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Structural bearings —

Part 10: Inspection and maintenance

The European Standard EN 1337-10:2003 has the status of a British Standard

ICS 91.010.30

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 1337-10:2003.

The UK participation in its preparation was entrusted to Technical Committee B/522, Structural bearings, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 17, an inside back cover and a back cover.

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English version

Structural Bearings - Part 10: Inspection and maintenance

Appareils d'appui structuraux - Partie 10: Surveillance

Lager im Bauwesen - Teil 10: Inspektion und Instandhaltung

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

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Contents

Foreword

This document (EN 1337-10:2003) 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of an identical text or by endorsement, at the latest by January 2004, and conflicting national standards shall be withdrawn at the latest by January 2004.

The entire European Standard EN 1337 consists of 11 Parts listed here below:

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 restraint bearings

Part 9 – Protection

Part 10 – Inspection and maintenance

Part 11 – Transport, storage and installation

Annexes A and B are informative.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard applies to the inspection and maintenance of bearings designed in accordance with EN 1337-1, when used in the construction of bridges or structures requiring similar bearing systems. It presupposes the existence of guidelines for the regular inspection of the whole structure during its service life.

It may also be used as appropriate for the inspection and maintenance of bearings designed and/or installed before the introduction of this European Standard.

This European Standard specifies the aspects of each type of bearing that shall be inspected and recorded. It does not specify permissible values. For these reference shall be made to the relevant parts of this European Standard and to the drawings and design calculations for the bearing and the structure.

NOTE 1 Attention is drawn to the particular necessity for regular inspection and maintenance of bearings as, without such inspection and maintenance, premature failure may occur.

NOTE 2 National regulations may exist on the subjects covered by this European Standard and, therefore, they prevail on it.

2 Normative references

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

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

EN 1337–11: 1997, *Structural bearings – Part 11: Transport, storage and installation.*

3 Definitions and symbols

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

3.1
inspection
regular observation, noting and reporting

3.1.1
regular inspection
close visual inspection without measurements, spaced at equal, resonably frequent, intervals

3.1.2
principal inspection
similar to a regular inspection but in more detail and including precise measurement

3.2
maintenance
servicing and replacement

3.2.1
servicing
cleaning, greasing, painting and repair of minor defects

3.2.2
replacement
renewal of major parts of a bearing or of the entire bearing

3.3 Symbols

h protrusion of PTFE

v_x displacement in the main direction of movement of the structure

v_y displacement transverse to the main direction of movement of the structure

α_x angle of rotation in the main direction of movement of the structure

α_y angle of rotation transverse to the main direction of movement of the structure

s_1 clearance to allow rotational movement

s_2 clearance between vertical surfaces

s_3 clearance between guide surfaces

s_4 clearance of vertical movements of the structure

4 General requirements for regular and principal inspections

The condition of the bearings in a structure shall be checked visually, at least as often as the regular inspection of the structure (or failing this at the time of the principal inspection) or if the construction work is not subject to regular inspection, by an inspector, with competent knowledge of bearings, at least as frequently as the structure is inspected. If it is necessary to enable the inspector to do this, bearings shall be cleaned prior to the inspection.

The bearings should be inspected after an accidental collision with the bridge, such as an over-high vehicle colliding with the deck, or after an exceptional event, such as an earthquake.

Should the inspector encounter conditions that he is unable to explain or detect fully, or for which he is unable to recommend remedial action, he shall seek, if need be, the assistance of a special expert before completing his report.

Depending on the outcome of the inspection one of the following steps shall be undertaken:

no action;

further measurements of the movement capacity (under extreme temperatures, different loads, etc.);

further test procedures;

repair (corrections of the position, replacement of the entire bearing or of parts, renewal or supplement of the protection against corrosion or underneath packing with mortar, etc.).

5 Regular inspection

In the regular inspection the following properties shall be checked:

a) sufficient capacity for residual movement with respect to the type of the bearing, taking into account the temperature of the structure;

b) visible defects:

– cracks;

– incorrect position;

– unforeseen movements and deformations;

c) condition of bedding and fixing;

d) condition of corrosion protection, dust protection and seals;

e) condition of sliding and rolling surfaces;

f) visible defects of adjoining structural parts.

The results shall be recorded. An example is shown in annex B.4. The report shall be filed with plans and drawings of the structure.

