POT BEARINGS

K

BS5400-9

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K - Series

Description
K series is a range of structural bearings which meets the full requirements of BS5400 Sections 9.1 & 9.2. The bearings are proven for this standard by their design and operation for the last 25 years.

The standard range comprises multi-axis rotation bearings in Fixed, Constrained and Free configurations to support loads up to 30,000 kN. Current design practice has demonstrated the need for a range of bearings with higher horizontal load capacity.

Bearing Types
The K range of bearings are available in three types: -

- 30K Fixed
- 31K Guided - Free to move in one horizontal direction
- 22K Free to move in any horizontal direction

Typical 31K Details - Exploded View

Support and Installation
Important - See pages 11 - 13 for Installation and Maintenance.

Concrete Stress
Where suitable reinforcement of the concrete has been provided the allowable concrete stress is dependent on the relative dimensions of the bearing/structure interface, the total support area and the characteristic stress of the concrete. The stress on the structure should therefore be checked to ensure that it is acceptable.

At the Nominal Rating capacity tabulated the mean stress approaches 20N/mm².

Design Loads
The designation of loadings varies depending on the design code employed. The tabulated load capacities list Nominal rating, at which load the base concrete stress is 20N/mm² maximum. The working stress / serviceability limit state maximum loads are determined by the allowable PTFE stresses. The ultimate limit state maximum load characteristics are determined by the strength characteristics of the bearing and incorporate the material and partial safety factors γ_c and γ_M as required by BS5400.

The practice of stating working loads, or nominal loads is inappropriate for limit state designs. The required movements should be specified in the part number as described below.

The clearance between the constraints must not be used to accommodate any structural movement.

Rotation
All the bearings can rotate at least 0.01 radians about any horizontal axis. The maximum for each bearing is shown in the tables.

Translations
The dimensions for the 31K (Constrained) and 22K (Free) bearings are shown in the tables for the following movements -

- Longitudinal
  - 31K 100mm total
  - 22K 200mm total

Concrete Stress
Withdrawn as simply as possible. See page 10.

Standard fixings are designed to ensure the bearings can be accommodated in the top and base members of the structure. This enables a variety of fixing methods to be used. Fixing holes are provided in the top and base members of the structure.

Attachment
Fixing holes are provided in the top and base members of the bearings. This enables a variety of fixing methods to be used. Standard fixings are designed to ensure the bearings can be removed as simply as possible. See page 10.

Designation of Part No.
The part number of a bearing is simply built up as below –

Examples:
- a above the full part number is 30K 500/33
- b above the full part number is 31K 500/BS
- c above the full part number is 22K 500/20/10/NB

Suffix Letters
By adding a two letter suffix to the bearing part number the type of fixing may be designated -

- First letter - Top plate fixing
- Second letter - Base plate fixing

- N No fixings
- B Bolts and washers only
- S Bolts, washers & sockets

Examples:
- BS signifies -
  - B (top plate fixing) Bolts & washers
  - S (base plate fixing) Bolts, washers & sockets

N.B. If standard K series fixings are not used, care should be taken to ensure that bolts can be fitted without dismantling the bearing. Bolts are hexagon head to BS 3692 grade 8.8

For example:
- 30K 500/33 S
- 31K 500/BS B
- 22K 500/20/10/NB S

Pot Bearings

K - Series

Transverse
- 31K NIL (see page 6 & 7)
- 22K 20mm total

Movements in increments of 50mm total can be supplied. The top plate dimensions and the top plate fixing centres should be increased accordingly.

N.B. 31K bearings should not be used where movement is required at right angles to the constraints. The required movements should be specified in the part number as described below.

The clearance between the constraints must not be used to accommodate any structural movement.

Fig. 1 K Pot Bearing - Guided

Fig. 2 K Pot Bearing - Free

Fig. 3 K Pot Bearing - Fixed
**30K - Fixed Pot Bearing**

### Bearing Design Loads

Bearings should be selected to suit the appropriate design code. The maximum vertical and horizontal loads shown in the tables may be taken in combination.

