SLOVENSKI STANDARD
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Konstrukcijska leģiģļ a ï 6. del: Linijska in toļ kovna zasuļ na leģiģļ a

Structural bearings - Part 6: Rocker bearings

Lager im Bauwesen - Teil 6: Kipplager

Appareils d'appui structuraux - Partie 6: Appareils d'appui a balanciers

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Structural bearings - Part 6: Rocker bearings

Appareils d'appui structuraux - Partie 6: Appareils d'appui à balanciers

Lager im Bauwesen - Teil 6: Kipplager

This European Standard was approved by CEN on 2 February 2004.

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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.

CEN members are the national standards bodies of 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.

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Contents

page

Foreword

This document (EN 1337-6:2004) 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of an identical text or by endorsement, at the latest by October 2004, and conflicting national standards shall be withdrawn at the latest by January 2006.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.

The 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

Annex A is normative and annex B is informative.

This document includes a Bibliography.

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 specifies the requirements for the design and manufacture of rocker bearings. In order to accommodate displacements rocker bearings can be combined with a sliding element in accordance with EN 1337-2. Bearings which are subjected to rotation greater than 0,05 rad resulting from the characteristic combination of actions are outside the scope of this part of EN 1337. This part of EN 1337 does not apply to rocker bearings made with materials other than those specified in clause 5.

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.*

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

EN 1337-7, *Structural bearings - Part 7: Spherical and cylindrical PTFE bearings.*

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

EN 1337-10, *Structural bearings — Part 10: Inspection and maintenance.*

EN 1990*, Eurocode - Basis of structural design.*

EN 10025, *Hot rolled products of non-alloy structural steels — Technical delivery conditions.*

EN 10083-1, *Quenched and tempered steels — Part 1: Technical delivery conditions for special steels.*

EN 10083-2, *Quenched and tempered steels — Part 2: Technical delivery condition for unalloyed quality steels.*

EN 10088-2, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip for general purposes.*

EN 10160, *Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method).*

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

EN ISO 4287, *Geometrical product specifications (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters (ISO 4287:1997).*

EN ISO 6506-1, *Metallic materials - Brinell hardness test - Part 1: Test method (ISO 6506-1:1999).*

ISO 1083, *Spheroidal graphite cast iron – Classification.*

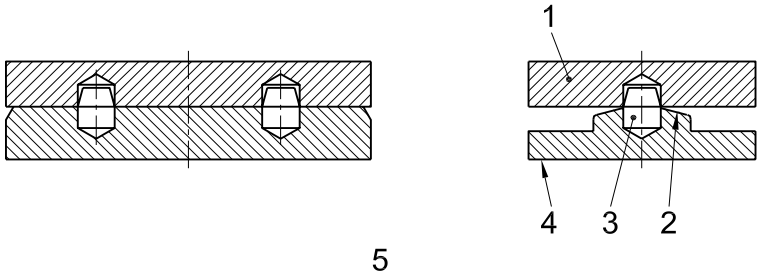
ISO 3755, *Cast carbon steels for general engineering purposes.*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
line rocker
bearing which is formed by a partial cylindrical surface rolling on a flat plate. It permits rotation about an axis parallel to the axis of the curved surface (see Figure 1). If necessary the rocker and rocker plate can be inverted

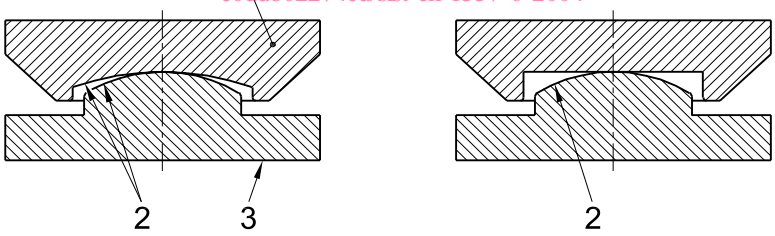


Key

1 Rocker plate
2 Cylindrical surface
3 Line rocker bearing
4 Line rocker
5 Line rocker bearing

Figure 1 —Typical line rocker bearing

3.1.2
point rocker
bearing which is formed by a convex spherical surface rolling on a flat or concave spherical surface of larger radius (see Figure 2)



Key

1 Rocker plate
2 Spherical surfaces
3 Point rocker

Figure 2 — Typical point rocker bearing

3.1.3
rocker
component with a curved convex surface formed on one face. The curved surface can be a portion of a cylinder or sphere (see Figures 1 and 2)

3.1.4
rocker plate
component which operates in contact with the rocker. It can be flat or a concave portion of a sphere (see Figures 1 and 2)

3.1.5
shear dowel
component which provides positive mechanical restrain to horizontal loads

3.2 Symbols

For the purposes of this European Standard, the following symbols apply.

