BRITISH STANDARD

BS EN
1337-5:2005

Structural bearings —

Part 5: Pot bearings

The European Standard EN 1337-5:2005 has the status of a British Standard

ICS 91.010.30

BSI
British Standards

National foreword

This British Standard was published by BSI. It is the UK implementation of EN 1337-5:2005. It partially supersedes BS 5400-9-1:1983 and BS 5400-9-2:1983 which will remain current until the remaining parts of the BS EN 1337 series have been published, the last part being Part 8.

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A list of organizations represented on B/522 can be obtained on request to its secretary.

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Foreword

This document (EN 1337-5:2005) 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of an identical text or by endorsement, at the latest by December 2006, and conflicting national standards shall be withdrawn at the latest by December 2006.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.

The European Standard EN 1337 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This part of EN 1337 specifies the requirements for the design and manufacture of pot bearings which will be used for operating temperatures between – 40 °C and 50 °C.

This part of EN 1337 does not apply to pot bearings made with other materials than those specified in clause 5.

Bearings which are subjected to rotation α_d greater than 0,030 rad (see Figure 2) under the characteristic combination of actions or which incorporate elastomeric pads larger than 1500 mm in diameter are beyond the scope of this document.

Depending on the climatic region where the construction work is located the bearings can be designed to one of the following classes related to minimum operating temperatures (the minimum shade air temperatures): - 25 °C or – 40 °C.

When required to accommodate translational movements, pot bearings may be combined with sliding elements in accordance with EN 1337-2.

NOTE The minimum shade air temperature for a location should be obtained from meteorological data appropriate to a 120 year return period. Consideration should be given to adjustment of this temperature for height and local divergence such as frost pockets and sheltered low-lying areas if the data obtained applies to a general area rather than to a specific location.

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*.

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 10025-1, *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*

EN 10083-3, *Quenched and tempered steels — Part 3: Technical delivery conditions for boron steels*.

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

EN 12163, *Copper and copper alloys — Rod for general purposes*.

EN 12164, *Copper and copper alloys — Rod for free machining purposes*.

EN ISO 527-1, *Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:1993 including Corr 1:1994)*.

EN ISO 527-2, *Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2:1993 including Corr 1:1994)*.

EN ISO 1133, *Plastics - Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics (ISO 1133:1997)*.

EN ISO 2039-1, *Plastics - Determination of hardness - Part 1: Ball indentation method (ISO 2039-1:2001)*.

EN ISO 4288, *Geometrical product specifications (GPS) - Surface texture: Profile method - Rules and procedures for the assessment of surface texture (ISO 4288:1996)*.

EN ISO 7500-1, *Metallic materials - Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines - Verification and calibration of the force-measuring system (ISO 7500-1:2004)*

ISO 1083, *Spheroidal graphite cast irons — Classification*.

ISO 1183, *Plastics — Methods for determining the density of non-cellular plastics*.

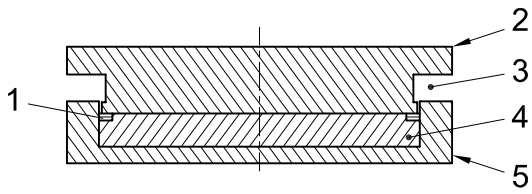
ISO 3755, *Cast carbon steels for general engineering purposes*.

ISO 6446, *Rubber products — Bridge bearings — Specification for rubber materials*.

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply (see Figure 1).



Key

1 Internal seal

2 Piston

3 Protection by external seal in this area

4 Elastomeric pad

5 Pot

NOTE Pot bearings can be used with the pot inverted.

Figure 1 — Details of a pot bearing

3.1.1
accumulated slide path
the sum of the relative movements between the internal seal and the pot wall resulting from variable rotations

3.1.2
elastomeric pad
component which provides the rotational capability

3.1.3
external seal
component or material which is used to exclude moisture and debris from the gap between the piston and the pot

3.1.4
internal seal
component which prevents escape of the elastomer material through the clearance between the recess walls and the piston when a compressive force is applied

3.1.5
lubricant
special grease used to reduce the friction between the pad and the metallic components for the purpose of reducing wear as well as the rotation stiffness

3.1.6
piston
component which closes the open end of the recess in the pot and bears on the elastomeric pad

3.1.7
pot
component with a machined recess which contains the elastomeric pad, piston and internal seal

3.1.8
pot bearing
structural bearing consisting of an elastomeric pad (rotational element) confined in a cylinder by means of a close fitting piston and an internal seal

3.1.9
sliding pot bearing
pot bearing combined with a sliding element to accommodate translational movement in one or any direction

3.2 Symbols

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

3.2.1 Latin upper case letters

A	cross section area, in square millimetres
D	internal diameter of pot, in millimetres
D_O	outer diameter of pot ring, in millimetres
F_0	factor in restoring moment formula for zero rotation
F_1	factor in restoring moment formula for lubricated pad
F_2	factor in restoring moment formula for unlubricated pad
$F_{w,}$	resistance of weld in Newton per millimetre
$F_{xy,}$	applied horizontal load, in Newton
H	depth of the cylindrical recess in millimetres
M	resistance moment from pad and internal seal in test in Newton millimetre
M_e	resistance moment from pad and internal seal in Newton millimetre
M_R	additional moment from friction between piston and pot in Newton millimetre
M_T	total resistance moment from rotation in Newton millimetre
N	axial force in Newtons
R	radius of contact surface in millimetres
T	thickness of the pot base in millimetres
V	total transverse or shear force in Newton
V'	total transverse or shear force per unit length in Newton per millimetre

$V_{e,}$ shear force due to elastomer pressure in Newton

3.2.2 Latin lower case letters

b calculated piston/pot contact width, in millimetres

d diameter of elastomeric pad, in millimetres

d_{ct} effective contact diameter of upper surface, in millimetres

d_{cb} effective contact diameter of lower surface, in millimetres

f_U ultimate strength of material, in Newton per square millimetre

f_y yield strength of material, in Newton per square millimetre

$f_{e,d}$ design contact strength of the elastomer, in Newton per square millimetre

t nominal thickness of elastomeric pad in millimetres

w width of piston face in millimetres

3.2.3 Greek letters

γ_M partial safety factor

α rotation angle due to permanent and variable actions, in radians

α_1 resultant rotation angle due to permanent actions, in radians

α_2 resultant rotation angle due to traffic loads, in radians

θ rotation angle in restoring moment test, in radians

3.2.4 Subscripts

Rd design resistance

d design value

Sd design internal forces and moments from actions

u ultimate limit state

3.3 Abbreviations

PTFE polytetrafluoroethylene

POM polyoxymethylene (acetal)

4 Functional requirements

4.1 General

A pot bearing shall be capable of transferring applied vertical and horizontal loads between the superstructure and substructure and shall permit limited rotational movement (see 6.1.2). The internal seal system shall prevent extrusion of the elastomer from the pot.

These requirements shall be met with adequate reliability and durability, see EN 1990.

It is assumed that adequate reliability, durability, load bearing capacity and rotation capability result from adopting the design procedures given in clauses 5 and 6.

When using an internal seal system indicated in annex A, pot bearings designed and used in accordance with this part of EN 1337 are considered to meet the aforementioned requirements.

4.2 Tests for durability

When necessary (see 5.4) the long term functioning according to 4.1 shall be tested in accordance with annex E.

Acceptance criteria for these tests are:

— there shall be no extrusion of cohesive elastomeric material.

— the compression deformation under the test load shall have not increased for at least 24 h.

NOTE Wear of the seal and discoloration of the lubricant is acceptable in these tests.

5 Materials

5.1 General

Materials used for the manufacture of pot bearings shall be in accordance with the requirements given in the following sub-clauses.

5.2 Ferrous materials for pot and piston

The pot and piston shall be manufactured from ferrous materials in accordance with one of the following standards: EN 10025, EN 10083-3, EN 10113-1, EN 10088-2, ISO 3755, ISO 1083.

Specification and certification of material shall correspond to the requirements for resistance and durability, weldability, if applicable, and the operating temperature specified (see clause 1).

5.3 Elastomeric materials

The elastomer material used for the elastomeric pad shall be natural or polychloroprene rubber in accordance with ISO 6446.

5.4 Internal seal

Suitable internal seals are given in annex A.

The internal seals given in annex A shall be classified with regard to the standard accumulated slide path, given in annex E as follows:

— Seals according to A.1.1 accumulated slide path “b”, 1000 m

— Seals according to A.1.2 and A.1.3 accumulated slide path “c”, 2000 m

— Seals according to A.1.4 accumulated slide path “a”, 500 m

NOTE All seals given in annex A can be considered as suitable, according to the state of the art.

Internal seals made from materials not specified in annex A are beyond the scope of this standard and the test procedures described herein are not necessarily applicable, particularly with regard to long term effects.

For a seal system not specified in annex A, the ability of a pot bearing to satisfy these requirements shall be verified by testing in accordance with 4.2.

5.5 Lubricant

The lubricant shall not be harmful to the elastomer or other components and shall not cause excessive swelling of the elastomer.

Swelling of the elastomer is excessive when the relative change in weight is ≥ 8 % at 50 °C.

6 Design requirements

6.1 Design fundamentals

6.1.1 Principles of design calculation

For the design of bearings, the principles given in clause 5 of EN 1337-1:2000 apply.

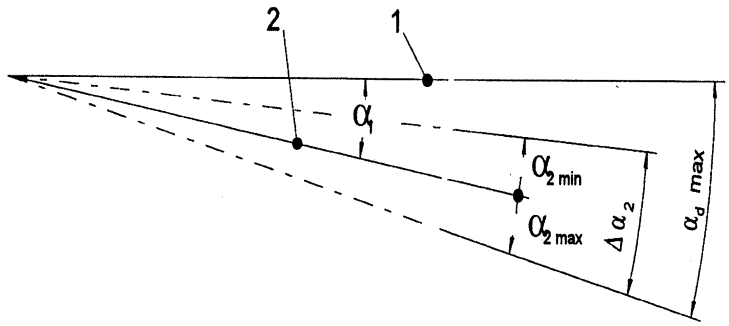
The design values of the effects (forces, deformations, movements) from the actions at the supports of the structure shall be calculated from the relevant combination of actions according to EN 1990.