In case of visible defects or damage which are likely to affect the function, checks according to clause 6 shall be carried out.

6 Principal inspection

6.1 General

Principal inspections shall be carried out at less frequent intervals than regular inspections (see A.5) and will normally replace one of these. They are intended to result in a precise record of the condition of the bearing and, if properly interpreted and acted upon, will ensure that the bearing will continue to function as intended until the next principal inspection.

It is recommended to carry out the first principal inspection within one year of the structure being put into service and the results compared with the details recorded in accordance with clause 7 of EN 1337–11: 1997.

The principal inspection shall include all the points covered by the regular inspection but in more precise detail. Points of particular importance for each type of bearing are given below. Figures are also included showing the main dimensions to be recorded for each type of bearing. These shall be measured with dead load only on the structure whenever possible. If this is not feasible details of the live loading shall be provided as precisely as possible.

The obtained measurements shall be compared with the design values. Hence the capacity of the bearing for all anticipated future movements and loads shall be checked.

Type numbers in 6.2 correspond to the type numbers in EN 1337–1.

6.2 Specific checks for the different types of bearings

6.2.1 Sliding part of bearings with PTFE elements (see Figure 1)

For the bearings No. 1.3, 1.4, 1.5, 1.7, 1.8, 2.2, 2.3, 3.3, 3.4, 3.5, 4.2, 4.3, 5.2, 5.3, 6.2, 7.3, 7.4 the protrusion h between the sliding surface and the plate containing the PTFE sheet shall be measured at sufficient points to find the minimum value; v_x, v_y and h to be recorded.

Where visible the condition of the sliding surface and its fixings shall be reported.

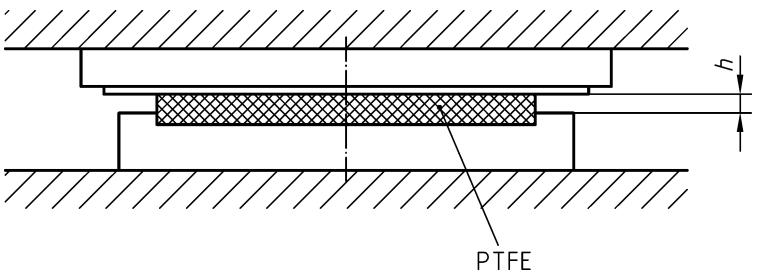


Figure 1 —Sliding part of combined bearings

6.2.2 Elastomeric bearings and the elastomeric part of combined bearings (see Figure 2)

For the bearings No. 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8 the visible surfaces shall be checked for cracks and excessive deformations. If cracks extend to the inner steel-plates of the bearing, the report shall inform the owners of this situation and of the risk of corrosion and failure of the product. Moreover, consideration shall be given to replacement of the bearing.

α_x, α_y, v_x and v_y to be recorded.

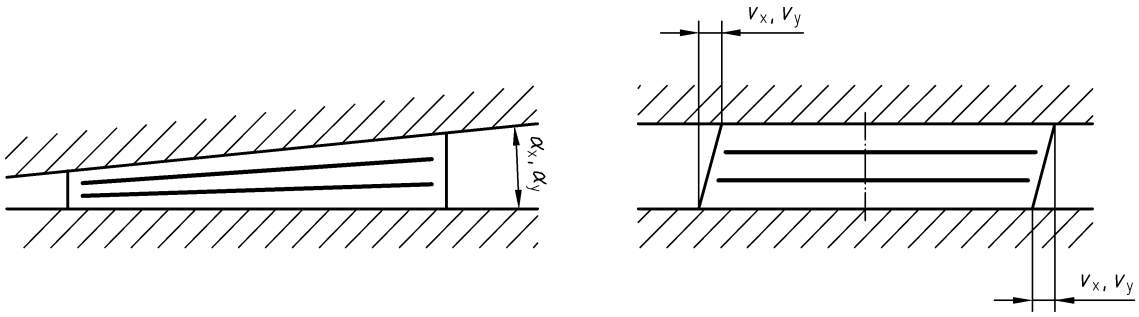


Figure 2 — Elastomeric bearing

6.2.3 Single roller bearings (see Figure 3)

For the bearings No. 6.1 and 6.2 the condition of the rolling surfaces, the continuity or otherwise of the line of contact, sloping movement, rotation about the vertical axis, offset in rolling plane, the relative positions of the top and bottom plates v_x and the rotation angle α shall be recorded. The condition of any guiding devices shall be reported.

