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European Assessment Document for

Pot bearings with special internal sealing for increased action effects



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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD applies to pot bearings with special internal seal for increased action effects in the following referred to as “pot bearings” and composed of:

- Pot
- Piston
- External seal
- Elastomeric pad
- Lubricant
- Necessary guides (if relevant),
- Restraints (if relevant)
- Sliding elements as defined in EN 1337-2¹ (if relevant)

as defined in EN 1337-5 and

- special internal seal

deviating from EN 1337-5.

Examples are given in Figure 1.1.1.

The pot bearings may be equipped with additional load measuring device(s), if this load measuring device(s) does/do not influence the performance of the pot bearing according to the ETA.

This EAD covers the pot bearings with operating temperatures between -40 °C and $+50\text{ °C}$ as defined in EN 1337-5, Clause 1. Regarding boundary conditions for operating temperature, those given in EN 1337-5, Clause 1, apply. For the use in combination with a sliding element the operating temperatures according to EN 1337-5, Clause 1, apply.

The product is not fully covered by the following harmonised technical specification: EN 1337-5:2005 due to the special internal seal made of Polyoxymethylen (POM), whereas the property Melt flow index MFI 190/2, 16 deviates from the Melt flow index MFI defined in EN 1337-5, Table A.2, and due to an increased characteristic contact strength of the elastomeric pad (as deviation to EN 1337-5:2005, Clause 6.2.1.1) and/or increased accumulated sliding path (as deviation to EN 1337-5:2005, Annex E, Clause E.1).

The contact strength of the elastomeric pad is increased beyond 60 N/mm^2 up to 120 N/mm^2 (as deviation to EN 1337-5:2005, Clause 6.2.1.1).

The accumulated sliding path can be higher than 2000 m.

Consequently, the assessment methods given in EN 1337-5 for the assessment of a load bearing resistance and rotation capacity as well as for durability are not fully applicable.

The assessment methods specified in Clause 2.2 of this EAD do not apply to bearings which are subjected to a rotation α_d greater than 0,030 rad (see Figure 2, EN 1337-5) under the characteristic combination of actions or which incorporate elastomeric pads larger than 1500 mm.

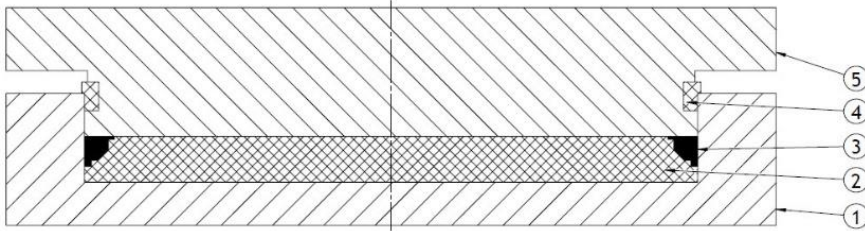
Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

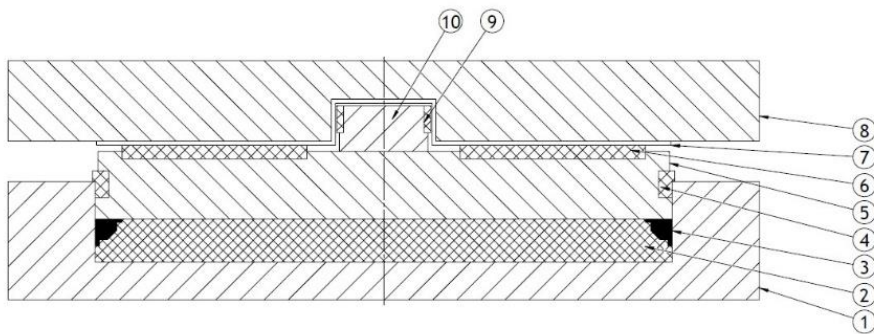
Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

¹ All undated references to standards or to EADs in this EAD are to be understood as references to the dated versions listed in chapter 4

