Bearings for Bulk Conveyors

Idler Bearing Arrangements for Bulk Conveyors

Summary

This article discusses bearings used in conveyor idlers and pulleys. It begins with conveyor idlers, which use standard bearings as the newly developed seize-resistant bearings. Then it covers bearing housings used in conveyor applications. This article is reprinted from the SKF "S-Range" handbook series, publication number SKF 3209, 1981. The bearing system design can be subjected to change.

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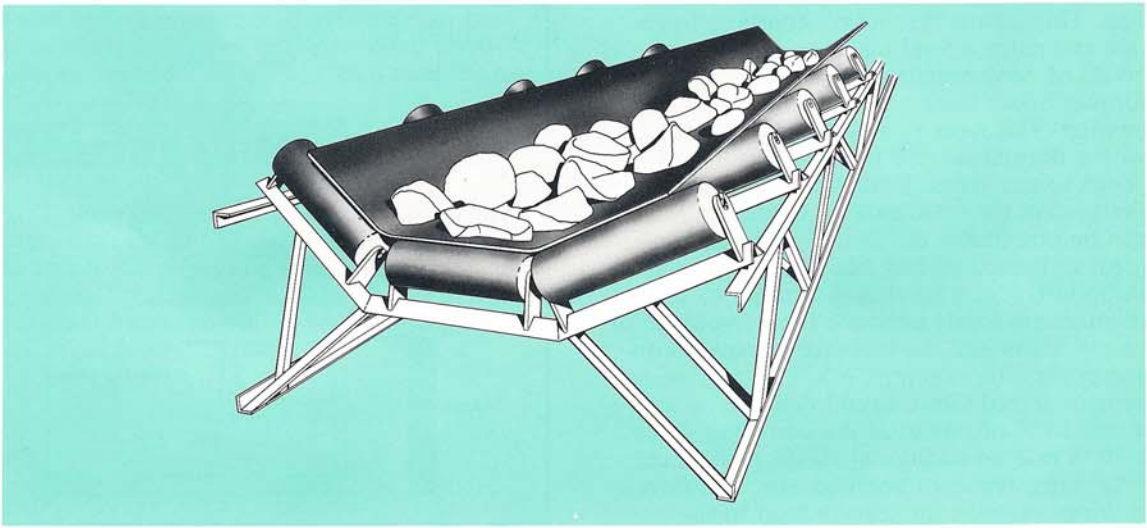
Bulk conveyors – general

This leaflet deals with the bearings used in conveyor idlers and pulleys. The first part is mainly concerned with the conveyor idlers, which use standard bearings as well as the newly developed seize-resistant bearings. The introduction of the latter type has changed the traditional approach of using tight seals, particularly for conveyors over 500 m long. An outline of the housings, which can be used with the pulley bearings, will be found on page 21.

Bulk conveyors fall into two basic categories, i.e.

- those which operate under hostile conditions and are maintained to high standards, i.e. frequently regreased;
- those which are exposed to very hostile conditions, such as water and dust, and are difficult to maintain because of inaccessibility.



S-Range of bearings for bulk conveyors

The selection of bearings for a particular application is generally governed by the prevailing operating conditions, but may also be determined by various standards relating to that application. These factors, plus the wide experience gained by SKF over many years, have all been taken into account when selecting this S-Range of bearings for bulk conveyors. The complete S-Range of bearings for bulk conveyors is shown, in matrix form on pages 12 to 14.

