Wolf Kunststoff-Gleitlager GmbH

ZEDEX®

Tribological Polymer Parts

SUCCESSFUL COMPONENTS AND APPLICATIONS MADE OF OUR PLASTICS

A word about our products and services

Since the usage of plastic wear elements could lead to problems, the decision concerning whether, where and how plastic can be used, requires a high degree of experience. For example in a gear construction already in use, it is not enough to replace an existing metal gear by a plastic one, without letting a specialist analyse the installation, construction and loads to which the gear will be subjected.

Services

Since decades we are specialized in solving problems, that may come into being using plastic wear elements. Your benefits start with a customer service and problem analysis. A subsequent dimensioning lead to an optimum material selection or, if no ideal materials are in our range, to an optimum material formulation, that permit us to developed and produce the compound according to the customer's initial requirements. Then after a plastic-oriented design of all components follows the prototyping of the parts, which are subjected to bench tests under simulated field conditions. Afterwards successful field trials at the customer's, we will select the optimal production process and manufacture the mass production.

Experience

The long experience in this field, has led us to offer nowadays a wide range of semi-finished plastic products and standard parts, which are used not only in easy way applications, but often also in complicated ones, in which they achieve better results than metal parts. Thanks to decades of experience, we are now in the position, to manufacture not only plastic parts, but also to advise our costumers at best and to let them take advantage of our know-how.

Know-How

From the problem statement to the volume production, new plastic wear parts are especially developed and designed by the specialists of the company Wolf to fulfil the customers requirements always taking into account their installation; examples include: plain bearing bushes, sliding rails, threaded nuts, gears, timing pulleys, track rollers, bearing shells, metal-plastic cladding strips, plastic sheathing of metal rollers, wear items according to customer drawings, etc...

Our services at a glance:

- ✓ Laboratory tests, plastic testing, damage analysis
- ✓ Design, calculations and helpdesk, Compound development with specific properties
- ✓ Training courses on the subject of plastics

Our products:

- ✓ Granules
- ✓ Semi-finished products
- ✓ Finished products (injection-molded, machined, 3D)
- ✓ Coating
- ✓ Polyurethane for marine-and pump-sector etc.

Legend

Part icons

 Plain bearing bushes	 Bearing shell	 Drum	 Gear
 Thrust bearing	 Bearing segment	 Linear guideways	 Seal
 Slotted bushing	 Cross grooves structure	 Wiper / scraper	 Pipeline
 Flanged bushing	 Track roller	 Threaded nut	 Ball joint

Requirement icons

 High temperatures	 Chemicals	 Impacts and vibrations	 Antistatic
 Contact with water	 Edge pressure	 High PV values	 Electrically conductive
 Abrasive particles	 High load	 High precision	

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Industrial machine and plant production 18-62

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ZX-100 Family

The "little" PEEK

The All-round solution for various fields of application. Whether in food industry or for rough outdoor use. It is designed for dry-running operations, and compared to bronze you save in weight and costs.

What can be replaced? (Relative values, 10 = good, 1 = bad)

	Temperature	Strength	Resilience	Friction	Precision	Wear	Cost	PV-value	Chemicals	substitutes for
ZX-100K	**4**	**6**	**7**	**8**	**7**	**9**	**9**	**6**	**3**	
ZX-100A	**1**	**5**	**7**	**7**	**5**	**9**	**9**	**6**	**3**	
ZX-100EL55/63	**1**	**1**	**8**	**5**	**3**	**4**	**9**	**1**	**3**	
ZX-100MT	**4**	**7**	**6**	**8**	**8**	**8**	**9**	**5**	**3**	
PA 4.6	4	7	7	4	2	4	9	4	3	
PA6	2	5	7	3	4	7	10	4	3	
PA6.6	2	6	7	3	3	4	10	4	3	
PA6G	2	5	7	4	3	4	10	4	4	
PE UHMW	2	2	9	9	1	8	10	3	6	
PTFE + 60 % Bz	8	2	5	6	3	4	6	3	2	
PVDF	5	4	8	6	3	7	7	3	7	
POM	2	6	6	7	3	6	10	4	3	
PET	3	6	7	4	6	4	10	4	3	
PBT	3	6	6	5	2	4	10	3	3	
Stainless steel	9	10	5	2	10	3	8	1	8	
Sintered bronze	8	10	5	5	10	4	6	2	1	

ZX-324 Family

The Allrounder, as PEEK, only better

For high temperatures combined with high surface pressure. ZX-324 is based on PEEK, but has got a higher wear resistance than PEEK.

What can be replaced? (Relative values, 10 = good, 1 = bad)

	Temperature	Strength	Resilience	Friction	Precision	Wear	Cost	PV-value	Chemicals	substitutes for
ZX-324	**8**	**7**	**5**	**7**	**7**	**4**	**3**	**6**	**8**	
ZX-324V1T	**8**	**8**	**4**	**8**	**7**	**3**	**3**	**6**	**6**	
ZX-324V2T	**8**	**6**	**5**	**8**	**7**	**4**	**3**	**7**	**9**	
ZX-324V11T	**7**	**7**	**4**	**6**	**8**	**4**	**4**	**8**	**8**	
ZX-324VMT	**8**	**8**	**3**	**8**	**9**	**9**	**2**	**7**	**8**	
PEEK	8	6	7	5	7	4	3	6	8	
PPS	6	7	3	6	8	2	6	2	9	
PEI	6	6	8	5	8	3	6	2	4	
TPi	8	6	6	5	7	4	3	6	7	
Ceramic Al_2O_3	10	10	1	10	10	4	3	5	9	
Stainless steel	9	10	5	2	10	3	8	1	8	

ZX-410 Family

The precise

For the middle sliding speed areas, high surface pressure and high precision - even at high temperatures.

What can be replaced? (Relative values, 10 = good, 1 = bad)

	Temperature	Strength	Resilience	Friction	Precision	Wear	Cost	PV-value	Chemicals	
ZX-410	**8**	**7**	**4**	**6**	**9**	**7**	**5**	**8**	**5**	
ZX-410V7T	**8**	**8**	**3**	**8**	**10**	**9**	**4**	**8**	**6**	
ZX-410VMT	**8**	**8**	**3**	**7**	**9**	**8**	**5**	**8**	**6**	**substitutes for**
PEEK	8	6	7	5	7	4	3	6	8	
PEEK mod.	8	8	3	8	9	9	2	7	8	
PEI	6	6	8	5	8	3	6	2	4	
PA12	3	3	9	6	3	4	9	3	3	
PA 4.6	4	7	7	4	2	4	9	4	3	
PPS	6	7	3	6	8	2	6	2	9	
TPi	8	6	6	5	7	4	3	6	7	

ZX-530 Family

The Specialist for chemicals

Particularly well suited for applications where aggressive chemicals are used. ZX-530 combines the advantages of ceramic and PTFE, and offers high wear resistance and low friction.

What can be replaced? (Relative values, 10 = good, 1 = bad)

	Temperature	Strength	Resilience	Friction	Precision	Wear	Cost	PV-value	Chemicals	substitutes for
ZX-530	**7**	**6**	**5**	**6**	**7**	**9**	**5**	**9**	**9**	
ZX-530CD3	**7**	**6**	**3**	**7**	**8**	**10**	**4**	**7**	**9**	
ZX-530KF15	**7**	**7**	**3**	**6**	**8**	**8**	**5**	**7**	**9**	
ZX-530EL3	**6**	**6**	**6**	**7**	**7**	**8**	**5**	**7**	**7**	
ZX-530EL3AG2	**6**	**6**	**6**	**7**	**7**	**8**	**5**	**7**	**7**	
PTFE	8	2	9	9	3	2	8	1	10	
PEEK	8	6	7	5	7	4	3	6	8	
PBT	3	6	6	5	2	4	10	3	3	
PVDF	5	4	8	6	3	7	7	3	7	
PPS	6	7	3	6	8	2	6	2	9	
Stainless steel	9	10	5	2	10	3	8	1	8	
Ceramic Al_2O_3	10	10	1	10	10	4	3	5	9	
TPi	8	6	6	5	7	4	3	6	7	

ZX-550 Family

The alternative to PTFE

The alternative to PTFE and PTFE compounds - with better creep resistance, less wear and higher PV-values.

What can be replaced? (Relative values, 10 = good, 1 = bad)

	Temperature	Strength	Resilience	Friction	Precision	Wear	Cost	PV-value	Chemicals	
ZX-550	**8**	**2**	**7**	**7**	**3**	**9**	**3**	**4**	**10**	
ZX-550PV	**8**	**2**	**8**	**9**	**3**	**9**	**4**	**5**	**10**	**substitutes for**
PTFE	8	2	9	9	3	2	8	1	10	
PTFE+60% Bz	8	2	5	6	3	4	6	3	2	
PVDF	5	4	8	6	3	7	7	3	7	
PE UHMW	2	2	9	9	1	8	10	3	6	

ZX-750 Family

The king's class

ZX-750 has got the highest PV-values of the ZEDEX® materials.
Also at temperatures of 300°C it keeps a straight face.

What can be replaced? (Relative values, 10 = good, 1 = bad)

	Temperature	Strength	Resilience	Friction	Precision	Wear	Cost	PV-value	Chemicals	
ZX-750V5T	**9**	**8**	**7**	**6**	**7**	**10**	**2**	**10**	**8**	
ZX-750V5KF	**9**	**8**	**5**	**7**	**10**	**10**	**2**	**8**	**8**	**substitutes for**
PEEK	8	6	7	5	7	4	3	6	8	
PAI	8	7	6	4	8	5	4	7	6	
PI	8	7	7	4	7	9	2	8	7	
TPi	8	6	6	5	7	4	3	6	7	

Sliding elements in sawing machine

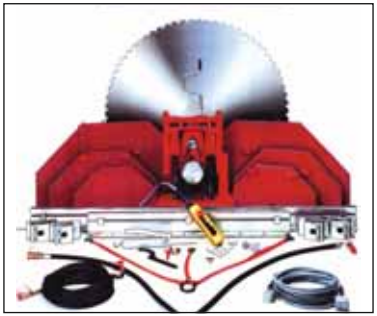
Material
ZX-100MT

Description of the application
Sliding surfaces in concrete sawing machine as dirt resistant bearing. The sliding guides are used to guide the saw table, which leads the concrete parts during the cutting.

Problem
Concrete dust, concrete grit and cooling emulsions penetrate into the bearing. A long life, high precision, low friction and a low price was requested.

Problem-solving
Slideway made of ZX-100MT with a honeycomb structure able to collect the grit, meet the required properties. The slideway have following dimensions 60 x 40 x 20 mm, and its groove width is 1,75 mm and depth 4 mm.

Advantages
Low wear, lubrication is no longer required. High cost reduction thanks to the injection moulding production.



Slide bush in hacksaw

Material
ZX-100K as replacement for bronze.

Description of the application
The slide bush made of ZX-100K used as slideway in a hacksaw, it replaced the bronze material.

Advantages
Price reduction and low wear.

Slideway in a grinding machine

Material
ZX-100K as replacement for bronze.

Description of the application
Slideways made of bronze for a grinding machine were replaced from those made of ZX-100K.

Problem
Abrasive dust can enter in the bearing's seat; lubrication should be avoid.

Problem-solving
Unlike bronze, with ZX-100K a lubrication can be eliminated.

Working life
Although the slideways are persistently exposed at abrasive dust, the working life with the usage of ZX-100K was significantly increased

Advantages
Low wear, dry running.

Threaded nut in the drive of cross table

Material
ZX-100K as replacement of PTFE

Description of the application
The threaded nut described here is used in the drive of cross tables (XY positioning system). The up-to-now used material was PTFE and its hub is 25 mm. The polished and hardened threaded rod (60 HRC) is driven from a step motor.

Load
$F_a = 30\,N$
$n = 790\,min^{-1}$

Problem
Stick-Slip-free, dry-running, highly accurate positioning and in addition, because of the machine is driven by a stepper motor, also a high damping were required.

Problem-solving
A threaded nut TR12 x 3 made of ZX-100K is used, which in comparison to the previously used PTFE is much shorter.

Working life
It reaches a minimum working life of 10 years.

Advantages
Unlike a ball screw spindle, the pair trapezoidal threaded rod and the made of ZX-100K threaded nut, has got an excellent damping. The highest accuracy is achieved. Through a thin-wall zone, in which the threaded nut has got no thread, it can be easily preloaded, whereby a positioning accuracy of 1 micron can be achieved. The backlash (lost motion) is reduced to 0.

Slideway in machining center

Material
ZX-100K as replacement for PTFE and PTFE compound.

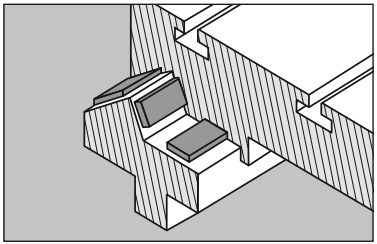
Description of the application
The application concerns to sliding guides made of PTFE, which carry the bearing of the machining center.

Problem
Plastic deformation (creep), thereby guidance inaccurate, low vibration absorption, bad bondability, high friction, high wear, thereby low working life, bad emergency running properties.

Problem-solving
Here ZX-100K slide guides were used in place of the PTFE ones, and they have been bonded to the existing working table.

Working life
The previously used guides reached a working life of 1,5 years. With the ZX-100K slide guides a working life of 4 years with a greater accuracy is now achieved.

Advantages
High positioning accuracy, high vibration absorption, durable bonding, lower friction forces, thereby less energy costs, low wear, long working life and excellent emergency running properties in case of lubrication failure.



Industrial machine and plant production

Slideway in machining center

Material
ZX-100K as replacement
for PTFE-bronze compound.

Description of the application
The sliding guide (previously made of PTFE-bronze compound) is used in a horizontal machining center. The component is used as a guide for the vertical and horizontal axis of the pallet supply system.

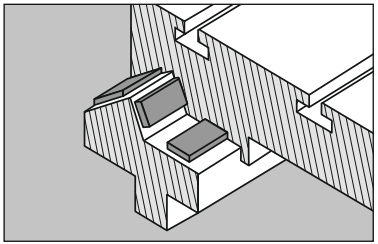
Load
The sliding speed is ca. 15 up to 20 m/min. The surface pressure is 0,1 N/mm². It is used at room temperature.

Problem
The wear of the up-to-now used material was too high. A material with improved wear characteristics was searched. The fastening should be realized with a bonding system and it should permanent last.

Problem-solving
Instead of the PTFE-bronze compounds now massive sliding guides made of ZX-100K are bonded.

Working life
Since 1999, the sliding guides made of ZX-100K have been used as standard feature.

Advantages
Thanks to the good bondability, the slide guides made of ZX-100K could replace the PTFE-bronze compound ones. A subsequent machining when assembled is no longer required. Also the wear has been reduced. The material tends to creep significantly less than the previously used material.



Slideway in a CNC-lathe

Material
ZX-100K as replacement
for PTFE Bronze-Compound.

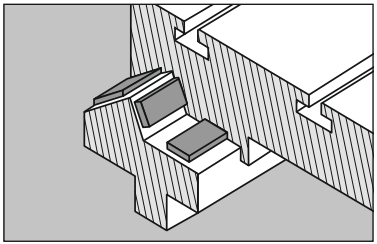
Description of the application
Previously a PTFE-bronze compound as material for sliding guide in NC lathes was used.

Problem
High plastic deformation (creep), thereby dramatically guidance inaccurate, low vibration absorption, bad bondability, thereby no durable connection, high friction forces, high wear, thereby low working life, bad emergency running properties.

Problem-solving
The previous material has been replaced by ZX-100K slideways, which were easily bonded onto the existing working table.

Working life
The previous guides achieved so far a working life of only 2,5 years. With the ZX-100K sliding guides a working life of 7 years has been achieved, with a considerably higher accuracy.

Advantages
High positioning accuracy, high vibration absorption, durable bonding, lower friction forces, thereby less energy costs, low wear, long working life and excellent emergency running properties in case of lubrication failure.

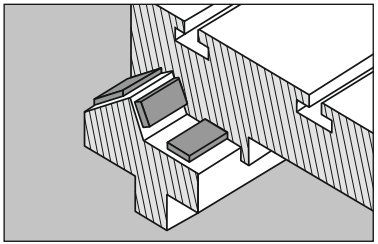


Slideway in a CNC-lathe

Material
ZX-100K

Description of the application
For guiding the support in CNC lathes
slide guides made of ZX-100K can be used.

Advantages
The sliding guides made of ZX-100K allow an exact guidance.
Through the usage of ZX-100K one can get along without lubrication.
Thanks to the low wear, a long working life is to be expected.



Turret bearing in a CNC-lathe

Material
ZX-100K

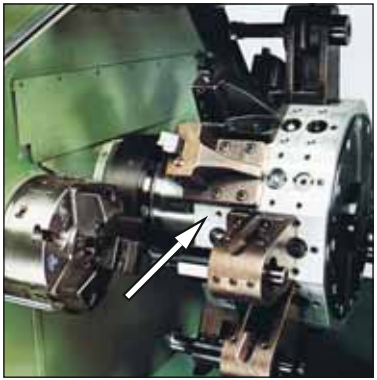
Description of the application
A suitable material for a backlash-free plain bearing bush of the turret in a CNC-lathe was searched.

Problem
The previous material was too expensive and had a high break-loose torque.

Problem-solving
Here was used a plain bearing bush made of ZX-100K, which operates backlash-free.

Working life
The bushing is been used since 1985 without any problem.

Advantages
Price reduction and longer working life.



