set at ambient, elevated or low temperatures.*

ISO 1431-1, *Rubber, vulcanized or thermoplastic - Resistance to ozone cracking - Part 1: Static strain testing.*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1337-1:2000 and the following apply.

3.1.1
batch
individual mix or blend of mixes of elastomer, when used for bearing production or a number of identical components produced at the same machine setting

3.1.2
elastomer
macromolecular material, which returns to approximately its initial dimensions and shape after substantial deformation by a weak stress and release of stress. In this part of the standard it defines the compound that will be used for the production of a rubber part or parts.

3.1.3
elastomeric bearing
bearing comprising a block of vulcanised elastomer that may be reinforced with one or more steel plates

3.1.4
laminated bearing
elastomeric bearing reinforced internally with one or more steel plates, chemically bonded during vulcanisation

3.1.5
plain pad bearing
elastomeric bearing consisting of a solid block of vulcanised elastomer without internal cavities

3.1.6
sliding elastomeric bearing
laminated bearing with a PTFE sheet, at top surface, which may be vulcanised directly onto the outer layer of elastomer or fixed to a steel plate, in contact with a sliding plate

3.1.7
sliding plate
component which bears on and is immediately adjacent to the top sliding surface of a bearing. It can be:

a) a single piece of austenitic steel,

b) a thin plate of austenitic steel fixed to a mild steel supporting plate,

c) a thin plate of austenitic steel bonded to an elastomeric interlayer which is vulcanised to a mild steel supporting plate.

3.1.8
strip bearing
plain pad bearing for which the length is at least ten times the width

3.1.9
top sliding surface
polytetrafluoroethylene surface vulcanised on to an elastomeric bearing, in contact with the sliding plate which allows relative translatory displacement

3.2 Symbols

For the purposes of this document, the following symbols apply.

3.2.1 Latin upper case letters

A Overall plan area of elastomeric bearing .... mm²

A'	Effective plan area of laminated bearing (area of the steel reinforcing plates)	mm²
A_r	Reduced effective plan area of elastomeric bearing	mm²
C_c	Compressive stiffness of a bearing	N/mm
D	Overall diameter of circular bearing	mm
D'	Effective diameter of circular laminated bearing	mm
E	Modulus of elasticity	MPa
E_b	Bulk modulus	MPa
E_{cs}	Intersecting compression modulus	MPa
E_d	Design load effects	
F_{xd}, V_{yd}	Horizontal design forces	N: kN
F_{xy}	Maximum resultant horizontal force obtained by vectorial addition of v_x and v_y	N: kN
F_{zd}	Vertical design force	N: kN
G	Nominal value of conventional shear modulus of elastomeric bearing	MPa
G_{dyn}	Conventional shear modulus of elastomeric bearing under dynamic actions	MPa
G_e	Shear modulus of elastomer	MPa
G_g	Conventional shear modulus of elastomeric bearing determined by testing	MPa
K_{ce}	Factor for strain due to compressive load for elliptical bearing	
K_{de}	Factor for vertical deflection for load for elliptical bearing	
K_{se}	Factor for restoring moment for elliptical bearing	
K_f	Friction factor	
K_h	Factor for induced tensile stresses in reinforcing plate	
K_L	Type loading factor	
K_m	Moment factor	
K_p	Stress correction factor for the steel reinforcing plates	
K_r	Rotation factor	
K_s	Factor for restoring moment	
M_e	Experimental value of restoring moment	N x mm: kN x m
M_d	Design value of restoring moment	N x mm: kN x m
R_d	Design value of resistance	

R_{xy} Resultant of the forces resisting to translatory movement

S Shape factor

S_1 Shape factor for the thickest layers

S_d Design value of an internal force or moment of a respective vector of several internal forces or moments

T_o Average total initial thickness of bearing ignoring top and bottom covers .... mm

T_b Total nominal thickness of bearing .... mm

T_{bo} Mean total initial thickness of bearing.. mm

T_e Total nominal thickness of elastomer .... mm

T_q The average total initial thickness of elastomer in shear, including the top and bottom covers when these are not restrained for shearing. .... mm