NOTE The decisive design values are assumed to be available from a bearing schedule as shown in prEN 1993-2. Until prEN 1993-2 is available the guidance given in annex B of EN 1337-1:2000 may be used.

6.1.2 Rotation limitation

6.1.2.1 General

The relationship between the permanent and variable rotation angles is shown in Figure 2.



Key

1 Starting position (after installation)

2 Position due to rotation α_1 caused by permanent actions

α_{2min}, $\alpha_{2\,max}$ negative and positive rotation angles due to variable loads.

$\Delta\alpha_2$ range of rotation angles due to extreme positions of variable loads

$$\alpha_{max} = \alpha_1 + \alpha_{2max} \quad (1)$$

Figure 2 — Diagramatic representation of rotation angles

6.1.2.2 Rotation limitation

Under the characteristic combination of actions the maximum rotation α_{dmax} shall not exceed 0,03 rad.

Under the frequent combination of actions the difference in rotation $\Delta\alpha_{d2}$ shall not exceed 0,005 rad.

6.1.2.3 Variable rotation

Variable rotations result in an accumulated slide path, which affects the durability of the internal seal.

When required the actual accumulated slide path $S_{A,d}$ shall be calculated with data provided by the bridge designer using the following formula:

$$S_{A,d} = n_v \times \Delta\alpha_2 \times \frac{D}{2} \quad (2)$$

$$S_{A,d} \le c \times s_T \quad (3)$$

in which:

$S_{A,d}$ = actual accumulated slide path due to characteristic traffic loads

n_v = number of vehicles (lorries) for the intended life of the bearing

c = factor to correct for the difference between the constant amplitude slide path used in the tests and the variable amplitude movements which actually occur due to traffic (equals :5)

s_T = accumulated slide path a,b or c in accordance with 5.4 or derived from testing in accordance with annex E

It is assumed that $\Delta\alpha_2$ has been determined using an appropriate single vehicle model. In the absence of such data, Fatigue Load Model 3 in accordance with ENV 1993-3 should be used.

NOTE The field of application of the internal seals corresponding to the technical classes listed in 5.4 is given in annex G, provided that no calculative verification is carried out.

6.1.3 Restraint moments due to rotation

6.1.3.1 Restraint due to rotation of elastomeric pad and internal seal

For the verification of the adjacent structural parts the maximum value of the restraint moment M_{emax} of the elastomeric pad shall be assumed to be:

$$M_{emax} = 32 \times d^3 \times (F_0 + (F_1 \times \alpha_1) + (F_2 \times \alpha_{2max})) \quad (4)$$

where:

F_0, F_1 & F_2 shall be determined from type tests conducted in accordance with annex D.

d is the diameter of elastomeric pad (mm)

M_{emax} is the restraint moment from the pad

α_1 is the resultant rotation angle due to permanent actions effects, in radians (rad), see Figure 2.

α_{2max} is the resultant rotation angle due to variable actions, in radians (rad) see Figure 2.

6.1.3.2 Resistance to rotation due to pot/piston contact

The additional moment $M_{\mu max}$ caused by friction at the pot/piston contact surface shall be considered. In determining this moment the maximum coefficient of friction between the pot wall and the piston shall be taken as 0,2.

6.1.3.3 Total restraint due to rotation

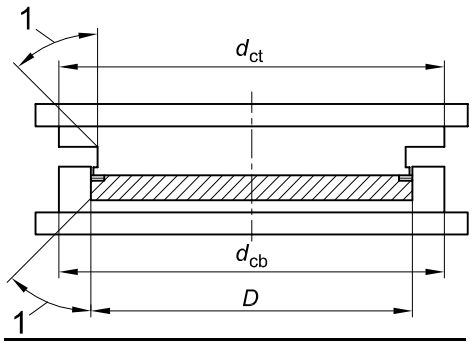
The total restraint due to rotation to be considered in the design of the adjacent structure and bearing components shall be taken as the vectorial sum of the moments determined in accordance with 6.1.3.1 and 6.1.3.2.

6.1.4 Vertical deformation

If the elastic compression stiffness of the bearing is of relevance to the design of the adjacent structure it shall be determined by means of testing (see annex B).

6.1.5 Load distribution through components

The load dispersion angle through a component, as shown in Figure 3, shall be taken as 45° unless a greater angle is justified by calculations which take into account the characteristics of the adjacent components, materials and structural members. In no case shall the load dispersion angle exceed 60°.



Key

1 Load dispersion angle

Figure 3 — Load distribution through components

6.1.6 Combination with sliding elements

When a pot bearing is combined with a sliding element in accordance with EN 1337-2, the interaction of the respective components particularly with regard to their relative stress and strain shall be considered. Additional mechanical and geometrical effects e.g. due to lateral forces in guides (friction, couple from action and reaction) causing eccentricities additional to those resulting from resistance to rotation as given in 6.1.3 shall be taken into account.

6.2 Design verification

6.2.1 Elastomeric pad

6.2.1.1 Contact stress

The design axial force N_{Sd} shall meet the following condition under the fundamental combination of actions:

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

Where:

$$N_{Rd} = \frac{N_{Rk}}{\gamma_M} \text{ is the design value of resistance of the elastomeric pad} \quad (5)$$

N_{Rk} is the characteristic value of resistance of the elastomeric pad

The characteristic value of the resistance shall be determined from:

$$N_{Rk} = \frac{\pi}{4} \times d^2 \times f_{e,k} \text{ where:} \quad (6)$$

d is the diameter of elastomeric pad (mm)

$f_{e,k}$ is the characteristic contact strength of the elastomer given by $f_{e,k}$ = 60 N/mm^2

NOTE 1 The compressive resistance $f_{e,k}$ of the elastomer in pot bearings, that leads to N_{Rk} is limited by the effectiveness of the seal preventing the elastomer from extruding between the piston and the pot wall.

NOTE 2 The partial factor γ_M may be chosen in the National Annex of the relevant Eurocode.

The recommended value of γ_M = 1,30.

6.2.1.2 Minimum thickness

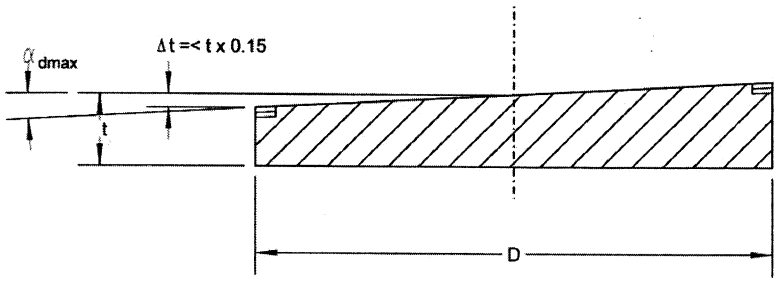


Figure 4 — Permissible deflection in elastomeric pad

The dimensions of the elastomeric pad shall be such that under the characteristic combination of actions the total rotation α_{dmax} (see Figure 2) does not cause a deflection, Δt, at the perimeter greater than 15 % of the pad thickness t (See Figure 4).

To comply with this requirement the minimum elastomeric pad thickness shall be:

$$t_{min} = 3{,}33 \times \alpha_{d\,max} \times d \qquad (7)$$

In addition the elastomeric pad thickness, t_{min}, shall not be less than $\frac{d}{15}$

6.2.2 Pot

For designing the pot to accommodate the lateral elastomeric pressure and the forces due to applied horizontal actions, the design stresses in the pot shall not exceed the design value of the yield strength at any section due to the fundamental combinations of actions.

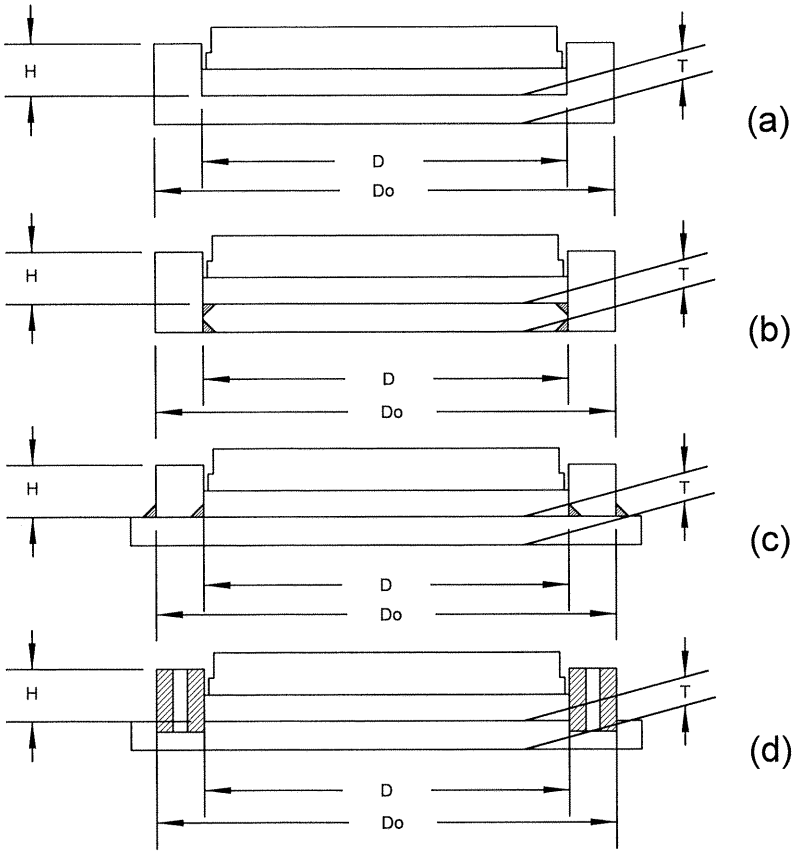


Figure 5 — Types of pot construction

The analysis of the pot shall be based on the following assumptions:

– The analytical model comprises the pot as well as the adjacent structural members and the boundary conditions due to fixing devices.

— The elastomeric pad is assumed to have hydrostatic characteristics under pressure.

— The pressure between piston and pot walls resulting from external horizontal actions is assumed to be parabolically distributed over half of the perimeter and the maximum value is taken as 1,5 times the mean value.