Industrial machine and plant production

Ball joint in machining center

Material
ZX-100K as replacement for bronze.

Description of the application
Ball joint made from ZX-100K for swivelling bearing guidance of power and control lines.

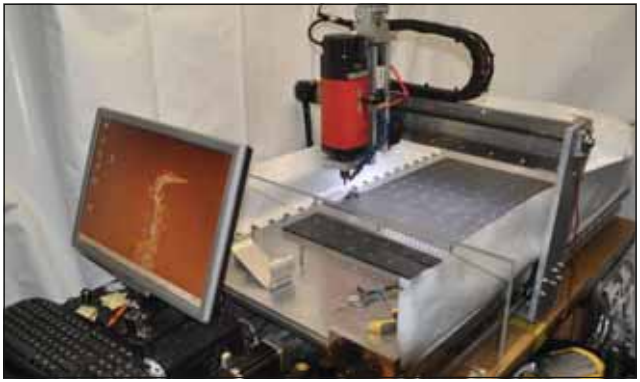
Advantages
Using ZX-100K in dry running conditions occurs nearly no wear. Furthermore, the component is so smooth and adjustable, that it can be stopped in any position.

Spindle nut in a portal milling machine

Material
ZX-100K

Description of the application
The spindle nut (TR 16 x 4) made of ZX-100K are used for the drives in the X, Y and Z direction (movements: 470, 950 and 120 mm). They are driven by three stepper motors with a torque of 300 Ncm.

Advantages
High positioning accuracy, very low wear.



Bushings for folding gate in HSC machining center

Material
ZX-100K

Description of the application
Bushings and thrust washers made of ZX-100K are used as bearing in a folding gate.

Problem
High surface pressure, high speed up to 300 m/min, high acceleration up to 3g. Edge pressure caused by bending. The previous material had to much problem with wear.

Problem-solving
The new ZX-100K components meet the required properties.

Advantages
Lower wear, high strength.

Slideway in horizontal drilling machine

Material
ZX-100K as replacement for epoxy compound.

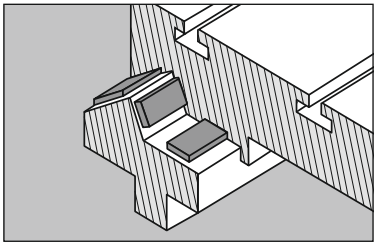
Description of the application
The up-to-now used components are slideways made of epoxy resin which lead the support of a horizontal drilling machine.

Problem
High costs, Stick-Slip, high wear, short working life, low emergency running properties and vibration resistance.

Problem-solving
The guides made of epoxy resin were replaced by those made of ZX-100K, which have been bonded to the existing working table.

Working life
The previously used guides showed, after a period of 2 months, a strong stick-slip, so they had to be replaced. With ZX-100K guides, so far a completely stick-slip free, working life of 3 years has already been achieved.

Advantages
High positioning accuracy, a high vibration absorption, higher strength, lower friction forces, less wear, excellent emergency running properties in lubrication failure, chemical resistance and improved dimensional stability.



Industrial machine and plant production

Round guide system in sintered metal press

Material
ZX-530 as replacement for bronze.

Description of the application
The following described plain bearing bushes are used in tool adapters for sintered tools in hydraulic presses, cross head and base plates. The up-to-now used bronze bushings in the column guide, had to be lubricated.

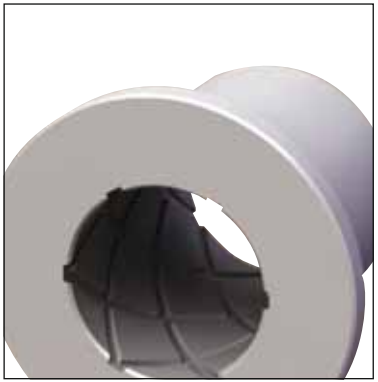
Load
Centrifugal forces up to 200 N/mm², speeds up to 6 m/min.

Problem
The fine dust is attracted from the greasy, making the device rapidly soiled. In the future during the tools' changing, the adapter should not be washed completely. So far, high environmental impact (disposal of used greasy enriched with metal powder, etc.)

Problem-solving
Thanks to a preload bushings made of ZX-530, with an optimized honeycomb structure on the inner diameter, the penetration of aggressive fine dusts on the sliding surfaces is prevented.

Working life
With this system so far 500.000 parts were manufactured, which is equivalent to 1 million hubs.

Advantages
Time saving through the elimination of the lubrication process and during tool changing, additional savings of lubricant and of disposal costs. Thanks to the dry running conditions the guides and tools stay clean.

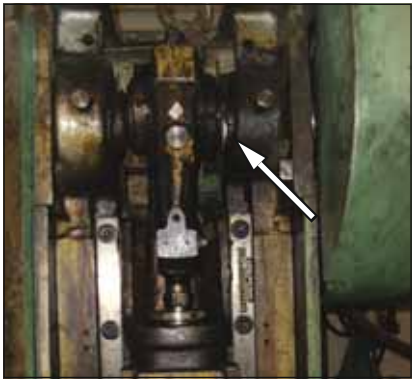


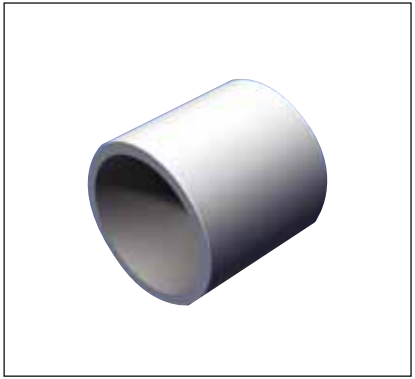
Plain bearing bush in a press

Material
ZX-100K as replacement for bronze.

Description of the application
The bronze bushings in a press have been replaced by bushing made of ZX-100K.

Advantages
Higher damping than with bronze. Now it can work without lubrication; at the same time the wear was significantly reduced.





Seals in drill machine

Material
ZX-410 as replacement for bronze

Description of the application
The sealing rings are installed in pillar drilling machine with 5kW motor power and up to 50mm bore diameter. The dimensions of the seal is Ø 258/243 x 32mm.

Problem
High costs because of the necessity of lubrication for bronze.

Problem-solving
By switching to ZX410 lubrication is no longer necessary and for a better cooling bores have been placed in the radial grooves

Advantages
Less maintenance, lower costs

Guide bushing

Material
ZX-530CD3

Description of the application
The bushing is used as guiding of a vibration generating piston in pneumatic cylinders of grinders.This produces a cross-grinding on the work-pieces.The piston is driven by compressed air (oil and water free).
The cylinder is fitted with radial slots, so that the air can enter and exit through them. The system works, in principle, as a two-stroke engine. The piston stroke is 36mm at a sliding speed of 350 m/min.

Problem
So far, a coated steel sleeve which was glued into a cylindrical aluminium body, was used. Unfortunately the adhesive was dangerous to human health, the applying of the coating was laborious and had poor adhesion to the steel sleeve.
The coating was also highly sensitive to shocks. Therefore, they were seeking for an easy solution in which even dry running would have been possible. A service life from 5 up to 10 years was required.

Problem-solving
Instead of a glued and coated sleeve, now a bushing of ZX.530CD3 is used, which will be polished in the inner diameter after its tight fit in order to improve its tribologiacal properties.

Advantages
Easy installation, thanks of the cooling system by the driving air, a very low guidance clearance of 0,019 - 0,023 mm is possible, hardly measurable wear.

previous solution
Coated steel sleeve

New variant
Bushing from ZX-530CD3

Industrial machine and plant production

Rack drive wheels in horizontal transport device

Material
ZX-530 as replacement
for PTFE and PVDF.

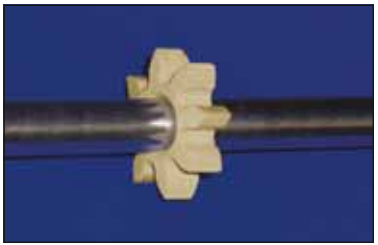
Description of the application
The rack drive wheel made of PTFE and subsequently PVDF, is used in a horizontal transport device for PCB production. The rack drive wheel must keep its tight sit also at elevated temperatures and in presence of aggressive chemicals.

Problem
In the production line, the PCB are immersed in etching baths. The transport device is so exposed to the aggressive etching media. A rack drive wheel made of a material with low wear on the edges, high strength at elevated temperatures and that maintains its tight fit through force fitting was searched. The previous materials have not satisfactorily fulfilled these requirements.

Problem-solving
The injection-moulded rack drive wheel made of ZX-530, has replaced the PTFE and PVDF ones.

Working life
The working life is 8 years.

Advantages
The rack drive wheel made of ZX-530 has a significantly higher wear resistance than those of PTFE and PVDF. Also, its strength is much higher. Thanks to the low wear the PCB can not be soiled.
The rack drive wheel runs quieter.
Thanks to its very high chemical and wear resistance ZX-530 is ideally suited for this application.



Ball koints in rolling mills' equipment

Material
ZX-100K as replacement for bronze.

Description of the application
The spherical plain bearing is used in steel industry plants, where it is exposed to high temperatures and high loads. The ball joint is available in various diameters from Ø140 to Ø180 mm. To fix it, it is provided with a threaded bore in the centre.

Problem
The recent material had to be lubricated with oil very often.

Problem-solving
Conversion to the usage of ZX-100K and therefore to the exclusion of lubrication. The bearing operates now water-cooled.

Advantages
Only through the elimination of oil lubrication a cost advantage of more than 35.000€/ year could be achieved.

Slide rails in rolling mills

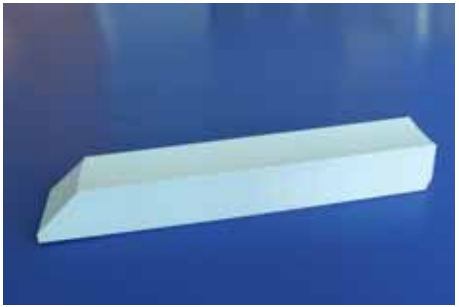
Material
ZX-100K as replacement for bronze.

Description of the apllication
Slide rails are used in rolling mills as a guide for rolled tubes.

Problem
The component is subjected to high loads and edge pressures and by the recent bronze guiding system a too expensive lubrication and maintenance was required.

Problem-solving
ZX-100K instead of bronze.

Advantages
lower purchasing costs, less maintenance.



Slipper blocks for a cardan joint in a rolling mill

Material
ZX-100K as replacement for bronze.

Description of the application
The component is assembled in a universal joint in piercing mills.

Problem
High efforts and high maintenance costs. The component must be frequently lubricated.

Problem-solving
ZX-100K instead of bronze.

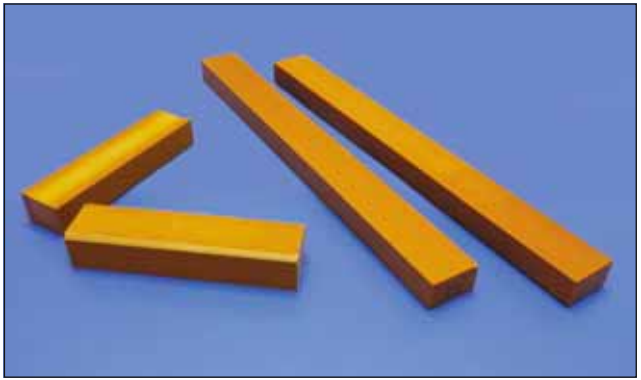
Advantages
ZX-100K needs almost 80% less lubrication.

Slideway in particle board press

Material
ZX-750V5T

Description of the application
The existing slideway of a particle board press was converted from a greasy lubrication application to a dry running one. The picture on the right shows the situation before the changeover to ZX-750V5T.

Advantages
Thanks to its extremely high PV values and high wear resistance, ZX-750V5T works now in this press in dry running condition.



Industrial machine and plant production

Sideway in a press

Material
ZX-100K as replacement for bronze.

Description of the application
The slideway made of ZX-100K stands in front of the packaging unit, under the chain of a press for the lamination of furniture fronts.

Problem
The wooden parts should not become contaminated by lubricants.

Problem-solving
With ZX-100K lubrication is not required. Low friction and low wear guarantee also a long working life.

Slide bush in head saw

Material
ZX-100K as replacement for bronze.

Description of the application
The plain bearing bush made of ZX-100K support the guide rolls in a head saw.

Problem
The previously used bronze bushings had an excessive wear.

Problem-solving
With dry running ZX-100K bushing, the wear have been significantly reduced.

Trapezoidal threaded nuts in carcase press

Material
ZX-100K as replacement for bronze.

Description of the application
The application relates to the spindle drive for a carcase press in the woodworking industry. The previously used trapezoidal threaded nut made of bronze is now manufactured with ZX-100K. It has only got an outer metric thread M 59 x 1,5 as fastening. With this thread, the ZX-100K nut is screwed and bonded into a steel housing. On outer part of the pressure pad of a press stand two of these trapezoidal threaded nut are used. These run on trapeze spindles made of 9SMnPb36 and transmit the entire pressing force to the to be pressed cabinet body.

Load
Cyclic tensile stress and compressive load, tensile: up to 1.000 N each motion nut, pressure: up to 20.000 N each motion nut, speed: 233 rpm, duty cycle: 80%.

Problem
The previous solution was not maintenance-free. Finding a material that offers, with only an unique lubrication during assembly, maintenance-free and a working time of at least 6 years was the requirement. In addition, also the costs have to be minimized.

Problem-solving
A motion nut made of ZX-100K with a trapezoidal thread TR 40 x 12 and a length of 85 mm has been proved as suitable.

Working life
Since 1995, the motion nut has been used without any problem.

Advantages
ZX-100K replaces an expensive bronze motion nut and woks maintenance-free with an unique initial lubrication.

Threaded nuts in machines for the furniture industry

Material
ZX-100K

Description of the application
The threaded nut is used for height adjustment of a work table. The housing is made of a machined steel pipe. The spindle is made of free machining steel, with a surface roughness of Ra=0.8 µm.

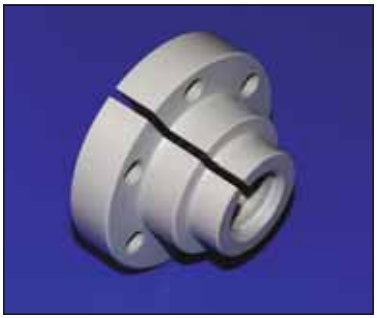
Load
The long-term load is 1.000 N with a spindle speed of n=23 rpm. Additionally, every 180 s for a time of 120 s, an axial load of 2.000 N (total 3.000 N) takes place on the spindle nut. Then the cycle starts all over again. The ambient temperature varies between -5 °C and +40 °C.

Problem
For the motion nut, a material with low wear and also maintenance-free was required.

Problem-solving
For this application a motion nut made of ZX-100K with a trapezoidal thread TR 28 x 3 and a length of 30 mm was used.

Working life
Field tests with an incremented load and a duty cycle of 100 % have shown that the motion nut subjected to these parameters, and after the required working life, has signs neither of wear nor of plastic deformation. It has been used as standard feature since 1996.

Advantages
Maintenance, cost reduction



Rolls in adhesive roller machine

Material
ZX-100K as replacement for polyamide.

Description of the application
In this application it is about rolls in a adhesive roller machine. Previously as material polyamide was used.

Problem
In this application a high precision, dimensional stable and anti-adhesive material is required. The accuracy and precision of the clearance, which is extremely important for the functionality of the machine, had to be improved. Polyamide should be replace because of its dimensional changes due to the high moisture absorption.

Problem-solving
Polyamide's rolls were replaced from the ones made of ZX-100K.

Advantages
Higher precision, thereby precisely defined clearance (0,3 mm before, 0,03 mm now), anti-adhesive properties, better machinability and thereby cheaper, better surface quality. Higher wear resistance. The surface can be easily re-machined if necessary.

Scraper in adhesive roller machine

Material
ZX-100K

Description of the application
The component is used to seal the adhesive chamber of an adhesive roller machine. The wipers are at the shaft ends of the glue-application rollers.

Problem
The scrapers have to be very wear resistant, anti-adhesive and slippery. The dry and hard glue must be easily removed from the scrapers, without let them being damaged.

Problem-solving
In this application, ZX-100K scrapers are used.

Advantages
Longer working life and more versatility. The glue can be easily removed from the strippers made of ZX-100K. The scrapers are very wear resistant, dimensionally stable and distortion-free and nevertheless have a high chemical resistance.

Spur gear in re-reeling, slitting and filament winding machine

Material
ZX-100K

Description of the application
The following spur gears are used to drive the main spindle in high performance re-reeling, slitting and filament winding machines.

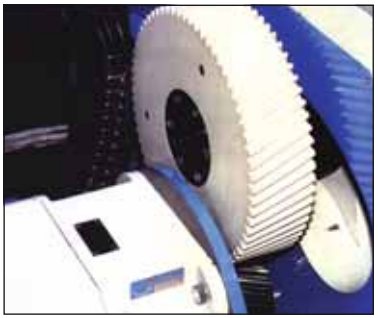
Load
The power to be transmitted is 38 kW. The speed range is between 1050 rpm and 3.000 rpm. The gear ratio is 2,33. The ambient temperature is 25°C.

Problem
It was searched a material that allows maintenance-free with dry running condition and reduced noise.

Problem-solving
The required properties are now satisfied with a helical gear made of ZX-100K with a module of 5 mm, a teeth number of 70 and a width of 140 mm.

Working life
Since 1991, the gears have been working without any problem.

