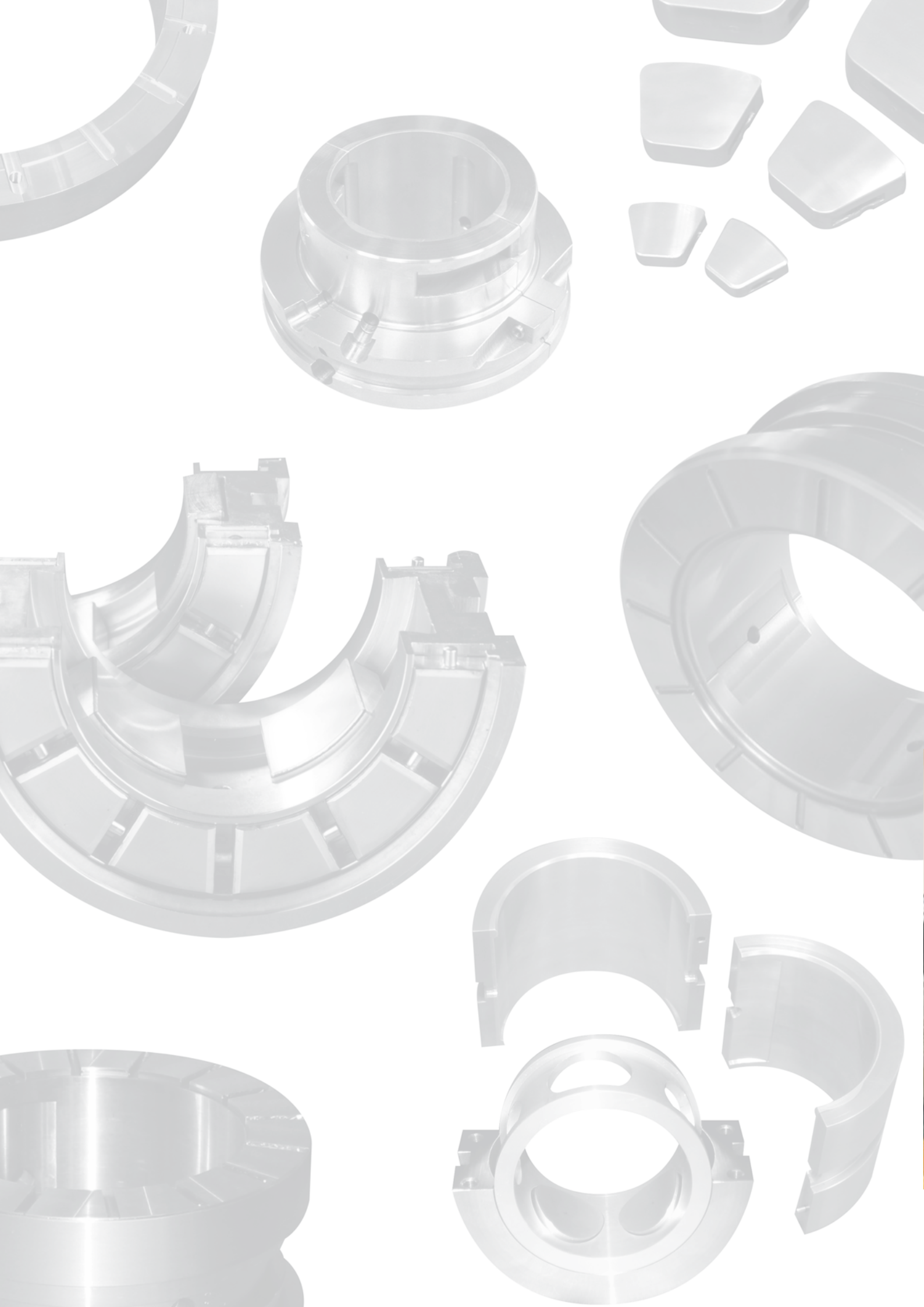


**St/WM-multilayer plain bearings**  
*Hydrodynamic and hydrostatic bearings*





## **Plain bearings**

### *General*

**The plain bearing is one of the oldest and, at the same time, one of the most advanced machine elements.**

**»A plain bearing forms only one part of a tribological system. The required operational safety can only be achieved when both other partners of the system, i.e. the shaft and the lubricant, fully meet all the requirements placed upon them!«**