### Horizontal Loading

The 30K fixed bearing will resist a horizontal force acting in any direction. In order for the bearing to support the maximum horizontal loads stated in the tables, a minimum concurrent vertical load of 0.33 x the Nominal Vertical rating must be present. At ULS, the actual load combination may permit the use on a load higher than that shown in the table. We will be pleased to advise.

### Concrete Stress

Where suitable reinforcement of the concrete has been provided the allowable concrete stress is dependent on the relative dimensions of the bearing/structure interface, the total support area, and the characteristic strength of the concrete. The stress on the structure should therefore be checked to ensure that it is acceptable. At the Nominal Rating capacity tabulated the mean stress approaches 20N/mm².

### Calculation of Combined Loads

Combined Horizontal Load = \( \left( \frac{\text{Transverse load}}{2} + \frac{\text{Longitudinal load}}{2} \right) \)

### Bearing Nominal Vertical

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* Excluding fixings

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Bearing Design Loads

Bearings should be selected to suit the appropriate design code. The maximum vertical and horizontal loads shown in the tables may be taken in combination.

Horizontal Loading

The 31K guided bearing will resist a horizontal force acting at right angles to the main direction of movement. In order for the bearing to support the maximum horizontal loads stated in the tables, a minimum concurrent vertical load of 0.33 x the Nominal Vertical rating must be present.

At ULS, the actual load combination may permit the use on a load higher than that shown in the table.

We will be pleased to advise.

Transverse Movement

31K Bearings are designed to accommodate in one direction only. Movement transverse to the constraint is nominally zero.

In practice the transverse movement is 1mm maximum. Standard 31K bearings should not be used where movement is required at right angles to the constraint. Special bearings can be offered for such requirements.

Concrete Stress

Where suitable reinforcement of the concrete has been provided the allowable concrete stress is dependent on the relative dimensions of the bearing/structure interface, the total support area, and the characteristic strength of the concrete. The stress on the structure should therefore be checked to ensure that it is acceptable.

At the Nominal Rating capacity tabulated the mean stress approaches 20N/mm².

Bearing Design Loads

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* Excluding fixings

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### 22K - Sliding Pot Bearing

#### Bearing Design Loads

Bearings should be selected to suit the appropriate design code. If in doubt seek our advice.

#### Concrete Stress

Where suitable reinforcement of the concrete has been provided the allowable concrete stress is dependent on the relative dimensions of the bearing/structure interface, the total support area, and the characteristic strength of the concrete. The stress on the structure should therefore be checked to ensure that it is acceptable.

At the Nominal Rating capacity tabulated the mean stress approaches 20N/mm².

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* Excluding fixings

**Concrete Stress**

Where suitable reinforcement of the concrete has been provided the allowable concrete stress is dependent on the relative dimensions of the bearing/structure interface, the total support area, and the characteristic strength of the concrete. The stress on the structure should therefore be checked to ensure that it is acceptable.

At the Nominal Rating capacity tabulated the mean stress approaches 20N/mm².

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Where suitable reinforcement of the concrete has been provided the allowable concrete stress is dependent on the relative dimensions of the bearing/structure interface, the total support area, and the characteristic strength of the concrete. The stress on the structure should therefore be checked to ensure that it is acceptable.

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By adding a two letter suffix to the bearing part number the type of fixing may be designated -

First letter - Top plate fixing
Second letter - Base plate fixing

N - No fixings
B - Bolts and washers only
S - Bolts, washers & sockets

e.g. 7055 signifies:
B (top plate fixing) Bolts & washers
S (base plate fixing) Bolts, washers & sockets

N.B. If standard K series fixings are not used, care should be taken to ensure that bolts can be fitted without dismantling the bearing.