Advantages
Maintenance, noise reduction.



Honeycomb structure bushing in a filament winding machine

Material
ZX-100K as replacement for bronze.

Description of the application
The here described bearing is used in filament winding machines for the paper industry. It supports the centre sleeve, that transports the to be wrapped paper roll. The paper rolls have a diameter of 2 m and the shaft has a length of 3 m. The bearing was up-to-now made of bronze.

Problem
With the lubricated bronze bearing the precision was a problem also with a solid lubricant. A material that allows a higher precision was needed. Furthermore, a low break loose torque is required.

Problem-solving
Here a plain bearing bush made of ZX-100K with a honeycomb structure, needed to reduce the static and kinetic friction, has been used. The bushing is manufacture with a tolerance of 2-3 hundredths of a millimetre, with an outer diameter of 185 mm, an inner diameter of 165 mm and a length of 80 mm. The groove depth is 1 mm, the groove width 3 mm. The bearing clearance is 0,05 mm.

Working life
The bushings is been successfully used since 1992.

Advantages
70% price reduction , improved precision, dry running, no high break loose torque.

Bearing in franking and paper-folding machine

Material
ZX-530 as replacement for sintered bearing.

Description of the application
The bearing in franking and paper-folding machines was previously a sintered bearing. They were used to support the conveying shafts and track rollers.

Load
The bearing will be loaded by the pressure force of the track rollers.

Problem
The sintered bearings must be calibrated when mounted. The previously used sintered bushings require a complex assembly, since they need a very smooth-running with minimal clearance, which requires an accurate calibration. This also leads to high costs.

Problem-solving
Now close-tolerance injected moulded bushings made of ZX-530 have replaced sintered bushings. The inner diameter is 8 G7. The shaft has got a diameter of 8 h8. The maximum clearance is 0,049 mm.

Working life
The bearing made of ZX-530 have been successfully used as standard feature since 1997.

Advantages
Maintenance-free by dry running conditions. The bearing made of ZX-530 must no longer be calibrated when mounted. By replacing the sintered bearing, a cost reduction for both the mechanical parts and the assembly is achieved.

Threaded nut in a paper cutting machine

Material
ZX-530 as replacement for bronze.

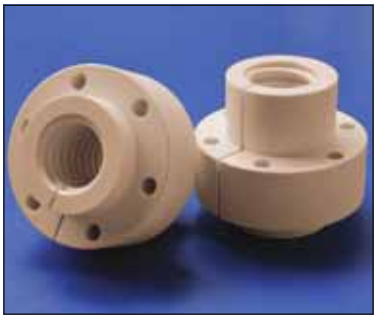
Description of the application
The threaded nuts installed in a horizontal transport device in a paper cutting machine, are used to drive the positioning part of to be cutting of 1.000 sheet paper stacks. So far, threaded nuts made of bronze were used.

Load
F_a = 8.000 N
n = 540 min^{-1}
Stroke = 300 mm
Duty cycle= 20 %
Rolled screw

Problem
The current bronze threaded nuts require a high maintenance and should therefore be replaced with dry-running motion nuts.

Problem-solving
Now a threaded nut with a trapezoidal thread TR 40 x 9 and a length of 65 mm is used as replacement for a bronze motion nut. To guarantee a high efficiency, even at high temperatures the motion nut has got an axial slot.

Advantages
Maintenance by dry running, reduced power consumption, thereby saving costs.



Industrial machine and plant production

Toothed wheel / linear guide in packaging machine

Material
ZX-324V11T

Description of the application
A profiled shaft with three slide rails drives several sliding pieces (movable gears) into a packaging machine. Its stroke, transverse to the conveyor belt, has got a range of ± 720°, and moves itself in the axial direction, along the band, for ± 370 mm. The high-torque drive toothing on the outer diameter of the sliding pieces drives a toothed belt. The cycle time for a packaging operation is 0,75 s. During this time, 3/5 units of product are packed. Onto the grooves of the profiled shaft, ZX-530 sliding strips are bonded. The heat dissipation of the plastic-plastic-mating was verified with a calculation. The wear is minimal. Depending on the machine's size, three to five sliding pieces are assembled of the profiled shaft of the packaging machine. The profiled shaft is fix next to the conveyor belt. Through the axial degree of freedom, each sliding piece is enforced to run with the belt and stays always next to the to be packaged product.

Load
The moving weight is 1.5 kg.
The belt pretension force is 100 N.

Problem
The component should be designed, in order to obtain an excellent dynamics, low weight, minimal space requirement and maintenance-free. It must have both the function of a gear and of a linear guide.

Problem-solving
Thanks to the special machining on the inner diameter and the toothing on the outer diameter, the bushing meets the two requirements: the geometry of the inner diameter provides the axial degree of freedom and the toothing on the outer diameter drives the plunger, which carries the products in their packaging.

Working life

The packaging plant works in two shifts, 220 days per year. The bushing has got a working life of 1,44 x 10^8 cycles, which corresponds to a duration of approximately 8,5 years.

Advantages

Thanks to the lightweight construction, only small acceleration forces are required. The sliding piece needs only a unique lubrication when assembled.

Industrial machine and plant production

Sideway in a paper cutting machine

Material
ZX-100K as replacement for bronze.

Description of the application
The slideway made of ZX-100K guides the cutter bar in paper cutting machines.

Problem
The previously used bronze material showed an extreme wear. A lubrication is not allowed.

Problem-solving
The bronze slideways has been replaced by slideways made of ZX-100K. Its thickness tolerance is 0,05 mm and leads the cutter very accurately.

Working life
The working life is more than 5 years without any reduction of the cutting accuracy. Adjustments are not necessary.

Advantages
Lower wear, longer life, dry running.

Thrust bearing hinge in an electric monorail conveyor

Material
ZX-100K

Description of the application
Hanging conveying system for continuous assembling. In turn movements, due to the axial joint, lateral oscillations are possible and shaft alignment mistakes from production are balanced.

Load
There are high static and dynamic forces (60 kN). There are also constantly small movements of the hanging system, and impacts during loading and unloading as well.

Problem
A material that allows maintenance-free, dry running and adjustment in all axes was needed.

Problem-solving
In this application, special axial joint bearings (outer and inner diameter respectively 260 mm and 80 mm) made of steel with the sliding part made of ZX-100K are used.

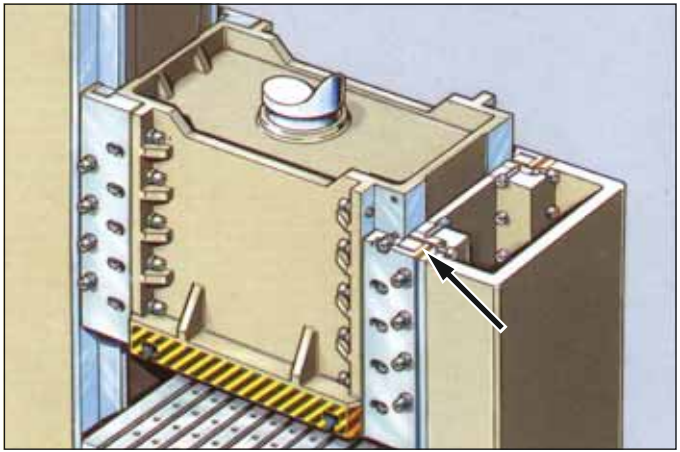
Working life
No limit in the working life are to be expected.

Advantages
Simple design and maintenance-free.

Plunger guide in car-body press

Material
ZX-100K

Description of the application
The application relates to slideways as plunger guide in a car-body press. This one was converted and tested in the "New materials for guides in highly-stressed forming machines" research report. Several different materials, including ZX-100K, were tested.



Load

The press pressing force is 8.000 kN. The stroke rate is 18 strokes per minute. The ram stroke is 705 mm. The maximum short-term surface pressures are approx. 120 N/mm². The maximum sliding speed is 25 m/min.

Problem

It should work without any lubrication in order to allow a maintenance-free guide and to do not soil the pressed products with lubricant. The guide clearance should be as small as possible. The guide should be designed with a negative clearances (with preload).

Problem-solving

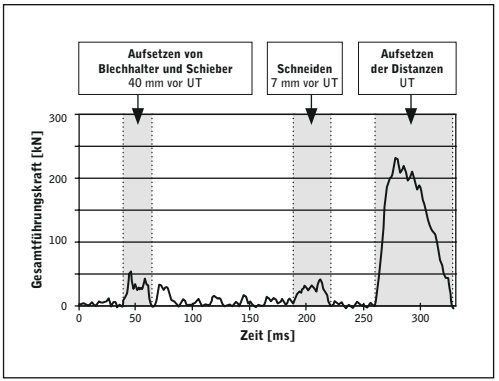
ZX-100K turned out as suitable material for the slideway. These slideways were monitored in a field trial over 1 year using measurement technology.

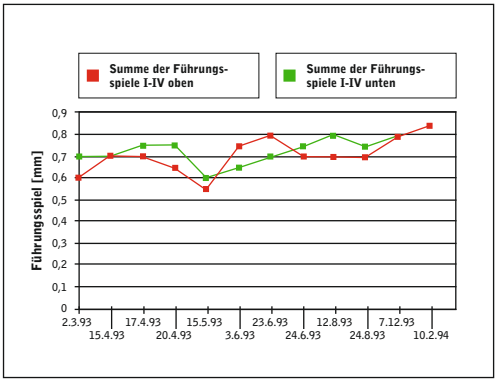
Working life

After a year production of 530.000 pieces in dry running conditions, only a very slight increase in the clearance, of approximately 0,015 mm, resulted. Other tested materials such e.g. ceramics, coating materials (DLC: diamond-like carbon, WC: tungsten carbide) were not suitable for this application.
Working life over 20 years with 24 hours of continuous operation.

Advantages

Maintenance-free, no soiled products.





Bushings and thrust bearing for Vario Shuttle

Material
ZX-100K

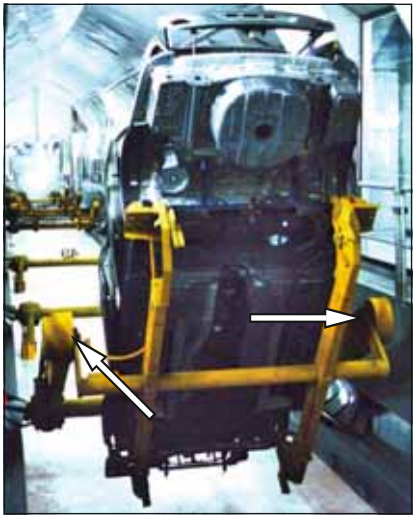
Description of the application
The Vairo Shuttle is used for the pre-treatment of the coachwork. It transports and pivots the car body during the pre-treatment in purification tanks, in which sometimes some aggressive chemicals are used. The bushings and washers are assembled as standard features in the arrow marked positions.

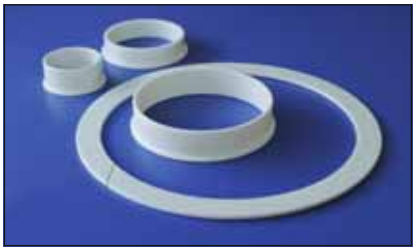
Problem
High edge pressure. The material must have a good chemical resistance.

Problem-solving
ZX-100K is used as material, since it has got the required properties.

Working life
Three years working life, despite the usage of a soft, 16 µm Rz rough shaft.

Advantages
Dry running, Maintenance-free.





Cutters in a shredding machine

Material
ZX-100K

Description of the application
The cutters are fixed onto the shaft with rubber laces. The shredded material is leaded from a side to the other one through the shredder shafts (depending on version, one up to four shafts). On the shaft's side there are the cutters that provide to protect the bearing from very small particles. Once a minute the cutters go up and down the wavelength for 1.500 mm.

Problem
Due to the shredded material, the cutters are expose to abrasive wear and they should not have any gap to the shaft. Also screws, staples and nails should not damage the cutters. The sealing of the bearings against dirt ingress must be permanently guaranteed.

Problem-solving
An axially fixed split bushing made of ZX-100K is used.

Advantages
The wipers do not need to be adjusted.

Slideway for rims removal

Material
ZX-530

Description of the application
In a demolition-equipment for car rims removal, slideways are used as linear guides for a special carriage with hydraulic feeding power are used.

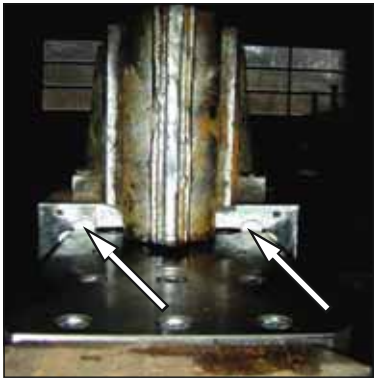
Load
Feeding power each carriage 220 KN
Advance stroke with V = 3 m/min
Return stroke with V = 6 m/min

Problem
High impact load from the bursting of the rims and high overturning torque. A higher durability than other plastic material and low maintenance operations were required.

Problem-solving
Three slideways with hardened and grounded guide rails and half rod-shaped sliding elements of ZX-530 have been used.

Working life
So far 200.000 wheels were demolished.

Advantages
Longer working life and low maintenance, easy and quick replacement of the worn sliding elements.



Sliding guide in a tyre spreader

Material
ZX-100K

Description of the application
The component is built as a wear part in hydraulic tyre spreaders . These are used by tire service centers for inspection and repair of tyres . The component carries out primarily the task of a slide bearing for pivoting movements .

Advantages
Low wear, dry running.

Industrial machine and plant production

Slideway for an automatic multi-storey car park

Material
ZX-530

Description of the application
The linear guides support the vehicle storage cage in the horizontal movements in the multi-storey car park.

Load
The linear guides carry the weight of a car (max. 2.000 kg). The sliding speed is about 60 m/min.

Problem
The up-to-now used bushing made a lot of squeaking noises. This must absolutely be avoided. The steel mating surfaces corrodes during the use.

Problem-solving
In this applications bushings made of ZX-530 with a honeycomb structure, ideal for the removal of rust particles are now use.

Working life
After 8.000 load cycles of normal service, 1,5 mm of wear was determined, which it is within the permissible range.

Advantages
Maintenance-free and dry running conditions, good wear properties. The rust on the shaft is mostly transported out thanks to this honeycomb structure. Small residues are let in the plastic sliding surface. No squeaking noises anymore.

Industrial machine and plant production

Trapezoidal threaded nuts in lift

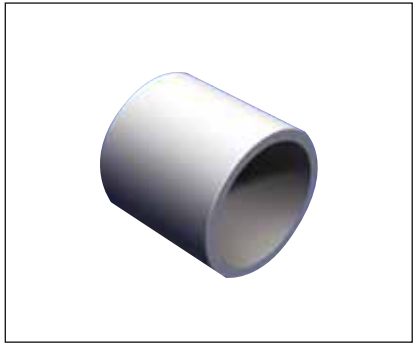
Material
ZX-100K

Description of the application
The trapezoidal threaded nut (TR 40) made of ZX-100K bears 5 tons and it is a standard feature in the drive of motors, used for the car lifting platforms. It is used as standard for 10 years and comes with a one-time lubrication.

Bushing in loading lift

Material
ZX-100K as replacement for bronze.

Description of the application
The slide bearing bushes made of ZX-100K in joints of a scissors lift for the load of storage shelving. The lift support up to 4 tons. Here bronze was replaced by the plastic material ZX-100K. The application works now maintenance-free.



Railway jacks motion nut

Material
ZX-410 as a replacement for bronze

Description of the application
The spindle nuts (TR 100 x16) are used in lifting devices for the repair of railway wagons. A device consisting of each 4 individual lifters.

Load
The lifting device has got a carrying capacity of: - first equipment -> 120 tons - second equipment -> 160 tons Both of them consist of 4 railways jacks each.

Problem
In many wagons repair factories railway jacks with motion nut of bronze are used. With this solution a periodical lubrication of the assembly is necessary.

Problem-solving
With ZX-410 a lubrication is only required just ones during the installation, further maintenance of the equipment is not needed.

Working life
The usage of ZX-410 motion nuts enabled an increase in service life of a minimum of three times. In order to achieve a maxi-mum working life of the motion nuts of ZX-410, they needed to be adapted to the spindle.

Advantages
less maintenanceincreasing of the working life, reduction machining time, improve of the working life of the lathe chisel, r eduction of the frictional forceReduction of operating temperature, reduction of noises during motion, costs dropped significantly

Transport and traffic technology

Plain bearing bushes for hydraulic truck tail-lift

Material
ZX-324V2T

Description of the application
The bushing showed here is built in several places in the articulated arms of the truck tail-lift.

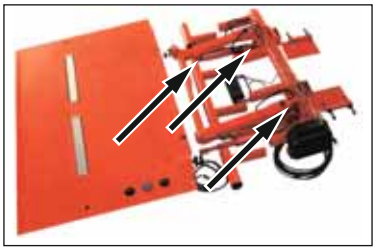
Load
The maximum surface pressure of the plain bearing bush is 120 N/mm², the speed is 4 rpm in combination with the ingress of dirt, water and road salt in the bearing area.

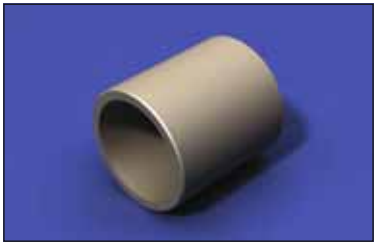
Problem
Since it is a welded structure, in the bearings geometry results errors, which carry to extremely high edge pressures. Maintenance-free, dry running conditions, and quiet operations were also required. A tested composite of epoxy resin and PTFE proved to be as unsuitable (Fracture).

