SI 2079
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SERVICE INFORMATION

WEAR ON PLAIN BEARINGS – KS PERMAGLIDE® P1 MATERIALS COMPARED

Bearing materials are constantly being developed and optimised in view of their operating conditions. The performance characteristics of the materials are adjusted by adapting the formulation. For special operating conditions, the performance of the components intensively tested on test rigs to suit real-life conditions. On the other hand, materials for a broad range of applications are investigated using standard tests. A material that can be used universally demonstrates a good performance under many operating conditions and can be used for many standard components.

Tribology distinguishes between wet and dry running. All KS Permaglide® materials are always suitable for both application conditions but P1 materials offer advantages in dry running, while P2 materials are preferably used in lubricated applications.

KS Permaglide® P1 materials

KS Permaglide® materials are manufactured using a tried-and-tested multi-layer composite construction. P1 sliding materials consist of a steel back, a porous, sintered bronze sliding layer and the solid lubricant PTFE with bulking agents, and they differ in terms of the formulation of the solid lubricant and the bronze alloy.

Material	Bearing back	Sliding layer	Solid lubricant
P180	Steel	Tin bronze	PTFE, $BaSO_4$ and other bulking agents
P14	Steel	Tin bronze	PTFE, ZnS
P10	Steel	Tin-lead-bronze	PTFE, lead

Test parameters

Material wear is a complex process that is influenced by many parameters – in addition to purely mechanical, dynamic and tribological parameters such as lubrication and friction conditions, the condition of the interacting sliding partner, i.e. its material, hardness and roughness, has a significant impact.
A preference for a material under the respective usage conditions can be derived using tests under standardised conditions with one parameter being varied.

The following test rigs are presented for comparing standard components:

1. **Rotation in dry running**
2. **Rotation in dry running with edge load**
3. **Rotation in wet running**

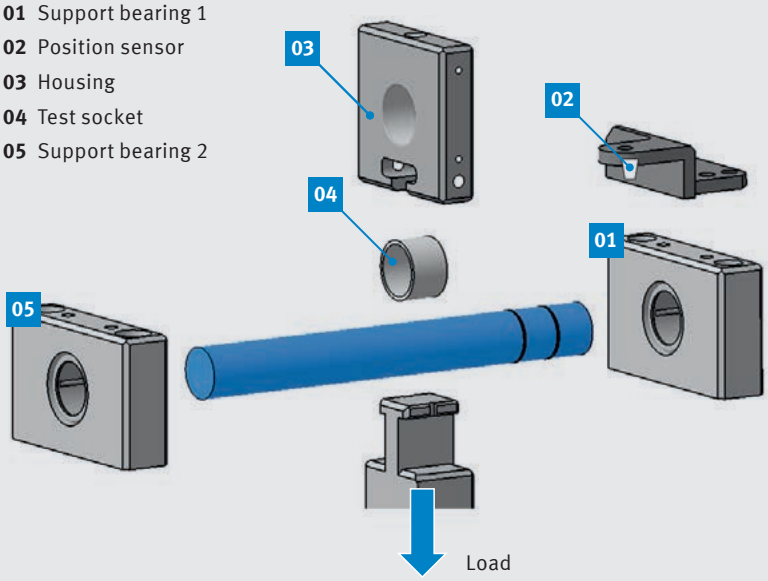
The new material KS Permaglide® P180 is characterised by the lowest wear amongst the materials tested and impresses both in dry running and in lubricated applications. This backs up the P180 material's credentials as a new universal material.

1. KS PERMAGLIDE® PLAIN BEARING TEST – ROTATION IN DRY RUNNING

Design and boundary conditions

- Bush dimensions
  Ø D_i 20 mm, Ø D_o 23 mm, W 15 mm
- Surface pressure 2 MPa
- Velocity 1 m/s
- Shaft material 100Cr6
- Hardness 58 + 2 HRC
- Roughness R_z 0.8 – 1.5 µm
- Conditions Dry, concentrated load