3.2.2 Latin lower case letters

a Overall width of bearing (shorter dimension of rectangular bearing)....................... mm

a_e Minor axis of elliptic bearing

a' Effective width of laminated bearing (width of the steel reinforcing plates)............. mm

b Overall length of a bearing (longer dimension of a rectangular bearing) .... mm

b_e Major axis of elliptical bearing

b' Effective length of a laminated bearing (length of the steel reinforcing plates)........ mm

c compression stiffness .... N/mm

f_y Yield stress of steel.. N/mm²

l_p Force free perimeter of elastomeric bearing

n Number of elastomer layers

t Thickness of plain pad or strip bearing .... mm

t_e Effective thickness of elastomer in compression.. mm

t_i Thickness of an individual elastomer layer in a laminated bearing .... mm

t_p Thickness of PTFE sheet.. mm

t_s Thickness of steel reinforcing plate .... mm

t_{so} Thickness of outer steel reinforcing plate .... mm

v_{cd} Total vertical deflection .... mm

v_x Maximum horizontal relative displacement in direction of dimension a .... mm

v_y Maximum horizontal relative displacement in direction of dimension b .... mm

v_z Vertical movement/deflection... mm

v_{xy} Maximum resultant horizontal relative displacement obtained by vectorial addition of v_x and v_y .... mm

3.2.3 Greek letters

α Angular rotation of a bearing .... rad

α_a Angular rotation across width *a* of a rectangular bearing ....rad

α_b Angular rotation across length *b* of a rectangular bearing.......................................rad

α_{ab} Resultant angular rotation across width *a* and length *b* of a rectangular bearing ....rad

α_d Angular rotation across the diameter *D* of a circular bearing ....rad

γ_m Partial safety factor for the resistance

δ Vertical deflection of individual elastomer layer...mm

Σ Sum of values

$\varepsilon_{\alpha,d}$ Design strain in elastomer slab due to angular rotation

$\varepsilon_{c,d}$ Design strain in elastomer slab due to compressive loads

$\varepsilon_{q,d}$ Design shear strain in elastomer slab due to translatory movements

$\varepsilon_{t,d}$ Total nominal design strain in elastomer slab

ε_z Compressive strain of a bearing

μ_d Design friction coefficient

μ_e Friction coefficient for elastomer

σ_c Compressive stress ....MPa

σ_m Average of the compressive stress...MPa

σ_s Tensile stress in steel ....MPa

τ Shear stress...MPa

3.2.4 Subscripts

d Design

dyn Dynamic

k Characteristic

max Maximum

min Minimum

t Total

u At ultimate limit state

3.3 Abbreviations

For the purposes of this document, the following abbreviations apply.

CR Polychloroprene Rubber

NR Natural Rubber

pphm Parts per hundred million by volume

PTFE Polytetrafluoroethylene

SLS Serviceability Limit State

ULS Ultimate Limit State

4 Requirements

4.1 General

The level of quality required for an Elastomeric Bearing is mainly defined in terms of product performance through the limiting values and quantifiable characteristics by reference to complete bearings.

The specifications for materials from which the product shall be manufactured complement the essential requirements.

To ensure appropriate levels of performance, it is also necessary to refer to the following parts of EN 1337:

- part 1 General design rules
- part 2 Sliding elements
- part 8 Guide bearings and restrain bearings
- part 9 Protection
- part 10 Inspection and maintenance
- part 11 Transport, storage, and installation

4.2 Functional requirements

Elastomeric bearings shall be designed and manufactured to accommodate translational movements in any direction and rotational movements about any axis by elastic deformation, in order to transmit in a correct manner, from one structural component to another, the design forces and accommodate the design movements derived from the structural analysis.

They can be combined with complementary bearing devices to extend their field of use, such as a sliding system, either temporary or permanent, or a constraining system in any direction.

Elastomeric bearings shall function correctly when they are subject to normal environmental conditions and maintenance, during an economically reasonable designed working life. Where exceptional environmental and application conditions are encountered additional precautions shall be taken (see EN 1337-9). The conditions shall then be precisely defined.

Although elastomeric bearings are designed to accommodate shear movements, they shall not be used to provide permanent resistance to a constantly applied external shear force.

4.3 Performance requirements for complete bearings

This section defines all quantifiable characteristics of complete bearings. It specifies also the type of test either type test or routine test, their frequency and the type of the samples (see clause 8).

