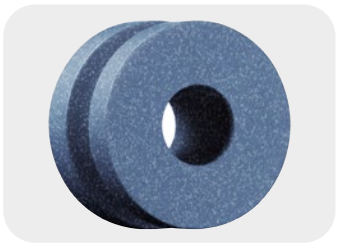
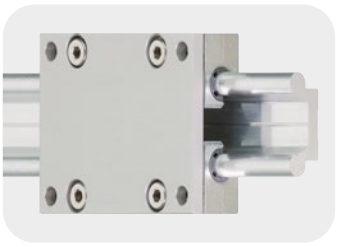
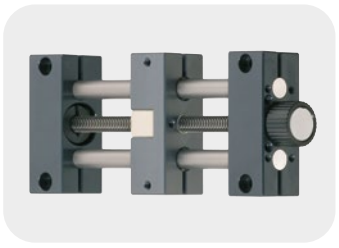
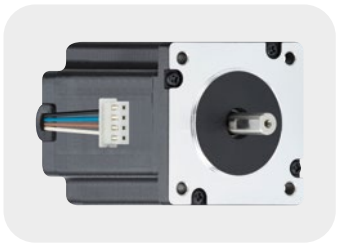
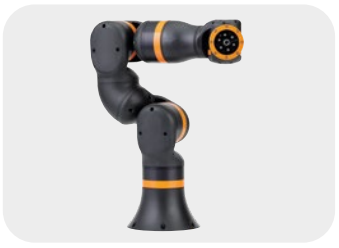
iglidur®
bearing technology





Our test laboratory

Materials are manufactured by igus® in accordance with the motto “Tech up, Cost down”. Our products are designed with great passion to extend the service life of machines and applications, eliminate maintenance and reduce costs. For our engineers, the quality and reliability of parts, i.e. their resilience and service life, are vital factors in development. Every igus® product is tested thoroughly before it is made available for sale. To this end, we have been operating our own test laboratory since 1985. It's not only the largest test laboratory for tribopolymers in the industry in terms of area, but it also conducts the highest number of product tests and test procedures.

What is tested and how?
Our facilities for testing applications and materials cover a total of 4,000m². Every business sector has its own test laboratory. However, we test some products together in one area. For example, 1,500m² is dedicated to testing chainflex® cables in our own energy chains. For especially long travels, 2,000m² of outdoor space is available. iglidur® plain bearings, drylin® linear bearings, and our Low Cost Automation components are tested in an area of over 300m². The latter partly under real conditions in quality assurance. To be able to develop new cleanroom-compatible products faster, we operate our own cleanroom laboratory with an ISO Class 1 cleanroom system in cooperation with the Fraunhofer IPA. An outdoor testing area, a laboratory for noise tests and the climatic chamber with -40°C completes our test area. To achieve maximum realistic conditions, we also test customer applications and conduct standard industry tests.

We would love to test your application
You don't want to test and would like to subject your application to a material test before using it? Or do you have an unusual application for which you need a suitable component? No problem. We will test your application in our test laboratory and use our know-how to find the best igus® solution for you. Regardless of whether it is a plain bearing, energy chain, cable, linear technology, bar stock or Low Cost Automation.

How many tests are conducted in the test laboratory?
Annually, a large number of tests and material examinations are conducted in the numerous test facilities.

Laboratory facts

- Total area of igus® test laboratory: 4,000m²
- More than 15,000 tests, about 4,000 of them for e-chains® and chainflex® and around 11,000 of them for dry-tech® (rotating, pivoting, linear, tumbling, heated, underwater, and so on.)
- 450 test rigs for plain bearings
- 10 billion e-chain® cycles
- 3,500 tested cables
- 400 customer-specific tests

igus.eu/testlab

What happens to the test data?
The use of testing data does not stop after development. We have been developing innovative online tools since 2001 and sensor-based smart plastics since 2016, which are based on the database of our test laboratory results. With these online tools, the economic efficiency and reliability of our products can be determined quickly and very easily online 24/7. This means a high degree of transparency for our customers, enabling engineers to find the most cost-effective, functioning solution to their problem. More than 40 tools are available to you free of charge.

Sustainability

Sustainable product developments

Plastic is a much-discussed material. We know that high-performance plastics can contribute to protecting resources and the environment, and we have made this the focus of our activities.

We look at plastics in three phases: during their production, in use and at the end of the product's life. We will give you our answers to sustainability questions for both our products and everyday life at igus®. Not everything has been answered yet, and for some things, especially with regard to sustainable production, we are still working on answers and solutions.

igus® has been focusing more and more on sustainability in manufacturing and products since 2018. As a result, we are now also able to state the carbon footprint of a large number of our iglidur® plain bearings. In addition, there are new products that are largely or completely made from recycled material from our own production. And these are also tested in the laboratory and have a predictable service life.