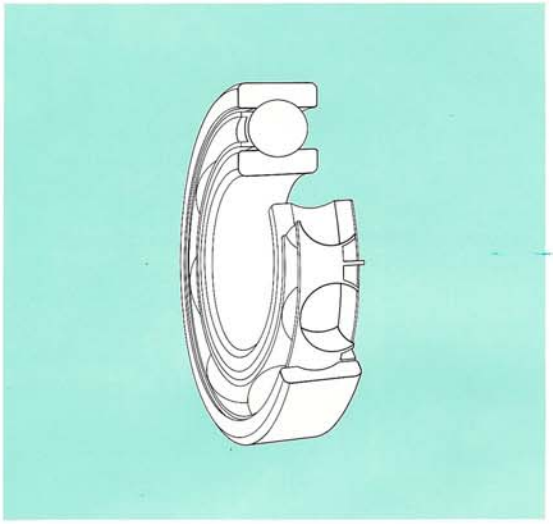
Bearing types

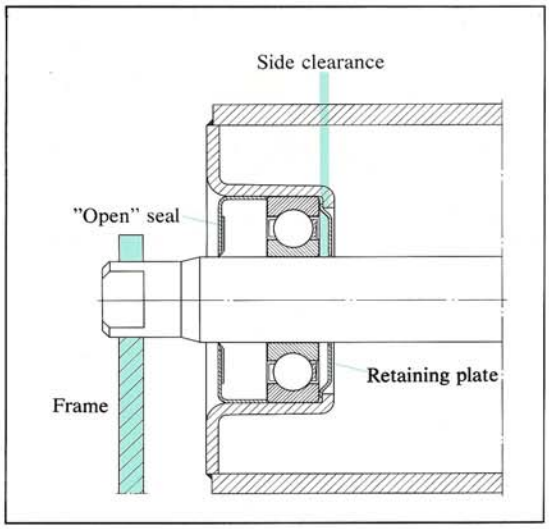
Single row deep groove ball bearings
These bearings are generally chosen for the conveyor idlers because they are simple in design and normally require little attention in service. They are also capable of carrying considerable axial loads in either direction, as well as radial loads, even at high speeds.

The SKF seize-resistant bearing

The seize-resistant bearing is basically a single row deep groove ball bearing and was first introduced in 1974. It features a special cage design and raceway control so that it will operate in a clog contaminated condition. This means that it will continue to rotate and carry a load under relatively high levels of contamination without high friction torque. Some wear will take place in the bearing. The wear rate is commensurate with a normal service life of the order of seven to ten years. With these bearings in the system the incidence of seized rollers can be practically eliminated and this has a great influence on belt life and power consumption. It can be shown that a 1 to 10 relationship exists between the percentage of seized idlers and the increase in power consumption. For example, a 5 % rate of seized or near-seized idlers would demand an additional 50 % of power at the conveyor drive, a 10 % rate an additional 100 % power, etc. SKF seize-resistant bearings are, therefore, making a significant contribution to the lowering of power consumption. However, they have a restricted speed and load range. Full details are given in the table on pages 26 and 27.

It should be noted that the bore and outside diameter follow the ISO Diameter Series 2 and 3, but the width and corner chamfers are reduced. This reduction in width is a design feature to avoid the lodging





of contaminants in critical areas, and is associated with dirt deflecting prongs on the flexible cage.

The table shows a maximum permissible misalignment of 12 minutes of arc (0,004 radians). This is higher than for standard bearings and is desirable because with conventional seal arrangements spindle bending occurs. With the low friction "open" seal described on page 19, the distance between the bearing and the spindle support in the frame will be shorter, thus reducing spindle bending.

Also shown in the table is "side clearance from bearing" which is the maximum permissible distance between the inside of the grease retaining plate and the side face of the bearing. This value is recommended with consideration to bearing service life as, if the cage becomes worn, it may leave the bearing sideways.

The outer ring of the seize-resistant bearing is more robust than that of a standard Diameter Series bearing to compensate for the poor support provided by thin-section pressed housings frequently used in idler rollers.

Self-aligning ball bearings
The self-aligning property of these bearings permits minor angular displacement of the shaft relative to the housing. They are, therefore, particularly suitable for use in the housings for the conveyor pulleys, where misalignment can arise from errors of mounting or shaft deflection.

Spherical roller bearings
These are also suitable for use in the housings for conveyor pulleys because of their self-aligning properties. They are also particularly suitable for heavily loaded applications on account of their high load rating.

Bearing data

With the exception of seize-resistant bearings, data on all the other bearings included in this S-Range will be found in the SKF General Catalogue. The data for the seize-resistant bearings will be found in the table on pages 26 and 27.

Bearing arrangement design

Conveyor idlers – hostile environment

Bearing selection
Standard metric single row deep groove ball bearings from series 62 and 63 are usually recommended (see matrix on page 12). These are housed in the rollers and the arrangement must incorporate highly efficient seals. The seals must be compact axially, as this feature directly influences the bending moment in the spindle and, in turn, bending creates misalignment across the bearing. Because of this, it is normal practice to employ bearings with a C3 radial internal clearance.

Bearing arrangement
The bearings should be chosen to give a calculated life of between 20 000 and 50 000 hours. They are subject to outer ring rotation, hence an interference fit in the housing and a clearance fit on the shaft are required. Care should be taken to ensure that the spindle deflection does not cause the maximum permissible angular misalignment between the inner and outer rings of the bearing to be exceeded.

Generally, it is tradition to use the same type and size of bearings for the return and troughing idlers. However, as the load is generally lighter, it is possible to use smaller bearings for the return idlers, and sometimes this is done for reasons of economy in larger conveyor systems.