NOTE The laboratory temperature range for testing has been enlarged from that normally specified, taking into account that the properties of elastomers suitable for bearings do not change significantly between 15 °C and 30 °C. In the event of a conflict between test results from two different laboratories the range 23 °C ± 2 °C should take precedence.

4.3.1 Shear modulus

The shear modulus (G_g) is the apparent "conventional shear modulus" of elastomeric bearings determined by testing at different temperatures or after ageing in accordance with the method specified in annex F (normative).

NOTE See informative annex D.

4.3.1.1 Shear modulus at nominal temperature

At a nominal temperature of 23 °C ± 2 °C the value G_g of the conventional shear modulus shall comply with one of the values given hereafter:

G_g * = 0,7 MPa G_g = 0,9 MPa G_g * = 1,15 MPa

*Only if specified by the structure designer.

The test shall be performed for type tests at a temperature of 23 °C ± 2 °C, and for routine test at a temperature of 23 °C ± 5 °C.

- Requirements: The value of shear modulus G_g obtained by test shall comply with the following tolerances:

G_g = 0,9 MPa ± 0,15 MPa

G_g^* = 0,7 MPa ± 0,10 MPa

G_g^* = 1,15 MPa ± 0,20 MPa

*Only if specified by the structure designer.

The sample surfaces shall be free from voids, cracks or faults for example arising from moulding or bonding defects.

- Testing conditions: The tests shall be performed not earlier than one day after vulcanisation.

4.3.1.2 Shear modulus at low temperature

At low temperature the conventional shear modulus shall comply with the following requirement:

G_g low temperature ≤ 3 G_g

The test shall be performed as a type test.

- Samples conditioning: The uncompressed bearing shall be air-cooled in a chamber at

-25 °C ± 2 °C for 7 days.

- It shall be supported in such a way as to allow free circulation of air around it.

- Testing conditions: - In a chamber at –25 °C ± 2 °C or

- At a maximum temperature of 25 °C provided that, during the test, the edge surface temperature shall not be higher than –18 °C.

- Mean pressure: 6 MPa.

4.3.1.3 Shear modulus at very low temperature

At very low temperature the conventional shear modulus shall comply with the following requirement:

G_g very low temperature ≤ 3 G_g

The test shall be performed as a type test.

- Samples conditioning: The uncompressed bearing shall be air-cooled in a chamber at –40 °C ± 3 °C for 7 days.

  - It shall be supported in such a way as to allow free circulation of air around it.

- Testing conditions: - In a chamber at –40 °C ± 3 °C or

  - At a maximum temperature of 25 °C provided that, during the test, the edge surface temperature shall not be higher than –18 °C.

  - Mean pressure : 6 MPa.

4.3.1.4 Shear modulus after ageing (3 days at 70 °C)

This test determines the variation of conventional shear modulus after accelerated ageing and shall be performed as a type test.

G_g after ageing ≤ G_g before ageing + 0,15 MPa

- Conditioning of the samples : the uncompressed bearing shall be stored in a heated chamber at :

  70 °C ± 2 °C for 3 days

  - It shall be supported in such a way as to allow free circulation of air around it.

- Testing conditions: The test shall be performed at laboratory temperature (23 °C ± 5 °C), not earlier than 2 days after the end of the ageing procedure.

4.3.2 Shear bond strength

The shear bond strength of elastomeric bearings shall determined in accordance with the method specified in annex G.

4.3.2.1 Shear bond strength at ambient temperature

At a temperature of 23 °C ± 5 °C the shear bond test shall be performed as a type and a routine test.

- Requirements : The slope of the force-deflection curve shall not show a maximum or a minimum value up to the maximum shear strain of 2. At maximum strain the edge of the bearing shall be free from splitting within the rubber due to moulding or bonding defects.

- Testing conditions : Mean pressure : 12 MPa

4.3.2.2 Shear bond strength after ageing (3 days at 70 °C)

After ageing the shear bond test shall be performed as a type test.

- Requirements: as in 4.3.2.1.

- Conditioning of the samples and testing conditions: as in 4.3.1.4.

4.3.3 Compression stiffness

The compression stiffness of elastomeric bearings shall be determined in accordance with the method specified in annex H.