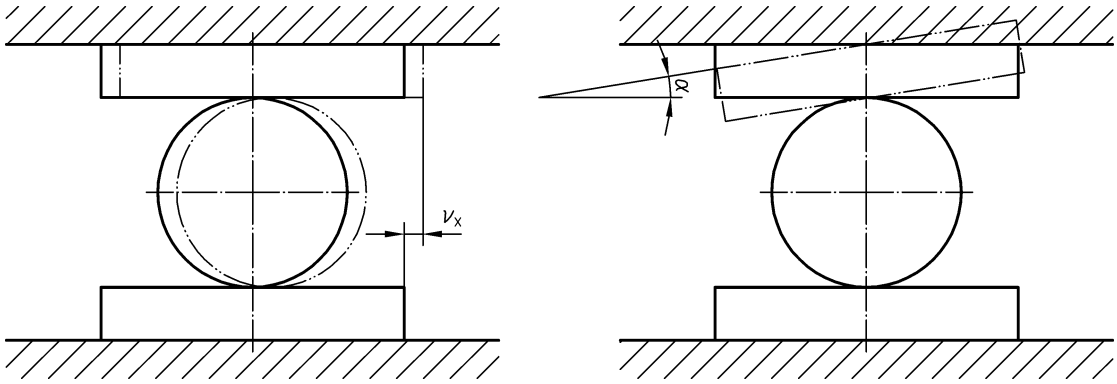


Figure 3 — Roller bearing

6.2.4 Pot bearings and the pot part of combined bearings (see Figure 4)

For the bearings No. 2.1, 2.2 and 2.3 s_{1min} and s_{1max} shall be recorded.

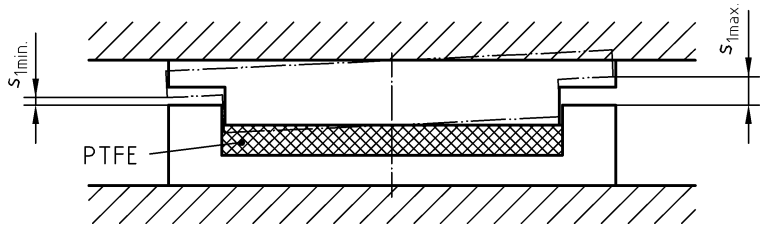
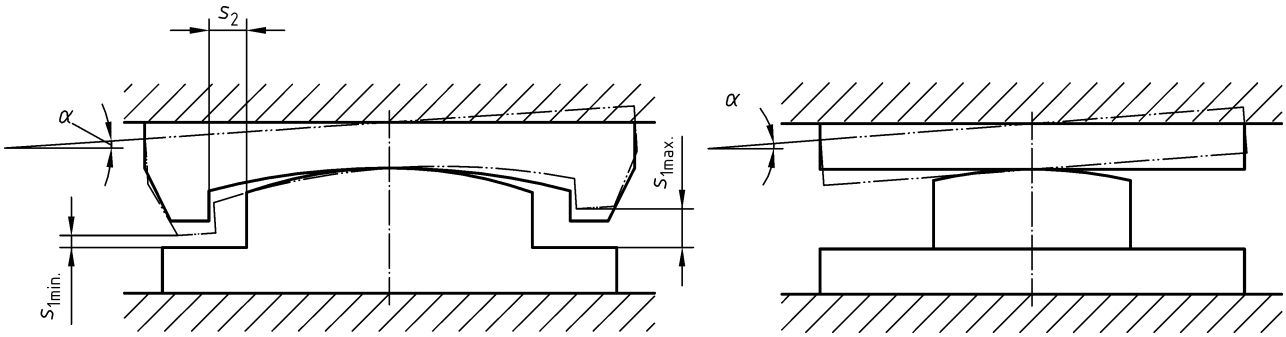


Figure 4 — Pot bearing

6.2.5 Rocker bearings, point rocker bearings, rocker part of combined bearings (see Figure 5)

For the bearings No. 4.1, 4.2, 4.3, 5.1, 5.2, 5.3 $s_{1min,max}$ and α shall be recorded. The condition of the rocking surfaces, the continuity or otherwise of the line of contact and the relative positions of the top and bottom plates shall be recorded.