Instead of a precise calculation under the above conditions (e.g. by means of finite element method) it is admissible to verify a pot designed according to Figures 5a) to c) by using the following simplified formulae considering the pot walls and the pot base as separate components. For this procedure the thickness of the pot base shall be at least 12 mm.

a) Pot walls subjected to tensile force:

$$V_{Sd} \leq V_{Rd}$$

where: $V_{Sd} = V_{e,Sd} + V_{Fxy,Sd}$ (8)

$$V_{e,Sd} = \frac{4N_{Sd}t}{\pi D} \quad (9)$$

$$V_{Fxy,Sd} = \sqrt{V_{Fx,Sd}^2 + V_{Fy,Sd}^2} \quad (10)$$

$$V_{Rd} = \frac{f_y \times A_R}{\gamma_M} \quad (11)$$

where $A_R = (D_0 - D) \times H$ (12)

b) Pot walls subjected to shear force:

$$V'_{Sd} =< V'_{Rd} \quad (13)$$

Where

$$V'_{Sd} = \frac{V_{e,Sd} + 1{,}5V_{Fxy,Sd}}{D} \quad (14)$$

$$V'_{Rd} = \frac{f_y \times (D_0 - D)}{2 \times \gamma_M \times \sqrt{3}} \quad (15)$$

c) Pot base subjected to tensile force:

$$V_{Sd} \leq V_{Rd}$$

Where $V_{Sd} = V_{e,Sd} + V_{Fxy,Sd}$ (16)

$$V_{Rd} = \frac{f_y \times A_p}{\gamma_M} \quad (17)$$

where $A_p = D_0 \times T$ (18)

d) Full penetration butt weld connecting the pot base to the pot wall within the pot wall (see Figure 5 (b)) :

$$V_{Sd} \leq V_{Rd}$$

Where $V_{Sd} = V_{e,Sd} + V_{Fxy,Sd}$ (19)

$$V_{Rd} =< \frac{f_y \times A_p}{\gamma_M} \quad (20)$$

where $A_p = D_0 \times T$ (21)

e) Partial penetration butt welds connecting the pot base to the pot wall within the pot wall:

$$V_{Sd} \leq V_{Rd}$$

Where $V_{Sd} = V_{e,Sd} + V_{Fxy,Sd}$ (22)

$V_{Rd} = \Sigma F_{w,Rd} . D$ (23)

where $F_{w,Rd}$ is given in prEN 1993-1-8

f) Fillet welds connecting the pot wall to the top of the pot base (see Figure 5(c)):

$$V'_{Sd} \leq V'_{Rd}$$

Where

$$V'_{Rd} = \Sigma F_{w,Rd} \qquad (24)$$

where $F_{w,Rd}$ is given in prEN 1993-1-8

NOTE The partial factor γ_M in (a) to (f) is given in EN 1993-1.

Similarly, in the absence of precise calculation, the verification of pots constructed by bolting [see Figure 5 (d)] shall use the action effects given above.

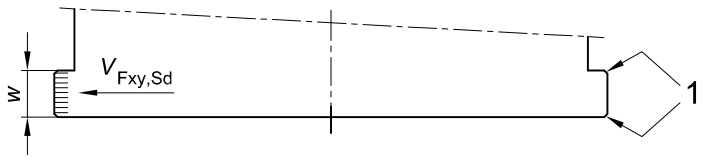
In all forms of construction, allowance shall be made for the adverse effects of any holes.

6.2.3 Piston/pot contact

6.2.3.1 General

The contact face of the piston may be designed as flat in accordance with 6.2.3.2 provided that the width of the piston contact face, *w*, is less than 15 mm (see Figure 6).

The mechanical resistance of contact faces shall be verified for the fundamental combination of actions in accordance with 6.2.3.2 or 6.2.3.3.



Key

1 Break edges

Figure 6 — Details of flat piston contact face

6.2.3.2 Flat contact surface

Flat contact faces shall be verified, so that:

$$V_{,Sd} \leq V_{,Rd}$$

where

$V_{,Sd}$ is the design value of the transverse force (N)

$$V_{Rd} = \frac{f_y \times D \times w}{1{,}5 \times \gamma_M} \qquad (25)$$

where

D is the internal diameter of pot (mm)

f_y is the yield strength of material (N/mm^2)

w is the width of piston face (mm)

NOTE γ_M values are defined in Eurocodes EN 1992 to EN 1999. Such values are defined in the national annex attached to the relevant Eurocodes. The recommended value is γ_M = 1.

6.2.3.3 Curved contact surface

Curved contact surfaces shall have a radius *R* (see Figure 7), of not less than 0,5 × *D* or 100 mm, whichever is the greater.

They shall be verified, so that

$V_{Sd} \leq V_{Rd}$

where

$$V_{Rd} = \frac{15 \times f_u^{\,2} \times R \times D}{E_d \times \gamma_M^{\,2}} \qquad (26)$$

where :

R is the radius of contact surface (mm)

f_U is the ultimate strength of material (N/mm^2)

E_d is the design modulus of elasticity (N/mm^2)

D see Figure 5

NOTE 1 The ability of curved surfaces and plates to withstand deformation under load is dependent upon the hardness of the material from 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 above expressions are based on the ultimate strength of the material.

NOTE 2 A force concentration factor 1,5 is included in the factor 15 (see 6.2.2).

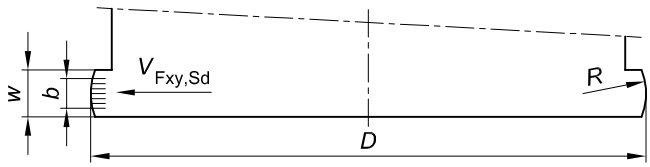


Figure 7 — Details of curved contact face

NOTE 3 γ_M values are defined in Eurocodes EN 1992 to EN 1999. Such values are defined in the national annex attached to the relevant Eurocodes. The recommended value is γ_M = 1.

6.2.4 Additional geometrical conditions for required rotation capacity

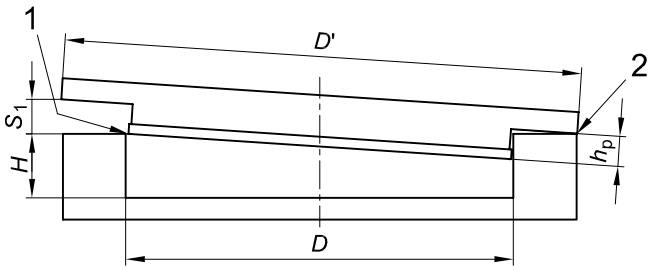


Figure 8 — Sketch illustrating geometrical conditions for rotation

For the fundamental combination of action it shall be shown that:

— The edge of the piston/elastomer contact face remains within the cylindrical recess formed by the pot wall around the whole circumference (Point 1 in Figure 8).

— There is no contact between the top of the pot wall and any other metallic component (Point 2 in Figure 8).

The above conditions are satisfied when:

$$H \geq t + (w - b) \times 0{,}5 + (\alpha_{d\,\max} \times 0{,}5 \times D) + a_{\mathrm{d}} \tag{27}$$

$$h_p = H - t + a_d + (\alpha_{dmax} \times 0{,}5 \times D') \tag{28}$$

Where $a_{\mathrm{d}} = 0{,}01 \times D$ or 3 mm whichever is greater, but not exceeding 10 mm.

For flat surfaces $b = w$.

For curved surfaces $b = 3{,}04\sqrt{\dfrac{1{,}5 \times V_{\mathrm{Fxy,Sd}} \times R}{E_{\mathrm{d}} \times D}}$

and $w = b + \alpha D$

where:

R is the radius of contact surface (mm)

E_{d} is the design modulus of elasticity (N/mm^2)

α_{dmax} is the design value of the maximum rotation angle (see Figure 2)

6.2.5 Fixing to the adjacent structure

To ensure safety against sliding in joints, the connection between bearing and structure shall be in accordance with 5.2 of EN 1337-1:2000.

6.2.6 Stress at the adjacent structure

Verification shall be in accordance with the relevant standard for the structure. The effective contact diameters d_{ct} and d_{cb} (see Figure 3) shall be determined in accordance with 6.1.5. Eccentricity e shall be determined from moments as defined in 6.1.3 and from the moment caused by design applied

horizontal loads. If a stress block is to be taken into account, the reduced contact area due to eccentricity can be determined from EN 1337-2:2004, annex A.

7 Manufacturing assembly and tolerances

7.1 Elastomeric pad

The tolerance on thickness shall be -0 +2,5 mm for $d \leq 750$ mm and -0 + d/300 for 750 mm < d < 1500 mm.

A vertical and/or horizontal subdivision of the elastomeric pad in several parts is admissible under the following conditions:

- The total pad meets the required tolerances.

7.2 Parallelism of outer surfaces

Where the upper and lower surfaces of a bearing are intended to be parallel the deviation from parallelism between any two pairs of points on the surfaces shall not be more than 0,1 % when the difference in the vertical distance between each pair is expressed as a percentage of the horizontal separating them. Where the upper and lower surfaces are intended to be inclined in relation to each other a similar tolerance shall apply between the actual and intended inclination.

7.3 Fit of components

7.3.1 Piston in pot

The maximum diametrical clearance between the pot and the piston shall not exceed 1 mm for metallic and POM seals and 0,8 mm for carbon filled PTFE seals. When using internal seals not described in annex A the clearance shall not exceed that which existed in the specimens tested in accordance with annexes E and F.

7.3.2 Elastomeric pad in pot

In the unloaded condition the diametrical clearance between the pot and the elastomeric pad shall not exceed 0,2 % of the diameter of the elastomeric pad or 1,0 mm whichever is greater.

7.3.3 Holes for fixing bolts

Tolerance for holes for fixing bolts shall be related to the function of the bolts and the likely conditions prevailing at the time of installation of the bearings. As a guide, holes for fixing bolts or locating devices shall be drilled within 1 mm of the position shown on the drawings.

7.4 Surface roughness

The surface roughness, R_{Y5i}, of the inner cylindrical surface of the pot in contact with the elastomer shall not exceed 6,3 μm. The plane surface of the pot in contact with the elastomer shall not exceed 25 μm when measured in accordance with EN ISO 4288.

The surface roughness, R_{Y5i}, of the plane surface of the piston in contact with the elastomer shall not exceed 25 μm when measured in accordance with EN ISO 4288.