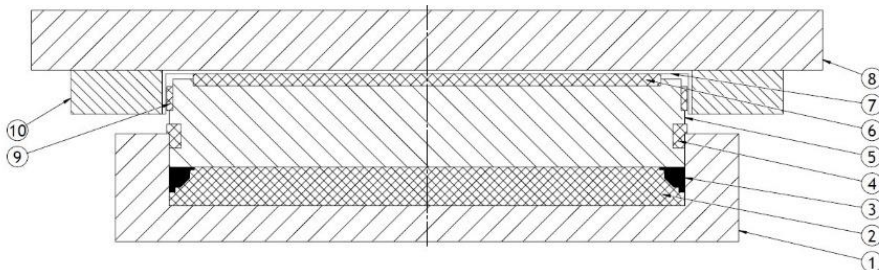
Figure 1.1.1 Examples of pot bearing with special internal seal according to this EAD



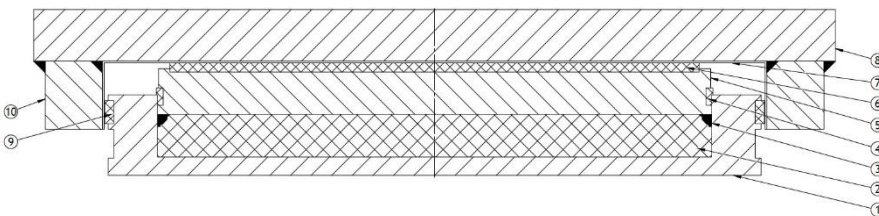
Key: (1) Pot; (2) Elastomeric pad; (3) Special internal seal; (4) External seal; (5) Piston



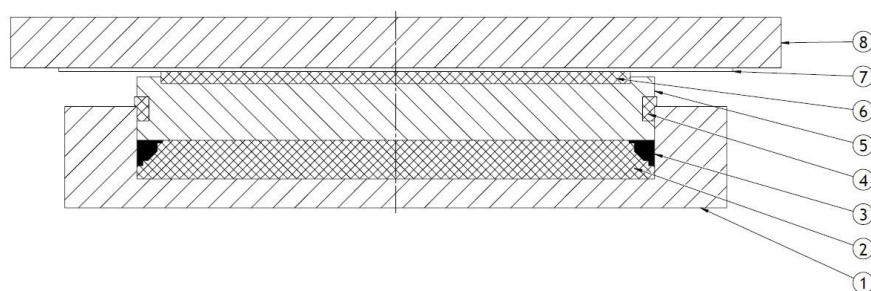
Key: (1) Pot; (2) Elastomeric pad; (3) Special internal seal; (4) External seal; (5) Piston; (6) Sliding Disc; (7) Sliding Sheet; (8) Sliding Plate; (9) Sliding Strip; (10) Guide Bar



Key: (1) Pot; (2) Elastomeric pad; (3) Special internal seal; (4) External seal; (5) Piston; (6) Sliding Disc; (7) Sliding Sheet; (8) Sliding Plate; (9) Sliding Strip; (10) Guide Bar



Key: (1) Pot; (2) Elastomeric pad; (3) Special internal seal; (4) External seal; (5) Piston; (6) Sliding Disc; (7) Sliding Sheet; (8) Sliding Plate; (9) Sliding Strip; (10) Guide Bar



Key: (1) Pot; (2) Elastomeric pad; (3) Special internal seal; (4) External seal; (5) Piston
(6) Sliding Disc; (7) Sliding Sheet; (8) Sliding Plate;

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The pot bearings are intended for the support of bridges or building works in accordance with EN 1337-5 and referring to in EN 1990, Table 2.1, Category 2.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the pot bearing with special sealing for the intended use of 10 to 25 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works².

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD

For the purposes of this EAD, the specific terms and definitions given in EN 1337-5, Clause 3, apply.

² The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

2 Essential characteristics and relevant assessment methods and criteria

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of the pot bearings is assessed in relation to the essential characteristics.

Table 2.1.1 Essential characteristics of the product and assessment methods and criteria for the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability			
1	Load bearing resistance	Clause 2.2.1	Level
		and EN 1337-5 (Table ZA.1.b regarding sliding elements)*	Level
2	Rotation capacity	Clause 2.2.2	Level
3	Coefficient of friction*	EN 1337-5 (Table ZA.1.b)*	Level
Aspects of durability			
4	Durability	Clause 2.2.3 and EN 1337-5 (Table ZA.1.b regarding sliding elements)*	Level
	* if sliding element is a part of the product		

2.2 Assessment methods and criteria for the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

2.2.1 Load bearing resistance

Purpose of the assessment

The purpose of the assessment is the determination of the characteristic contact strength.