Point rocker Linear rocker

Figure 5 — Rocker bearings

6.2.6 Spherical bearings and the spherical part of combined bearings, cylindrical bearings (see Figures 6 and 7)

For the bearings No. 3.1, 3.2, 3.3., 3.4, 3.5 α_{max} and h_{min} shall be recorded.

For the bearings No. 7.1, 7.2, 7.3, 7.4 h, v and α shall be recorded. Any tendency to rotate in a direction other than the design direction shall be reported.

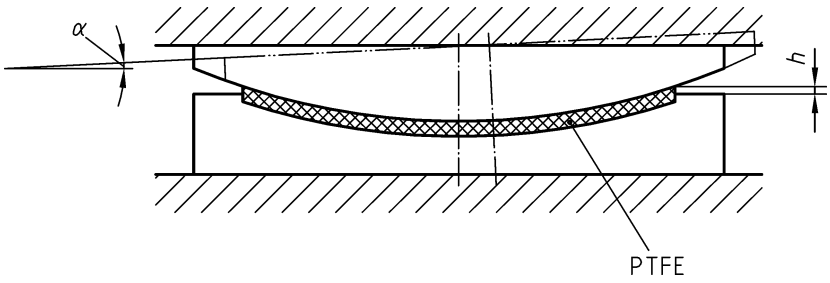


Figure 6 — Spherical or cylindrical bearing

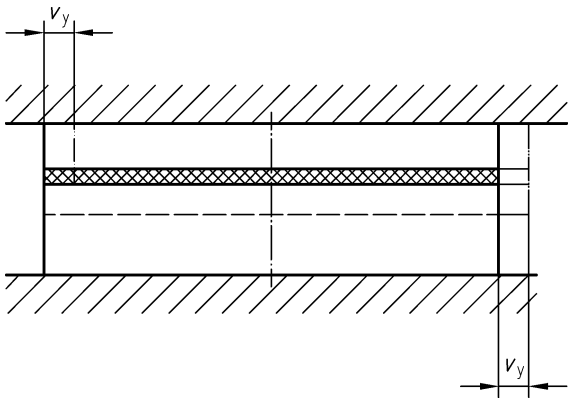


Figure 7 — Side view of a cylindrical bearing

6.2.7 Guide bearings and guiding elements of other bearings (see Figure 8)

For the bearings No. 8.1, 8.2 $s_{3\ min.}$, $s_{3\ max.}$, s_{4u}, s_{4o}, h_1 and h_2 (the maximum clearance between guide surfaces) shall be recorded where possible.

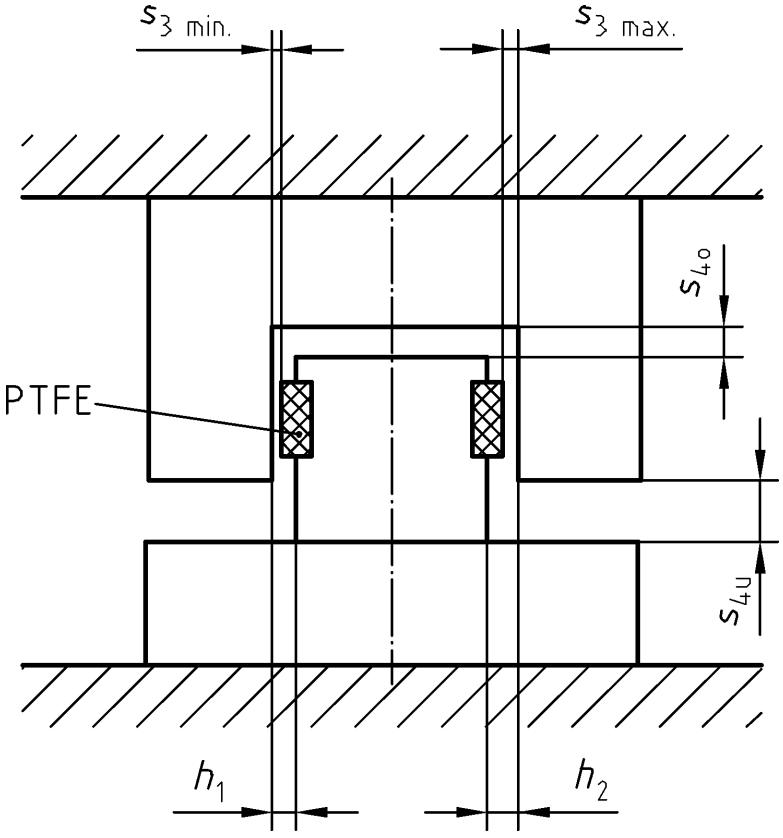


Figure 8 — Guide bearing

6.2.8 Special bearings

Any special bearing shall be checked in accordance with criteria laid down by the designers of the structure and the bearing.