Tolerances

Shaft	h7
Housing	M7

Lubrication
A good quality lithium soap grease containing rust inhibitors is normally recommended. The grease is packed into the bearing arrangement at the assembly stage. Up to 75 % of the free space should be filled.

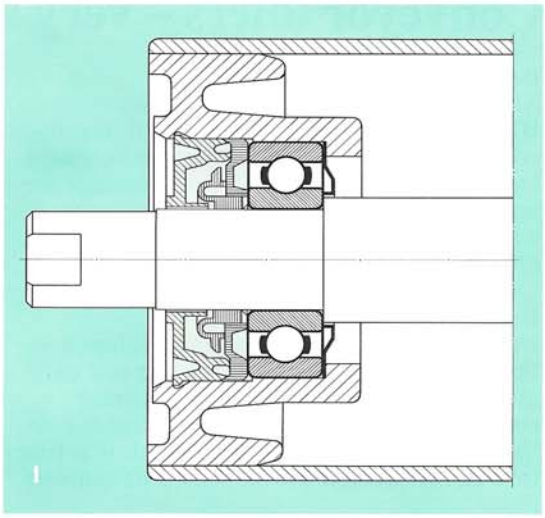
Seals

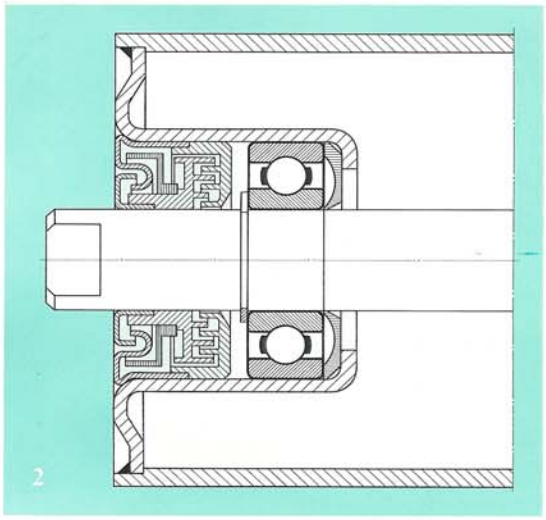
These can be placed into two categories, i.e. rubbing seals and labyrinth seals.

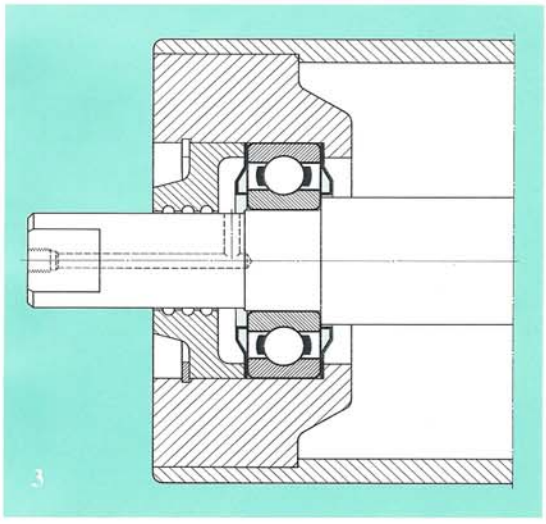
Rubbing seals can be designed for a wide range of pressures, the high pressure ones having good dirt excluding properties but unfortunately high friction, whilst the features of the low pressure seals are virtually the other way around.

Labyrinth seals are superficially attractive in that there is no rubbing contact and hence very little friction. Unfortunately, after a period of service under adverse conditions, they frequently clog with dirt, particularly when the conveyor is left unused for a period of time under alternately wet and dry conditions. In this contaminated condition, the resulting friction can be higher than that of a rubbing seal. To prevent this, supplementary mechanical seals or rubbing seals are incorporated in the arrangement both at the inboard and outboard positions.

Typical seal arrangements are shown in fig 1 to 3.







Conveyor idlers – very hostile environment

Bearing selection
SKF seize-resistant bearings, series BB1B 4202(00) and BB1B 4203(00), are recommended for this particular environment (see matrix on page 12). These bearings are specially designed to avoid seizure, even with high levels of contaminant within the grease.