α_d total design angular rotation in one direction, in radians (rad)

E_d design modulus of elasticity, in Newtons per square millimetre (N/mm^2)

e_d total design eccentricity of vertical load, in millimetres (mm)

$e_{2,d}$ design eccentricity due to rotation, in millimetres (mm)

$e_{3,d}$ design eccentricity due to translation, in millimetres (mm)

f_u ultimate strength of material, in Newtons per square millimetre (N/mm^2)

f_y yield strength of material, in Newtons per square millimetre (N/mm^2)

N_{Rd} design resistance of the contact surface

N'_{Rd} design resistance per unit length in Newton per millimetre (N/mm)

N_{Rk} characteristic resistance of the contact surface

N'_{Rk} characteristic resistance per unit length in Newton per millimetre (N/mm)

N_{Sd} design axial force, in Newtons (N)

N'_{Sd} design axial force per unit length, in Newton per millimetre (N/mm)

γ_m partial material safety factor

H distance between horizontal section to be verified and rocker contact area, in millimetres (mm)

L effective length of rocker surface, in millimetres (mm)

R radius of convex contact surface, in millimetres (mm)

R_1 radius of concave contact surface, in millimetres (mm)

V_{Sd} total transverse or shear force in Newtons (N)

4 Functional requirements

4.1 General

A rocker bearing shall be capable of transferring applied vertical and horizontal forces between the superstructure and the substructure. Line rockers shall permit rotation in one direction about the rocker axis. Point rockers shall permit rotation about any axis.

Rocker bearings may be used to resist horizontal forces. Resistance shall be by means of positive mechanical restraint such as shear dowels.

4.2 Load bearing capacity

The load bearing capacity of the rocker bearing shall be obtained from the design verification as a function of the geometry and the steel properties.

4.3 Rotation capability

The rotation capability of the rocker bearing is an intrinsic characteristic of the system based on its geometry and shall be declared by the manufacturer. Its maximum value shall be 0,05 rad.

5 Materials

5.1 General

Only ferrous material as specified in the following and in annex A shall be used in the manufacture of rocker bearing components.

Rockers and rocker plates shall be examined for cracks by ultrasonic testing in accordance with EN 10160 or by magnetic particle or dye penetrant methods. No components with linear defects revealed by these procedures are acceptable.

The low temperature impact properties of all steel mentioned in the following and in annex A shall comply with the requirements given in annex A. Impact tests shall be conducted as specified in the relevant standards. The minimum energy at -20 °C for the average of 3 samples shall be as given in annex A. Only one of these 3 samples may have a lower value which shall be at least 0,7 x the average specified in annex A.

The hardness of rocker and rocker plates shall be verified in accordance with EN ISO 6506-1. Both the hardness of the contact surfaces and the variation in hardness across the section shall be verified by tests carried out on the contact surfaces and across the ends.

5.2 Carbon steel

Carbon steel shall be in accordance with the requirements of EN 10025 or EN 10083-1 and EN 10083-2. The minimum yield strength shall be 240 N/mm^2.

5.3 Stainless steel

Stainless steel shall be in accordance with EN 10088-2. The minimum tensile strength shall be 510 N/mm^2 for any component.

5.4 Cast steel

Cast steel shall be in accordance with ISO 3755 and annex A.

5.5 Cast iron

Cast iron shall be of spheroidal graphite type in accordance with ISO 1083 and annex A.

6 Design

6.1 General

Design verification with respect to loading, rotation (movement) shall be determined in accordance with clause 5 of EN 1337-1:2000.

The design values of the effects (forces, deformations, movements) from the actions at the supports of the structure shall be calculated from the relevant combination of actions according to EN 1990.

NOTE 1 The decisive design values should be available from a bearing schedule as shown in EN 1990, annex E;1. Until EN 1991 is available the guidance given in annex B of EN 1337-1:2000 can be used. Sliding elements should be designed and manufactured in accordance with EN 1337-2.

Performance and durability of bearings designed according to this part of EN 1337 are based on the assumption that requirements established in clauses 6 and 7, as relevant, are complied with.