7 Servicing and replacement

Replacement of bearings or of parts of bearings shall be carried out avoiding any damage to the structure.

Jacks shall be applied only at intended load points. Permissible jacking forces and intended jacking distances shall not be exceeded. The structure shall be prevented from falling back in case of jack failure.

When movements of the structure are likely to occur during the time of replacement or repair of a bearing in the jacked up position these movements should be possible in a sliding or deforming manner.

Consideration shall be given to the risk that large horizontal loads (e.g. braking loads) due to elastic deformation of the bridge may act on the bearing. This risk shall be carefully investigated and necessary actions taken prior to any hoisting procedure.

All repair work shall be recorded in a report.

Annex A
(informative)

Explanations

A.1 The regular time intervals for inspections should follow national standards or specific guidelines or manuals for the structure.

A.2 It may be necessary to inspect the bearings more often than the whole structure. This will be particularly the case if an inspection reveals a possible source of future trouble.

A.3 In the case of unforeseen movement at the joints or railings or any other sign of distress the bearings should be inspected.

A.4 The following is a list of inspection equipment that is intended as a guide:

– plans and drawings, manuals, product specification, etc.;

– scaffolds and working platforms;

– lighting equipment;

– mirror;

– cleaning device;

– tools for removal of all coverings;

– feeler gauge;

– rule with sharp edge;

– spirit level;

– quadrant (protractor);

– vernier callipers;

– apparatus for measuring the thickness of protective layers;

– equipment for the measurement of cracks;

– telescope;

– thermometer;

– camera.

A.5 The requirements in clause 5, clause 6 and the advice A.1, A.2 and A.3 are intentionally imprecise, particularly with regard to time intervals. These can only be settled by the authority responsible for the care of the structure and are influenced by the type of bearings, and the difficulty and cost of access, the consequences of bearing failure and the speed with which any bearing fault may develop. Precise details of any detoriation should be recorded so that later inspection may clearly record the rate of progression. It should be borne in mind that the aim of the inspection regime is to detect bearing detoriation long before it becomes dangerous and to ensure that remedial work is carried out in time.

Annex B
(informative)

Report of inspection of bearings

B.1 General

This annex is intended to give guidance for the production of an inspector's report and includes a specimen form. The purpose of the form is to ensure that the inspector checks and reports on the principal aspects of each bearing. The completed form should then be used to initiate remedial action, when required. It should then be filed and be made available to the inspector for the next inspection. This will help to draw the inspector's attention to possible points of trouble and will enable him to note any progressive deterioration. It will also enable him to check that any recommended remedial work has been carried out. It should be noted that the layout of the form is not intended for direct copying, as it shall be expanded to allow the inspector sufficient space to make his report under each of the headings. Some bridge owners may also find it convenient to have different forms for different types of bearings. In which case only those headings relevant to the particular type of bearing need to be included on the form relating to that type.

The specimen form covers checks required for a principal inspection. For a regular inspection a simplified form may be used. Alternatively the same form may be used with the items relevant to a regular inspection clearly marked.

B.2 Determination of the temperature of the structure

This method is given by way of indication and has not been validated for all climatic conditions.

The actual temperature of the structure cannot easily be determined and in many cases may not be necessary, particularly where the bearings are of a type whose extremes of movement can be deduced by observation of such things as undisturbed dirt on sliding surfaces, or from indicators that show extremes of movement reached. In such cases it may be informative if the shade temperature is recorded when the inspection is made, with a comment on the weather and particular reference as to whether the sun is shining on the structure, or not, and whether the previous night had been much colder than the day, or not.

If a more precise means of estimating the temperature of the structure is required, it may be deduced from the estimated minimum effective bridge temperature "y (°C)" for the day.