Bearing arrangement
In the long conveyor, tension developed in the belt becomes the major factor not only in running power costs but also capital costs. The major capital cost is that due to the specification of the belt, which is a function of the tension developed. This tension load depends on the friction within the idler assembly, gravity effects due to an elevating run, and flexing of the loaded belt between the idler sets. The latter feature is much reduced by virtue of the high tension in a long conveyor. In the case of a long non-elevating conveyor the first function, i.e. friction within the idler assembly, becomes all important. In certain industries incidences of seized or near-seized idlers is acknowledged as a dangerous fire risk. The necessity to minimise friction within the idler assembly is important to the economies of the conveyor system, and in some industries, especially coal mining, vital to reduce fire risk.

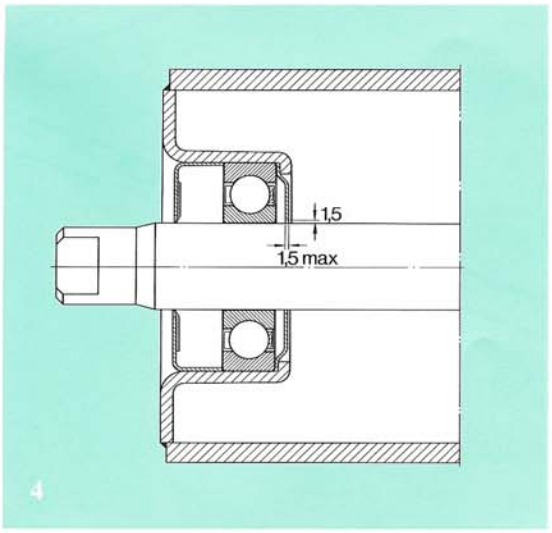
Friction with the idler assembly is influenced more by the seals than the bearing, but the use of the seize-resistant bearing permits the use of low friction seals.

Tolerances
The various recommended tolerances for shaft and housing will be found in the table on page 27.

Lubrication
A good quality lithium soap grease containing rust inhibitors is normally recommended. The grease is usually packed into the bearing arrangement at the assembly stage. Up to 75 % of the free space should be filled.

Seals
The recommended seal to be used in conjunction with seize-resistant bearings is the so-called "open" seal, which is a low-friction rubbing seal and, therefore, reduces power consumption. It incorporates a flexible diaphragm which exerts a very light pressure on a very narrow portion of the spindle. A further development is to have a simple grease retaining plate with a clearance to the spindle of 1,5 mm to allow for wear in the assembly. The plate can be of sheet steel, no more than 1,5 mm thick, so that it forms a "knife-edge" which restricts the lodging of dirt in critical areas.

Typical seal arrangements are shown in fig 4 and 5.



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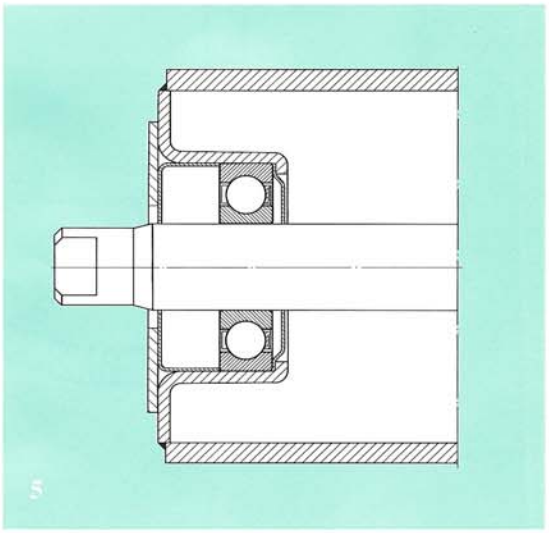
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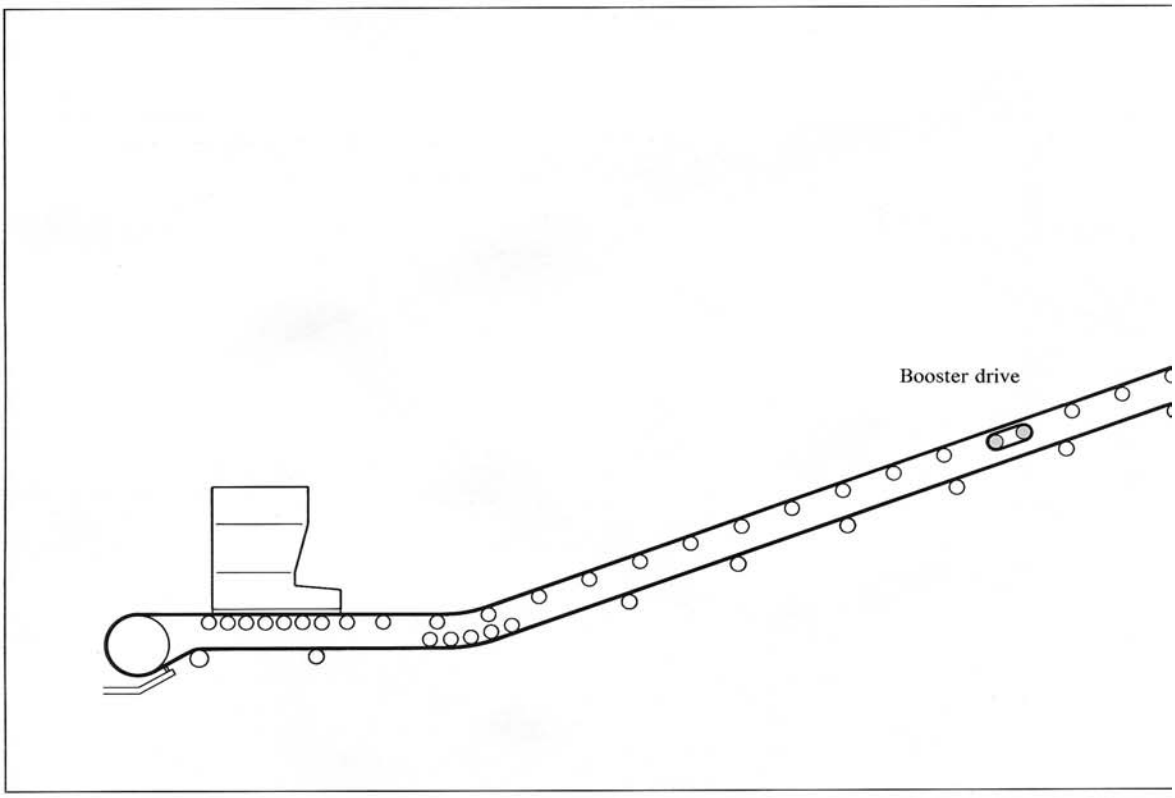
Conveyor pulleys