Certified according to ISO 14001
In order to make our environmental policy transparent and comprehensible, we have been certified according to ISO standard 14001 since 2019, a recognised basis for environmental management systems. This helps us towards having a CO_2 neutral factory.

99% recycled
99% of our rejects in injection-moulding production (sprues, defective parts) are recycled and reused in the manufacturing process.

CO_2 emissions
In 2021, we achieved 31.2% less CO_2 emissions than in 2020.This figure relates to Scope 1 and Scope 2 emissions. The switch to green electricity in mid-2021 and to climate-neutral gas in October 2021 played a key role here.

Power consumption
We purchase 100% green electricity and reduce the consumption of our machinery and equipment. We acquire injection moulding machines that are 40% more energy efficient. The power consumption was reduced by 11% in 2021, while increasing production.

clean igus® programme
Mechanical measures such as magnetic foils and guide plates prevent parts from falling out of the machines in the production process and becoming waste. The waste ratio (production waste + processed material) could be reduced by 21% in 2021 due to these and other measures.

The circular economy goes digital

Chainge
engineering plastics recycling

100t
of material returned as part of the chainge® recycling program since 2019

31.2%
CO_2 savings 2021 compared to 2020*

reguse **150**
renewed IT equipment sold internally and proceeds donated in 2022

196
new energy-efficient injection moulding machines, 275 old machines exchanged for new ones between 2021 - 2022

76,280
trees planted since 2020

A clean AI revolution saves on lubrication, maintenance and costs

GO ZERO Lubrication ... with motion plastics®

With "GO ZERO", we present our solutions for a lubrication-free and sustainable world. We are driving the clean revolution forwards with innovative products and materials in addition to pioneering technologies such as AI and VR. Apart from lubrication and maintenance, this saves time and money and reduces the impact on the environment.

Why bother with freedom from lubrication?

Even today, most applications can run without lubrication and easily save money and time.
The lowest-cost lubrication method is the one you don't need.

ZERO costs for lubricants
The costs of lubricants and their subsequent disposal have continued to rise in recent years. Expenses for incorrect or lack of lubrication are not even taken into account. Lubrication: money saved.

ZERO maintenance costs
Maintenance costs money, but also time. Shortage of skilled labour can also be countered with effectiveness. Recurring lubrication of bearing points is no longer necessary. Maintenance: time saved.

ZERO lubricants in the environment
To a large extent, forgotten liquid waste consists of so-called FOGs (fats, oil and grease). Half of the lubricants sold worldwide end up as pollution. And one litre of oil can contaminate one million litres of water. Causing unnecessary pollution.

What can you see? A bird? Two tractors? Something else? We see potential savings of €3 million!

Our goal is to make moving applications lubrication-free. That's why we try to discover possibilities for using our motion plastics® everywhere. One of the pioneers is the agricultural machinery manufacturer Lemken, who saves €88 every year by using iglidur® plastic bearings. An independent study by RWTH Aachen proves this.

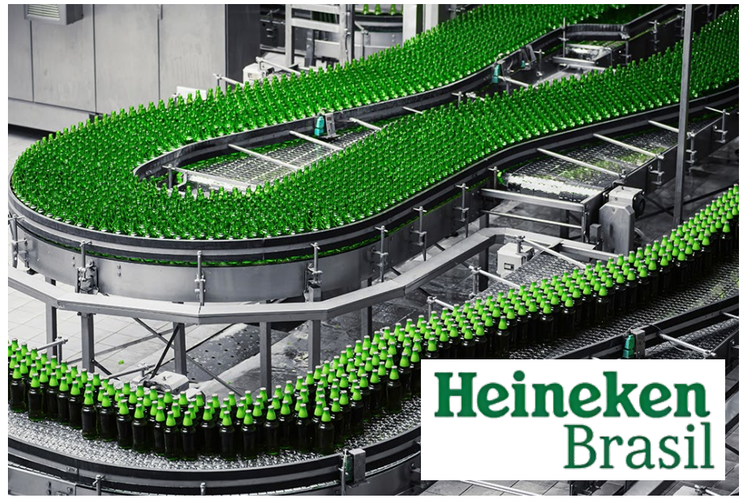
Study on lubrication-free systems with the RWTH Aachen

GO ZERO Lubrication - this is what our customers save

Savings per system or per machine

Costs of €2,815.49
1,560 hours of maintenance
180.08kg of CO_2 equivalent

Heineken Brasil uses self-lubricating igus bearing technology in conveyor belts, increasing reliability and minimising downtimes.