Problem-solving
In the articulated arms of the truck tail-lift cylindrical bushings made of ZX-324V2T, having an inner diameter of 30 mm, an outer diameter of 36 mm and a length of 30 mm are now installed.

Working life
25.000 load cycles as required. Afterwards 25.000 load cycles in the test stand, the bushing was still fully functional. Since 1996 it has been used as standard feature.

Advantages
The application works maintenance-free, there is no need for the greasy lubrication. The material supports high surface pressures.





Cylinder guide in mobile compactor

Material
ZX-100K

Description of the application
In the rubbish tracks mobile compactors, their hydraulic cylinders must be driven in a way to do not let them buckle. For this purpose, a suitable material is searched.

Load
The loading on the part is dependent from the ever-changing operating conditions (loading condition, rubbish mass, temperature) and may not be precisely measured.

Problem
The hydraulic cylinder should not buckle in the extended position. The enormous lateral forces and significant edge compression must be supported. Accurate force measurements were not performed. The vehicle works outdoor and therefore operates in a wide temperature range, from -20°C to +60°C. Furthermore during the working life it is always is contact with considerable pollution. The cylinder guide must be maintenance-free in dry running conditions.

Problem-solving
A machined U-profile made of ZX-100K is used. It guides the hydraulic cylinder of the mobile rubbish compactor.

Advantages
The hydraulic cylinder is securely supported also in fully extended position and the wear of the support U-profile is now very low. ZX-100K enables the maintenance-free operations.

Track roller in a rubbish truck

Material
ZX-100K as replacement
for cast polyamide.

Description of the application
The track roller is used in the axial guide of a refuse collection vehicle, which raises the bin over the cab and then empties the trash in the rubbish container.
So far PA6G was used.

Problem
Oscillations, vibrations and impacts.
In addition, water and dirt penetrate into the bearing seat. After a short working life, the track rollers made of PA6G had no sufficient clearance and they could not rotate anymore. This lack of clearance, which leaded to the grip, was caused from the dimensional changes of PA due to moisture absorption.
The new material must also have a high resistance to UV radiation, so that its mechanical properties are
minimal affected by.

Problem-solving
Now only track rollers made of ZX-100K are used. They do not have any significant dimensional change due to moisture absorption and therefore have got a constant bearing clearance.

Working life
The track rollers have been working since 1994.

Advantages
Now there is an operational safety, because no flattening, deformation and/or wear occurs. Through it, the working life is increased and a higher precision is reached.

Cladding strips in waste collection vehicle

Material
ZX-100K as replacement for polyamide.

Description of the application
Cladding strips are used in the horizontal guide of the rubbish container grabbers in the rubbish trucks. Polyamide has been used previously.

Problem
Oscillations, vibrations and impacts. In addition, water and dirt penetrate into the bearing. Polyamide should be replaced, because the wear resistance and the driving precision are not satisfactory, since it has got a high moisture absorption and thus change its dimensions and strength characteristics proportional to the moisture content. The new material must have a high resistance to UV radiation, so that its mechanical properties are minimal affected by.

Problem-solving
Cladding strips compose of laminated strips of steel and with ZX-100K cladded, which are manufactured respecting a very tight dimensional tolerance (max. 0,03 mm), are now used. These cladding strips are supplied ready to be assembled. Due to the very low moisture absorption of this material, its dimensions and strength properties remain unchanged even in outdoor applications.

Working life
The cladding strips are been used as standard feature since 1994 without problems.

Advantages
Longer life, higher driving accuracy.

Guiding belts in telescopic cylinders for a dump truck

Material
ZX-100K as replacement for PTFE Bronze-Compound.

Description of the application
The guiding belts of a dump truck are used in the telescopic bar and there are installed at various positions of the hydraulic cylinders. The previously used bearing material (PTFE-bronze compound) have to be replaced because of the excessive wear and plastic deformation.

Problem
In this application a very high wear resistance, low friction forces and high compressive strength are required.

Problem-solving
The bearing material ZX-100K is now used as guiding belts. They have an inner diameter of 100 mm and are slotted without any gap. The excellent results against the high edge pressure are due to the high elasticity and toughness of ZX-100K.

Working life
Excellent results have been achieved in test stands, even with excessive loads and worse conditions. E.g. was simulated a continuous operation at temperatures above 80 °C, and even under these conditions, the required number of load cycles has been achieved. The ZX-100K guiding belts have been used since 1994 without problems.

Advantages
Higher wear resistance, larger working life, easier installation, price reduction.

Slide bush for skip loader

Material
ZX-100MT

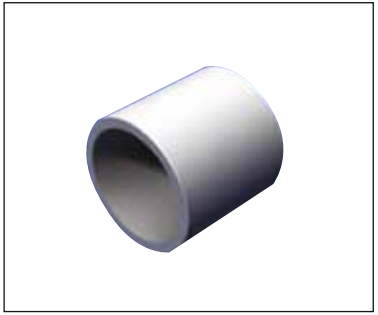
Description of the application
The plain bearing bushes are installed at the marked point. The bearing is responsible for raising and lowering the container. So far in this bearing point no plastic bushing have been used, but here was used a greasy lubricated steel bushing onto a nitrided steel shaft.

Problem
On the previous bearing points occur excessive wear. This should be avoided by using a plain bearing bush.

Problem-solving
Plain bearing bush made of ZX-100K with a outer diameter of 95 mm, inner diameter of 80 mm and a length of 90 mm are used. These bushings work maintenance-free in dry running conditions.

Working life
Working life of 15.000 load cycles as required. In test stands, after 15.000 load cycles, the test was terminated. The bushings were still in serviceable condition; they showed neither small signs of wear nor of deformation.

Advantages
The shaft does not have to be nitrided anymore, longer working life and maintenance-free with dry running condition.



Spherical cap in hydraulic cylinders for three-way tipper

Material
ZX-324

Description of the application
In the construction industry, the loading area of a tipper truck is loaded up to 30 tons of bulk material or bitumen with temperatures up to max. 250 °C. The loading platform is supported via a spherical cap of a the hydraulic cylinder. The cap is positively fit in the calotte at the end of the hydraulic cylinder and allows the tipping on three sides.

Load
300 kN with a temperature of the spherical cap of 250 °C (through hot bitumen) or also at temperatures below the freezing point. At these conditions, impacts and vibrations, caused by the loose contact of the truck loading platform, occur during the drive on unevenness ways. In both cases, the aforementioned load is overlapped from a relative movement between the ball and cap when lifting and lowering the platform.

Problem
Since that bearing seat is of difficult access, high maintenance costs for the re-lubrication incurred. Also for environmental reasons, a maintenance-free-in-dry-running-conditions bearing was requested.

Problem-solving
A spherical cap with a calotte diameter of 60 mm made of ZX-324 is used. The spherical surface is 6.300 mm².

Working life
10 years as requested. Working life in the test stand: afterwards 50.000 load cycles, which corresponds to approximately 13 years, the bearing was still fully functional.

Advantages
A cost reduction by dry running and maintenance-free has been archived, and therefore the lubricant environmental impact has been reduced.

Articulated bus

Material
ZX-100K

Description of the application
The bearing shells are used in the joint system of articulated buses .

Problem
The component is subjected to high loads, vibrations and shocks.

Advantages
low friction , low wear, good damping properties

Plain bearing bushes in hydraulic cylinders of a folding soft top

Material
ZX-100K

Description of the application
A suitable material for a slide bush is searched, which will be used in a car folding soft top. The plain bearing bush leads the piston rod of the hydraulic cylinder that opens and closes the folding top.

Problem
There are low radial forces. The material must support temperatures up to 80 °C, and short-term temperatures up to 130 °C, with also a withstand to impacts and vibrations. Therefore a high impact resistance and damping, low friction and very high wear resistance are required.

Problem-solving
In this application, plain bearing bushes made of ZX-100K with an inner diameter of 6,2 mm and a length of 8,4 mm are used.

Working life
The plain bearing bushes have been used as standard feature since 1990. Since then, no problems have occurred in the application.

Advantages
ZX-100K thanks to its excellent impact-damping, high wear and impact resistance, it is very well suited.

Bushing in car seat

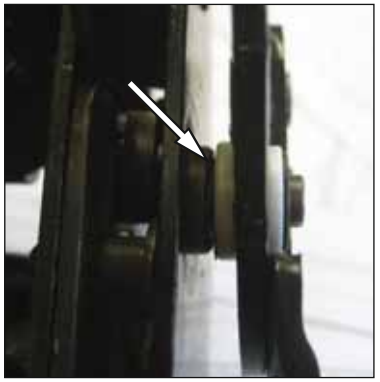
Material
ZX-100MT as a replacement for bronze.

Description of the application
The flange bushing made of ZX-100MT is installed in car rear seats allowing their folding down.

Problem
The prior bronze bushings had a too high wear and were too expensive for the application.

Problem-solving
Thanks to the substitution from bronze to ZX-100MT, the bushing must not be greased anymore.

Advantages
Lower costs, dry-running conditions.

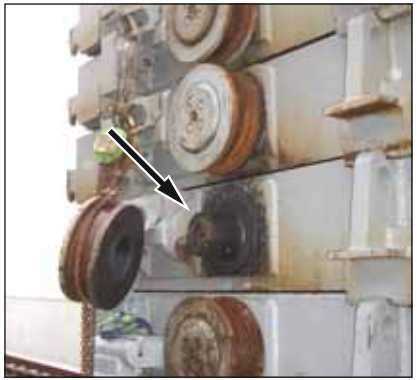


Plain bearing bush and thrust washer in rollers of a cargo hatch cover

Material
ZX-100K as a replacement for bronze.

Description of the application
The washer and bushing made from ZX-100K are assembled in track rollers that allow hatch covers to slide over the others.

Advantages
Dry running conditions are possible, and through it a cost saving and a reduced environmental impact can be reached.



Bearing bushing in engine of a sport boat

Material
ZX-100A and ZX-100K as replacement for PA11.

Description of the application
In the suspension of a outboard motor of a sport boat originally bushings made from PA11 were used. The previously used PA11 should be replaced, since this material did not meet the requirements.

Problem
High specific compressive load in combination of vibrations and impacts, which are caused by the swell and the high speed. In addition, the material must have a high resistance to salt water and UV radiation, so its properties will not be affected by. The loads lead the previous material to a big plastic deformation and wear of the bushing.

Problem-solving
Plain bearing bush made of ZX-100K and injected moulded bushing made of ZX-100A are now used instead of PA11.

Working life
The without problems working life expectation is at least five years.

Advantages
Very small deformations, better impact and vibration dampening, longer working life, no lubrication necessary.

Components in commercial aircrafts

ZX

Material
ZX-410

Description of the application
In this application plain bearing bushes made from the material ZX-410 are used in the aircraft backrest seats of the passengers.

ZX

Material
ZX-410

Description of the application
Bushings made from ZX-410 in pumps for drinking water supply in aircraft.

Sensor housing in the aircraft drinking water supply

Material
ZX-530 as replacement for PSU

Description of the application
The sensor housing is used in the drinking water supply of commercial aircrafts.

Problem
A Material with a high diffusion tightness and the drinking water approval (KTW) was searched. The previous material could not meet these requirements satisfactorily.

Problem-solving
The sensor housing material is now made of ZX-530. During the DIN EN ISO 15106-3 test (electrolytic process), a water vapour permeability of 0,07 g/(m² x day) (23 °C, RH 85 % to 0 %) was measured. The dielectric ε_R is over a temperature range of -20 to 140 °C constant.

Advantages
The high diffusion tightness is granted with ZX-530. The material and the component produced with ZX-530, it is approved for contact with drinking water.

Plain bearing bush in chassis of regional train

Material
ZX-100K

Description of the application
The bushings are used in the wheel suspension of regional trains.

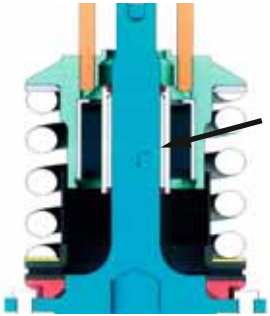
Load
Average static radial loads: 2 - 5 kN
Max. statistic load: 15 kN
Radial impact load: 25 - 30 kN
Impact duration in 0,003 seconds
Movement: linear, harmonic movement
Movement length: 40 - 80 mm
(theoretical) mechanical stop 166 mm,
Linear frequency: 1,19 - 1,54 Hz

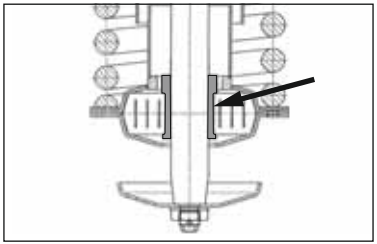
Problem
Average temperature: 10 °C, ambient temperature: - 30 °C up to + 40 °C. The part is exposed to impacts and vibrations.

Problem-solving
In the application are used plain bearing bushes made of ZX-100K.
Mating surfaces: shaft, steel X20Cr13 (1,4021), Ra=0,8 µm, grounded,
Shaft diameter: 54 mm (+ 0,2)
Maximum admissible clearance after working life: 2 mm.

Working life
At least 2 years or 240 000 kilometers.

Advantages
Maintenance-free and reduced costs.





Bearing segments for current collector of elevated train

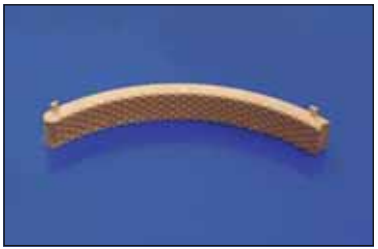
Material
ZX-530

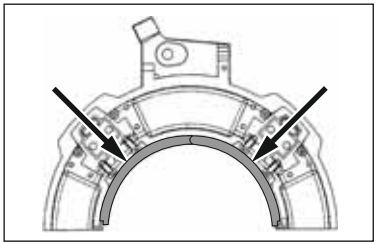
Description of the application
A bearing segment is used in current collectors for elevated trains. Here the current comes from the bottom. The maximum surface speeds are at 360 m/min.

Problem
For this application, an electrically insulating, dirt-resistant material, which allows a small clearance, is required. Maintenance-free in dry running condition and free movement are also required.

Problem-solving
Here the material ZX-530 is used. The 90° arc bearing segments are directly injection moulded.

Advantages
The bearing segments do not need to be adjusted. They are maintenance-free and have been proved and tested for outdoor application.





Lift and crane vehicles

Plain bearing bush in the steering of straddle carriers

Material
ZX-100K as replacement for bronze.

Description of the application
Straddle carriers are lift trucks, that transport ship containers in the harbour. The containers will be lift in the middle of the base frame of the straddle carrier and can be carried to the desired location. The plain bearing bushes are used in the steering mechanism of the wheels and allow their rotation. Previously, bronze has been used for the bushings.

Load
The maximum bearing force is 350 kN at the season-dependent ambient temperature.

Problem
High maintenance costs; the bronze bushings must be lubricated.

Problem-solving
Now plain bearing bushes made of ZX-100K are used (Ø 280 / 240 x 150 mm). The bushings work in dry running conditions. The stainless mating rotating surface is spray coated and it has got a hardness of 68 HRC. The sealing is realized by a stem seal. This is assembled with two O-Rings in approx. 6 mm deep groove.

Working life
With this sealing system, after 3 years of service life, the wear was only 0,05 mm without any sign of deformation.

Advantages
Maintenance-free thanks to dry running condition, low wear.

Track rollers in telescopic booms of working platform

Material
ZX-100K as replacement for PA6G.

Description of the application
The track rollers are used to guide the telescopic boom of a mobile work platform, that allows a max. working height of 50 m. The rollers are pressed on bearings. So far a cast polyamide material was used.

Load
The maximum load is 200 kg, at the maximum working height and at a lateral operating distance of 17 m. Up to a load of 80 kg, a lateral outreach of max. 20 m is possible. The ambient temperature lies between -10 °C and +40 °C.

Problem
The previously used PA6G has a very high water absorption, which caused a bad dimensional stability. Due to this, the track roller lose its tight fit on the bearings.

Problem-solving
Now track rollers made of ZX-100K are used, which have got no dimensional changes due to moisture absorption. The track rollers have got the following dimensions: outer diameter of 100 mm, Inner diameter of 72 mm, width 38 mm.

Working life
So far no problems occurred with these ZX-100K track rollers.

Advantages
ZX-100K has a very low water absorption, less wear and therefore longer life.

Slideway in crane boom

Material
ZX-100K

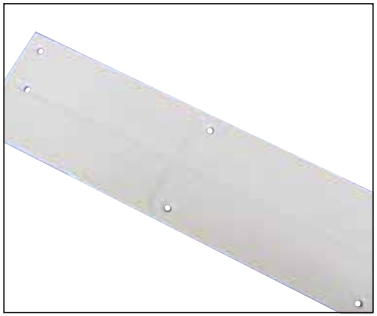
Description of the application
In this application, a suitable bearing material for the storage of the telescopic boom has been searched. The slideway is located in the rectangular guiding tube in which the boom is guided.

Problem
For esthetical reasons the lacquer mating surface of the boom must not be damaged by the sliding movement The bearing is also subjected to the weather conditions and direct sunlight exposure. There is a high surface pressure, caused by edge pressures. In addition vibrations and impacts occur during the drive. Dry running, very low wear on the slideway, no damage to the lacquer mating surface, tight thickness tolerances and absolute dimensional stability are also required.