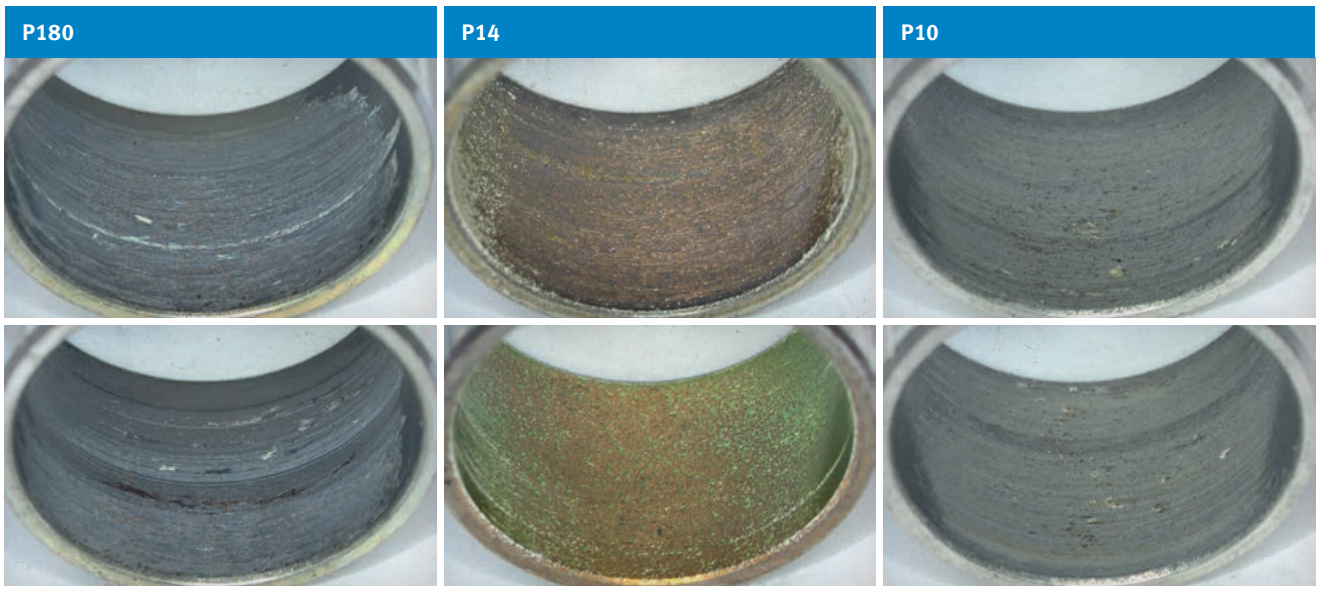
The test pieces are pressed into the housing. The load is introduced radially downwards via the housing. A shaft coupling drives the shaft.



Test setup for rotation in dry running

Test result

For the materials P180 and P10, the wear on the sliding layer is 75% lower than for the material P14. Macroscopically, this is clearly identifiable in the bronze sliding layer that is present on the full surface. The test parameters for the material P14 were at the load limit and in the case of material P14 in particular, the increase in the friction value could be observed as the temperature increased.



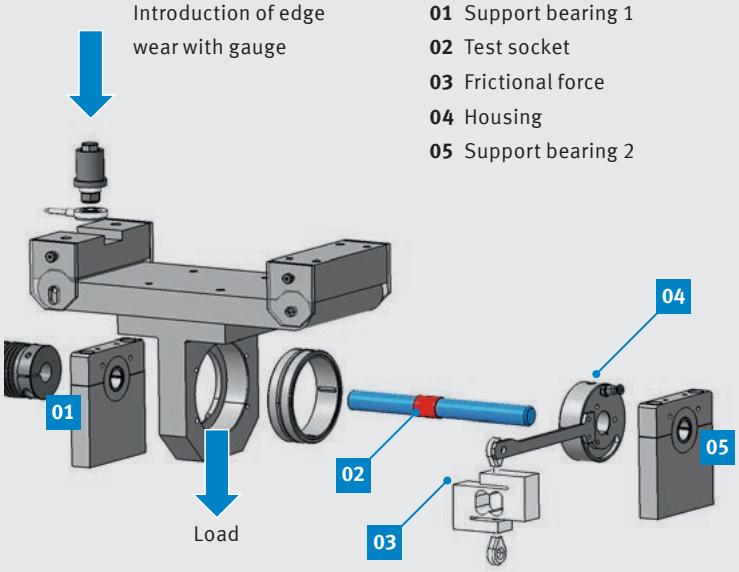
Wear on the sliding layer for P180, P14 and P10 plain bearings after the test rotation in dry running

2. KS PERMAGLIDE® PLAIN BEARING TEST – ROTATION IN DRY RUNNING WITH EDGE LOAD

Design and boundary conditions

- Bush dimensions
  Ø D_i 20 mm, Ø D_o 23 mm, W 15 mm
- Surface pressure
  gradually 1 to 17 MPa
- Velocity 0.15 m/s
- Tilting 70 µm
- Shaft material 100Cr6
- Hardness 58 + 2 HRC
- Roughness R_z 0.8 – 1.5 µm
- Conditions Dry, concentrated load

When testing with edge load, a tilting moment is introduced via the housing in addition to the static base load. The tilting can be increased in 10 steps of 1 MPa each.



Test setup for rotation in dry running with edge load

Test result

In this test, too, removal of the sliding layer is very different depending on the material and significantly lower for the material P180. In the case of edge riding, the run-in contact ratio increases with increasing wear, meaning that if the edge wear grows too great, seizure can quickly occur, which destroys the shaft.