7.5 Corrosion protection

Requirements for corrosion protection are given in EN 1337-9.

Corrosion protection systems shall not be applied to the internal surfaces of the pot nor to the surfaces of the piston in contact with the pot and elastomer.

Where dissimilar materials are used in combination the effects of electrolytic corrosion shall be considered.

7.6 External seal

An external seal shall be provided in the area shown in Figure 1 to exclude moisture and debris. The seal shall remain effective under actions applying to verification of serviceability limit state and it shall not be possible for it to be damaged by the piston under these actions.

7.7 Lubrication

The elastomer contact surfaces of the pot and piston shall be amply lubricated on assembly using material in accordance with 5.5. After the pad has been inserted additional lubricant shall be applied to the free inner surface of the pot wall.

7.8 Sharp edges

All sharp edges shall be broken.

8 Conformity evaluation

8.1 General

The tests and inspections specified in this clause shall be carried out to demonstrate conformity of the construction product (pot bearing) with this part of EN 1337. In the case of sliding pot bearings clause 8 of EN 1337-2:2004 also applies.

The given system of evaluation of conformity is also valid for non-series production.

8.2 Control of the construction product and its manufacture

8.2.1 Factory production control

The extent and frequency of factory production control by the manufacturer and by a third party (if required) shall be conducted in accordance with Table 1. In addition, it shall be checked by controlling the inspection certificates as listed in Table 2 that the incoming raw material and components comply with this part of EN 1337.

NOTE For factory production control see annex C.

8.2.2 Initial type testing

The extent of type-testing shall be conducted in accordance with Table 1.

Type testing shall be performed prior to commencing manufacture. It shall be repeated if changes in the construction product or manufacturing processes occur.

Certificates containing material properties established in clause 5 with 5.3 and 5.5 as well as identification characteristics of internal seals not specified in annex A shall be individually examined during type-testing and shall be retained by the manufacturer of the pot bearing and by the third party (if required).

Type testing of material properties and identification characteristics of the elastomeric pad, internal seal and lubricant may be omitted if it is shown that the combination of these materials has previously passed type testing as specified in Table 1 for any pot bearing.

Type testing shall be supplemented with the relevant calculations from clause 6 for the evaluation of the final performance of the pot bearing.

8.3 Raw materials and constituents

Compliance with the product requirements specified in clause 5 or examined during type testing in accordance with A.2 shall be verified by means of inspection certificates in accordance with EN 10204 to the level stated in Table 2.

8.4 Sampling

Random samples shall be taken from the running production.

9 Installation

The bearing shall be installed within a tolerance of ± 0,003 radians of the intended inclination of the contact surfaces of the structure.

10 In-service inspection

In-service inspection shall be in accordance with the requirements of EN 1337-10. Visible defects shall include evidence of the extrusion of elastomer and the presence of wear debris from the pot or, in the case of sliding pot bearings, from the sliding interface.

If S 1 < 1 mm (see Figure 8) or so large that the contact surface of the piston has become visible the causes shall be investigated and remedial works undertaken if necessary.

Table 1 — Control and testing of the construction product

Type of control	Subject of control	Control in accordance with	Frequency
Factory production control	Dimensions	Manufacturer's Drawing	Every bearing
	Surface roughness	7.4	
	Fit of components	7.3	
	Lubrication	7.7	
	Internal seal end gap	Annex A	
	Internal seal end details	Annex A	
	Corrosion protection	7.5	
	Parallelism	7.2	
	External seal	7.6	
	Marking	EN 1337-1:2000, 1.7.3	
Type-testing	As in factory production control above except corrosion protection and marking	As above	Once
	Restoring moment (rotation stiffness)	Annex E	
	Long term loading capability [a] Long term rotation capability [a]	4.2 4.2	
	Seal systems not specified in annex A	4.2, 5.4	
	Material properties	5.3, 5.5, 8.2.2	

[a] Only for internal seals not specified in annex A or for seals specified in annex A but operating beyond their specified capability.

Table 2 — Specific testing of raw materials and constituents

Type of inspection certificate in accordance with EN 10204	Subject of control	Control in accordance with	Frequency
3.1.B	Ferrous materials for pot & piston	Standards listed in 5.2	Every batch
	Elastomeric pad	5.3 [a], 7.1	
	Brass	A.1.1, A.2.1	
	POM seal	A.1.2, A.2.2	
	Carbon filled PTFE seal	A.1.3, A.2.3	
	Stainless steel seal	A.1.4, A.2.4	
	Seal system not specified in annex A	8.2	
	Lubricant	5.5	Every 500 kg batch

[a] Only tensile strength and hardness.

Annex A
(normative)

Internal seals

A.1 General requirements

A.1.1 Brass seal

The internal brass seal shall be fitted into a formed recess in the upper edge of the elastomeric pad and shall consist of a number of split rings formed to the internal diameter of the pot. When fitted, the gap between the ends of the ring shall not exceed 0,5 mm and the gaps in adjacent rings shall be equally disposed around the perimeter of the pot. Where possible no gap should coincide with the point of maximum rotation movement on the pot wall.

Rings with a minimum cross-section of 10 mm × 2 mm may have slits 7 mm deep × 0,5 mm wide spaced at 5 mm around the inner diameter to facilitate forming. Rings with a smaller cross-section shall not have slits.

Table A.1 — Allowable solid brass sealing ring configurations

Diameter *d* mm	Minimum cross-section mm	Slits	Number of rings
≤ 330	6 × 1,5	Not permitted	2
> 330 < 715	10 × 1,5	Not permitted	2
= 715 <1500	10 × 1,5	Not permitted	3
< 1500	10 × 2	7 mm × 0,5 mm 5 mm spacing	3

A.1.2 POM seal

The POM sealing chain shall consist of individual interlocking elements, which can adapt easily to deformation.

Width and height of the individual elements shall be:

a) elastomer diameter $d \leq 550$ mm: 10 mm ± 0,5 mm;

b) elastomer diameter $d > 550$ mm: 15 mm ± 1,0 mm.

The POM sealing ring shall be moulded as an integral part of the elastomeric pad during the vulcanisation process to ensure correct functioning. See Figure A.2.

A.1.3 Carbon filled PTFE seal

The carbon filled PTFE seal shall be completely recessed into the elastomeric pad.

The cross section, dimensions and end details of the ring shall be as shown in Figure A.1.

A.1.4 Stainless steel seal

The sealing ring shall be made from stainless steel strip formed into an equal or unequal angle section inserted between the elastomeric pad and the pot wall.

The leg length and thickness of the section shall meet the following.

a) with notches:

where diameter d ≤ 700 mm - leg length 5 mm to 10 mm, thickness 1 mm minimum; where diameter d > 700 mm leg length 15 mm to 17 mm, thickness 1,5 mm minimum; the minimum overlap of the ring ends shall be 20 mm; where the thickness > 1 mm, the ends shall be reduced in thickness at the overlap position.

b) without notches:

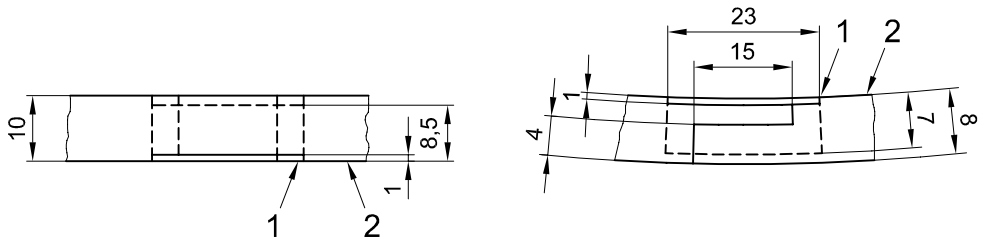
minimum leg length 3 mm;

minimum thickness 1 mm;

minimum overlap 5 mm;

where the thickness > 1 mm, the ends shall be reduced in thickness at the overlap position.

Dimensions in millimetres



Key

1 Brass angle

2 Sealing ring

Figure A.1 — Typical seal joint

A.2 Material requirements

A.2.1 Brass seal

The material used for the brass seal shall be grade CuZn37 or CuZn39Pb3, as specified in EN 12163 and EN 12164 respectively, in the metallurgical condition used in the type tests.

A.2.2 POM seal

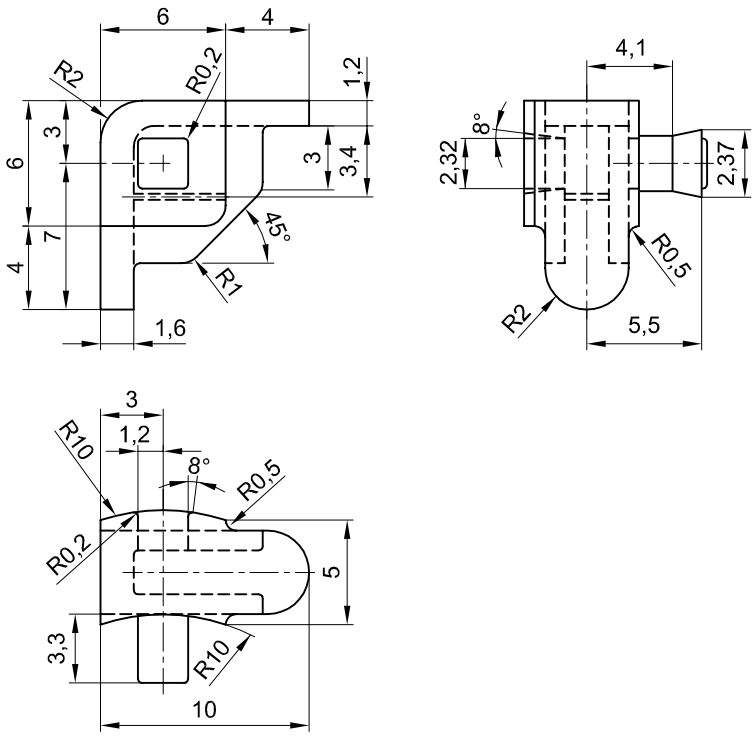
The material used for the moulded seals shall be polyoxymethylene (POM) and shall have the properties shown in Table A.2.