The pot bearing shall be capable to transfer applied vertical and horizontal loads between the superstructure and substructure and at the same time the internal seal system shall prevent extrusion of the elastomer from the pot (EN 1337-5, Clause 4.1).

Assessment method

Due to the special internal seal resulting in an increased characteristic contact strength of the elastomeric pad the product shall be tested according to Annex A of this EAD.

It shall be assessed whether an extrusion from the pot bearing with special internal seal according to this EAD occurs or not. As according to EN 1337-5, Clause 4.1, the functional requirement of the pot bearing for its intended use is depending on condition that no extrusion of the elastomeric pad from the pot occurs,

the related characteristic contact strength applied in the assessment shall be considered as outcome of this test.

The outcome of this assessment of load bearing resistance is the characteristic value of the axial resistance N_{Rk} and characteristic value of the transverse resistance V_{Rk} .

The characteristic value of the axial resistance is defined as:

$$N_{Rk} = \frac{\pi}{4} d^2 f_{e,kEAD}$$

Where: d is diameter of the elastomeric pad and $f_{e,kEAD}$ is the characteristic contact strength applied in the assessment procedure according to Annex A. The provisions according to EN 1337-5, Clause 6.2.1.2, apply.

The characteristic value of the transverse resistance V_{Rk} is defined as minimum between characteristic transverse resistance of the pot ($V_{Rk,pot}$) and characteristic transverse resistance of the piston/pot contact ($V_{Rk,pt}$).

The characteristic transverse resistance of the pot is defined as minimum among following values:

$$V_{Rk,pot} = \min (V_{Rk,pt}, V_{Rk,ps}, V_{Rk,bt}, V_{Rk,bs})$$

- Resistance of pot walls subjected to tensile force

$$V_{Rk,pt} = f_{yk} \cdot A_r, \text{ where } A_r = (D_o - D) \cdot H, \text{ (see EN 1337-5, Figure 5)}$$

- Resistance of pot walls subjected to shear force

$$V_{Rk,ps} = \frac{f_{yk} \cdot (D_o - D)}{2 \cdot \sqrt{3}}$$

- Resistance of pot base subjected to tensile force

$$V_{Rk,bt} = f_{yk} \cdot A_p, \text{ where } A_p = D_o \cdot T$$

- Full penetration butt weld connecting the pot base to the pot wall within the pot wall (see Figure 5(b) of EN 1337-5)

$$V_{Rk,bs} = f_{yk} \cdot A_p, \text{ where } A_p = D_o \cdot T$$

f_{yk} is the characteristic compressive yield strength of steel used for manufacturing the restraining ring.

All other symbols used in the formulas are defined in EN 1337-5, Clause 6.2.2.

The characteristic transverse resistance of the piston/pot contact is defined as minimum among following values, applying the provisions defined in EN 1337-5, Clause 6.2.3.1:

$$V_{Rk,pt} = \min (V_{Rk,f}, V_{Rk,c})$$

- Resistance at the flat contact faces

$$V_{Rk,f} = \frac{f_{yk} \cdot D \cdot w}{1,5}$$

where: D is the internal diameter of pot [mm], f_{yk} is the characteristic yield strength of material (N/mm²) and w is the width of piston face [mm] (see EN 1337-5, Figure 6)

- Resistance at the curved contact surface

$$V_{Rk,c} = \frac{15 \cdot f_u^2 \cdot R \cdot D}{E_d}$$

where: R is the radius of contact surface [mm], f_u is the ultimate strength of material (N/mm²), E_d is the design modulus of elasticity [N/mm²]

Expression of results

The characteristic value of the axial resistance N_{Rk} and characteristic value of the transverse resistance V_{Rk} shall be expressed in [kN] and stated in ETA.

2.2.2 Rotation capacity

Purpose of the assessment

Purpose of assessment is the determination of the rotational angle α_d [rad] (EN 1337-5, Figure 2) and maximum restraint moment M_{emax} as defined in EN 1337-5, Clause 6.1.3.1.