Wear on the sliding layer for P180, P14 and P10 plain bearings after the test rotation in dry running with edge load

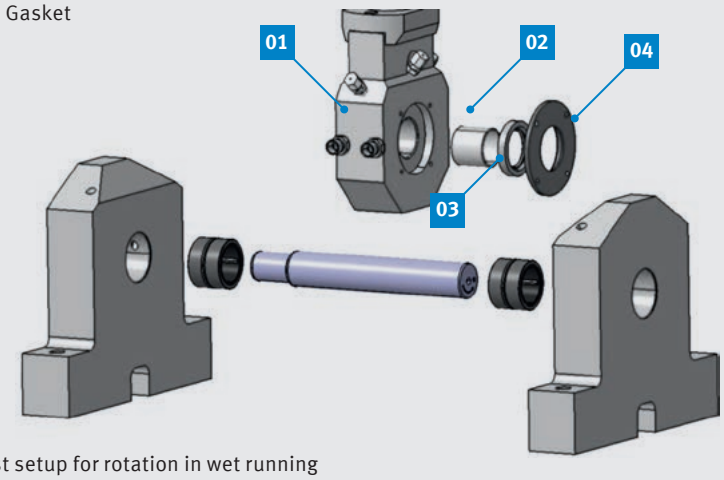
3. KS PERMAGLIDE® PLAIN BEARING TEST – ROTATION IN WET RUNNING

Design and boundary conditions

- Bush dimensions
  Ø D_i 20 mm, Ø D_o 23 mm, W 15 mm
- Oil type HLP 46
- Oil pressure 80 bar
- Dynamic load 60 MPa
- Velocity 6 m/s
- Shaft material 100Cr6
- Hardness 58 + 2 HRC
- Roughness R_z 0.8 – 1.5 µm
- Conditions Wet, concentrated load

Mixed friction conditions or hydrodynamic states can be investigated on wet test rigs. Signs of erosion can also be caused on a layer material.

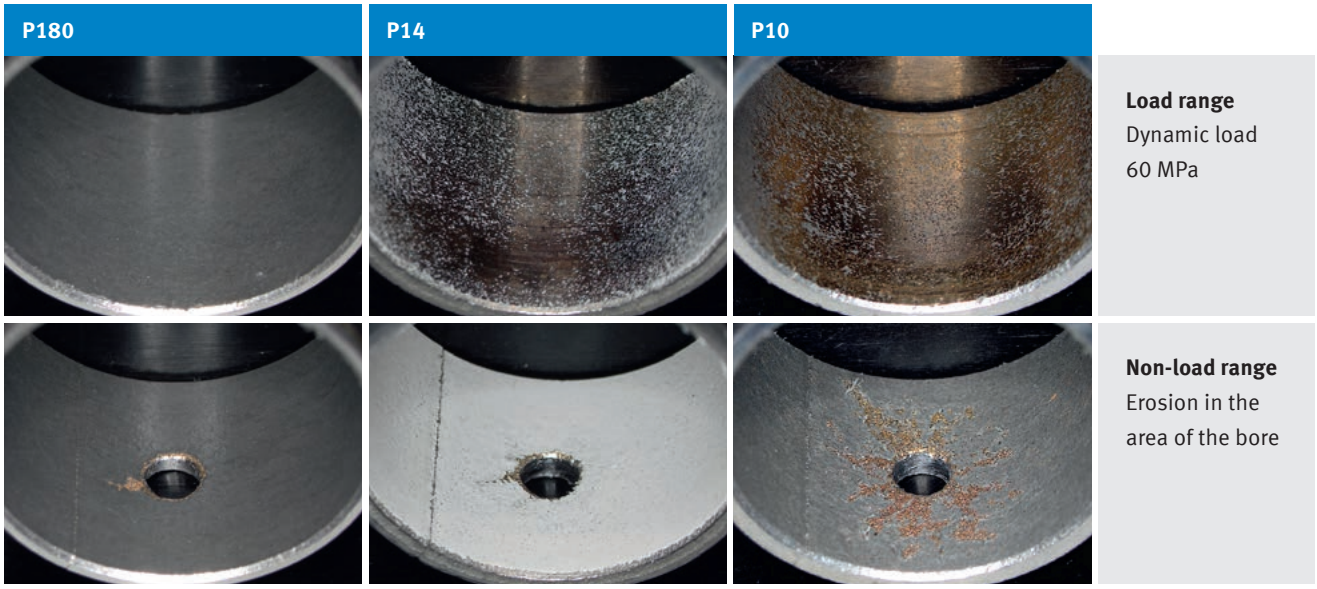
01 Socket housing with oil supply and temperature measurement
02 Test socket
03 Cap
04 Gasket



Test setup for rotation in wet running

Test result

The adhesion of the PTFE running-in layer can be regarded as equivalent for the materials P10 to P14. In these conditions, these materials tend towards flow erosion. The new material developed P180 with an almost intact surface proved to be much more resistant to erosion.



Load range
Dynamic load
60 MPa

Non-load range
Erosion in the area of the bore

Wear on the sliding layer for P180, P14 and P10 plain bearings after the test rotation in wet running