Savings per system or per machine

Costs of €87.36
13 hours of maintenance
1.4kg CO_2 equivalent

Rockinger uses a self-lubricating wear insert in the KS80 ball coupling, which makes lubrication superfluous and minimises maintenance.

Savings per system or per machine

Costs of €88
14.7 hours of maintenance
6.3kg CO_2 equivalent

Lemken specialises in the manufacture of agricultural equipment for soil cultivation, sowing and crop protection and saves 22 lubrication points per cultivator.

dry-tech® | Lubrication-free made easy ...

iglidur® plain bearings

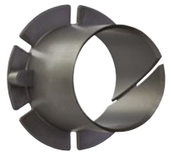
Sleeve bearings

Flanged bearings

Thrust washers

Guide rings

Split bearings



Split bearings, anti-rotation feature

Double flange bearings

Two hole flange bearings

Preloaded sleeve bearings

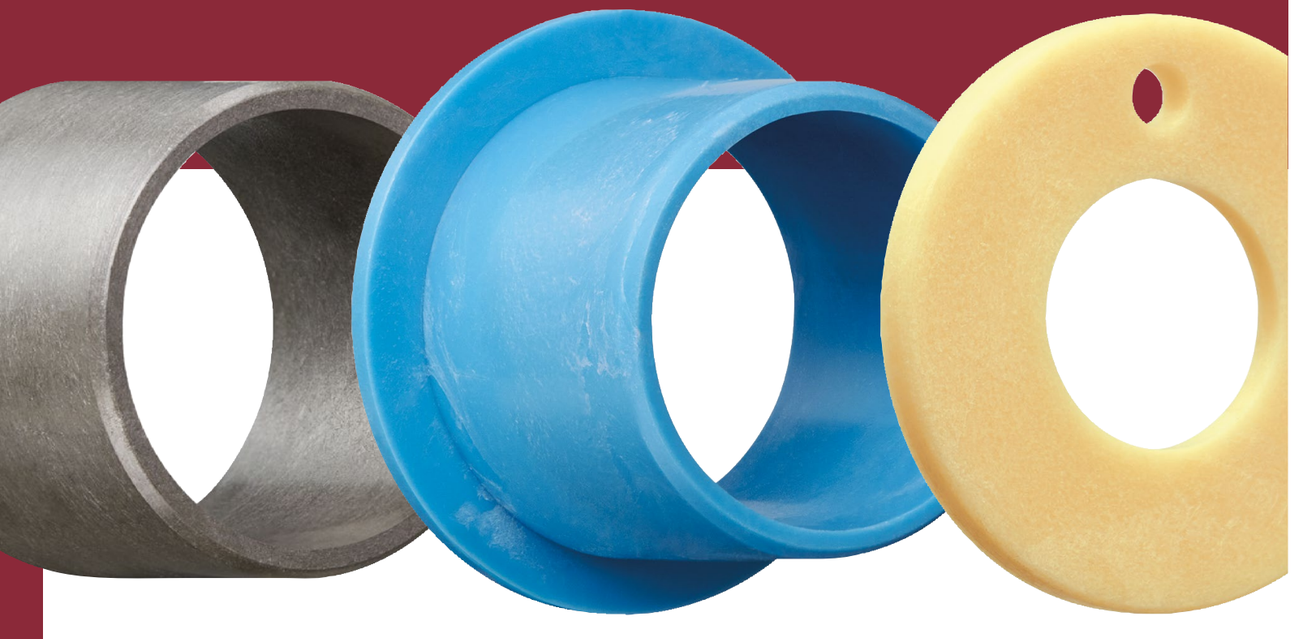
Preloaded flanged bearings

Disc springs

FastLine

iglidur® bearing technology

Plain bearings



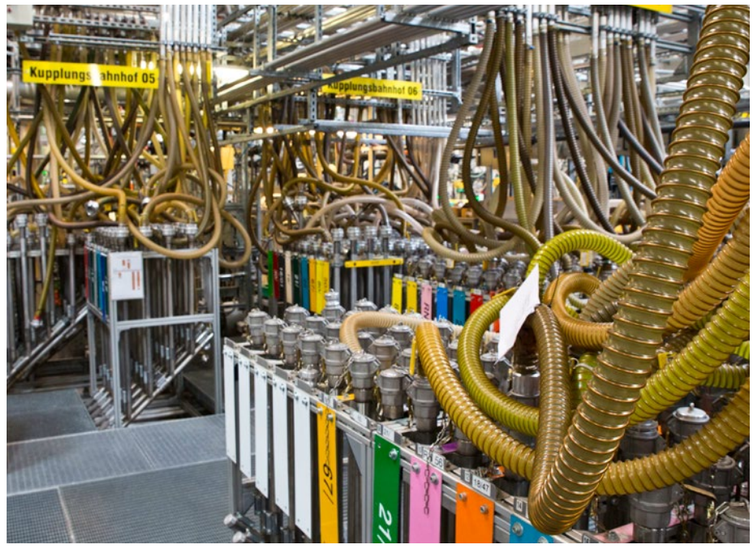
Always the right plain bearing for any application