Problem-solving
Slideways made of ZX-100K are now used. In addition, the boom was painted with a modified colour.

Working life
After extensive tests of more than 40 materials, ZX-100K has been chosen and it is now used as standard feature. In the future, also other bronze bearings should be changed with the ZX-100K ones.

Advantages
Even under load with ZX-100K slideways, an extension of the telescopic arm is possible. Preservation of the painting. No problems for outdoor use and low maintenance thanks to dry running conditions.



Bearing strips in crane base bearing

Material
ZX-100K as replacement
for cast polyamide with oil.

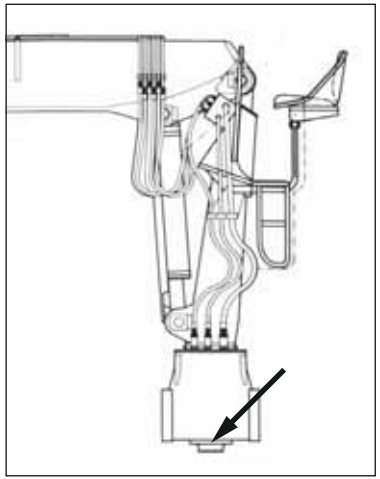
Description of the application
In the case of crane attachments for trucks bearing strips are applied on the crane base. Previously bearing strips of cast nylon with oil were used.

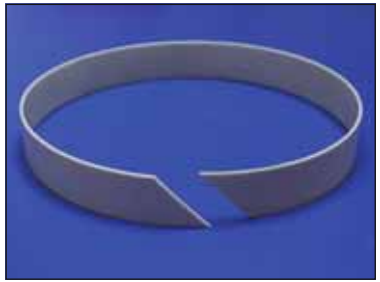
Problem
There is a high surface pressure, overlapped with a relative motion. The original material is to be replaced because of the excessive wear, too high friction values and too high plastic deformation. Due to the polyamide moisture absorption, the dimensional tolerances could not be observed.

Problem-solving
ZX-100K bearing strips with the following dimensions are used: length 525 mm, width 70 mm and thickness 2,5 mm.
The thickness tolerance is 0,05 mm.

Working life
ZX-100K bearing strips have been working without any problem since 1993.

Advantages
Thanks to the dry running conditions, a very long working life with high precision and minimal costs has been achieved.





Thrust bearing hinge for forestry machine

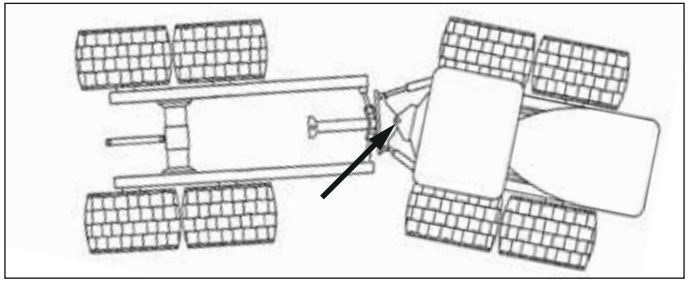
Material
ZX-100K as replacement for bronze.

Description of the application
The thrust bearing hinge in forestry machines (previously bronze) is assembled between tractor and trailer.

Problem
The previously expensive lubricated bronze bushings had to be replaced with dry running ones.

Problem-solving
ZX-100K plain bearing bushes are now used.

Advantages
Price reduction and dry running condition.



Lift and crane vehicles

Slide rail in a timber crane boom

Material
ZX-100K

Description of the application
For a timber crane, used for loading and unloading of trunks, a material for sliding rails were searched which resists the high loads in rough environments. The slide rails are in the inner telescopic tube and serve to guide the telescopic boom.

Load
The maximum load of the crane, taking into account the necessary security, is 2.050 kg, whereas at a lateral operating distance of 3 m, the max. load is 900 kg. The ambient temperature is, depending on the season, between approx. -10 °C and +40 °C.

Advantages
The slide rails are exposed to weather conditions, dirt and wood particles. The slide rails are subjected to high edge pressure, especially with big loads and when the boom is extended. The lubrication should be avoid.

Problem-solving

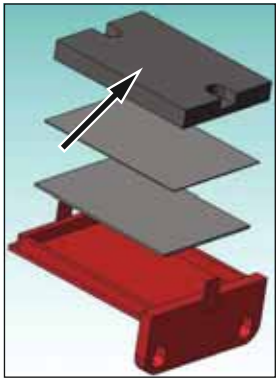
In the boom ZX-100K slide rails are now used.
They meet all the requirements.
Their dimensions are:
Length 130 mm
Width 90 mm
Thickness 15 mm

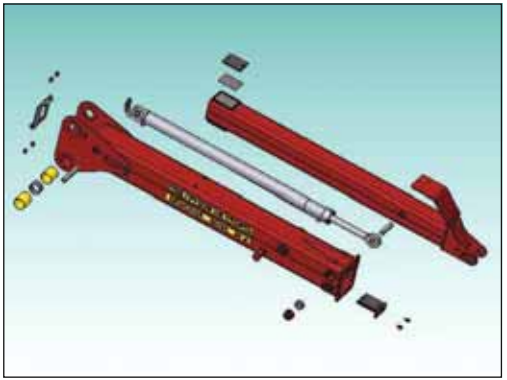
Working life

The ZX-100K slide rails have been used without any problem since their first application.

Advantages

With the use of ZX-100K slide rails no lubrication is necessary. This maintenance-free operation is ensured.





Agricultural and construction machinery

Plain bearing bush in classifier machine

Material
ZX-100K as replacement for polyamide.

Description of the application
In a classifier machine a plain bearing bush (previously polyamide) is used.
Technical data:
Motor power: 5,5 kW
Spiral: Ø 1.200 mm
Length: 6.500 mm
Inclination angle: 18°
Speed: 4-8 rpm

Problem
The bearing comes in contact with a mixture of 50 % water and 50 % sand, which quick wears the current material. The original material must be replaced in order to reduce the wear and thereby achieving a longer working life.

Problem-solving
Now ZX-100K is used.

Working life
The working life has been increased from 1 week to 6 months.

Advantages
Less wear, longer service life.

Plain bearing bush in cultivator

Material
ZX-100K as substitute for polyamide.

Description of the application
Bushing made of ZX-100K for the lifting mechanism of a cultivator. The replaced material was polyamide, because the previous working life was too low.

Problem
The material is exposed to impacts, vibrations and abrasive sand and dust grains as well. Polyamide could not withstand these conditions so long.

Problem-solving
Thanks to the ZX-100K better wear characteristics, the working life has been extended.

Advantages
Less wear and tear,
longer service life.

Worm gear in a drum mower

Material
ZX-100K as substitute for polyamide.

Description of the application
The worm gear of a drum mower drive, which is responsible for the propulsion of the entire drum mower, is assembled directly above the axle and is covered by a case. The worm was made of polyamide.

Problem
In the application the temperature is always approximately 80 °C. In addition, dirt can enter into the bearing seat. The previously used greasy lubricated material should be replaced in order to achieve a higher working life.

Problem-solving
A ZX-100K worm wheel with a diameter of 155 mm and a width of 28 mm has been used. The worm wheel is only lubricated when installed, a subsequent lubrication is not necessary.

Working life
Experiments with double load have confirmed that ZX-100K is suitable for this application, since no wear signs occurred. This worm wheels is used since 1993 without any problem.

Advantages
Maintenance, less friction, longer working life and an easier and cheaper cover (without any protection against dirt) can be used.

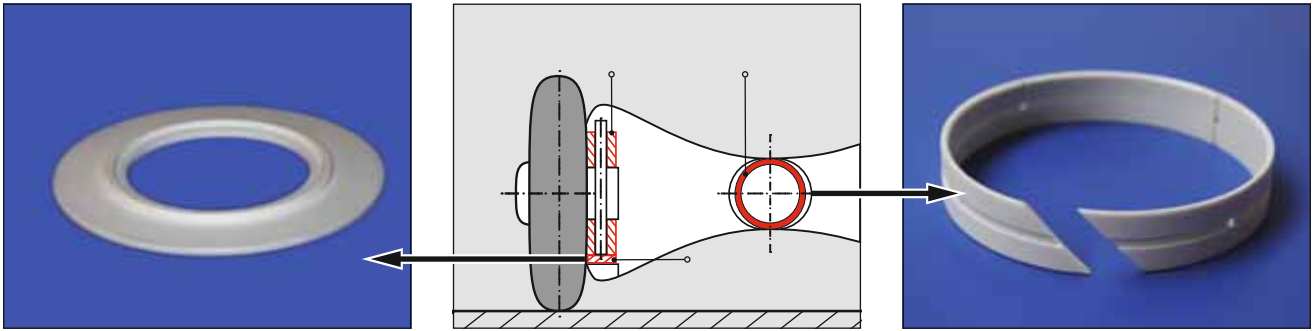
Steering knuckle bearing for tractor

Material
ZX-100A plain bearing bush as substitute for bearings and needle bearings made of bronze.

Description of the application
The application relates to radial and axial steering knuckle bearing, and radial axle and swing axle bearing for tractors and farm tractors as well. The bushings and bearing washers are installed at the red marked point in the drawing. Originally, needle bearing were used as axle bearing. The radial bearing was made of bronze.

Problem
When driving on uneven surfaces, vibrations and impacts occur (impact factor of 2-3). The resulting surface pressures can be up to 30 N/mm². In addition, dirt and water can pass through the fields and penetrate into the bearing seat. The previously installed bronze bushings and needle bearings should be replaced in order to reduce costs and at the same time to increase the working life.

Problem-solving
ZX-100A bush bearings and thrust washer are used. The outer diameter of the bushings is 47 mm with an inner diameter 40 mm and its length is 45 mm.



Working life
The bushings have been installed worldwide as standard equipment since 1972. So far the application did not have any problem.

Advantages
Costs reduction, working life increment, better weather resistance, better corrosion resistance, lighter.

Thrust washer in combine harvester

Material
ZX-100K

Description of the application
In the chassis in a combine harvester a thrust washer of ZX-100K is used.

Advantages
In spite of dirt and dust particles that can enter into the bearing, the material ZX-100K impresses with excellent wear properties.

Bearing shell in combine harvesters

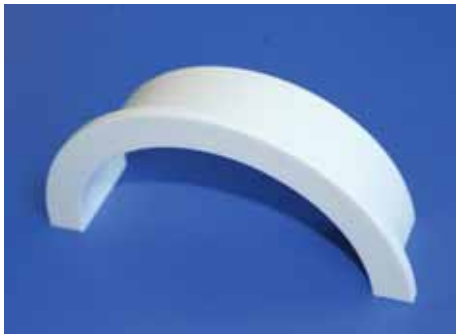
Material
ZX-100K as a replacement for bronze

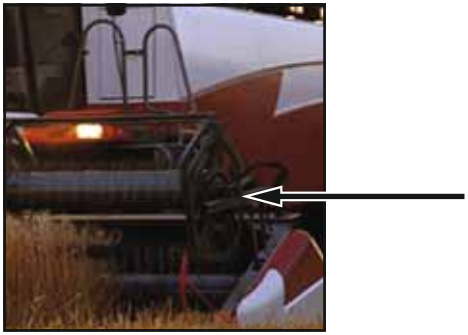
Description of the application
The bearing shells of ZX-100K serve as support of the reel of a combine in substitution for bronze bearing shells.

Problem
Because of the high lubrication maintenance costs and the enormous environmental impact, a more suitable material has being searched. Additionally dirt and dust can entering the bearing, reducing significatively the working life of stardard materials, since it acts as an abrasive paste for the bearing.

Problem-solving
Bearing shells of ZX-100K are now used.

Advantages
The material works in dry running condition and has got a really good resistance to abrasive particles.
By eliminating the lubrication, the environmental impact was eliminated and costs were reduced.





Bushing in tunnelling machine

Material
ZX-100K

Description of the application
The machine is used in mining and tunnelling. The plain bearing bushes are made of ZX-100K and are assembled in the swivel mechanism of the tunnelling machine allowing the swivel movement of the boom.

Problem
The machine is used in dirty and dusty environments (rock particles, partly mixed with water).

Problem-solving
Bushings made from ZX-100K meet the high customer requirements.

Plain bearing bushes for chain bearing roller

Material
ZX-100K as replacement for bronze.

Description of the application
The ZX-100K bushings support the chain bearing rollers of a cable excavator used for mining.

Advantages
The existing bushings made of bronze were replaced. Doing so, the wear was reduced and the application has been converted in dry running conditions.

Chain bearing rollers in bucket-wheel excavator

Material
ZX-100K as replacement for bronze.

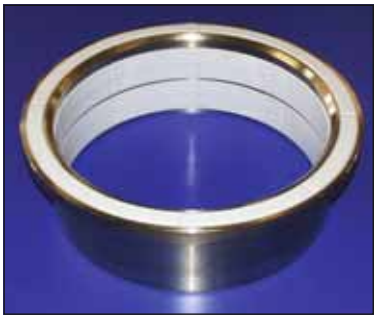
Description of the application
The chain bearing roller in bucket-wheel excavators serves to guide and transport the chain of the suspension. The chain bearing roller is supported by a bushing.

Problem
Dirt and water can enter into the bearing seat. The bearings of the rollers should work in dry running condition and have minimal wear as possible. A replacement for lubricated bronze bushings were searched.

Problem-solving
A plain bearing bush made of ZX-100K, which requires no lubricants, is used.

Working life
In a 17 month field trial, a 50 % shorter chain bearing roller was tested. Afterwards the test, has been observed that dirt and abrasive particles entered into the bearing, but the bushings showed no wear signs and it was as good as new.

Advantages
Dry running, maintenance-free and cost reduction for the components.



Cam-wheel bearing in bucket-wheel excavator

Material
ZX-100K

Description of the application
The plain bearing bush supports the cam-wheel of the chassis drive. The cam-wheel drives the drive chain of a large open-pit mine excavator. The weight of the excavator is supported from the running gear units, which are supported from the cam-wheel on the drive chains. The cam-wheel is mounted in the front chassis and transmits the driving power of the electric motors on the drive chains.

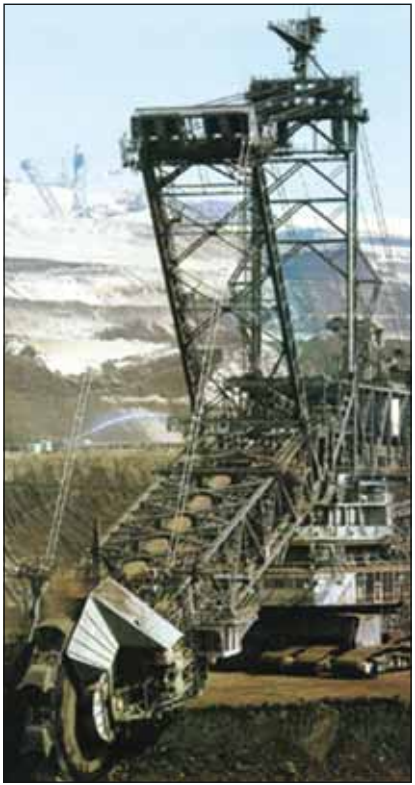
Load
The weight of the excavator is about 13.000 tons. The load is distribute over 16 drive chains.

Problem
The working life should be 5 years with no lubrication.

Problem-solving
Composite bearings , consisting in a brass bushing with sliding elements of ZX-100K are used.

Working life
After two years working life, at the first disassembly, no wear signs has been established.

Advantages
Maintenance-free because the bearing is lubricated uniquely when assembly.



Spherical cap in bucket-wheel excavator

Material
ZX-324

Description of the application
A spherical cap made of ZX-324 is used for the storage of the main undercarriage of the world's largest excavator. Sphere's diameter 1.000 mm. The bearing is composed of segments, whom are bonded in the sphere's housing.

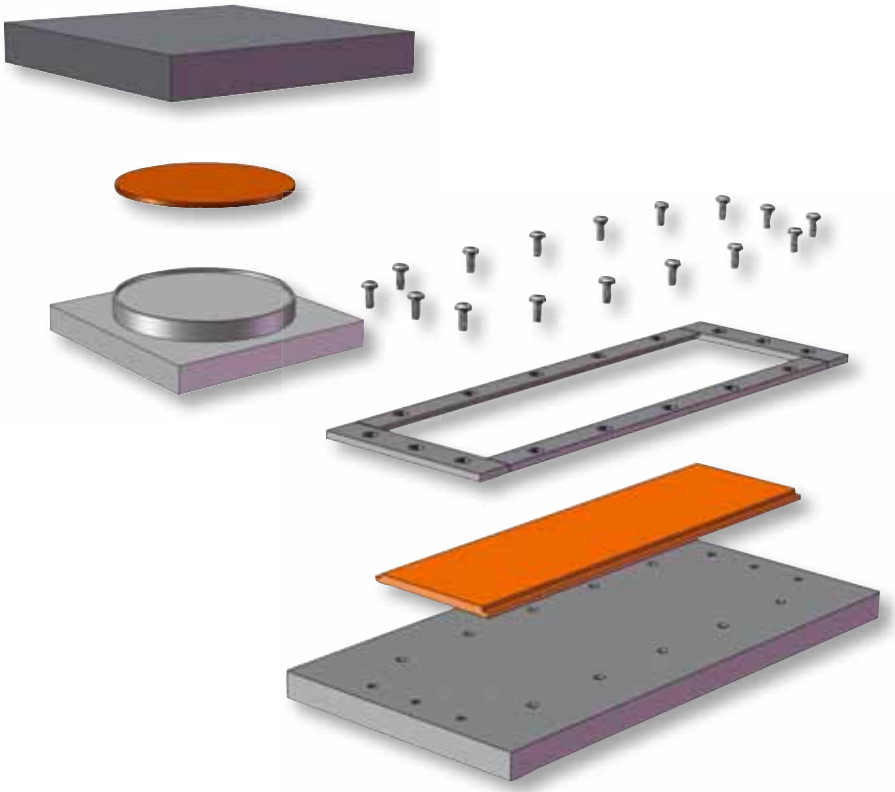
Advantages
Dry-running, high strength.