Assessment method

The rotation capacity of the pot bearing shall be tested according to Annex A of this EAD. The test can be done in conjunction with the assessment of load bearing capacity (Clause 2.2.1 of this EAD).

If no extrusion of the pad from the pot bearing occurs, the functional requirement according to EN 1337-5, Clause 4.1, is met, and additional geometrical conditions for required rotation capacity according to EN 1337-5, Clause 6.2.4 shall be assessed.

The restraint moments factors shall be assessed according to Annex B of this EAD.

Expression of results

The maximal applicable rotational angle $\alpha_{d,max}$ in [rad] and restraint moment factors F_0 , F_1 and F_2 shall be stated in ETA.

2.2.3 Durability

Purpose of the assessment

The purpose of the assessment is the determination of the accumulated sliding path, including the assessment of the compatibility of the special internal seal with adjacent material according to functional requirements EN 1337-5 (Clause 4).

Assessment method

The pot bearing shall be assessed according to Annex A of this EAD. This approach follows the conditions given in Clause 4.1, 4.2 in EN 1337-5. The test can be done in conjunction with the assessment of the load bearing capacity (Clause 2.2.1 of this EAD) and the assessment of rotational capacity (Clause 2.2.2 of this EAD).

Additionally, for the assessment of compatibility of the special internal seal with adjacent materials and the resistance to chemical and environmental influences and aging effects of the material for the special internal seal according to this EAD in comparison to the material for the special internal seal defined according EN 1337-5 (Annex A, Clause A.1.2), the following applies:

1. For four test specimens of each of the materials for internal seal the mechanical properties ultimate tensile strength and ultimate strain shall be assessed according to EN ISO 527-2 at standard laboratory conditions according to EN ISO 23529, Clause 5 ~~ambient temperature~~. Compatibility is given when the mean values are in conformity with the values for the material for internal seal according to EN 1337-5 as defined in EN 1337-5, Table A.2.
2. Four further test specimens of each of the materials for internal seal shall be subjected to accelerated ageing (70 °C; duration: 168 hours, according to EN ISO 23529, Clause 10). The mechanical properties ultimate tensile strength and ultimate strain shall be assessed, according to EN ISO 527-2 after ageing.
3. Four further test specimens of each of the materials for internal seal, submerged in silicon grease (lubrication) as defined in EN 1337-5, Clause 7.7, shall be subjected to accelerated ageing (70 °C;

duration: 168 hours, according to EN ISO 23529, Clause 10). The mechanical properties ultimate tensile strength and ultimate strain shall be assessed according to EN ISO 527-2.

4. Four further test specimens of each of the materials for internal seal, submerged in elastomeric material used for elastomeric pad as defined in EN 1337-5, Clause 5.3, shall be subjected to accelerated ageing (70 °C; duration: 168 hours, according to EN ISO 23529, Clause 10). The mechanical properties ultimate tensile strength and ultimate strain shall be assessed.

For the assessment of the ultimate tensile strength and the ultimate strain before and after accelerated ageing EN ISO 527-2, as stated in EN 1337-5, Table A.2 applies.

The compatibility is given when the mean values in the change after the aging of the ultimate tensile strength and the ultimate strain of the materials for the internal seal according to this EAD meet the values for the material stated in EN 1337-5, A.2.2.

The compatibility of the special internal seal according to this EAD with adjacent materials and the resistance to chemical and environmental influences and aging effects in comparison to the materials for the internal seal defined according EN 1337-5 (Annex A, Clause A.1.2) is a pre- condition for the expression of the resulting accumulated sliding path in the ETA.

Expression of results

In the ETA the resulting accumulated sliding path [m] shall be stated.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: 95/467/EC, as amended by 2001/596/EC and 2002/592/EC (EU).

The system is: 1.