For concrete bridges (occurring at 08.00 ± 1 hour):

$$y = 1{,}14\ x_1 - 1{,}1$$

where

x_1 is the 48 hour mean shade temperature obtained by taking the average of:

the minimum shade temperature for the day;

the maximum shade temperature for the previous day;

the minimum shade temperature for the previous day;

the maximum shade temperature for the day before the previous day.

For composite bridges (occurring at 07.00 ± 1 hour):

$$y = 1{,}14\ x_2 - 2{,}6$$

where

x_2 is the 24 hour mean shade temperature obtained by taking the average of:

the minimum shade temperature for the day;

the maximum shade temperature for the previous day.

For steel box bridges (occurring at 06.00 ± 1 hour):

$$y = 1{,}1\ x_3 - 1{,}3$$

where

x_3 is the minimum shade temperature for the day.

In general, the inspection is not made when the structure is at its minimum temperature. If however when the structure is at its minimum temperature its position is noted at a suitable reference point, then any subsequent movement may be used in estimating the actual temperature of the structure from the minimum effective temperature "y (°C)".

B.3 Guidance for completion of each item on the form

B.3.1 Location of bearing/identification

The precise location of the bearing in the structure should be given in such a way that anybody reading the form can identify the position of the bearing without any doubt. The identification given should be the unique serial number described in EN 1337–1. This will give confirmation that the correct bearing has been identified from the description of its location. If this serial number is not visible, this should be noted and remedial action recommended to provide a permanent visible record of the number on or adjacent to the bearing. If the serial number is not available, then a numbering system for the bearings in the structure should be substituted with a unique number for each bearing. This unique number should then be shown in a permanent form either on or adjacent to the bearing.

B.3.2 Type of bearing/manufacturer

The description of the type of bearing should correspond to the description given in EN 1337–1. The manufacturer's name should agree with the information required in EN 1337–1.

B.3.3 Drawing Number

The number of the manufacturer's drawing for the bearing should be given. This drawing should be available to the inspector for reference before he carries out his inspection.

B.3.4 Protective cover

If the bearing does not have a protective cover, the inspector should indicate whether one is required. If any protective device was originally provided, either on the bearing or adjacent to it, its current condition should be reported.

B.3.5 Indicator

If the bearing was not originally provided with a movement indicator, but the provision of one would be both practical and advantageous, this should be noted. If one has been provided the inspector should check that it is in place and functioning.

B.3.6 Position of indicator

If an indicator is in place and functioning, its reading should be noted.

B.3.7 Movement in bearing

The movements of a bearing are measured from a supposed "stationary“ reference point; the movement directions are recorded on a sketch for analysis. This is particularly necessary where angular deformation is being recorded. In combined elastomeric and sliding bearings movement due to sliding should be shown separately from that due to elastomeric deformation. In the case of preset (or predeformed) bearings, account is taken of this initial condition.

B.3.8 Clearances and protrusions

See clause 6. Particular note should be made of any significant change in this reading when compared with previous inspections.

B.3.9 Bearing with sliding planes

The condition of all sliding surfaces should be checked where possible. Parts of stainless steel surfaces are usually exposed, and a feeler gauge or thin steel rule can usually be used to check that the edges of a PTFE surface are where intended. It has to be considered that wear, dirt or corrosion of moving surfaces will increase resistance to movement.

B.3.10 Elastomeric bearing

It is normal that a correctly functioning elastomeric bearing shows some shear deformation and slight regular bulging between reinforcing plates within the bearing. Apart from these the bearing surface should be smooth and free from blemishes. Irregular bulging is likely to indicate misplaced plates or bond failure.

B.3.11 Roller bearings and linear rocker bearings

Roller bearings should be checked to ensure that they are in contact with their upper and lower plates throughout the entire length of the roller. A light behind the bearing will help with this check. A check should be made to ensure that the line of contact is at right angles to the direction of movement or rotation.

Where bearings rely on a lubricant to function efficiently they should be checked to ensure that an adequate supply remains and that it has not deteriorated.

B.3.12 Pot bearing, point rocker bearing

See clause 6.

B.3.13 Locking device/guiding device

Temporary locking devices should be checked to ensure that they have been released and are not impeding the movement of the bearing. Similarly, where bearings have been designed to allow movement during construction and have then been locked to prevent subsequent movement, the locking device should be checked to ensure that it is still performing its intended function. Guides in guided bearings and guide bearings should be checked for deformation caused by excess guide force and for the integrity of the sliding surfaces. Particular attention should be paid on skewed or curved bridges.