Plain bearings made of iglidur® and igutex® materials are predestined for use in applications in which lubricants of any kind are to be dispensed with. Empirical tests and sophisticated algorithms can be used to calculate the service life in the customer application and thus determine the ideal material in advance. Our plain bearings are available from stock in a wide range of standard shapes in over 10,000 dimensions. Alternatively, customised products according to customer specifications are also available.

- Increasing the durability, performance and quality of bearing points
- Cost savings through reduction of unit, maintenance and complaint costs
- Tested in 10,000 tests per year and successfully used by over 250,000 customers worldwide
- Reduces environmental contamination through avoidance of lubricants and optimised abrasion behaviour
- Predictable service life ensures predictable maintenance intervals

Introduction

Everything from one source



In-house compounding and bar stock production

Benefits
- Especially cost-effective
- No lubrication
- Resistant to dirt, dust and lint
- Corrosion and chemical-resistant
- Can be used in liquid media
- Vibration-dampening
- Suitable for rotating, oscillating and linear movements

Typical application areas
- Bicycle construction
- Plant construction
- Packaging
- Offshore

With over 230,000 parts and more than 15,000 plain bearing products, igus® offers a huge portfolio of standard sizes. In addition to standard dimensions from stock, customised products are also possible. Prototyping, mould construction and volume production take place at igus®. The smallest numbers can be realised as well as large-volume blanket orders.

Quality and reliability
Our focus is on quality and accuracy as well as speed. Continuous quality controls are carried out in the pre-series and volume production processes. Depending on requirements, 100% checks are also carried out here using fully automatic optoelectronic testing and sorting systems. igus® is certified according to ISO 9001, ISO/TS 16949 and ISO 14001-2015, among others.

Material development and compounding
In order to consistently ensure the high quality of iglidur® materials, we have been relying on our in-house expertise in material development and compounding for decades. In total, igus® processes 2,000 tons of plastic per year (as of 2023).