**Cylindrical journal bearings had already been designed and successfully used a long time before their functioning was fully understood and could be calculated.**

**The question as to whether plain bearings or roller bearings are more favourable cannot be answered in general, but has to be dealt with in each individual case. Both bearing types have their inherent characteristics and advantages that have to be carefully considered with regard to their respective requirements before making a decision.**

**Today, a great number of special designs such as multi-surface plain bearings, offset bearings, and tilting pad bearings ensure that optimum plain bearings can be built for a wide range of loads and rotational speeds in order to meet the highest demands placed upon their functioning and operational safety.**

**The operational safety of our plain bearings is granted through a comprehensive performance for our customers. Taking the operational data as the starting point, we compute and design the plain bearings, manufacture them in a state-of-the-art quality with the help of modern facilities and support our customers in the application of our products.**

**With regard to technical advice, prototype manufacture and practical testing, our high-capacity Product Development Department is at your disposal at any time.**



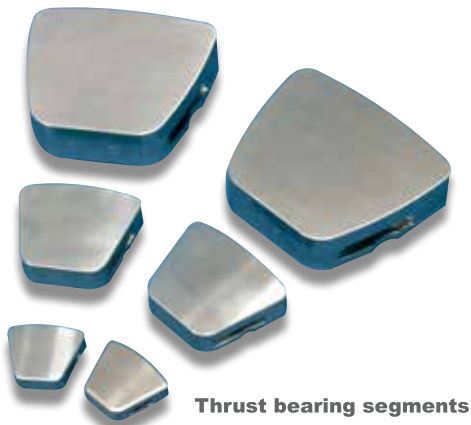


**St/WM-multilayer plain bearings**  
*Hydrodynamic and hydrostatic bearings*

We manufacture hydrodynamic and hydrostatic bearings under the product designation St/WM, in particular:

- plain journal bearings
- plain journal and thrust bearings
- tilting pad journal bearings
- tilting pad journal and thrust bearings
- thrust rings
- tilting pad thrust bearing

For the material combination, we preferably use support shells of C10 or C15, and employ tin or lead alloys of high purity to be used as bearing materials.



Thrust bearing segments

**Fields of application**

Established fields of application are:

- piston and rotary pumps
- piston and turbo-compressors
- turbines
- couplings
- electric motors and generators
- machine-tools
- gears
- bearings for rolls
- cement and lime plants
- crushers and comminution installations
- gas machines
- blowers/ventilators
- mills and framed saws
- tube mills
- grinding spindles
- presses and centrifuges
- printing and paper machines

**Advantages**

The essential advantages of plain bearings are:

- simple structure and little radial space required
- split bearings for easy maintenance
- noise-free operation, also with high rotational speeds
- optimum attenuation of vibrations
- immunity to shock loads
- wear-free operation with lowest and highest rotational speeds
- long service-life without material fatigue
- increased price advantage of plain bearings against roller bearings with increasing constructional size
- cost-efficient repair of large plain bearings in case of damage



tilting-pad bearing



norixlager®



You obtain optimized bearings by making use of the classical advantages of hydrodynamic plain bearings in comparison to other bearing types.

The field of application of multilayer plain bearings can be expanded considerably by hydrostatic bearings offering utmost guiding precision and maintaining the bearing capacity during standstill, too.