Table A.2 — Physical and mechanical properties of POM

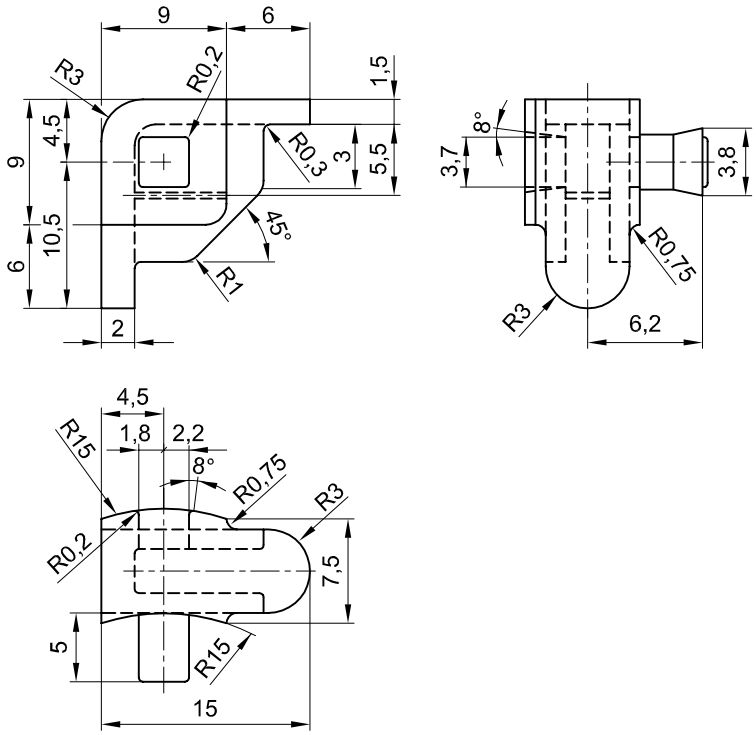
Property	In accordance with	Requirements
Density	ISO 1183	1410 kg/m^3 ± 20 kg/m^3
Melt flow index MFI 190/2, 16	EN ISO 1133	10 g/min ± 2,0 g/min
Ultimate tensile strength	EN ISO 527-2	≥ 62 N/mm^2
Ultimate strain	EN ISO 527-2	≥ 30 %

The dimensions shall be as shown in Figure A.2 a) and b).

Dimensions in millimetres



a) Small POM element (For diameter of elastomeric pad up to 550 mm)



b) Large POM element (For diameter of elastomeric pad above 550 mm)

Figure A.2 — Dimensions of POM seal

A.2.3 Carbon filled PTFE seal

The material composition shall consist of PTFE + 25 % carbon.

The material properties shall be in accordance with the requirements of Table A.3 below.

Table A.3 — Mechanical and physical properties of carbon filled PTFE seal

Properties	In accordance with	Requirements
Density	ISO 1183	2100 kg/m^3 to 2150 kg/m^3
Ultimate tensile strength	EN ISO 527-2	≥ 17 N/mm
Ultimate strain	EN ISO 527-1	≥ 80 %
Ball hardness	EN ISO 2039-1	≥ 40 N/mm

The material properties shall be verified on samples taken from finished tubes at 23 °C and 50 % humidity.

The ultimate tensile strength and the ultimate strain shall be determined with a speed *C* = 50 mm/min on test samples with a PTFE thickness of 2 mm ± 0,2 mm in accordance with EN ISO 527-2.

The ball hardness shall be determined on samples with a minimum thickness of 4,5 mm.

A.2.4 Stainless steel

The material used for the stainless steel seal shall be as specified in EN 10088-2, 1.4401 or 1.4311.

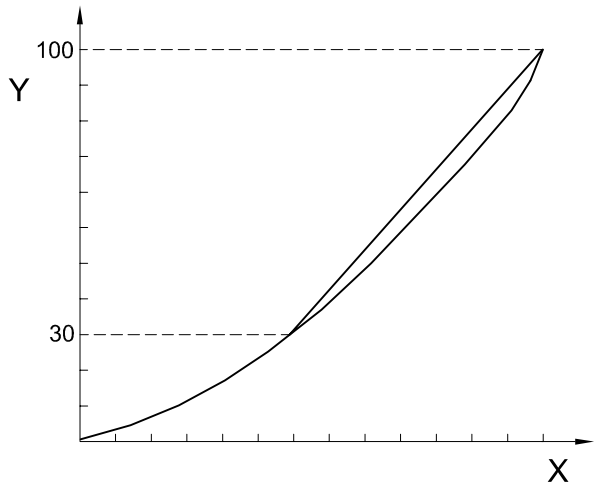
Annex B
(informative)

Determination of compression stiffness

B.1 General

If the compression stiffness of a bearing is critical to the design of the structure, the stiffness should be determined by test. As the load/deflection characteristics of pot bearings are markedly non-linear in the lower load range the stiffness should be determined between 30 % and 100 % of the test load range. The stiffness obtained by this method can be assumed to yield results with an accuracy of ± 20 % of the actual stiffness in service. See Figure B.1.

NOTE Rate of loading = 0,05 N/mm^2/s and maximum stress = 35 N/mm^2.



Key

x Deflection
y Load

Figure B.1 — Typical load/deflection curve

B.2 Conditioning

As there is a "bedding in" period with bearings a conditioning load equal to the maximum test load should be applied for 30 min before the load/deflection readings are started.

B.3 Method of calculation

Approximate values for compression stiffness can be obtained by calculation using the bulk modulus of the elastomer as the elastic modulus.

Annex C
(informative)

Factory Production Control (FPC)

C.1 General

C.1.1 Objectives

The manufacturer should exercise a permanent FPC.

NOTE A quality management system based on the relevant part of the EN ISO 9000 series or equivalent, including specific requirements from this standard, can be considered as suitable.

The manufacturer is responsible for organising the effective implementation of the FPC system. Tasks and responsibilities in the production control organisation should be documented and this documentation should be kept up-to-date. In each factory the manufacturer can delegate the action to a person having the necessary authority to:

a) identify procedures to demonstrate conformity of the construction product at appropriate stages;

b) identify and record any instance of non-conformity;

c) identify procedures to correct instances of non-conformity.

C.1.2 Documentation

The manufacturer should draw up and keep up-to-date documents defining the FPC which he applies. The manufacturer's documentation and procedures should be appropriate to the construction product and manufacturing process. All FPC systems should achieve an appropriate level of confidence in the conformity of the construction product. This involves:

a) the preparation of documented procedures and instructions relating to FPC operations, in accordance with the requirements of this part of EN 1337 (see C.1.3);

b) the effective implementation of these procedures and instructions;

c) the recording of these operations and their results;

d) the use of these results to correct any deviations, repair the effects of such deviations, at any resulting instances of non-conformity and, if necessary, revise the FPC to rectify the cause of non-conformity.

C.1.3 Operations

FPC includes the following operations:

a) the specification and verification of raw materials and constituents;

b) the controls and tests to be carried out during manufacture of the construction product according to a frequency laid down in Table 1;

c) the verifications and tests to be carried out on finished construction products according to a frequency which may be laid down in the technical specifications and adapted to the product and its conditions of manufacture.

NOTE 1 The operations under (b) centre as much on the intermediate states of the construction product as on manufacturing machines and their adjustment, and equipment etc. These controls and tests and their frequency are chosen based on type of construction product and composition, the manufacturing process and its complexity, the sensitivity of product features to variations in manufacturing parameters etc.

NOTE 2 With regard to operations under (c), where there is no control of finished construction products at the time that they are placed on the market, the manufacturer should ensure that packaging and reasonable conditions of storage do not damage the construction products and that the construction product remains in conformity with the technical specification.

NOTE 3 The appropriate calibrations should be carried out on certified measuring and test instruments.

C.2 Verifications and tests

C.2.1 General comments

The manufacturer should have or have available the installations, equipment and personnel which enable him to carry out the necessary verifications and tests. He can, as his agent, meet this requirement by concluding a sub-contract agreement with one or more organisations or persons having the necessary skills and equipment.

The manufacturer should calibrate or verify and maintain the control, measuring or test equipment in good operating condition, whether or not it belongs to him, with a view to demonstrating conformity with the specification or the test reference system to which the specification refers.

C.2.2 Monitoring of conformity

If necessary, monitoring is carried out on the conformity of intermediate states of the product and at the main stages of its production.

This monitoring of conformity focuses where necessary on the construction product throughout the process of manufacture, so that only products having passed the scheduled intermediate controls and tests are despatched.

C.2.3 Tests

Tests should be in accordance with the test plan (Table 2) and be carried out in accordance with the methods indicated in this part of EN 1337.

NOTE Initial type tests on the product may not be carried out by the manufacturer himself but should be carried out and validated by an approved body.

The manufacturer should establish and maintain records which provide evidence that the construction product has been tested. These records should show clearly whether the construction product has satisfied the defined acceptance criteria. Where the construction product fails to satisfy the acceptance measures, the provision for non-conforming product should apply.

C.2.4 Treatment of construction products which do not conform

If control or tests show that the construction product does not meet the requirements, then necessary corrective action should immediately be taken. Construction products or batches not conforming should be isolated and properly identified. Once the fault has been corrected, the test or verification in question should be repeated.

If construction products have been delivered before the results are available, a procedure and record should be maintained for notifying customers.

C.2.5 Recording of verifications and tests (manufacturer's register)

The results of FPCs should be properly recorded in the manufacturer's register. The construction product description, date of manufacture, test method adopted, test results and acceptance criteria should be entered in the register under the signature of the person responsible for control who carried out the verification.

With regard to any control result not meeting the requirements of this part of EN 1337, the corrective measures taken to rectify the situation (e.g. a further test carried out, modification of manufacturing process, scrapping or rectifying of the product) should be indicated in the register.

In the case of third party surveillance the records should be made available to the third party for examination.

C.3 Traceability

It is the manufacturer's, or his agent's responsibility to keep full records of individual construction products or product batches, including their related manufacturing details and characteristics and to keep records of to whom these construction products or batches were first sold. Individual construction products or batches of products and their related manufacturing details should be completely identifiable and traceable. In certain cases, for example bulk products, a rigorous traceability is not possible.

Annex D
(normative)

Determination of restraint moment

D.1 Introduction

This test procedure describes the method of determining the restraint moment in pot bearings as a function of the rotation angle. The results shall be used to determine the factors in the restoring moment formula (see 6.1.3.1).