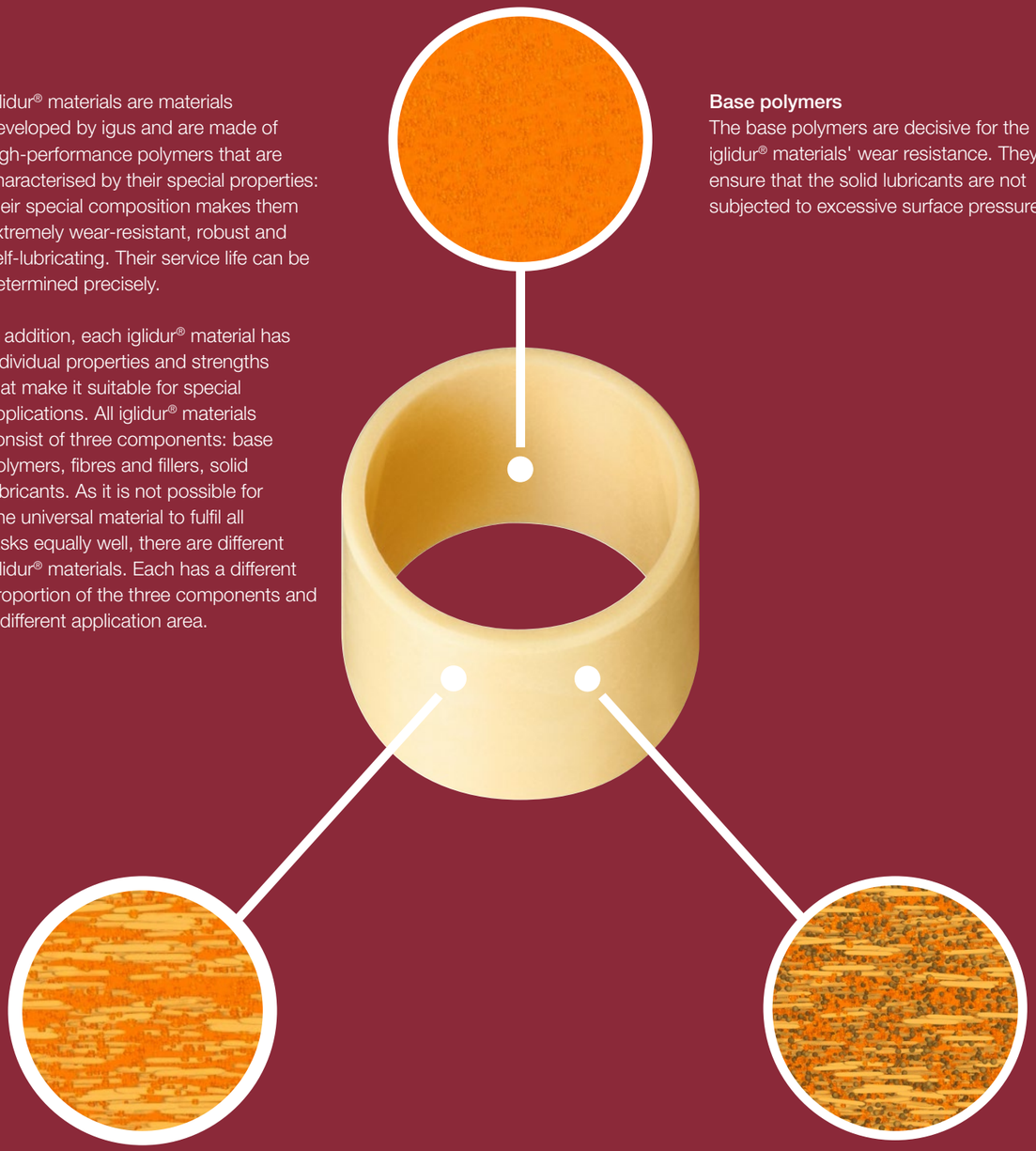
Our test laboratory for plain bearings
With their tribological properties, our polymer plain bearings fulfil the highest requirements for a long service life without additional lubrication. To achieve this quality, we carry out over 135 trillion test movements per year in our plain bearing test laboratory spread over 250m². We test and develop materials and plain bearings under real conditions with the goal of providing you with the best solution made of polymer for your application.

Laboratory and development: test laboratory for iglidur® plain bearings

What is iglidur®?

iglidur® materials are materials developed by igus and are made of high-performance polymers that are characterised by their special properties: their special composition makes them extremely wear-resistant, robust and self-lubricating. Their service life can be determined precisely.

In addition, each iglidur® material has individual properties and strengths that make it suitable for special applications. All iglidur® materials consist of three components: base polymers, fibres and fillers, solid lubricants. As it is not possible for one universal material to fulfil all tasks equally well, there are different iglidur® materials. Each has a different proportion of the three components and a different application area.



Base polymers
The base polymers are decisive for the iglidur® materials' wear resistance. They ensure that the solid lubricants are not subjected to excessive surface pressure.

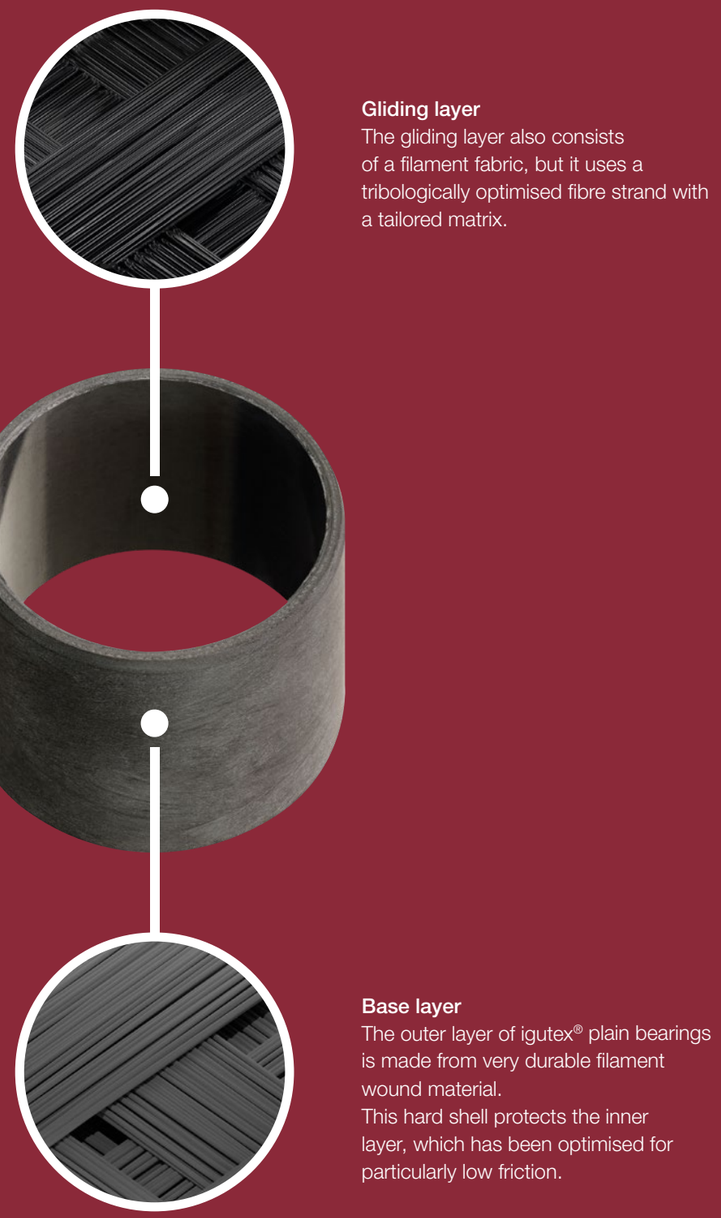
Fibres and fillers
These components strengthen the materials so that they withstand high forces or edge loads and can be used continuously.