B.3.14 Protection against corrosion

Where bearings contain parts that are prone to corrosion they should be checked to ensure that the protective measures to prevent this are still functioning. In general the aim should be to repair or replace any corrosion protection before it has failed sufficiently to allow any substantial amount of corrosion to take place.

B.3.15 Position and condition of outer plates/anchorages

Where bearings have outer plates these should be checked for any sign of displacement relative to either the bearing or the surrounding structure. Any bolt or other form of anchorage should be checked to ensure that it has not become loose or otherwise inactive.

B.3.16 Damage to steel parts

All steel parts should be checked for any sign of distortion due to overload and for any other sign of damage. Any sign of cracking or yelding should give immediate cause of concern, particularly with regard to roller and rocker bearings.

B.3.17 Condition of adjacent structural elements

In many cases the first indication that a bearing is malfunctioning is the appearance of damage in an adjacent part of the structure. Alternatively deterioration of the adjacent structure may lead to malfunctioning of the bearing. It is therefore important for any bearing inspection to include the adjacent structure and its condition should be reported.

B.3.18 Remarks

Under the "remarks" heading any condition of interest not covered by a specific heading should be reported. An unusual noise associated with the passage of traffic or otherwise is a particular example. Comments should also be made where these may assist in the interpretation of the report, or, when the next inspection is being made, will draw the attention of the inspector to possible points of weakness.

B.3.19 Result of inspection, required actions

After completing his inspection the inspector should be able to write either that the condition of the bearing is satisfactory and functioning correctly, or that it is deficient in some respect. If the latter is the case he should indicate if urgent remedial action is required, if remedial action is required but can be deferred until convenient, or if remedial action can be deferred until after the next inspection. In some instances he may observe a condition that he is either unable to diagnose or is not equipped to fully examine. This should be noted together with any suggestions.

B.3.20 Following inspection

The date when the next inspection whether regular or principal is due should be noted. This will depend on the frequency of inspection required for the particular type of bearing in conjunction with the type and location of the structure in which it is incorporated. This should be specified by the owner of the structure and may be based on guidance given by the designers of the bearing and the structure. In cases where deterioration is suspected or apparent it may be necessary to set an earlier date for the next inspection to check on the need for remedial action.

B.4 Report of inspection of bearings (specimen)

Structure: ……

Name of inspector: ……

Year of construction: ……

Date of the inspection: ……..

Actual temperature of the structure: ……

			Bearing ...	Bearing ...
1	Location of bearing/Identification (see 7.3 of EN 1337–1:2000)			
2	Type of bearing/Manufacturer (see Table 1 of EN 1337–1:2000)			
3	Drawing No.			
4	Protective cover	required		
		in place		
5	Indicator	required		
		in place		
6	Position of indicator	mm		
7	Movement in bearing (to be split in combined bearings where both parts are free to move)			
	Translation longitudinal	v_x		
	Translation transverse	v_y		
	Rotation longitudinal	α_x		
	Rotation transverse	$\alpha_{max.}$		
8	Clearances/ protrusions	h		
		s_{1min}		
		s_{1max}		
		s_2		
		$s_{3min.}/s_{3max.}$		
		s_{4u}/s_{4o}		

(continued)

(concluded)

		Bearing ...	Bearing ...
9	Sliding bearings fastening defects and condition of stainless steel sheet, contact to PTFE		
10	Elastomeric bearing: appearance, description of cracks, uplift		
11	Roller bearing and linear rocker bearings: Line of contact, plates plane, parallel, rolling surface, correct angle, lubricant		
12	Pot bearing, point rocker bearing		
13	Locking device Guiding device (for guided bearings and guide bearings)		
14	Protection against corrosion		
15	Position and condition of outer plates/anchorages		
16	Damage to steel parts		
17	Condition of adjacent structural elements (structure, mortar, sockets)		
18	Remarks (e.g. unexpected noise, dirt etc.)		
19	Result of inspection, required actions (correction, replacement, repair etc.) (if necessary, use separate sheet)		
20	Following inspection (year) (state whether regular or principal inspection)		
NOTE All dimensions to be in millimetres and all angles to be in degrees. A positive sign indicates a direction away from the fixed point of the structure and downwards if referring to vertical movement.			

Signature of inspector ……

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