Bolts are Hexagon Head to BS 3692 grade 8.8

Installation

CONSIDER THE EFFECTS IF BEARINGS ARE NOT CORRECTLY INSTALLED

Our structural bearings are manufactured to close tolerances by skilled technicians working in clean conditions. To obtain the requisite performance from bearings it is imperative that they are properly handled at the work site and installed with the same care as when they were assembled in the factory. The following notes will assist those responsible for specifying and supervising the installation of structural bearings.

Please note that Ekspan are able to provide installation and supervision.

Bearings must be installed with precision to meet the bridge and bearing design criteria.

Storage

Our structural bearings are protected from contamination under normal working conditions by an efficient sealing system. Care should be taken in storage to prevent contamination and damage to the working surfaces.

Handling

Robust transportation devices are fitted to all bearings to ensure that the components are maintained in their correct relative positions before and during installation. The devices are normally finished in red paint. Unless special devices have been specified, they should not be used for slinging or suspending the bearings beneath beams.

Due to unpredictable conditions, which may occur during transportation or handling on site, the alignment and presetting (if applicable) of the assembled bearing should be checked against the drawing. Do not endeavour to rectify any discrepancies on site. The bearing should either be returned to Ekspan or, where practical, an Ekspan engineer should be called in to inspect and reassemble. Bearings too heavy to be lifted by hand should be properly slung using lifting equipment.
**Presetting**

If bearings are required to be preset eg where once only large movements may occur during stressing operations, this should be specified as a requirement and should only be carried out in our works prior to despatch. Do not attempt this operation on site.

**Bedding**

Bearings must be supported on a flat rigid bed. Steel spreader plates must be machined flat and smooth to mate exactly with the bearings’ upper and lower faces. Bearings may also be bedded on epoxy or cement mortar or by dry packing. Whichever system is preferred for the particular structure it is of extreme importance that the final bedding is free from high or hard spots, shrinkage, voids, etc.

Unless there is a specific design requirement, the planar surfaces must be installed in a horizontal plane. The correct installation of bearings is vital for the bearing performance. Costly repairs become necessary all too often due to inadequate specification or poor site supervision. The bearings should not be loaded until the bedding mortar has cured.

**Cast-In-Situ Structures**

Care must be taken to ensure that the bearings are not damaged by the formwork or contaminated by concrete seepage. The interface between the top plate and the formwork should be protected and sealed.

Owing to the loading effects of a wet concrete mass, the top plates should be propped to prevent rotation and plate distortion.

**Bearing Removability**

Where possible, bearings should be fixed in such a manner as to facilitate removal. Our bearings have generally been designed with this in mind. However, when selecting the bearing type preferred, the removability feature should be highlighted in your enquiry.

**Removal of Transport Brackets**

These brackets, normally painted red should only be removed once the bearing is properly installed and ready for operation.

**Bearings Installation Check List**

**DO -**

1. Handle carefully and where necessary with adequate craneage.
2. Store in a clean dry place.
3. Ensure that the bearings are installed in the correct location and orientation.
4. Ensure that the bearings are installed on a flat rigid bed before the design loads are applied.
5. Ensure that the fixings are uniformly tightened.
6. Complete any site coatings and make good paint damaged during handling and installation.
7. Protect working surfaces during the placing of in-situ concrete.
8. Keep the bearings and surrounding areas clean.
9. Remove any temporary transit clamps etc. before the bearings are required to operate.
10. Take special care to support top plates when casting in-situ concrete.