Solid lubricants
They lubricate components made of iglidur® materials independently, preventing friction. They are distributed throughout the material in the form of microscopic particles.

What is igutex®?

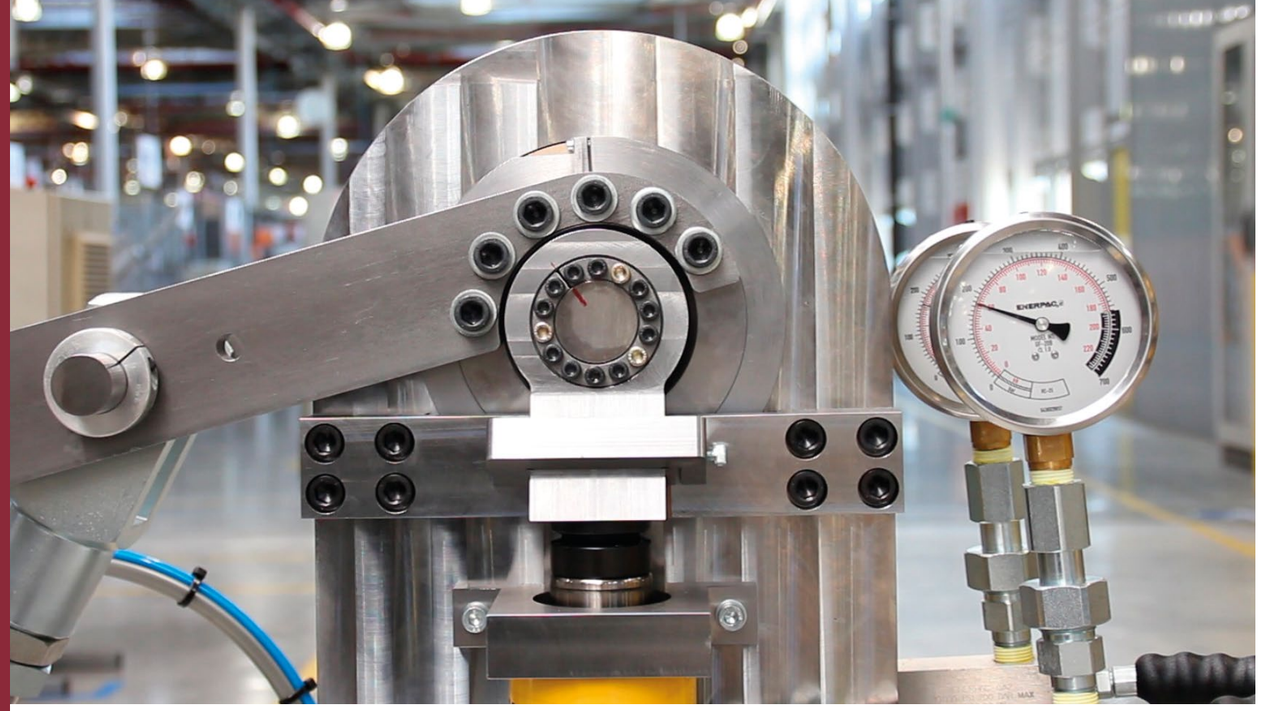
igutex® plain bearings consist of fibre composite materials, which is the name of a fabric made of high-strength fibre filaments connected by means of a matrix - usually synthetic resin. The processing or weaving methods depend on the area of application and the shape to be produced.