NOTE 2 The design of rocker bearings is based on the assumption that load passes through a Hertzian contact area between two surfaces with dissimilar radii.

NOTE 3 Line rocker bearings permit rotation about an axis parallel to the line of contact. Point rockers permit rotation about any axis.

γ_m values are defined in Eurocodes EN 1992 to EN 1999. The recommended value is $\gamma_m = 1$.

NOTE 4 When values for partial factors have been selected in Member States, which diverge, for specific works, from the recommended value given in EN 1992 to EN 1999, these values apply in the territory of this Member State. Such values are defined in the national annex attached to the relevant Eurocodes.

6.2 Curved surfaces

The curved surfaces of line rockers shall be of cylindrical shape, those of point rockers shall be spherical.

6.3 Surfaces in contact

Surfaces in contact shall have the same nominal strength and hardness.

6.4 Preventing of sliding

Mechanical devices shall be provided to prevent contact surfaces of rocker bearings sliding on one another.

6.5 Dimensioning of components

6.5.1 Dimensions of line rocker

NOTE 1 The ability of curved surfaces and plates to withstand deformation under load is dependent upon the hardness of the material of which they are made. There is not a constant relationship between hardness and yield stress of steel but there is between hardness and ultimate strength. Consequently the following expressions are based on the ultimate strength of the material.

The design axial force per unit length of rocker contact N'_{Sd} shall meet the following condition under the fundamental combination of actions:

$$N'_{Sd} \leq N'_{Rd} \tag{1}$$

Where $N'_{Rd} = \frac{N'_{Rk}}{\gamma^2_m}$ is the design value of resistance per unit length of rocker contact.

N'_{Rk} is the characteristic value of resistance of the contact surface per unit length.

$$N'_{Rk} = 23 \times R \times \frac{f_u^2}{E_d} \tag{2}$$

γ_m values are defined in Eurocodes EN 1992 to EN 1999. The recommended value is $\gamma_m = 1$.

NOTE 2 When values for partial factors have been selected in Member States, which diverge, for specific works, from the recommended value given in EN 1992 to EN 1999, these values apply in the territory of this Member State. Such values are defined in the national annex attached to the relevant Eurocodes.

In determining the values of N_{Sd} the effects of asymmetric loading due to transverse eccentricities and applied moments shall be considered (see also 6.10.3 of EN 1337-1:2000).

6.5.2 Point rocker in spherical seating

The concave and convex spherical radii shall be selected so that:

$$N_{Sd} \leq N_{Rd} \tag{3}$$

Where $N_{Rd} = \frac{N_{Rk}}{\gamma^3_m}$ is the design value of resistance of the contact surface.

N_{RK} is the characteristic value of resistance of the contact surface.

$$N_{Rk} = 220 \times \left(\frac{R_1 - R}{R_1 \times R} \right)^2 \times f_u^3 \times \frac{1}{E_d^2} \tag{4}$$

γ_m values are defined in Eurocodes EN 1992 to EN 1999. The recommended value is $\gamma_m = 1$.

NOTE When values for partial factors have been selected in Member States, which diverge, for specific works, from the recommended value given in EN 1992 to EN 1999, these values apply in the territory of this Member State. Such values are defined in the national annex attached to the relevant Eurocodes.

6.5.3 Point rocker on a flat surface

The spherical radius R in contact with a flat surface shall be selected so that:

$$N_{Sd} \leq N_{Rd} \tag{5}$$

Where $N_{Rd} = \frac{N_{Rk}}{\gamma^3_m}$ is the design value of resistance.

N_{RK} is the characteristic value of resistance of the contact surface.

$$N_{Rk} = 220\ R^2 \times f_u^3 \times \frac{1}{E_d^2} \tag{6}$$

γ_m values are defined in Eurocodes EN 1992 to EN 1999. The recommended value is $\gamma_m = 1$.

NOTE When values for partial factors have been selected in Member States, which diverge, for specific works, from the recommended value given in EN 1992 to EN 1999, these values apply in the territory of this Member State. Such values are defined in the national annex attached to the relevant Eurocodes.

6.5.4 Load distribution to other components

The rockers and rocker plates shall be so proportioned that loads are adequately distributed to adjacent components.

The maximum load dispersion through a component shall be taken as 45° unless a greater angle is justified by calculations, which take into account the characteristics of the adjacent components and materials. In no case shall load dispersion be assumed beyond a line drawn at 60° to the vertical axis (see Figure 3).