**From product development to manufacturing**  
*All advantages from one single partner*



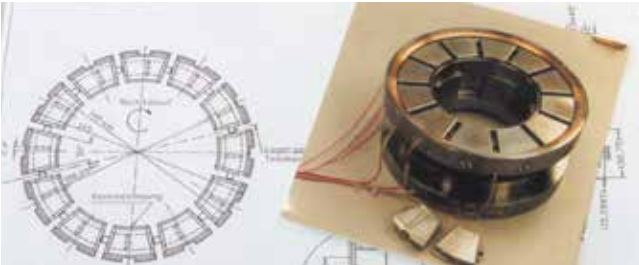
**We research and develop**

**We are curious by nature and believe that a stand-still means nothing else but a step backwards. That is why we research in close co-operation with Universities and skilled specialists to develop new plain bearing technologies. Some of the results are really exciting.**



**We test**

**In order to test the design and the computer simulations, we build your prototypes to test them on our test rigs, e.g. on the high-speed plain bearing test bench stand shown in the adjacent photograph.**



**We plan and design**

**Make use of our experience in research, development, and product design. In the case of new machine developments with bearing applications, we recommend you to contact us already during the planning or design stage. We will provide you with detailed installation proposals and the best solutions to your problems.**



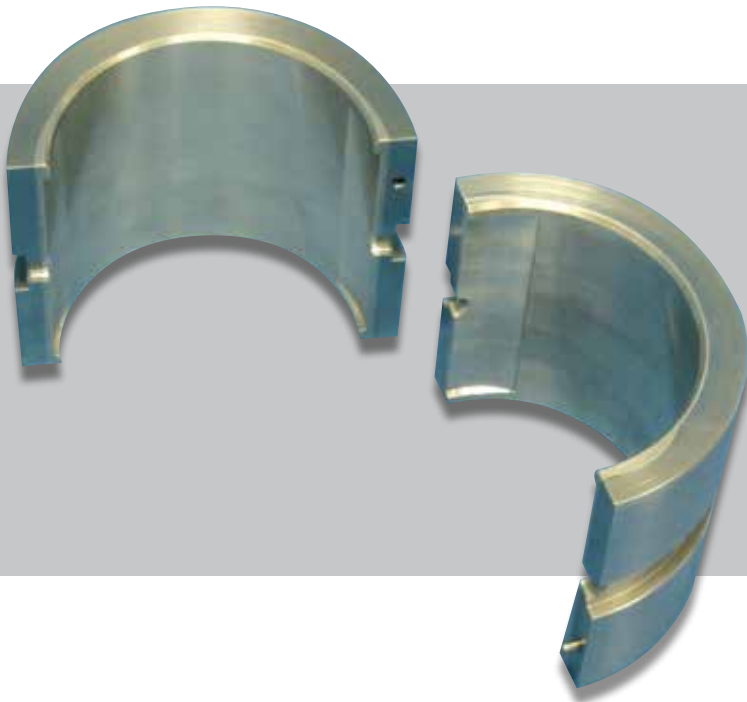
**We manufacture**

**The experience of our qualified employees together with the latest manufacturing methods combined with a modern quality management certified to DIN EN ISO 9001 guarantee you a high quality standard as well as delivery in due time.**



**We compute, help and advise**

**After making the decision on the optimum bearing type and lubricant, we employ our proven computing methods to determine the bearing capacity, the friction, lubricant requirements and wear resistance. We can provide you with all important data for a secure bearing operation. After installation and during operation of the bearings, we are at your disposal to provide you with further service at any time.**





**Our delivery programme**  
*Individual items or in series production - ready for installation*

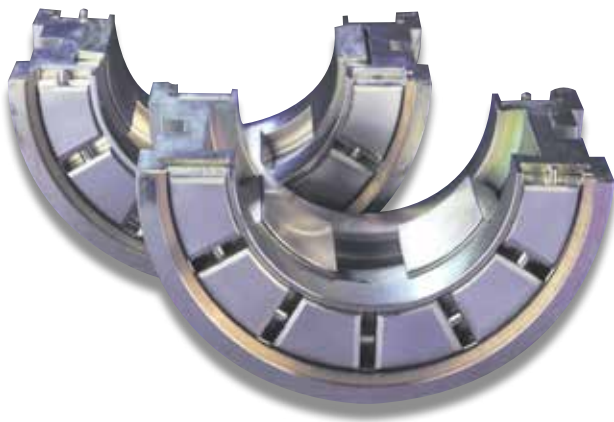
**Hydrodynamically lubricated radial bearings (journal bearing)**