High-tensile fibres in combination with special resins produce robust plain bearings featuring high compressive strength and rigidity. This technology can be used to create both bearings made from wound tubes and plates.



Gliding layer
The gliding layer also consists of a filament fabric, but it uses a tribologically optimised fibre strand with a tailored matrix.

Base layer
The outer layer of igutex® plain bearings is made from very durable filament wound material.
This hard shell protects the inner layer, which has been optimised for particularly low friction.



Unique worldwide

Service life calculation based on empirical data

In tribology - the science of wear and friction - wear tests are often carried out by means of the pin-on-disk method. Here, a disk rotates on the sliding material that is tested under a pin that slides on it.

This pin consists of the mating partner that is to be tested (e. g. steel with a steel shaft). After the test, the amount of abrasion is analysed. The disadvantage of this standardised procedure is, in our view, the closeness to practice. In real conditions, various load and motion profiles influence a geometry that differs strongly from the disk. To represent the characteristics of a bearing point as realistically as possible, igus® has developed several standardised test setups.

For decades, plain bearings from various materials have been pressed into a housing and tested in combination with different shafts in more than 10,000 tests per year. The tests were carried out under different temperatures and with different loads and motion profiles. The result of the wear test is given by measuring the loss of wall thickness. In real plain bearing applications, this is decisive for the clearance development and therefore the running performance of the bearing point.

The wear data obtained in the tests is fed into a comprehensive database, which in turn forms the basis for special design software. This software, specially developed by igus®, uses algorithms based on many years of experience from a large number of applications to determine the expected service life for customer applications. The high density of information on many different application scenarios allows sufficiently precise interpolation for almost any combination of application parameters in new applications. This makes it possible to calculate in advance what bearing material will last how long in which application, from among a large number of applications.

In combination with the transparent costs for the plain bearings, the "most cost-effective bearing that works" and the most economical and sustainable solution can be determined at any time. The operation of this software is also tailored equally to experienced and less experienced users and thus offers customers the possibility of quickly and easily calculating applications in advance, but also the working basis for igus® application consultants to be able to lead complex consulting projects to success more quickly.

Application example

iglidur® plain bearings in use

... in trailer coupling
The company Rockinger Agriculture GmbH received the green manus for the use of a wear insert made of iglidur® high-performance plastic.

... in cargo e-bikes
The patented tilting technology of the cargo e-bike from GLEAM allows you to ride it like a normal bike.

... in pedal axes
One product Demarko develops is an oscillating axle for an articulated lorry trailer. Bearing point lubrication poses a particular challenge.

... in infusion pumps
With a specially manufactured iglidur® J clip bearing, B. Braun AG guarantees a simple and high-quality solution despite the limited installation space.

... in solar systems
The requirements of Ecotherm were a plain bearing service life of 20 years, maintenance-free operation and low costs.

... in special excavators
Transporting earth from pits up to 65 metres deep. This is made possible by a pulley module from the French company Ets Payant.

Over 250,000 customers

Be inspired and discover more exciting application examples

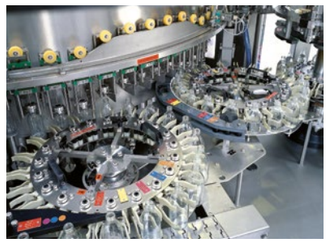
Over 250,000 customers worldwide rely on plain bearings made of iglidur® and igutex® materials. From brake pedals in cars to bearings in solar panel tracking systems. From the peristaltic pump in dialysis machines to the conveyor chain in machine tools. With iglidur® and igutex® plain bearings you improve performance and reduce costs.

The right material for every application

All-rounder
Materials for general purpose

Endurance runner
Materials for long service life

High temperatures
Materials for high temperatures

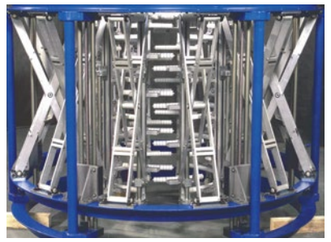


High media resistance
Materials with good media resistance

Contact with food
Materials for contact with food

Harsh environments
Materials for harsh environments

High loads
Materials for heavy-duty applications



Specialists
Materials for special application areas

Speed and pressure

The peripheral speed is always significant in plain bearings. The absolute speed is not crucial, but the relative speed between the shaft and the bearing. The surface speed is expressed in meters per second [m/s] and calculated from the speed n [rpm] with the following formula.
With varying speeds for example with pivoting movements, the value needed is the average surface speed v.