D.2 Preparation of test specimens

The bearings shall all have the same elastomer diameter between 500 mm and 600 mm. Elastomer thickness/diameter ratio shall be the same as or less than that intended for normal production. If the rotation device requires twin bearings (see Figure F.1), then two identical bearings are required for each test. Test bearings shall be specially manufactured to dimensions which give the most adverse combinations of tolerances of dimensions and surface roughness with the thinnest elastomeric pad in accordance with 6.2.1.2.

Prior to starting the testing the elastomeric pads shall be conditioned for 72 h at 70 °C in an oven. The oven shall be in accordance with F.4.

The temperature at the start of the test shall be the required minimum operating temperature, as defined in the scope.

Before installation in the test machine the assembled bearing shall be cooled until the temperature at the centre of the elastomeric pad is sufficiently low to ensure the temperature does not exceed the required test temperature during installation and before the first movement. This temperature shall be maintained for 72 h. The assembled bearing shall then be installed in the test machine and the tests conducted when the temperature at the centre of the elastomeric pad has risen to the required test temperature.

Testing may be carried out using either the set-up shown in Figure F.1 or Figure F.2.

D.3 Test procedure

Each bearing shall be tested following the procedure described below. Testing shall be carried out with the elastomeric pad both lubricated and un-lubricated.

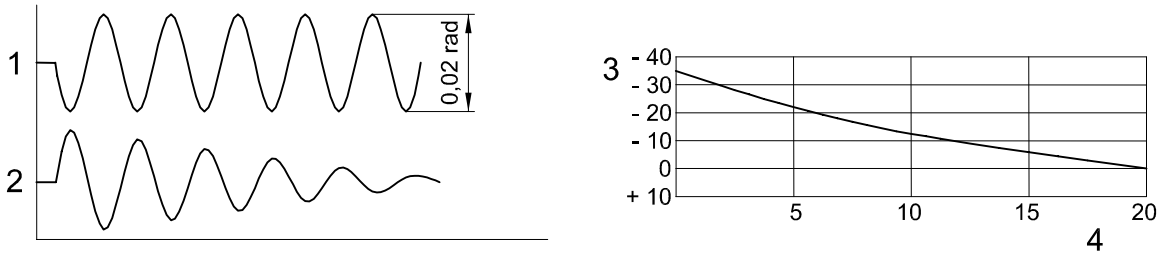
The temperature of the bearing shall be recorded continuously throughout the test.

a) Apply a vertical load, F_z to produce an elastomer contact stress of 35 N/mm^2 at a rate of approximately 0,5 N/mm^2/s;

b) Apply a sinusoidal movement of ± 0,01 radians through the lever arm. At least five cycles are required with a frequency of 0,003 Hz (333 s) $\leq f <$ 0,006 Hz to simulate live load rotation α_2 (see Figure E.1);

c) Record the restraint moment and rotation angle continuously. Record the temperature at the centre of the elastomeric pad.

d)



Key

1 Rotation angle

2 Rotation load Fa (see Figure 1)

3 Temperature T, °C

4 Time, min

5 Average elastomer temperature

Figure D.1 — Records of restraint moments and temperature

D.4 Evaluation of restraint moment factors

The results of the tests at – 20 °C shall be used to determine the factors F_0, F_1 and F_2 in the restraint moment formula (see 6.1.3.1). The factors shall be determined as shown below.

When determining the eccentricities e_0, e_1 and e_2 the values for M_0, M_1 and M_2 shall be taken as the average results of the tests performed on 3 bearings (see D.2).

The value of factor K shall be taken as 2,0 if the test is performed with a pair of bearings, see Figure F.1 and as 1,0 if a test set-up according to Figure F.2 is used.

The factors F_0, F_1 and F_2 shall be determined as follows:

a) The factor F_0 shall be taken from:

$$F_0 = \frac{e_0}{d} \qquad \text{(D.1)}$$

with

$$e_o = \frac{M_o}{2 \times K} \times \frac{1}{F_z} \qquad \text{(D.2)}$$

where:

M_0 is the moment at $\theta = 0$ radians with elastomeric pad un-lubricated (see Figure D.2)

b) The factor F_1 shall be taken from

$$F_1 = \frac{e_1}{d} \times 100 \qquad \text{(D.3)}$$

with

$$e_1 = \frac{M_1}{K} \times \frac{1}{F_z} \qquad \text{(D.4)}$$

where:

M_1 is the moment at θ = 0,01 radians with elastomeric pad lubricated (see Figure D.2.)

c) Factor F_2 shall be taken from

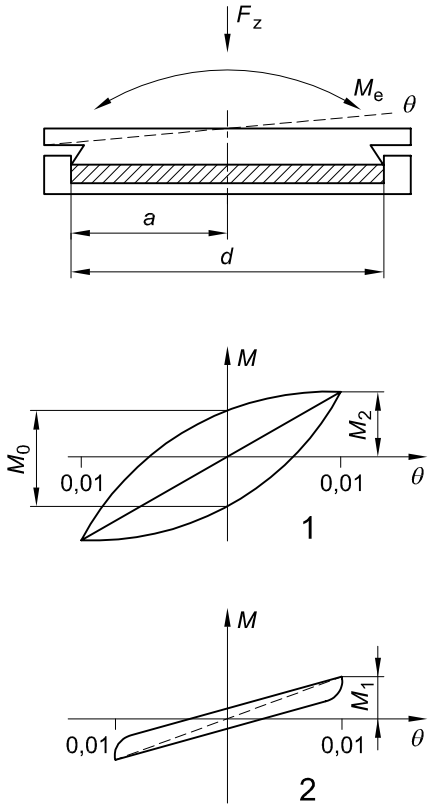
$$F_2 = \frac{(e_2 - e_0)}{d} \times 100 \qquad \text{(D.5)}$$

with

$$e_2 = \frac{M_2}{K} \times \frac{1}{F_z} \qquad \text{(D.6)}$$

where:

M_2 is the moment at θ = 0,01 radians with elastomeric pad un-lubricated (see Figure D.2)



Key

1 Unlubricated

2 Lubricated

Figure D.2 — Typical moment/rotation-angle diagram

D.5 Test report

The test report shall include the following:

a) description of the pot bearing assembly;

b) dimensions of the bearings tested;

c) identification of materials and material verification;

d) date and duration of the tests;

e) any abnormal occurrences during the test;

f) comment on the condition of the pot bearing after the test;

g) photographs taken of the dismantled bearing after the test;

h) roughness of the inner surfaces of the pot and piston before the test;

i) indication as to which method of testing was used;

j) temperatures recorded during the tests;

k) restoring moments and rotation angles recorded during the tests;

l) calculated restraint moment factors (see D.4) applicable to the required minimum operating temperature;

m) reference to EN 1337-5.

Annex E
(normative)

Long term rotation and load test

E.1 Introduction

The test procedures described in E.3 confirm the performance of the pot bearing subjected to oscillating relative movements between the pot wall and the internal seal and the required ultimate load capacity in rotated state. The acceptance criteria are specified in 4.2.

The movement of the internal seal at the pot wall is determined by the rotation angle and the diameter of the elastomeric pad.

The accumulated slide path shall comply with one of the standard values given below:

a) 500 m

b) 1000 m

c) 2000 m

E.2 Preparation of test specimens

According to the test equipment used (see F.2) one or two test bearings are required. For bearings with elastomer diameter up to 1500 mm the wear test shall be carried out on bearings with elastomer diameter ≥ 550 mm.

Prior to starting the testing the elastomeric pad shall be conditioned for 72 h in an oven at 70 °C. The oven shall be in accordance with F.4. The extraction of the elastomeric pad and the assembling of the test bearing shall be performed under the control of the manufacturer or his representative.

After conditioning, the inner surfaces of the pot and the elastomeric pad shall be lubricated and assembled as described in the manufacturing procedure.

E.3 Test procedure

Each bearing shall be tested at room temperature (+10 °C < t < +30 °C) following the procedure described below.

a) apply a vertical load to produce an elastomer contact stress of 35 N/mm^2 at a rate not exceeding 0,5 N/mm^2/s;

b) apply sinusoidally a minimum rotation angle + 0,0025 and –0,0025 rad. as shown in Figure E.1 through the lever arm at a frequency 0,25 Hz < f < 2,5 Hz;

c) continue the test until the selected accumulated slide path has been achieved. If the temperature in the pot near the internal seal at the point of the greatest relative movement exceeds a value of 40 °C then the test frequency shall be reduced or the bearing shall be cooled down;

d) continuously record the restoring moment, rotation angle and the temperature inside the pot near the inner seal. Moment/rotation angle diagram shall be drawn and recorded frequently;

e) after the required number of cycles remove the test specimens and check that the elastomer has not been extruded from the pot;

f) if no defects are detected install the bearing in the compression testing machine together with a wedge plate in accordance with F.3. Arrange the piston in such a way that the maximum clearance is achieved in the most adverse position and apply a compressive load to produce an elastomer contact stress of 60 N/mm^2 for a period of 168 h for non-metallic seals and 24 h for metallic seals;

g) install movement transducers to measure the vertical deflection of the bearing (see Figure E.2);

h) release the load at the same rate (alternatively the load may be applied and released in small increments);

i) record all deflections and loads continuously throughout the period of the test;

j) after the test check that the elastomer has not been extruded from the pot.