Bearing pad in bridge bearing

Material
ZX-100K / ZX-410VMT as a replacement-for PTFE

Description of the application
The bearing pads are installed between bridge piers and bridge deck, to allow movements due e.g. to thermal expansion or seismic activity. So far PTFE bearing pads were used.

Problem
The PTFE was too much sensitive to stress and wear, which led to creep and to deformation. The PTFE could not meet the requirements of the application already after short time, and that is why the search for alternatives was initiated.

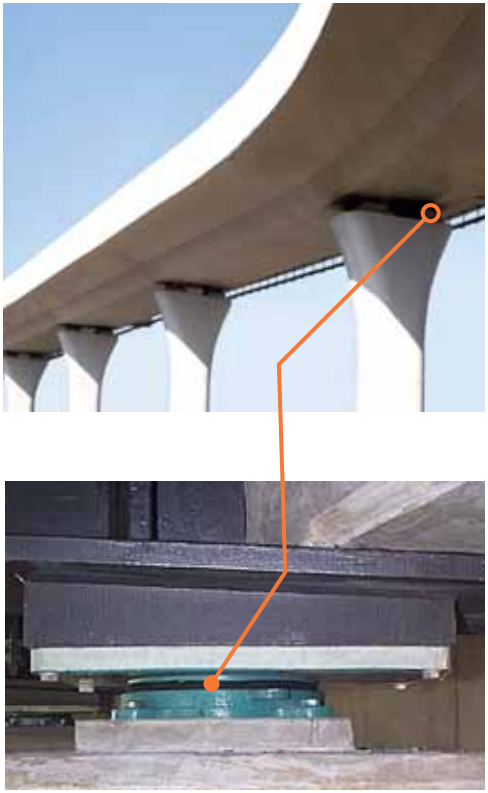


Problem-solving

We replaced the previously used material by our material ZX-100K, which has allowed a durable surface pressure up to 30 MPa. At this time our material ZX-100K already got the certification for bridges and ZX-410VMT is intensively tested, so far with great success and satisfaction.

Advantages

With ZX-100K the problems with permanent deformation due to creep do not occur. The wear was decreased, beacuse of the excellent tribological properties and the working life was significantly lengthened.



Food industry

Food industry

Slideway in a meat processing machine

Material
ZX-100K

Description of the application
Slideway made of ZX-100K for the lifting mechanism in a meat processing machine.

Advantages
ZX-100K meet the FDA requirements and the Regulation 10/2011/EG for repeated food contact and have been successfully used since many years in the food industry.

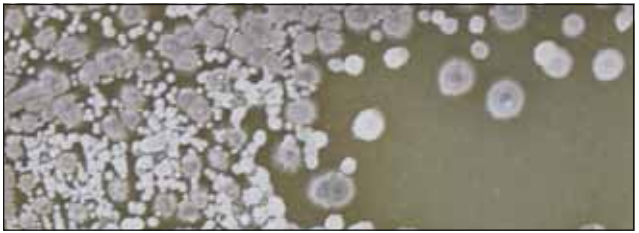
Food industry

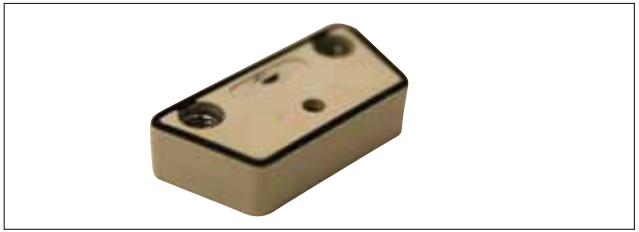
Slideway in a beverage filling line

Material
ZX-530EL3AG2 as replacement
for PTFE-carbon fibre woven fabric.

Description of the application
The sliding guide made of ZX-530EL3AG2 is used in a beverage filling plant of the food industry.

Problem
The so far used guides made of PTFE-carbon fibre woven fabric could not be used in the application, since the threads broke by tightening the screws. The increasing hygiene requirements must be granted and a sufficient load capacity has to be achieved. The tribological properties (friction and wear) must be optimized.





Problem-solving

The problem was solved with a co-injection moulded metal plate and an integrated sealing O-Ring used during the assembly. ZX-530EL3AG2 decimates the vegetative bacteria and spores (Bacillus atrophaeus). For example, the 60 % of the germ "Candida parapsilosis" has been killed after 1,5 hours of continuous contact with ZX-530EL3AG2. To do not let this effect acts only on the surface with a sudden subsequent ousting of micro antibacterial substances, the nanostructural active ingredient was also encapsulated and homogeneously incorporated in the material. In this way a gradual, slow and continuous release of the active substance is ensured to the surface. In addition, the tribological properties (friction and wear) for use in wet areas have been optimized, increasing the elongation at break and the tensile stress at yield. The development time, from the conceptual formulation to the shipping of the injection moulded product, was 8 weeks. The problem was solved, the product was improved and the previous costs have been met.

Advantages

Antimicrobial, universally applicable, extremely wear resistant, good slip-behaviour, ductile, highly resistant to chemicals. Application fields are for example: highly stressed gears, bearings, motion nuts, chain guides, and various slide and wear parts in areas with high hygiene requirements or in direct contact with unpacked food.

Plain bearing bushes made of ZX-100K in a beverage filling machine. Polyamide was substituted.

Scraper in food grade pump

Material
INKUPAL G900

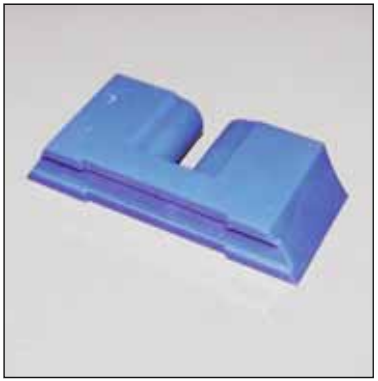
Description of the application
The scraper is used as bearing for the main shaft of a high density solids pumps for viscous food, pharmaceutical and chemical products.

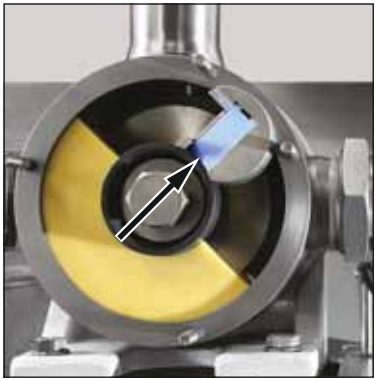
Problem
Because of the abrasive media (e.g., seeds in the strawberry jam), the material must be high wear resistant. The long term operating temperature is 90 °C. Furthermore, a daily steam sterilization with a duration of 10 min at temperatures of 100-120 °C is scheduled.

Problem-solving
Through the use of the material Inkupal G900, a reduction of wear and thus an improvement in efficiency and the working life has been reached.

Working life
By switching to Inkupal G900 an increasing of the running time from approx. 350 hours to approx. 500 hours has been reached.

Advantages
Higher efficiency and service life through reduced wear.





Slide bush in refrigeration equipment

Material
ZX-100K as replacement for POM.

Description of the application
The plain bearing bushes, use as bearing of shafts that transport frozen foods. The bushing are built-in directly in the area in which the foods are frozen. So far, the bearings were made of POM.

Problem
An alternative material, that offers full functionality, even at temperatures below -30 °C, and in extreme cases below -80 °C, has been searched. Dry running conditions, with as low as possible wear in order to avoid the contamination of the transported foods, with a long as possible working life have also to be achieved. A daily steam sterilization at 100-120 °C with a duration of 10 minutes is scheduled.

Problem-solving
ZX-100K satisfies the required properties and replaced the bushings made of POM.

Working life
On test benches, a working life of 250 hours, without any measurable wear, was reached. The sockets are installed since 1992.

Advantages
Dry running conditions, higher working life, functional safety even under extreme low temperatures.

Transport chain in a bottling line

Material
ZX-530AB as a replacement for POM.

Description of the application
The here described transport chain is used in a beverage filling line for the food industry. The transported PET bottles slide on it with high speed. The chain is ca. 80mm width. The transport chain was up-to-now made of POM.

Problem
With a POM transport chain the customer had problems with the sterilisation process, resulting in precision problems after it, wear and friction values. A material that allows a resistance to the sterilisation process, i.e. precision, was needed. Furthermore, a low friction value is required.

Problem-solving
Here a injection moulded transport chain made of ZX-530AB has been tested. It has got no problem with the sterilisation process, and the wear and, most important, the friction values has been reduced.

Working life
The transport chain will be used as standard feature at the beginning of next year.

Advantages
Improved precision, low friction value against PET bottle, low wear and high resistance to sterilisation.

Food industry

Bearing shells for spiral conveyers

Material
ZX-530

Description of the application
Bearing shells are used as bearing for the spiral conveyer of sugar wash.

Problem
For this application has been searched a material, which is approved for direct contact with food, has got a high chemical resistance and that is suitable for steam sterilisation.

Problem-solving
Problem-solving
ZX-530 was used after succsessfully tests as material for bearing shells.

Advantages
The material can withstand a continuous temperature of 60°C and a brief steam temperature of 134°C. ZX-530 has also got sufficient resistance to the acid medium (pH 3.5 up to 4.5). The prescribed conformity according to Regulation 1935/2004/EC is with ZX-530 satisfied.

Plain bearing bush in dough mixer machines

Material
ZX-100K

Description of the application
The bushings of ZX-100K are used in the rotating device for the bowl of dough mixer.

Advantages
Excellent gliding characteristics, smooth running, low wear and extended workng life.

External rollers and dosing piston in dough machine

Material
ZX-100K

Description of the application
ZX-100K is used as the outer roller and piston in a dough and moulder machine. The dough is forced through a funnel into the drum opening. The dosing piston presses the dough through the recesses of the rotating drum, in which the dough is preformed. The dough in excess is then conveyed back by means of a scraper.

Advantages
ZX-100K is used for its anti-adhesive effect and its approval for applications with direct food contact.

Dough rollers

Material
ZX-530

Description of the application
In plants for industrial bakeries dough roller of ZX-530 with different diameters are used. The shell of ZX-530 is here mounted on a stainless steel shaft.

Advantages
ZX-530 is used because of its high resistance to sourdough and aggressive cleaning agents and also its anti-adhesive effect

Food industry

Moulding roller for meat pies

Material
ZX-100K as a replacement for stainless steel.

Description of the application
So far, shapes of stainless steel were used as moulding roller for meat pies.

Advantages
Through the usage of ZX-100K the working life was significantly increased and the costs were reduced. The very good anti-adhesion properties of ZX-100K facilitates the demoulding of the finished moulded dumplings.

Scraper in meat processing machines

Material
Inkulen 1000

Description of the application
This part is used as a scraper for shafts mounted in meat process-ing machinery.

Advantages
Thanks to the low friction and anti-adhesion properties of Inkulen 1000 is now used.

Half-shells for screw conveyors

Material
ZX-100K als Ersatz für PE

Description of the application
The half-shells are used in screw conveyors on ships, for the conveying of mussels. The half-shells have been hot bent from plates saving so material cost.

Problem
Earlier PE-plates were used as bearing, causing big problems with the wear. The wear values were so high that it was necessary to replace the bearing every month, which had led to large maintenance efforts and therefore costs.

Problem-solving
As a replacement for PE was used ZX-100K und it was successfully tested.

Advantages
Thanks to the installation of half shell ZX-100K bearings, the tribological properties, such as friction and wear, were significantly improved and the maintenance significantly reduced. Since 2 years our bearing is tested in the real life and it is still working perfectly

Measurement and laboratory technology

Impeller shaft and bearing for bioreactor

Material
ZX-530 replaces PTFE and PEEK.

Description of the application
Up to now, for the agitation of the culture medium was used a stainless steel shaft, with bearings made of PTFE or PEEK. The miniaturized bioreactor is part of parallel cultivation systems.

Problem
After a short usage, due to the severe wear, an inadmissible high backlash came into being, which led to oscillations and to an impairment of the proliferation cell. Therefore, a new material that also meets the following requirements was required: autoclavable at 121°C, continuous operation at 37 °C, minimal abrasion with a smooth run, food grade, not cytotoxic, speeds 20-120 rpm, stick-slip-free, not magnetic.

Problem-solving
ZX-530 is now used to replace PTFE and PEEK. After the initial tests, ZX-530 showed to be extremely resistant to wear and Stick-Slip free. ZX-530 is biocompatible, not toxic for the cells and it is now used as impeller shaft.

Advantages
ZX-530 can be sterilized, has got a low wear and a good stick-slip behavior.

Slide guides in a measurement system

Material
ZX-100K

Description of the application
The axle guides in high-precision measurement systems are supported by sliding guides. The linear guide must be manufactured with a tolerance of 1 µm. The repeatability of positioning must be very high. The measurement system is air-guided and the positioning have to be repeatable.

Problem
The axle guides do not have to be readjusted. Excellent dimensional stability with temperature changes and moisture presence has to be provided.

Problem-solving
Thanks to the high precision in manufacturing, the objective can be achieved with ZX-100K. A re-machining is not required when assembled.

Advantages
The guides do not require any lubrication and are not readjusted. By external influences, such as temperature and humidity, there is no dimensional changes.

Threaded nut in coordinate measurement machine

Material
ZX-100K as replacement for brass.

Description of the application
The threaded nuts in coordinate measuring machines are connected to the positioning table and have to run extremely smoothly, in order to achieve the maximum possible efficiency. As counterpart there is a spindle made of St50. Precision: 1 µm. So far, the threaded nut was made of brass.

Problem
In order to achieve an overall efficiency greater than 75 %, the friction coefficient has to be smaller than 0,03. The previous solution was too expensive and a cheap alternative had to be found.

Problem-solving
A threaded nut made from ZX-100K without any pitch error and any preloading, allows a smooth and easy run.
Screw: M6 x 1,25
Length: 10 mm
Stroke: 25 mm
Fa: ±200 N
n: 300 rpm
Duty cycle: 10 %
lubricated with LM 47

Advantages
The ZX-100K threaded nut replaced the expensive brass nut. Higher efficiency, longer working life and price reduction have been achieved.

Thrust bearings in oxygen valve

Material
ZX-410

Description of the application
The thrust bearings are mounted at the end of the steel spindle and transmit the applied by hand axial force to a locking mechanism. Since at the locking mechanism no relative movements of the steel spindle must occur, a thrust bearing made from ZX-410 was here applied. To converts the rotational and translational motion to a pure translational motion.

Load
At a low sliding speed, the max. surface pressure (short-term) is 530 N/mm² for a time of 60 s.

Problem
The previously used thrust bearing from conventional high-performance plastics are not suitable and should be replaced due to their short lifetime (failure due to low tenacity).

Problem-solving
Here thrust bearing made from ZX-410 are used. The thrust bearing have an outer diameter of 16 mm and a thickness of approx. 7 mm.

Working life
A lifetime of 10 years was reached. Since 1995, the thrust bearings have been used as standard feature without any problem.

Advantages
Working life extension.

Iris diaphragm in a camera

Material
ZX-410V7T as replacement for Aluminium.

Description of the application
ZX-410V7T is used, thanks to its high wear resistance and dimensional stability, as iris diaphragm in High-Tech camera lenses.
The iris closes the objective.

Advantages
Very tight tolerances in injection moulding, high wear resistance, very low thermal expansion at an operating temperature from -40 °C to +60 °C are needed. Aluminium, due its high wear, has been replaced from ZX-410V7T.

Electromagnetic clutch

Material
ZX-530

Description of the application
The magnetic clutch is used for components in laboratory equipment with shafts 8-10 mm and rotation speeds up to 1,500 rpm. A high chemical resistance, food grade, heat resistance up to 200 °C (short term), high wear resistance and lubrication-free operation are the customer requirements.

Advantages
Using the material ZX-530 all requirements have been met. Very good tribological properties, high chemical resistance, dry running conditions, FDA approved, vacuum compatible.

Medical technology

Slide guide for operating table

Material
ZX-550

Description of the application
In hospital operating tables, the adjustment in the horizontal direction has to be guarantee. This is made possible thanks to a slideway of steel cladded with plastic material.

Load
The operating table is designed for patients up to 150 kg and the table plate has got a weight of 20 kg. On the table plate are anchored additionally equipments and tools.

Problem
The material must be sterilisable in order to maintain sterile the operating room. The slideway must work without any kind of lubrication.

Problem-solving
It is used a steel bar cladded with ZX-550.

Advantages
Thanks to low friction, good stick-slip behaviour and low creep, ZX-550 is now used as a sliding guide for the patient support in operating tables. Because of the low wear the guide does not have to be readjusted. The material can be sterilized.

Orthopedic toe alignment splint

Material
ZX-324FDW2

Description of the application
This application relates to an orthopedic toe alignment splint for the post-operative usage.

Load
The splint must be loaded with at least 25 N, with a maximum thickness of only 3 mm.