- Circular cylindrical radial bearing, e.g. as per DIN 7473
- Split bearings, e.g. as per DIN 7474
- Bearings as per DIN 31690, Part 2, with cylindrical, concentric, or spherical seats
- Multi-surface plain bearings, e.g. bearings with oval clearance, offset bearings, lobed bearings with 3 or 4 lobes
- Tilting pad bearings for radial or combined radial/axial load
- With thrust collar on one or both sides
- With hydrostatic discharge to serve as starting and run-down assistance
- With electrical insulation against voltage punctures



**As per customer's specification or as per own design**

- Eccentric bushes
- Oil ring bearing
- Thrust washers
- Bearing rings with and without flange
- Floating plain bearings
- Slide plates
- Guide shoes
- Crossheads
- Hydrostatically lubricated journal and thrust bearings



**Hydrodynamically lubricated axial bearings (thrust bearing)**

- Circular or split design
- Operational on one or both sides, with reduced thrust surface
- For one or two directions of rotation
- With rigid slide surfaces or tilting pads
- For single or changing directions of rotation
- With circular tilting pads



**Repair and overhaul**

Apart from the manufacturing of new multilayer plain bearings, we also repair used bearings by applying a new lining of bearing metal with the following pre-machining or finish.

Bearing metals and support shells

Chemical composition						
% (mass)	MW 10	MW 80	MW 81	MW 81 S	MW 88	MW 89
Pb	Rest	2	max. 0,06	max. 0,06	max. 0,06	max. 0,06
Sn	9 – 11	80	81	81,3	88	89
Cd	-	-	1,2	-	0,8	-
Cu	0,7	6	5,0	6	3,5	3,5
Sb	14 – 16	12	12	12	7,5	7,5
Ni	-	-	0,3	-	0,2	-
As	0,6	-	0,5	Ag 0,1	<0,1	-
Zn				0,6		-

Technological data*							
Hardness and elevated temperature hardness							
HB 10/250/180	20 °C	21	27	35	24	28	23
	50 °C	16	23	28	20	23	17
	100 °C	15	13	17	12	16	10
	150 °C	10	7	10	10	9	8

Tensile stress								
0,2% Proof stress	R <sub>p0,2</sub>	MPa	43	62	84	76	66	46
Tensile strength	R <sub>m</sub>	MPa		89	102	78	100	77
Extension	A <sub>5</sub>	%		3,0	1,5	1	8,4	11,2
Elastic modulus	E	MPa		55700	52500	57000	49500	56500

Compression stress			20°C	100°C	20°C	100°C	20°C	100°C	20°C	100°C	20°C	100°C
0,2% Offset yield strength $\sigma_{d0,2}$	MPa		62	37	80	48	90	50	63	30	47	27
2% Offset yield strength $\sigma_{d2}$	MPa		87	69	122	80	107	64	103	60	76	45
Compression strength $\sigma_{dB}$	MPa		189	121	195	126	190	91	235	136	157	100
Strain at failure $\varepsilon_{dB}$	%		46	53	34	34	36	44	39	44	47	50

Bonding strength								
(steel C 10; bearing metal thickness = 6mm) (DIN ISO 4386, Part 2)								
	R <sub>CH</sub>	MPa	70	39	98	71	86	75

Dynamic stress								
Fatigue strength under reversed bending stresses								
	σ <sub>bW</sub>	MPa	±25	±28	±39	±35	±33	±29

Impact fatigue limit							
Average number of impacts before breaking			490	910	2856	2689	3741
Average work resulting from impacts before breaking	J		134	250	785	739	1028

\* The indicated values are average values.