E.4 Test report

The test report shall include the following:

a) description of the pot bearing assembly;

b) dimensions of the bearing tested;

c) identification of materials and material verification;

d) date and duration of the tests;

e) any abnormal occurrences during the tests and their influence on the test result;

f) comments on the condition of the pot bearing after the test (see 4.2);

g) photographs taken during and after the tests;

h) the moments, rotation angles and temperatures recorded as shown in Figure E.1;

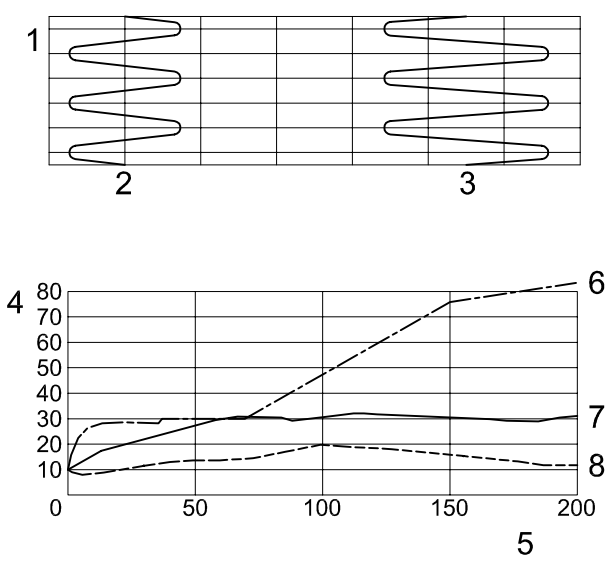
i) the description of the wear and increase in restoring moments throughout the test;

j) record of the check that the elastomer has not extruded from the pot;

k) the acceptability of the result taking into account the requirements in 4.2;

l) reference to EN 1337-5;

m) selected accumulated slide path.



Key

1 Time

2 Rotation θ (rad)

3 Moment M (kNm)

4 Temperature (°C)

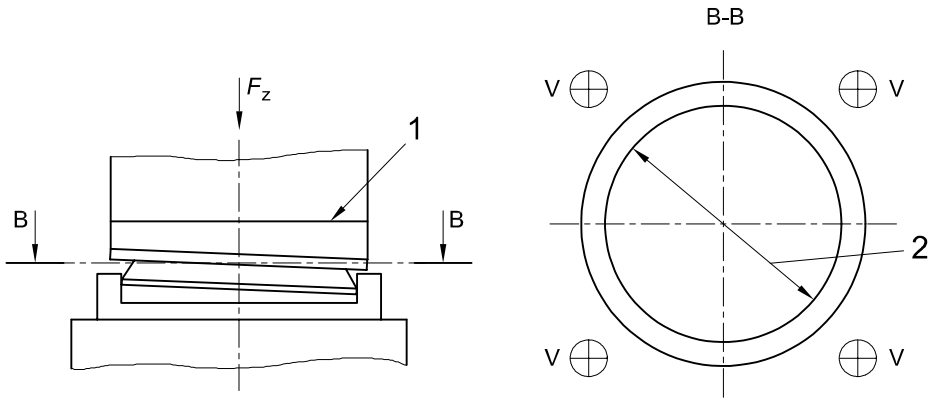
5 Slide path (m)

6 Moment M_1 (kNm)

7 Temperature (°C)

8 Moment M_0 (kNm)

Figure E.1 — Examples of results measurements



Key

1 Wedge plate

2 Rotation θ (rad)

Figure E.2 — Test set-up – Position of measuring points

Annex F
(normative)

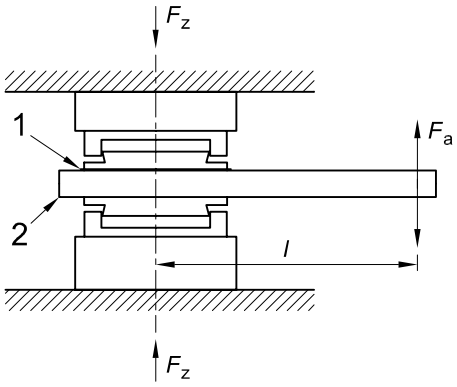
Test equipment

F.1 Compression testing machine

The test equipment shall be at least as accurate as a machine conforming to EN ISO 7500-1 and shall ensure that the base plate remains horizontal and that the applied vertical loads are evenly distributed. The range of the machine shall be such that the specimen is subjected to a load between 15 % and 85 % of the full scale reading.

F.2 Rotation attachment

The compression testing machine shall be equipped with an attachment capable of accommodating either two pot bearings as shown in Figure F.1 or one pot bearing and a hydrostatic bearing capable of sustaining the full test load as shown in Figure F.2. The attachment shall be capable of continuously rotating the bearings ± 0,01 radians by means of a double-acting hydraulic cylinder acting on a lever arm. The movement shall be sinusoidal with a frequency adjustable between 0,003 Hz and 0,5 Hz.

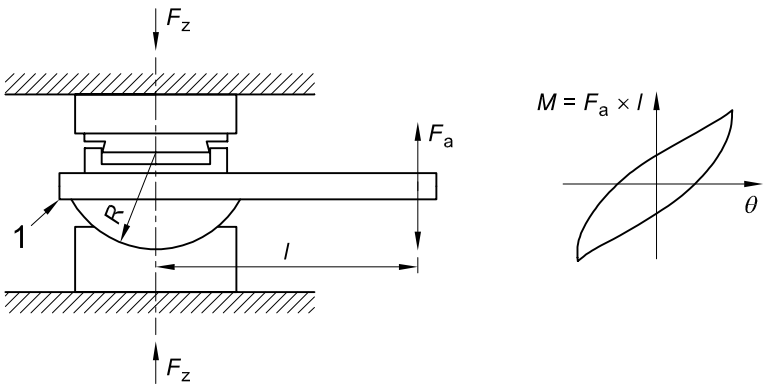


Key

1 PTFE sliding element

2 Lever arm

Figure F.1 — Test set-up using two pot bearings and one sliding surface



Key

1 Lever arm

Figure F.2 — Test set-up using one pot bearing and a hydrostatic spherical bearing

F.3 Wedge plate

A steel wedge plate with a slope of 3 % shall be provided. The plate shall be machined on both sides.

F.4 Heating equipment (oven)

Heating equipment shall be capable of maintaining the elastomeric pad at a temperature of 70 °C for 72 h, before the pad is assembled in the bearing.

F.5 Measuring instruments

Electronic measuring equipment shall be fitted capable of continuously measuring and recording digitally or in analogue form, all specified forces, movements and temperatures.

Annex G
(informative)

Application of internal seals

The table applies to beam bridges, normally of the box girder type. Other types of bridges as cable-stayed bridges or suspension bridges need special consideration.

Table G.1

Type of traffic / Type of construction	Lorries in Traffic Category (see ENV 1991-3:1994, Tab. 4.5)				Railways
	1	2	3	4	
	class of accumulated slide path				
Prestressed concrete	b, c	b, c	a, b, c	a, b ,c	c
Concrete	c	b, c	b, c	a, b ,c	c
Steel Composite Steel	c	c	b, c	a, b ,c	c

Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under a mandate[1)] given to CEN by the European Commission and the European Free Trade Association.

The clauses of this and other European Standards, shown in this annex, meet the requirements of the mandate given under EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the pot bearings covered by this annex for the intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

WARNING: Other requirements and other EU Directives, not affecting the fitness for intended uses, can be applicable to the structural bearings within the scope of this annex.

NOTE 1 In addition to any specific clauses relating to dangerous substances contained in this standard, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (accessed through http://europa.eu.int/comm/enterprise/construction/internal/dangsub/dangmain.htm"

This annex establishes the conditions for the CE marking of pot bearings intended for the uses indicated in Tables ZA.1.a and ZA.1.b and shows the relevant clauses applicable.

This annex has the same scope as clause 1 of this standard and is defined in Tables ZA.1.a to ZA.1.b.

1) M/104 "Structural bearings" as amended by M/132.

Table ZA.1.a - Relevant clauses for Pot bearings without sliding elements

Construction products: Pot bearings without sliding elements as covered in the scope of this document			
Intended uses: In buildings and civil engineering works			
Requirements	**Requirement clause(s) in this and other European Standard(s):**	**Mandated level(s) or class(es):**	**Notes:**
Load bearing resistance	EN 1337-5 Clauses ⟶4 ⟶5 ⟶6.1.1 ⟶6.2.3 ⟶6.1.5 ⟶6.2.1.1 ⟶6.2.2	None	kN
Rotation capacity	EN 1337-5 Clauses ⟶4 ⟶6.1.1 ⟶6.1.2 ⟶6.1.3 ⟶6.2.1.2 ⟶6.2.4 ⟶7.3.1 ⟶7.3.2 ⟶7.4 ⟶7.7	None	radians
Durability aspects	EN 1337-5 Clauses ⟶4.2 ⟶5 ⟶6.1.1 ⟶6.1.2.3 ⟶7.5 ⟶7.6 ⟶7.8 EN 1337-9:1997, clause 4	None	–

Table ZA.1.b - Relevant clauses for sliding pot bearings

Construction products: Sliding pot bearings covered in the scope of this document **Intended uses**: In buildings and civil engineering works			
Requirements	**Requirement clause(s) in this and other European Standard(s):**	**Mandated level(s) or class(es):**	**Notes:**
Load bearing resistance	EN 1337-5 Clauses ⟶4 ⟶5 ⟶6.1.1 ⟶6.1.5 ⟶6.2.1.1 ⟶6.2.2 ⟶6.2.3	None	kN
Rotation capacity	EN 1337-5 Clauses ⟶4 ⟶6.1.1 ⟶6.1.2 ⟶6.1.3 ⟶6.2.1.2 ⟶6.2.4 ⟶7.3.1 ⟶7.3.2 ⟶7.4 ⟶7.7	None	radians
Durability aspects	EN 1337-5 Clauses ⟶4.2 ⟶5 ⟶6.1.1 ⟶6.1.2.3 ⟶7.5 ⟶7.6 ⟶7.8 EN 1337-9:1997, clause 4	None	–
Load bearing resistance (of sliding element)	EN 1337-2: 2004, clauses 5, 6.2, 6.3, 6.4, 6.6, 6.8, 6.9, 7.1, 7.2 and 9	None	kN
Coefficient of friction (of sliding element)	EN 1337-2: 2004, clauses 4, 5, 6.1, 6.5, 6.7, 7.5	None	Tabulated value (Table 11)
Durability aspects (of sliding element)	EN 1337-2: 2004, clauses 7.3, 7.4 EN 1337-9:1997, clause 4	None	–

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these MSs are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option “No performance determined” (NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

ZA.2 Procedures for attestation of conformity of pot bearings

ZA.2.1 System(s) of attestation of conformity

The systems of attestation of conformity of the pot bearings, indicated in Tables ZA.1.a and ZA.1.b, in accordance with the Decision of the Commission 95/467/EC of 1995/10/24 as given in Annex III of the mandate for “Structural bearings", is shown in Table ZA.2 for the indicated intended uses and relevant level(s) or class(es):

Table ZA.2 — System(s) of attestation of conformity

Product	Intended use(s)	Level(s) or class(es)	Attestation of conformity systems
Pot bearings; sliding pot bearings	In buildings and civil engineering works where requirements on individual bearings are critical (1)	None	1
	In buildings and civil engineering works where requirements on individual bearings are not critical (2)		3
System 1: See Directive 89/106/EEC (CPD) Annex III.2.(i), without audit testing of samples System 3: See Directive 89/106/EEC (CPD) Annex III.2.(ii), Second possibility			
(1) Critical in the sense that those requirements may, in case of failure of the bearing, put the works or parts thereof in states beyond those regarded as serviceability and ultimate limit states. (2) Not critical in the sense that those requirements may not, in case of failure of the bearing and under normal circumstances, put the works or parts thereof in states beyond those regarded as serviceability and ultimate limit states.			