Problem
A sterilisable material, that withstands the high loads and allows a stick-slip free rotation of ± 70° was searched. The bearing must be backlash free.

Problem-solving
Now as material ZX-324FDW2 is used. The material is dyed in RAL 7035 and satisfies the required properties.

Advantages
Sterilisable material, high strength, high elasticity, lower friction. The material is physiologically safe.

Slide guide in operation robot

Material
ZX-530

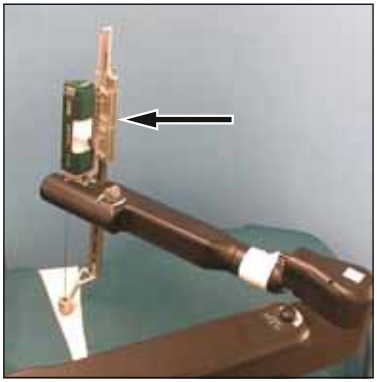
Description of the application
Robot-assisted liver biopsy under clean room conditions: on a robotic arm, a 190 mm long biopsy needle is guided by means of a prismatic linear guide. After each operation, the device must be sterilized in an autoclave at 150 °C and then has to work again tactfully and accurately.

Problem
The device must be sterilized at a temperature of 150 °C in an autoclave. It calls for high precision, sensitivity and as low as possible weight.

Problem-solving
Now in usage are a linear guide with a prismatic cross-section, DKLFP 10 carriages, guide rails made of aluminium with hard-coated surface and sliding elements made from ZX-530.

Working life
Through adjustability of the slide clearance and the low mechanical stress, an endless working life is expected.

Advantages
Maintenance free and low weight, sterilisable.



Clip bearings in X-ray machine

Material
ZX-530LR6

Description of the application
The clips bearing made of ZX-530LR6 are used in X-ray machines.

Problem
"Ordinary" plastics can be electrostatically charged through friction. In a subsequent discharge the tensions can lead to the damaging of the sensitive X-ray machines. Therefore an electrical conductivity material was required. Additionally the material should also have good tribological properties.

Problem-solving
ZX-530LR6 fulfils also the requirement about the electrical conductivity. Tests made by the X-ray units manufacturer, have shown an surface resistivity of 70-160 kΩ by a voltage of 100V.

Advantages
Electrically conductive, low friction and low wear.

Bushing in artificial knee joints

Material
ZX-100K and ZX-750V5T

Description of the application
The application involves bearing bushes in artificial knee joints.

Problem
High surface pressures and high wear resistance are required in order to do not exceed a max. clearance of 0,05 mm.

Problem-solving
Bearings made of ZX-750V5T (with less load ZX-100K is used) meet the extreme requirements of artificial knee joints.

Advantages
High wear resistance, high allowable surface pressure.

ZX-750V5T

ZX-100K

Slide bush in mammography device

Material
ZX-530 replaces PA11 and PEEK.

Description of the application
The so-called double bearing is assembled into the film processing unit of mammography equipment and it works as bearing of the shafts used for the film transport. Previously were used plain bearing bushes made from PA11, PEEK or other special compounds.

Problem
It is required a high chemical resistant bearing material, because the bearing has to operate with chemicals with pH-values from 2 to 12. Additionally salts and abrasive particles may penetrate into the bearing seat. The bearing must have a tight bearing clearance and furthermore it should not considerably change its mechanical properties, not even under the influence of ozone. The previously used ball bearing did not meet the required demands. The previously used ball bearing and the steel shaft had a too high wear.

Problem-solving
Now ZX-530 is used as bearing material, thanks to its very high chemical resistance (similar to PTFE) and very high wear resistance.

Working life
2 years is the new working life of the double bushing made of ZX-530. After test bench and laboratory experiments, the material was classified as ideal and the previously used material was replaced. ZX-530 is now used a standard feature in this and other applications.

Advantages
Increasing of the working life, reliability, less wear.

Slide bush in film processing device

Material
ZX-530 plain bearing bush as replacement for rolling bearing.

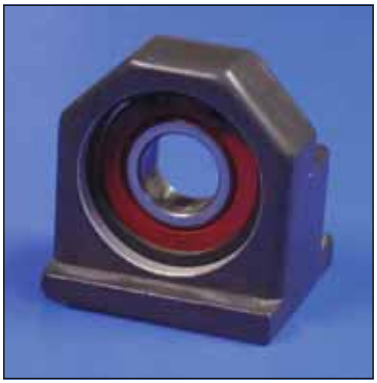
Description of the application
The bearing is installed into the film processing unit of x-ray devices and it works as bearing of the shafts, that are used for the film transport.

Problem
It is required a high chemical resistant bearing material, because the bearing has to operate with chemicals with pH-values from 2 to 12. Additionally salts and abrasive particles may penetrate into the bearing seat. The bearing must have a tight bearing clearance and furthermore it should not considerably change its mechanical properties, not even under the influence of ozone. The previously used rolling bearing were too much loaded. Extremely high wear, on the bushing and the steel shaft, led to premature failures.

Problem-solving
Since the slide bearings made of polyamide 11 and then of PEEK brought no satisfactory results, ZX-530, which shows a very high chemical resistance, low coefficients of friction and a very high wear resistance, is now used as bearing material. After test bed trials and laboratory tests this material has been classified as excellently suitable and the previously used anti-friction bearings have been replaced. Since then, ZX-530 has been installed as a standard feature in these applications, with a cost advantage of 4,5 € per piece.

Working life
The high wear on the bushing and on the stainless steel screw was strongly minimised, and so a working life of at least 5 years (it still works now) was achieved.

Advantages
High wear resistance, lower coefficients of friction, significant price reducing.



Before: Rolling Bearing

After: Slide Bearing made of ZX-530

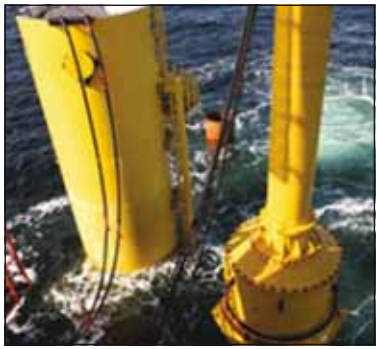
Energy and water supply

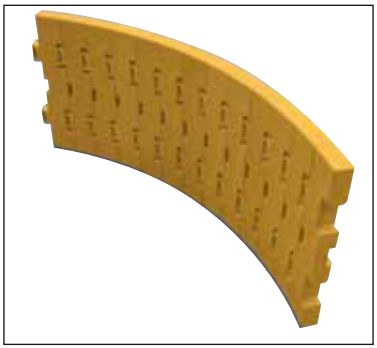
Energy and water supply

Bearing segments in deep-sea hammer

Material
ZX-750V5T

Description of the application
This segmental bearing, made of ZX-750V5T (Ø 700 mm), guides and leads into water the floating weight of 28 tons in a deep-sea hammer. This extreme stress subjected part operates in unlubricated conditions, with a 50 Hz impact frequency and a drop height of 1 m. The bearing segmented of ZX-750V5T holds the extreme conditions and runs maintenance free.

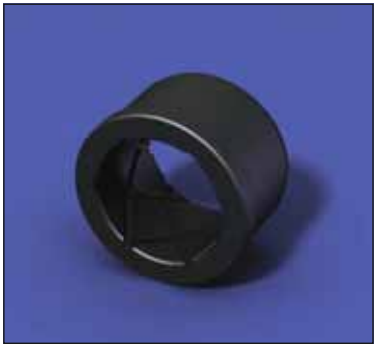




Bushing in hydrodynamic screw

Material
ZX-530CD3

Description of the application
Bushing made from ZX-530CD3 as support in a hydrodynamic screw.



Slide bush in look gates

Material
ZX-100K

Description of the application
Reconstruction of an existing plain bearing system for look gates in a hydroelectric power plant in the form of two bearing shells and bushings for all pre steering shafts

Load
Pressure force 200 kN each main pivot bearings, rotary speed 0,5 rpm.

Problem
The existing greasy lubrication should be integrated again into the plain bearing system. The geometry errors, incurred by the coarse steel construction, should be compensated from the bearing.

Problem-solving
2 half shell bearings made from ZX-100K with milled greasy grooves, have been integrated into the existing cast iron housing. The existing greasy lubrication system was integrated on customer's request.

Working life
No limit on the working life are expected.

Advantages
Better wear resistance and indifference to geometry errors.

Slide rails and stop bars in lock gates

Material
ZX-100K and ZX-410
as replacement for bronze.

Description of the application
In lock gates, underneath and above the water level slide rails and stop bars made of bronze with graphite lubrication points are used. A gate has got a dimension of 18 m x 18 m and by means of a hydraulic cylinder is moved. One cycle takes about 1 hours, 15 times per day. The supporting force acts between slide rails made of our plastic material (now ZX-100K and ZX-410 in the mobile door side) and solid concrete portals with screwed steel bars.

Problem
The original bronze rail showed too much wear and were already partially broken. In addition, a big noise was criticized.

Problem-solving
33 slide rails made of ZX-100K with a cross-section of 70 mm x 20 mm in different lengths (average approx. 393 mm) are now used. Theoretical possible short term pressure up to 80 MPa. Test specimens had been loaded up to 140 MPa without any problem. 3 slide rails made of ZX-410 with a cross section of 70 mm x 20 mm, length 393 mm are now used. Theoretical possible short term pressure up to 140 MPa. Test specimens had been loaded up to 180 MPa without any problem. Counter sliding element: finely milled steel plates. The complete line of plastic and steel plates deviates max. 1 mm from the straight line.

Working life
It works since 2007 without any problem.

Advantages
Excellent long term stability.

Plain bearing bushes in sewage purification plant

Material
ZX-100K as replacement for bronze.

Description of the application
In the responsible for the movement rake's track rollers of a sewage purification plant, a bushings is installed. This previously was made with bronze.

Problem
The previously used bronze bushings had to be lubricated every day and had only a very short working life. They demanded a dry-running bushing and a lifetime of at least 1 year.

Problem-solving
Bushings are now made of ZX-100K. For applications with a dirt ingress into the bearing, the bushing are designed with a honeycomb structure onto the inner diameter.

Working life
After a period of 3 years, no tear or signs of wear are evident on the bushing.

Advantages
Extremely high wear resistance in dry running conditions.

Gear segments in sewage purification plant

Material
ZX-100K as replacement for polyamide.

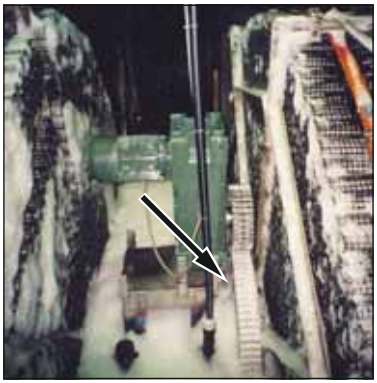
Description of the application
In the drive of a Ø 3.000 mm filter drum in a biological sewage purification plant, a plastic gear wheel made of 8 segments is used. (Module 10, tip diameter 1.000 mm, cog width 100 mm). In this area, the plant had to be rebuilt completely, because of the undersizing of the power train (gears made of PA with too high wear).

Problem
High impact force (driving torque 5.400 Nm), alkaline water quality from the cleaning operation. A maintenance-free and robust solution for harsh operating conditions was searched.

Problem-solving
The main criterion was the force and the high starting torque transmission into the plastic gear. The solutions were two gear segments made from ZX-100K, one next to the other assembled and connected via a stainless crown wheel to the drive shaft. Thanks to that the force is introduced onto the plastic in the outside part. The manufacturing tolerances allow the interchangeability of all gear segments.

Working life
The lifetime is, depending on duty cycle, of several years.

Advantages
Maintenance-free operation and flexible manufacturing of the parts.



Bearing in submersible pump

Material
ZX-100K

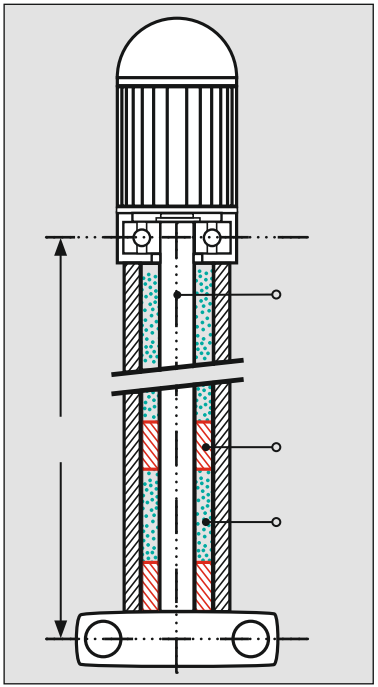
Description of the application
Shaft bearing of a exceptional length submerged pump with electric motor (N= 8kW, n= 1450 rpm). The bushings are used as support of the approx. 10 m long drive shaft (Diameter 80 mm).

Problem
Due to the long shaft, combined with its relatively high rotatory speed, in the centre bearing results high edge pressures caused by the deflection of the shaft. The challenge was to extend the working life from the current six weeks (material combination carbide metal / silicon carbide), since a bushing exchange is associated with enormous costs.

Problem-solving
To satisfy the required properties now plain bearing bushes made from ZX-100K are used.

Working life
The achieved lifetime with a bushing made of ZX-100K, under the same conditions as for the hard-metal bearings, is more than 3 years.

Advantages
The replacement of shaft protection sleeve made of silicon carbide is no longer required. Longer lifetime.



Split ring in groundwater pump

Material
ZX-100K as replacement for bronze.

Description of the application
The underground water pumps keep the mine free of water to ensure the coal production. This water is mixed with abrasive dirt. A shaft moves it self through several stages and each of them must be sealed on both sides with split rings. The split rings work with no-contact and have been made of bronze.

Problem
The dirt particles should not wear out bearings and split rings. So far, the metal bushings worn out completely, and the shafts abraded the housing. This should be avoided by using plastic bushings. The lifetime should be increased. The installation must be simplified in order to reduce unit costs.

Problem-solving
The material for the split rings now is ZX-100K. The split rings are pressed and have less wear.

Advantages
The unit costs were lowered through reduced installation costs. Changing the bushing, the bearing seats must not be drilled anymore. The working life is increased.

Sphere seal in underground hydrant

Material
INKULON SVC 20 as replacement for hard rubber.

Description of the application
To seal underground hydrants, the same used also in road constructions, a ball made of hard rubber was previously used. The ball in the underground hydrants is loose assembled and through the line pressure, it is pressed against the outlet in order to seal it.

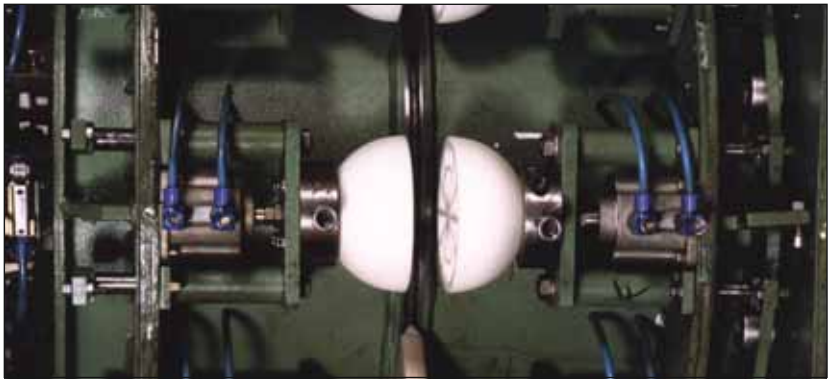
Load
The line pressure is generally 10 bar and in exceptional applications (e.g. highlands) are even up to 15 bar.

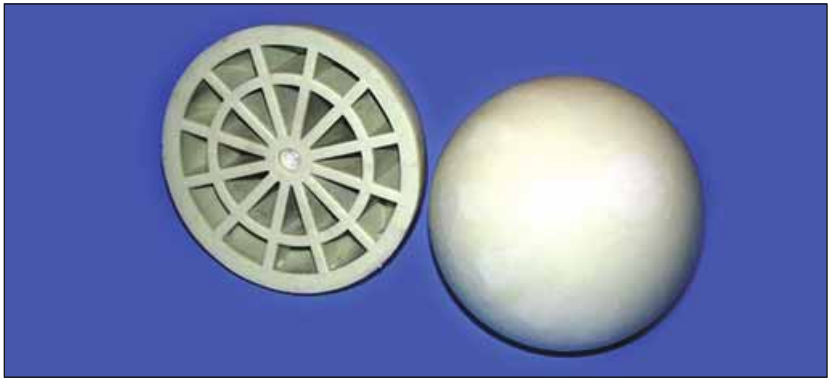
Problem
The ball's material must be abrasion resistant, physiologically safe and can not be deformed by the water pressure. The ball roundness must be very accurate and its centre of gravity must be centred.
To ensure a watertight in the series production, with the previously used balls made of hard rubber, the customer had to invest in additional costs in quality control, since the balls were very fragile and by impacts they could have been damaged and/or lead to leaking.

Problem-solving
Here a ball made from INKULON SVC 20 with a diameter of 105 mm with reinforcement ribs is now used. This material is characterized by its harmlessness and high mechanical strength.

Working life
Required service life 50 years; at least 30 years. In bench tests after a number of load cycles of 50.000, which represents a lifetime of 13 years, no problem occurred. The balls have been used as standard feature for 10 years without failure.

Advantages
Cost effective, physiological properties, high wear resistance, high pressure resistance, chemical resistance and watertightness can be ensured.





Energy and water supply

Slide bush in hydroelectric power plant pump

Material
ZX-100K replaces bronze.