Bearings

A wide variety of bearing assemblies may be used but in general, the rotating speeds are moderate and this combined with mounting on flexing steel structures, means that the normal solution is the self-aligning spherical roller bearing, grease lubricated. For lightly loaded systems with shaft sizes less than 55 mm self-aligning ball bearings are frequently used. See matrices on pages 13 and 14.

The process of selection involves an assessment of the applied load, which is fundamental to conveyor design. Basic rating lives in the range between 40 000 and 50 000 hours are generally required. For very slow speed applications such as belt feeders and other systems, an additional check should be made to see that the load ratio C/P is at least 3,5 to avoid excessively heavy bearing loads.

Loads on the pulleys in the region of a tandem drive have to be calculated accurately, as do those for booster drives. Small axial forces will inevitably arise from the belt. These can be considered in the bearing calculation by including 5 % of the belt tension. The spherical roller bearings are able to accommodate considerable axial loads, so that problems are seldom encountered. Good alignment of the pulley in relation to the running belt means low axial forces. Particular attention has to be applied in this respect to a snub pulley working in conjunction with a drive pulley, see sketch below; the alignment of the snub pulley axis, relative to the main drive pulley axis should be within 6 minutes of arc (0,002 radians).



Housings

Standard cast iron plummer block housings can be used. These are economical and as they are split, inspection is facilitated. They are readily available, therefore the demand for spares can easily be accommodated. The whole range of SNA, SD 31 and SDJC 31 housings may be employed, preferably fitted with grease nipples. The tables on pages 22 and 23 show the bearings and adapter sleeves which are used with these housings, but fuller details will be found in the SKF General Catalogue and Product Information 102. Dimensional details of the SDJC 31 housings shown in the table will be found on page 28.

For series 230 CCK spherical roller bearings, SN 30 plummer block housings are available for sizes up to and including 23056 CCK. These are shown in a separate table on page 24 together with appropriate bearings and adapter sleeves. Dimensional details of these housings will be found on page 29. Details of suitable housings for bearing sizes greater than 23056 CCK will be supplied by SKF on request.

Some industries specify the use of cast steel housings. The strength of the spheroidal graphite cast iron SSNAD plummer block housings is equivalent to similar cast steel housings (SSNAD housings are dimensionally the same as SNA housings). However, where there is a preference for cast steel, 443000 and 444000 housings, which are of the plummer block type, are available. For heavily loaded conveyor systems, an extra heavy housing series is available namely the SBDS series, which are one-piece cast steel housings. Details of these housings and others not shown in the SKF General Catalogue can be supplied upon request.