The attestation of conformity of the pot bearings in Tables ZA.1a and ZA.1.b shall be based on the evaluation of conformity procedures indicated in Tables ZA.3.a and ZA.3.b resulting from the application of the clauses of this or other European Standard indicated therein.

Table ZA.3.a — Assignment of evaluation of conformity tasks for pot bearings under system 1

Tasks		Content of the task	Clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to all characteristics of Table ZA.1.a	EN 1337-5 Clauses — 8.2.1 (factory production control) — 8.3 (raw materials and constituents) — 8.4 (sampling) — 8.2.1 (factory production control)
	Further testing (evaluation) of samples taken at the factory, where relevant	All characteristics of Table ZA.1b)	EN 1337-5 Clauses — 8.1 (conformity evaluation – general)
Tasks for the notified body	Initial type testing	All characteristics of Table ZA.1.a	EN 1337-5 Clauses — 8.2.2 (initial type testing) — 8.4 (sampling)
	Initial inspection of factory and of FPC	Parameters related to all characteristics of Table ZA.1.a	EN 1337-5 Clauses — 8.2.1 (factory production control) — 8.3 (raw materials and constituents) — 8.4 (sampling) — 8.2.1 (factory production control)
	Continuous surveillance, assessment and approval of FPC	Parameters related to all characteristics of Table ZA.1.a	

Table ZA.3.b — Assignment of evaluation of conformity tasks for pot bearings under system 3

Tasks		Content of the task	Clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to all characteristics of Table ZA.1.a	EN 1337-5 Clauses — 8.2.1 (factory production control) — 8.3 (raw materials and constituents) — 8.4 (sampling) — 8.2.1 (factory production control)
Tasks for the notified body	Initial type testing	All characteristics of Table ZA.1.a	EN 1337-5 Clauses — 8.2.2 (initial type testing) — 8.4 (sampling)

The evaluation of conformity of sliding pot bearings within the given systems of attestation of conformity shall be based on the evaluation of conformity subclauses of clause 8 of this part of EN 1337 and of EN 1337-2:2004, indicated in Tables ZA.3.c and ZA.3.d

Table ZA.3.c — Assignment of evaluation of conformity tasks for sliding pot bearings under system 1

Tasks		Content of the task	Clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to all characteristics of Table ZA.1.b	EN 1337-5 Clauses — 8.2.1 (factory production control) — 8.3 (raw materials and constituents) — 8.4 (sampling) — 8.2.1 (factory production control) EN 1337-2:2004 Clauses — 8.2.1 (general) — 8.2.3 (FPC) — 8.3 (raw materials and constituents) — 8.4 (sampling)
	Further testing (evaluation) of samples taken at the factory, where relevant	All characteristics of Table ZA.1b)	EN 1337-5 Clauses — 8.1 (conformity evaluation – general) EN 1337-2:2004 Clauses — 8.2.1 (general) — 8.2.3 (FPC) — 8.3 (raw materials and constituents) — 8.4 (sampling)
Tasks for the notified body	Initial type testing	All characteristics of Table ZA.1.b	EN 1337-5 Clauses — 8.2.2 (initial type testing) — 8.4 (sampling) EN 1337-2:2004 Clauses — 8.2.1 (general) — 8.2.3 (FPC) — 8.3 (raw materials and constituents) — 8.4 (sampling)
	Initial inspection of factory and of FPC	Parameters related to all characteristics of Table ZA.1.b	EN 1337-5 Clauses — 8.2.1 (factory production control) — 8.3 (raw materials and constituents) — 8.4 (sampling) — 8.2.1 (factory production control) EN 1337-2:2004 Clauses — 8.2.1 (general) — 8.2.3 (FPC) — 8.3 (raw materials and constituents) — 8.4 (sampling)
	Continuous surveillance, assessment and approval of FPC	Parameters related to all characteristics of Table ZA.1.b	

Table ZA.3.d — Assignation of evaluation of conformity tasks for sliding pot bearings under system 3

Tasks		Content of the task	Clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to all characteristics of Table ZA.1.b	EN 1337-5 Clauses — 8.2.1 (factory production control) — 8.3 (raw materials and constituents) — 8.4 (sampling) — 8.2.1 (factory production control) EN 1337-2:2004 Clauses — 8.2.1 (general) — 8.2.3 (FPC) — 8.3 (raw materials and constituents) — 8.4 (sampling)
Tasks for the notified body	Initial type testing	All characteristics of Table ZA.1.b	EN 1337-5 Clauses — 8.2.2 (initial type testing) — 8.4 (sampling) EN 1337-2:2004 Clauses — 8.2.1 (general) — 8.2.3 (FPC) — 8.3 (raw materials and constituents) — 8.4 (sampling)

ZA.2.2 Certificate and declaration of conformity

When compliance with the conditions of this annex is achieved:

a) for bearings under system 1, the certification body shall draw up a certificate of conformity (EC Certificate of conformity) with the information indicated below. This EC Certificate of conformity entitles the manufacturer to affix the CE marking, as described in ZA.3.

The EC Certificate of conformity shall include the following information:

— Name, address and identification number of certification body,

— Name and address of the manufacturer, or his authorised representative established in the EEA, and place of production,

— Description of the product (type, identification, use,...),

— Provisions to which the product conforms (e.g. annex ZA),

— Particular conditions applicable to the use of the product (e.g. provisions for the use of a bearing under certain conditions, etc),

— The certificate's number,

— Conditions and period of validity of the certificate

— Name of, and position held by, the person empowered to sign the certificate.

In addition, for each product covered by a certificate of the factory production control, the manufacturer shall draw up a declaration of conformity (EC Declaration of conformity) including the following information:

- name and address of the manufacturer, or his authorised representative established in the EEA;

- name and address of the certification body;

- description of the product (type, identification, use, ...), and a copy of the information accompanying the CE marking;

- provisions to which the product conforms (i.e. annex ZA);

- particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);

- number of the accompanying EC Certificate of conformity;

- name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or of his authorised representative.

Both documents shall be presented in the official language or languages of the Member State of the EU in which the product is to be used.

b) For bearings under system 3, the manufacturer shall draw up a declaration of conformity (EC Declaration of conformity) including the following information:

— Name and address of the manufacturer, or his authorised representative established in the EEA and place of production,

— Description of the product (type, identification, use,...), and a copy of the information accompanying the CE marking:

— Provisions to which the product conforms (e.g. annex ZA),

— Particular conditions applicable to the use of the product (e.g. provisions for the use of a bearing under certain conditions, etc),

— Name and address of the notified laboratories;

— Name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or of his authorised representative.

This EC Declaration of conformity entitles the manufacturer to affix the CE marking, as described in ZA.3.

This document shall be presented in the official language or languages of the Member State of the EEA in which the product is to be used.

ZA.3 CE marking

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EC and shall be shown on the Elastomeric bearing (or when not possible it may be on the accompanying label, the packaging or on the accompanying commercial documents.. The following information and characteristics shall accompany the CE marking symbol (where relevant)

- identification number of the notified body (only for products under system 1)
- name and address of the manufacturer
- last two digits of the year of affixing the CE marking
- number of the certificate of conformity (only for products under system 1)
- the number of this document (EN 1337-5)
- the product name and type
- information on the mandated characteristics:
    - values and, where relevant, level or class to declare for each essential characteristic as indicated in "Notes" in Tables ZA.1;
    - As an alternative, where possible, standard designation may be given. This designation should give information on all the characteristics, if all are not covered, then values for those not covered must be additionally given.

The NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements.

Examples for pot bearings are given in Figure ZA.1 for information to be given on the product and Figure ZA.2 for information to be given with the accompanying documents. Figure ZA.2 reflects the characteristics given in Table ZA.1.b.

CE conformity marking, consisting of the «CE»-symbol given in Directive 93/68/EEC.

Identification number of the certification body (when relevant)

Name or identifying mark of the manufacturer

Figure ZA.1 — Example of CE marking information on the bearing

CE **0123-CPD-0001**	*CE conformity marking, consisting of the «CE»-symbol given in Directive 93/68/EEC.* *Identification number of the certification body (when relevant)*
Any Co Ltd, PO Box 21, B-1050	*Name or identifying mark and registered address of the manufacturer*
04	*The last two digits of the year in which the marking was affixed*
0123-CPD-0456	*Number of the EC certificate of conformity*
EN 1337-5: 2004	*No. of European Standard*
BEARING N° ……	*Identification of product and intended use*
Pot bearing (with an accumulated slide path of 500/1000/2000 m) * with sliding elements for minimum operating temperature of –25/-40 °C*, for uses in buildings and civil engineering works where requirements on individual bearings are critical/non-critical*	*and*
BEARING Restoring moment factors F_{0}..... F_{1}..... F_{2}..... Yield strength of steel (MPa) Geometry (as in attached drawings or description) SLIDING ELEMENT Geometry (as in attached drawings or description) * delete as appropriate	*Information on mandated characteristics*

Figure ZA.2 — Example of CE marking information on the accompanying documents

In addition to any specific information relating to dangerous substances shown above, the product should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE European legislation without national derogations need not be mentioned.

Bibliography

[1] EN 1337-11, *Structural bearings — Part 11: Transport, storage and installation*.

[2] EN 1993-1, *Eurocode 3: Design of steel structures — Part 1: General design rules*.

[3] prEN 1993-2, *Eurocode 3: Design of steel structures – Part 2: Steel bridges*.

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