Note: This EAD applies to pot bearings in buildings and civil engineering works where requirements on individual bearings are critical as defined in EN 1337-5, Table ZA.2.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

Table 3.2.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Parameters according to EN 1337-5 Table ZA.3.a, the provisions for FPC: Clause 8.1, Clause 8.2.1, Clause 8.3, Clause 8.4	EN 1337-5 Table ZA.3.a	EN 1337-5 Table ZA.3.a	EN 1337-5 Table ZA.3.a	EN 1337-5 Table ZA.3.a
2	Parameters according to EN 1337-5 (Table ZA.3.c, the provisions for FPC)*	EN 1337-5 Table ZA.3.c	EN 1337-5 Table ZA.3.c	EN 1337-5 Table ZA.3.c	EN 1337-5 Table ZA.3.c
3	Physical properties**	According to the Control plan	According to the Control plan	EN 1337-5 ZA.3.a	EN 1337-5 ZA.3.a
4	Geometrical properties, related tolerances and configuration**	According to the Control plan	EN 1337-5 Clause A.1.2 and Figure A.2 a) and b).	EN 1337-5 Table ZA.3.a	EN 1337-5 Table ZA.3.a
4	Mechanical properties**	According to EN 1337-5, Annex A, Table A.2	According to the Control Plan	EN 1337-5 Table ZA.3.a	EN 1337-5 Tables ZA.3.a
	* if sliding element is a part of the product ** for internal seal				

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body of the product in the procedure of assessment and verification of constancy of performance for the product are laid down in Table 3.3.1.

Table 3.3.1 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	Notified Body will ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the pot bearing.	Verification of the complete FPC as described in the control plan agreed between the TAB and the manufacturer.	According to Control plan.	According to Control plan.	When starting the production or a new line
Continuous surveillance, assessment and evaluation of factory production control					
2	The notified body will ascertain that the system of factory production control and the specified manufacturing process are maintained taking into account of the control plan.	Verification of the controls carried out by the manufacturer as described in the control plan agreed between the TAB and the manufacturer with reference to the raw materials, to the process and to the product as indicated in Table 3.2.1	According to control plan	According to control plan	1 (one)/year

4 REFERENCE DOCUMENTS

EN ISO 527-2:2012	“Plastics – Determination of tensile properties – Part 2: Testing conditions for moulding and extrusion plastics”
EN 1337-2:2004	“Structural bearings - Part 2: Sliding elements”
EN 1337-5:2005	“Structural bearings - Part 5: Pot bearings”
EN 1990:2002+AC:2008+AC:2010	“Eurocode - Basis of structural design”
EN ISO 23529:2017	“Rubber - General procedures for preparing and conditioning test pieces for physical test methods”

ANNEX A LONG TERM ROTATION AND LOAD TEST

A.1. Scope

This annex describes the method of assessment of 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.

A.2. Principles

The assessment method given in EN 1337-5, Annex E, applies with the following deviations.

A.2.1 Introduction

Based on EN 1337-5, Annex E.

A.2.2 Preparation of test specimens

The test shall be carried out on bearings with a value of the elastomer diameter not less than 300 mm. The piston/pot contact surface shall be curved as given in EN 1337-5, 6.2.3.3. The clearance between pot and piston, defined by the manufacturer, shall be applied.

It is necessary to achieve a width of the gap between the contact surface of the piston and the pot wall equal to that appearing in a pot bearing with a diameter of the elastomeric pad of 550 mm in combination with a rotation angle of 0,03 rad during the load test in accordance with EN 1337-5, Annex E. Therefore, after the execution of the wear test, the contact surface of the piston of the specimen with a diameter of the elastomeric pad of at least 300 mm will be machined accordingly before the load test. Consequently, there is the identical situation given for the internal seal during the load test as it is the case when using a pot bearing with a diameter of the elastomeric pad of ≥ 550 mm in accordance with EN 1337-5, Annex E.

A.2.3 Test procedure

a) Apply a vertical load to produce an elastomer contact stress σ_{lirt} at a rate not exceeding 0,5 N/mm²/s;

where

$$\sigma_{lirt, EAD} = f_{e,k, EAD}/f_{e,k, 1337-5} \times \sigma_{lirt, 1337-5}$$

with

$f_{e,k, EAD}$ applied in the assessment procedure, > 60 N/mm²
(within the range according to the scope of this EAD)

$f_{e,k, 1337-5} = 60$ N/mm²

$\sigma_{lirt, 1337-5} = 35$ N/mm²

$f_{e,k,EAD}$ is specifying the characteristic contact strength of the elastomer.