Description of the application
Slide bush for a 12 m long main spindle in a centrifugal pump of a hydroelectric power plant. The flange bracket unit housing has got a outer diameter of 240 mm, shaft diameter 140 mm with tolerance h6. The clearance should be very tight (approximately 0,15 mm for big shafts and high speeds). The length of the bushing is 240 mm.

Load
The pump has a drive power of 315 kW. The shaft speed is 500 rpm, corresponding to a sliding speed of 220 m/min.

Problem
Usually water flows through the bearing seat. The pump operates continuously 24 hours per day, approx. 350 days a year. When starting and stopping there is no hydrodynamic lubricating film (process water lubrication), and this operation takes place in a mixed friction area which leads to require an extremely high wear resistance. The bearing seat caused for a loss greasy lubrication of 1 ton per year. For environmental reasons, several polymeric materials were tested. So far the best tested material achieved a service life of 7.000 operating hours with 4 mm wear. A longer working life of approximately 50.000 hours was required.

Problem-solving
A greasy lubricated bronze bushing was substituted with a bearing made of ZX-100K with longitudinal grooves. The 4 mm deep longitudinal grooves serve as a dirt deflector for the dirt which might penetrate with the service water into the bearing seat. The plain bearing bush is cooled in the normal operating condition with the service water.

Working life
After a running time of 20.000 hours, no wear was detected.

Advantages
The price of the bushings has been significantly reduced and the service life was at least doubled, further a additional lubrication is not anymore needed, so that the water contamination is greatly reduced.

Slide bush for guide vanes in water turbine

Material
ZX-100K

Description of the application
Bushes made of ZX-100K can even be used as bushing for guide vanes in water turbine (previously bronze with solid lubricant). Through the bearing of ZX-100K, the clearance can be kept low. The problems in which the bronze bearings incurred (corrosion and dirt) have been solved. The application now runs maintenance free and with reduced wear.

Plain bearing bush for turbine in a hydroelectric power plant

Material
ZX-100K as replacement for white metal.

Description of the application
Bearings for Francis turbine in a hydro-electric power plant. The plain bearing bush (previously bearings made from white metal) is used in the turbine as the main bearing of the turbine's wheel.

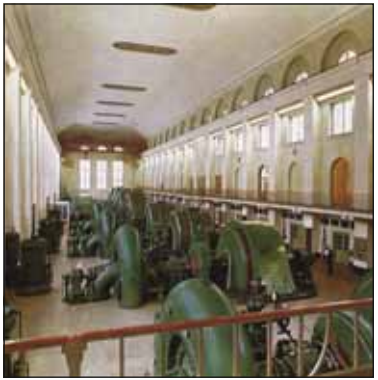
Load
The shaft transmits an output of 85 kW and exercise a surface pressure of about 1 N/mm² on the bearing at a sliding speed of 18 m/min.

Problem
The previously used bearing shells made from white metal had an excessive wear.

Problem-solving
As replacement for the existing bearing shells plain bearing bushes made from ZX-100K are now used. The bearing seat is completely sealed against water. The bushing's inner diameter is 200 mm and its length is 235 mm. The bearing clearance is 0,3 mm.

Working life
The plain bearing has been used since 1992 and until today no problems have occurred.

Advantages
Less wear, longer service life.



Plain bearing bush for turbine in a hydroelectric power plant

Material
ZX-100K

Description of the application
Bushings in a turbine for hydroelectric power plants. The bushing supports the main spindle of the turbine.

Load
The turbine has got an output of 920 kW.

Problem
The wear of the previously used bushing should be reduced.

Problem-solving
Now a bushing made from ZX-100K with a honeycomb structure is used. This honeycomb structure ensures the lubrication and the cooling with the service water. The bushing operates so with a hydrodynamic lubrication. Furthermore, these grooves carry out any possible existing dirt from the bearing seat. The result is a hydrodynamic friction process.

Working life
The bushings have been run in continuous operation since 2001.

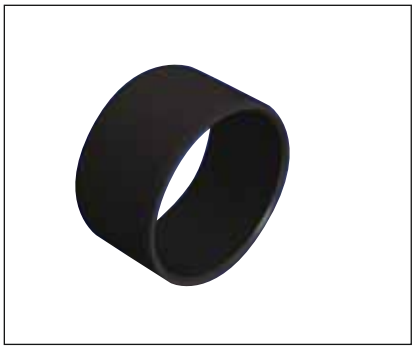
Advantages
Maintenance-free, longer working life, less wear and tear.

Energy and water supply

Bushing in wind turbine

Material
ZX-530CD3

Description of the application
Because of its extremely low wear, a bushing made of ZX-530CD3 is used in the gearbox of a wind turbine.



Threaded nut in solar panel

Material
ZX-100K

Description of the application
The threaded nut made of ZX-100K allows the movement of the solar panel, which follows the sun.

Sealing ring in ball valve

Material
ZX-530 replaces PTFE with gals fibre.

Description of the application
In plants for the extraction of a special fuel, ball valves, which are sealed with two sealing rings, are used. Previously, these seals were made of PTFE with 30 % glass fibre.

Problem
The valve must also can be switched at high pressure. The previous sealing rings made of PTFE with 30 % glass-fibre, did not withstand the required parameters. The large deformation of the PTFE rings, developed in short time, led to leakages.

Problem-solving
ZX-530 meets the demand for chemical resistance and dimensional stability.

Working life
ZX-530 is now used as standard feature. It meets the demand for chemical resistance, dimensional stability and low friction.

Advantages
The friction values are so low that a switching under full load can be done without any problem. This was previously not possible with PTFE with glass or with PEEK. Additionally, with ZX-530, the cost had been reduced of approx. 40 %.

Sealing ring of ZX-530 in ball valves

Another sealing ring made of ZX-530 in ball valves. ZX-530 is used over 180 °C as a sealing ring in ball valves because of the excellent creep resistance and good sliding properties when compared to PTFE.

Energy and water supply

Bearing of distribution pipes in columns of a refinery

Material
ZX-530 as replacement for PTFE.

Description of the application
Manifolds are used in alkylation columns of refineries. During a chemical reaction, the components come into contact with acid. Because of the necessary chemical resistance, up to now PTFE has been used as material. The star-shaped piping system is welded in its centre and can be assembly on the edge without any central support. The manifolds are fastened with a flange on top of the column.

Load
At a temperature of approx. 120 °C, this machine element has to support its own weight and the weight of the acids. Due to the poor creep behaviour and the high density of PTFE, it came to tearing off and thus the manifolds brake.

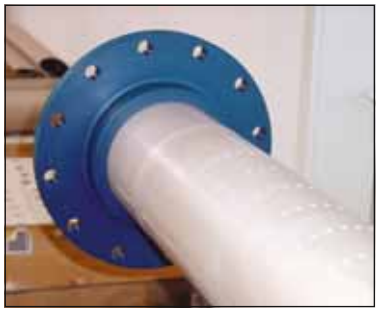
Problem
The tearing of the manifolds has to be prevent through the usage of a more suitable material.

Problem-solving
The problem was solved through the substitution of PTFE with ZX-530 as manifold and flange material.

Columns of a refinery

Working life
With the new material, the manifolds did not break.

Advantages
The manifold made from ZX-530 is much lighter than the previous one made of PTFE. The material maintains its strength also at the operating temperature. The chemical resistance is almost as good as that of PTFE.

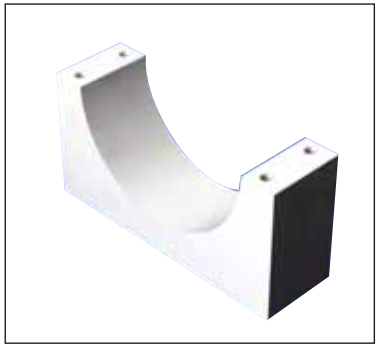

Manifold and flange


Part of a column

Central bearing in a biogas plant

Material
ZX-100K

Description of the application
The component made of ZX-100K is used as a centre bearing for impeller shafts in a biogas plant.

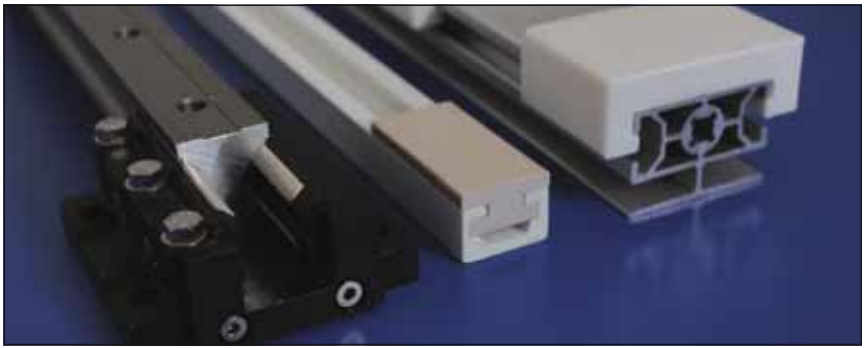


Other Fields of Application

Slideways

Material
Various ZEDEX materials.

Description of the application
Thanks to their excellent tribological properties, ZEDEX plastic materials are very good for linear guide systems. The low friction coefficients provide extremely low-noise operations and slip-stick free sliding movements.



Slide guide for fixing device

Material
INKUFORM AST

Description of the application
The slide guide made of antistatic Inkuform AST are used as carriage clamp in flexible fixing devices.

Advantages
Advantages are low friction and low wear.

Other Fields of Application

Linear guide systems for movable art object

Material
ZX-530

Description of the application
In an artistically designed theme of a crystal's world, a new "cabinet of curiosities" was created. The representation is an outsized accordion, which is constantly in motion. The necessary linear guides have been made from ZX-530.

Load
Off-centre force application of approximately 1kN.

Problem
Maintenance free and noiseless are required.

Problem-solving
The two linear guides DKLF2/48-60/A/5D with sliding elements made from ZX-530 were used with a mating rail made of anodized aluminium.

Working life
No working life limit are expected.

Advantages
Quiet, no necessity of lubrication, therefore, maintenance-free.

Other Fields of Application

Slide bush in dryer

Material
ZX-530

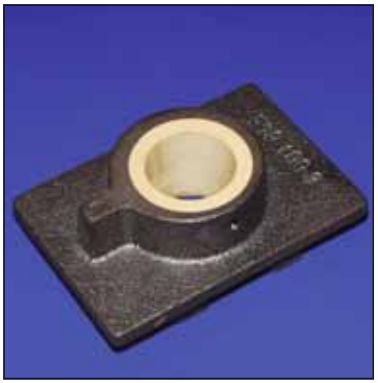
Description of the application
The bushing support the steel track rollers which transport the dried material through the dryer.

Problem
In the dry zone, temperatures up to 200 °C can be present; the continuous temperature is 160 °C. At this high temperature it can not be lubricated anymore with commercial lubricants. Dry running bushings are here required. The coefficient of friction should be reduced, the bushing should be wear resistant and should run smoothly. The bushings have also to run quieter than the previously used carbon bushings, which also wore out quickly.

Problem-solving
An injection-moulded bushing made of ZX-530 is used. The generated frictional heat is lower than the previously used carbon bushings, so that the operating temperature of the bearing bushing is only slightly above ambient temperature.

Working life
In field tests, after a period of one year, no measurable wear has resulted.

Advantages
The bushing runs smoothly and has a low coefficient of friction. Elimination of lubrication through dry running bushings. Maintenance is no longer required. The bushings run without wear.



Light ring for a signal lamp

Material
INKUPAL N100

Description of the application
The light rings are used as optical signal to indicate the operating condition of industrial machines and also in record-studios. The rings can be assembled and combined according to one's desires.

Problem
In this application, the topic of "design" is in foreground. A translucent material, which leaves the light shine through, without that the inside used technology can be seen, both in the illuminated and the non-illuminated state, was needed. In addition, a locking system that allows to exchange each segment in short time was required. Furthermore must be ensured that the climate of different locations around the world will not affect the function of the locking system.

Problem-solving
As material INKUPAL N100 has been chosen. The material meets the requirement of the light transmission. Thanks to a locking system similar to a bayonet catch, each ring can be replaced individually. Each light rings are separated by an aluminium ring that is also part of the locking system. An O-Ring assures the necessary tension for a firmly connection between the segments construction (up to a max. height of approx. 280 mm) and at the same time the tightness of the system. Experiments concerning hot and cool storages of the rings have shown the effectiveness of the locking system in different conditions of application.

Advantages
Diffuse light scattering at 100 percent structural homogeneity and a high-style look.

Other Fields of Application

Hinge bearing of fire-proof door

Material
ZX-530 as replacement for sinter bronze.

Description of the application
In aluminium fire door hinges, bushings with a clearance fit and a lock against rotation are used. The so far used bushings have been made of sintered bronze.

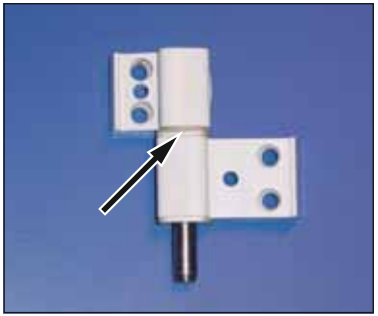
Load
Doors' weight of 200 kg, oscillatory motion of up to 80°, required service life: 2.000.000 cycles.

Problem
In the previous used sintered bronze bushings, in extreme heat situations, their oil could ignite. The bearing may thermally corrode, but it may not inflame. Also a quiet operation was required. A door lowering due to wear and deformation shall be not more than 0,5 mm.
Lubrication must be eliminated.
The door hinge shall not wear.

Problem-solving
An injection-moulded bushing made of ZX-530 is used. The material does not burn, but only decomposes at about 500 °C. The bushing works without any lubrication. The bushing's wear at 2 million load cycles was approx. 0,05 mm, whereas the bolt hinge had no wear signs.

Working life
In bench tests was simulated a duration of 20 years (open and close every 5 minutes, 24 hours a day, 7 days per week), in which a door closer opens and close the door 2.000.000 times with an angle of 80°. The material resulted out to be the ideal.

Advantages
Maintenance free by dry running conditions, fire behaviour UL V-0 (non-flammability), high wear resistance, low noise and smooth motion.



Rolls in power unit for elevator door

Material
ZX-100K as replacement for polyamide.

Description of the application
The rolls are mounted in the power unit for elevator doors. A plastic (previously polyamide) sheathed steel core is provided with a variable pitch groove in which works a driver. It always moves the door at constant speed but thanks to the variable pitch a variable door opening speed is obtained.

Problem
Since the previously used polyamide does not have sufficient strength and dimensional stability, it should be replaced by a more suitable material. Furthermore, the costs have to be reduced because the roll coverings made from PA were glued.

Problem-solving
Now rolls made of ZX-100K, which are manufactured with a high level of accuracy and without adhesion to the steel core are used.

Working life
The lifetime for this component is 10 years.

Advantages
Lower price, high wear resistance, low friction coefficients, dimensional stability and durability.

Other Fields of Application

Bearing shells for doors

Material
ZX-100K

Description of the application
The collar bearing shells are used as support for heavy doors in agriculture, which are subjected to high loads and temperature fluctuations between –20°C to 40°C .

Dimensions:
Ø120/130/150 x 40mm
Collar thickness 5mm

Advantages
The bearings withstand the high loads without any problems and do not require lubrication . The doors open and close quietly.

Plain bearing bushes in LED-Spotslights

Material
ZX-410

Description of the application
The plain bearing bushings are used in swivel joints of LED spotlights

Dimensions:
Ø1,8/3/5 x 2mm
Collar thickness 0.2mm

Guide bushing for drive element

Material
ZX-324V11T

Description of the application
The bushing supports driving elements. An accuracy of the inner diameter of the bushing of 0,0015 mm is too big. The drive should work smoothly. Two hollow shafts are coaxial assembled and the inner one is axially guided from the bushing.

Problem
The bushings should not any longer be worn out, as with the previously used bronze bushings.

Problem-solving
Thanks to very precise tolerance of bushing obtained during manufacturing, it does not need any longer to be re-machined when assembled.

Advantages
The used bushing work in dry running conditions.

Rotor blades in vacuum pump

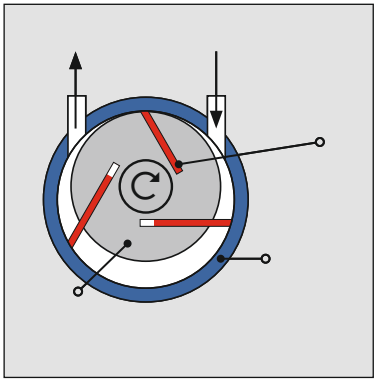
Material
INKUTEX GSB substitutes asbestos-containing material.

Description of the application
The rotary blades of a vacuum pump work in a cast iron housing and are responsible for the intake, compression and exhaust of the medium. The sliding speed of the rotor blades is up to 600 m/min at an operating temperature of 120 °C.

Problem
The previously used rotor blades made of asbestos-containing material had to be substituted for environmental reasons. In addition, the clearance between the rotor blades and the housing should be very small because the efficiency of the pump depends on it. The new material has got a high resistance to high temperature and chemicals (brake fluid in this case).

Problem-solving
The rotor blades made of INKUTEX GSB meet these requirements. They have a length of 600 mm and a width of 120 mm. The housing is tolerated with K5 and the blades are tolerated with g5, so that a very tight clearance can be reached.

Advantages
In the pump there are no asbestos-containing and environmentally hazardous substances anymore. The material has got a good temperature and chemical resistance.



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