Physical data*						
	MW 10	MW 80	MW 81	MW 81 S	MW 88	MW 89
Density kg/dm <sup>3</sup>	9,9	7,39	7,34	7,35	7,35	7,4

Linear extension coefficient						
at 20 – 100 °C mm · (mm · K) <sup>-1</sup> · 10 <sup>-6</sup>	24,0	21,6	20,2	21,0	23,8	23,4

Thermal analysis						
Lower melting point °C	240	183	235	235	233	233
Upper melting point °C	270	400	390	360	360	360

Casting temperature						
°C	480 – 520	520	520	540	440	440

\* The indicated values are average values.

Quality

Main-Metall is certified in accordance with DIN EN ISO 9001. In manufacturing our bearings, the materials and the manufacturing process in the mechanical workshop are subject to continuous quality tests with permanent documentation after each of the working steps. The tests are performed by employees independent from manufacturing and in accordance with internal quality guidelines or the regulations DIN 31670-8 »Test techniques and testing of the quality characteristics of geometry and material of plain bearings «.

We inspect:

- chemical analysis of the bearing metal and of the support shell material.
- geometrical measurement, test on deviation of shape and positional deviations.
- surface roughness.
- absence of cracks and lack of fusion with the help of the dye penetration test ISO 4386-3.
- non-destructive ultrasonic testing for lack of bonding. This is realized with several ultrasonic test units equipped with special sound heads. The test itself is made in accordance with the ISO guidelines 4386-1, testing class 1, 2, or 3 depending on the requirement.
- hardness test of the bearing metal according to DIN ISO 4384-1.
- in addition, there are destructive test methods for the mechanical workshop area available to be applied for random testing. This includes particularly the hammer-and-chisel test as a reliable checking method within the foundry industry, moreover the Chalmers test following the guidelines of the Tin-Research Institutes London or the destructive fusion test as per ISO 4386-2.
- the inspection of the metallic structural constitution is done microscopically.
- upon request, a micrograph can be produced.

The results of the final inspection are recorded in works protocols to serve as documents for the certification of material specification tests as per DIN EN 10204. Upon request, these documents are provided in the form of works certificates, test certificates and acceptance test certificates, and are enclosed with the delivery documents. Additionally, acceptance tests can be agreed upon and performed in our works by representatives of the customer.

Bearing metals

Metallic sliding materials used for multilayer plain bearings are mainly leaded bronze materials and lead, as well as tin cast alloys. Apart from the main components tin, lead and copper, these bearing metals contain antimony as a hardening alloy element. The bearing metals based on lead and tin have a characteristic structural constitution. Primarily or secondarily separated hard and brittle inter-metallic compounds are embedded in a soft eutectic basic mass. This is called a heterogeneous structure and is of great importance for the technological characteristics and the operational behaviour of the bearing.

The two most important alloy groups are:

- alloys rich in tin and lead-restricted, lead-free and cadmium-free alloys containing 80 % or more tin,
- alloys rich in lead with approx. 75 to 80 % lead and 1 to 12 % tin.

In our foundry, only original primary metals as per DIN ISO 4381 or high-quality lead and tin cast alloys of leading metallurgical works are being used. Upon request of the customer, it is also possible to cast any other standard or commercially available bearing metal on a lead and tin basis

Support shells

For the manufacture of support shells we use cast, forged and rolled metals under the consideration of DIN ISO 6280, predominantly made of:

- steel C10E or C15E as per DIN EN 10084 (with a content of C of up to a maximum of 0,25 %)
- cast copper alloys as per DIN EN 1982, e.g. CuSn12-C or CuSn7Zn4Pb7-C
- CuCr1Zr as per DIN EN 12420
- cast steel as per DIN EN 10293
- cast iron as per DIN EN 1561
- nodular cast iron as per DIN EN 1563

The premise for operationally safe multilayer plain bearings are support shells materials establishing an optimum bond with the bearing metal, e.g. the above mentioned low-carbon steels or cast copper alloys. All bonding surfaces have a surface roughness of Ra = 4 to 8 µm as per DIN ISO 6280.



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