**Routine Maintenance of Bearings**

1. Immediately following installation bearings shall be inspected to ensure that all aspects of ‘Installation of bearings’ have been adhered to and bearings shall subsequently be re-inspected not less frequently than every two years after their installation.
2. Paint and/or other specified protective coatings must be maintained in good and efficient condition and free from scratches or chips. Any areas of the protective coating showing damage or distress must be rectified.
3. Areas surrounding the bearings must be kept clean and dry and free from the adverse effects of external influences such as airborne debris or water/salt (for example emanating from leaking joints).
4. The wearing surfaces of the bearing must be checked to ensure that they are continuing to operate efficiently.
5. Fixing bolts must be checked for tightness.
6. Any bedding material showing signs of distress or ineffectiveness must be replaced and the reason for its failure investigated and corrected.
7. Routine inspections shall include a check that translational and rotational capacities of the bearing have not been exceeded and show no sign of being likely to exceed the requirements specified at the design stage.
BS4000 - Sample Quality Bearing Specification Clauses

1.01 The bearings should be designed in accordance with BS 5400 part 9 and be constructed from steel grade EN10025 S235 J2 or equivalent. (HIGH QUALITY STEEL GOOD LOADING CAPACITIES)

1.02 The sliding surface of the bearing must be fully welded to the top plate of the bearing. This prevents crevice corrosion de-lamination of the stainless steel ensuring bearing longevity. The stainless steel sliding surface should be mirror polished to a minimum of 8/1 P BS1449/ EN10088-2. Paint will be applied to overlap the welded area of the sliding surface so as to protect the area from the risk of corrosion. (REDUCES CORROSION IN UNLOADED AREAS WHICH IS THE CAUSE OF MOST BEARING FAILURES)

1.03 PTFE bearing surfaces shall be Virgin material with a dimpled surface and lubricated with silicon grease in accordance with BS 5400 part 9. The PTFE shall be retained in the bearing by a machined recess. (FRICITION IS AT A MINIMUM, LIFE IS EXTENSIVE AND BEARING LONGEVITY. THE PTFE CANNOT “CREEP”)

1.04 Guide sliding surfaces should also be fully welded and mirror polished. The wear surface of the guide shall be a mechanically restrained high load resistant material DU(B) mirror polished. The wear surface of the guide shall be dimpled surface and lubricated with silicon grease in accordance with BS 5400 part 9 and be constructed from steel grade EN10025 S355 J2 or equivalent. (REDUCES CORROSION IN UNLOADED AREAS WHICH IS THE CAUSE OF MOST BEARING FAILURES)

1.05 Pot bearing pistons are machined with a tightly controlled tolerance between the pot and the piston. (REDUCE EDGE PRESSURE EFFECTS ON RUBBER)

1.06 The rubber pad in a pot bearing is to have a minimum of 2 brass rings, which should be sized to meet and fit tight to the pot wall. (THIS IS KEY TO ENSURE THAT THE RUBBER IS RETAINED IN THE POT - IF NOT THEN THE RUBBER MAY EXTRUDE UNDER LOAD)

1.07 The rubber pad shall meet BS4000 part 9 and be natural rubber with a hardness of 55 to 65 IRHD. It will be preformed with a recess on the surface which allows the retaining rings to finish flush with the rubber. (THIS MEANS THAT WHEN THE BEARING IS LOADED THERE ARE NO AIR GAP TO CLOSE ENSURING THAT DATUMS ARE MAINTAINED)

1.08 The rubber pad shall fit in the pot without need for deflection. Corners should be moulded in such a way as to ensure that the pad fits to the machined pot base. (THIS ALSO REDUCES AIR ENTRAPMENT)

1.09 The outer surfaces of the bearing will be blasted to SA 3 and have the contract specified paint system applied. (THIS IS KEY TO ENSURE THAT THE BEARING FITS TO THE POT INSIDE)(A POT IS PRODUCED TO A DATUM WHICH MUST BE MAINTAINED)

USL Ekspan advise that the specification clauses above demonstrate good practice to ensure good quality bearings.

GOOD INSTALLATION

- Mechanical guide bearing and upper adaptor plate correctly installed.
- All bearing interfacing surfaces are horizontal.
- All surfaces are free from contaminants.

BAD INSTALLATION

- No tapered plate installed inducing additional rotations over maximum allowable.
- Incorrect fixings utilised.
- Welding completed with bearing in situ. Dirt and debris in and around bearing slide area.
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