Note: The value for $f_{e,k, 1337-5} = 60$ N/mm² is related to EN 1337-5, Clause 6.2.1.1.

b) Enlarge the rotation angle so that the same slide path per cycle (amplitude) is reached as in case of testing a pot bearing with an elastomeric pad of ≥ 550 mm diameter (as requested by EN 1337-5, Annex E). The testing frequency shall be adjusted accordingly in order to reach the same velocity range for the movement of the internal seal as defined in EN 1337-5, Annex E, Clause E.3, letter b, for elastomeric pads of diameter ≥ 550 mm;

c) Continue the test until the accumulated slide path (at least 2000 m) to be 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) As given in EN 1337-5, Annex E, Clause E.3, letter d);

- e) As given in EN 1337-5, Annex E, Clause E.3, letter e;
- f) As given in EN 1337-5 with the following deviation regarding contact pressure: Apply a compressive load to produce an elastomer contact stress of $f_{e,k, EAD}$ for a period of minimum 168 h for non-metallic seals;
- g) As given in EN 1337-5, Annex E, Clause E.3, letter g;
- h) As given in EN 1337-5, Annex E, Clause E.3, letter h;
- i) As given in EN 1337-5, Annex E, Clause E.3, letter I;
- j) As given in EN 1337-5, Annex E, Clause E.3, letter j.

A.2.4. Test report

Test report shall be stated as given in EN 1337-5, Annex E, with the following deviations:

- instead of reference to EN 1337-5 the reference shall be made to the test method in this EAD;
- reference to this Annex and any deviation from it;
- report of applied characteristic contact strength $f_{e,k, EAD}$ in relation to the defined criterion in A.2.3 letter e in this annex;
- report on clearance between pot and piston;
- relevant accumulated slide path in accordance with this EAD (see EN 1337-5, Annex E.4, letter m).

ANNEX B ASSESSMENT OF RESTRAINT MOMENT

B.1. Scope

This test procedure describes the method of assessing the restraint moment in pot bearings as a function of the rotation angle. The results shall be used to assess the factors in the restoring moment formula (see EN 1337-5, 6.1.3.1).

B.2. Principles

The assessment method given in EN 1337-5, Annex D, applies with the following deviations.

B.2.1 Introduction

As given in EN 1337-5, Annex D.

B.2.2 Preparation of test specimens

For pot bearings the assessment of the restraint moment shall be carried out on bearings with a value of the elastomer diameter not less than 300 mm.

B.2.3 Test procedure

a) Apply a vertical load to produce an elastomer contact stress σ_{drm} at a rate not exceeding 0,5 N/mm²/s;

where

$$\sigma_{\text{drm, EAD}} = f_{e,k \text{ EAD}}/f_{e,k \text{ 1337-5}} \times \sigma_{\text{drm, 1337-5}}$$

with

$f_{e,k, \text{EAD}}$	applied in the assessment procedure > 60 N/mm ² (within the range according to the scope of this EAD)
$f_{e,k, \text{1337-5}}$	= 60 N/mm ²
$\sigma_{\text{drm, 1337-5}}$	= 35 N/mm ²

$f_{e,k,\text{EAD}}$ is specifying the characteristic contact strength of the elastomer.

Note: The value for $f_{e,k, \text{1337-5}} = 60 \text{ N/mm}^2$ is related to EN 1337-5, Clause 6.2.1.1.

b) As given in EN 1337-5, Annex D, Clause D.3, letter b);

c) As given in EN 1337-5, Annex D, Clause D.3, letter c);

d) As given in EN 1337-5, Annex D, Clause D.3, letter d).

B.2.4 Evaluation of restraint moment factors

Based on EN 1337-5, Annex D.

With consideration of $\sigma_{\text{drm, EAD}}$, adjusted definition for F_z in D.3 is introduced:

$$F_z = \frac{f_{e,k,\text{EAD}}}{f_{e,k,\text{1337-5}}} \cdot 35 \text{ N/mm}^2 \cdot \frac{D^2 \pi}{4}$$

B.2.5. Test report

Test report shall be stated as given in EN 1337-5, Annex D, with the following deviations:

- Instead of reference to EN 1337-5 the reference shall be made to the test method in this EAD;
- Report of assessed characteristic contact strength.