Rotational movement:

$$v = \frac{n \cdot d1 \cdot \pi}{60 \cdot 1.000} \left[\frac{m}{s}\right]$$

Pivoting movement:

$$v = d1 \cdot \pi \cdot \frac{2 \cdot ß}{360} \cdot \frac{f}{1.000} \left[\frac{m}{s}\right]$$

In these equations:

d1 **= Shaft diameter [mm]**
f **= Frequency per second**
ß **= Angle of motion per cycle [°]**
n **= rpm**

Permissible surface speeds
iglidur® plain bearings were primarily developed for low to average surface speeds in continuous operation. Each pressure increase leads unavoidably to a reduction of the permissible surface speeds and vice versa.

The speed limit is determined by the thermal properties of the bearing. This is also the reason why different surface speeds can occur for the different movement types. For linear movements, more heat can be dissipated via the shaft, since the bearing uses a longer surface area on the shaft.

Surface speed and wear
Considerations regarding the permissible surface speeds should also include the wear resistance of the plain bearing. High surface speeds automatically bring correspondingly high wear rates with them. With higher surface speed, not only the wear rate rises but also the absolute wear.

Surface speed and coefficient of friction
In practice the coefficient of friction of plain bearings is a result of the surface speed. High surface speeds have a higher coefficient of friction than low surface speeds. The table on page 31 shows this relationship by using the example of a steel shaft (Cf53) with a load of 0.7MPa.

Load
The load of a plain bearing is expressed by the surface pressure (p) in MPa (corresponding to N/mm²). For this purpose, the radial load is determined on the projected surface of the bearing.

Radial bearing:

$$p = \frac{F}{d1 \cdot b1}$$

Thrust bearing:

$$p = \frac{F}{(d2^2 - d1^2) \cdot \frac{\pi}{4}}$$

In these equations:

F **= load in [N]**
d1 **= bearing inner diameter in [mm]**
b1 **= bearing length in [mm]**
d2 **= outer diameter of the bearing in [mm]**

Max. recommended surface pressure
A comparative value of the iglidur® material is the maximum recommended static surface pressure [MPa] at +20°C. The values of the individual iglidur® plain bearings differ greatly on this point. The value [p] indicates the pressure limit of a plain bearing. The plain bearing can carry this pressure permanently without damage. The given value applies to static operation; only very slow speeds up to 0.01m/s are tolerated under this pressure. Higher pressures than those indicated are possible if the duration of the load is short.

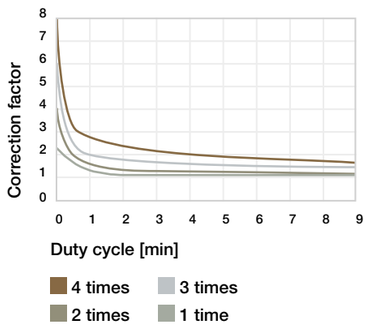
Pressure and speed
With decreasing radial load on the plain bearing, the permissible surface speed increases. The product of the pressure [p] and speed [v], the so-called pv value, can be understood as a measurement for the frictional heat of the bearing.

pv value and coefficient of friction

For plain bearings, the product is given a new value depending on the pressure [p] and the surface speed [v]. The pv value can be considered a measure of the frictional heat and can be used as an analytical tool to answer questions concerning the proper application of a plain bearing. For this purpose the actual pv value is compared with a permitted pv value calculable for the height. The permitted pv value depends on the shaft material, the ambient temperature and the duty cycle.

Correction factor

The permissible pv value can be increased in practical operation if the bearing temperature never reaches the maximum limit because of the short operating time. Tests have shown that this is true for operating times below 10 minutes. It is known that a longer dwell time makes a greater contribution to re-cooling. An important qualifier here is the ratio of the duty cycle and dwell times. The different curves of the diagram represent different ratios (3 x means that the dwell time is three times longer than the operating time).



Correction factor for p · v

Lubrication

Although iglidur® plain bearings are designed for dry operation, they are quite compatible with standard oils and greases. A single lubrication during the installation improves the start-up behaviour and the coefficient of friction, thus reducing the frictional heat. Due to this effect, the permissible loads for plain bearings can be increased by lubrication. The table shows the correction factors for pv value using lubrication.

Lubrication	Correction factor
Dry operation	1.0
During installation	1.3
Continuous, grease	2.0
Continuous, water	4.0
Continuous, oil	5.0

Correction of the tolerated pv value by means of lubrication

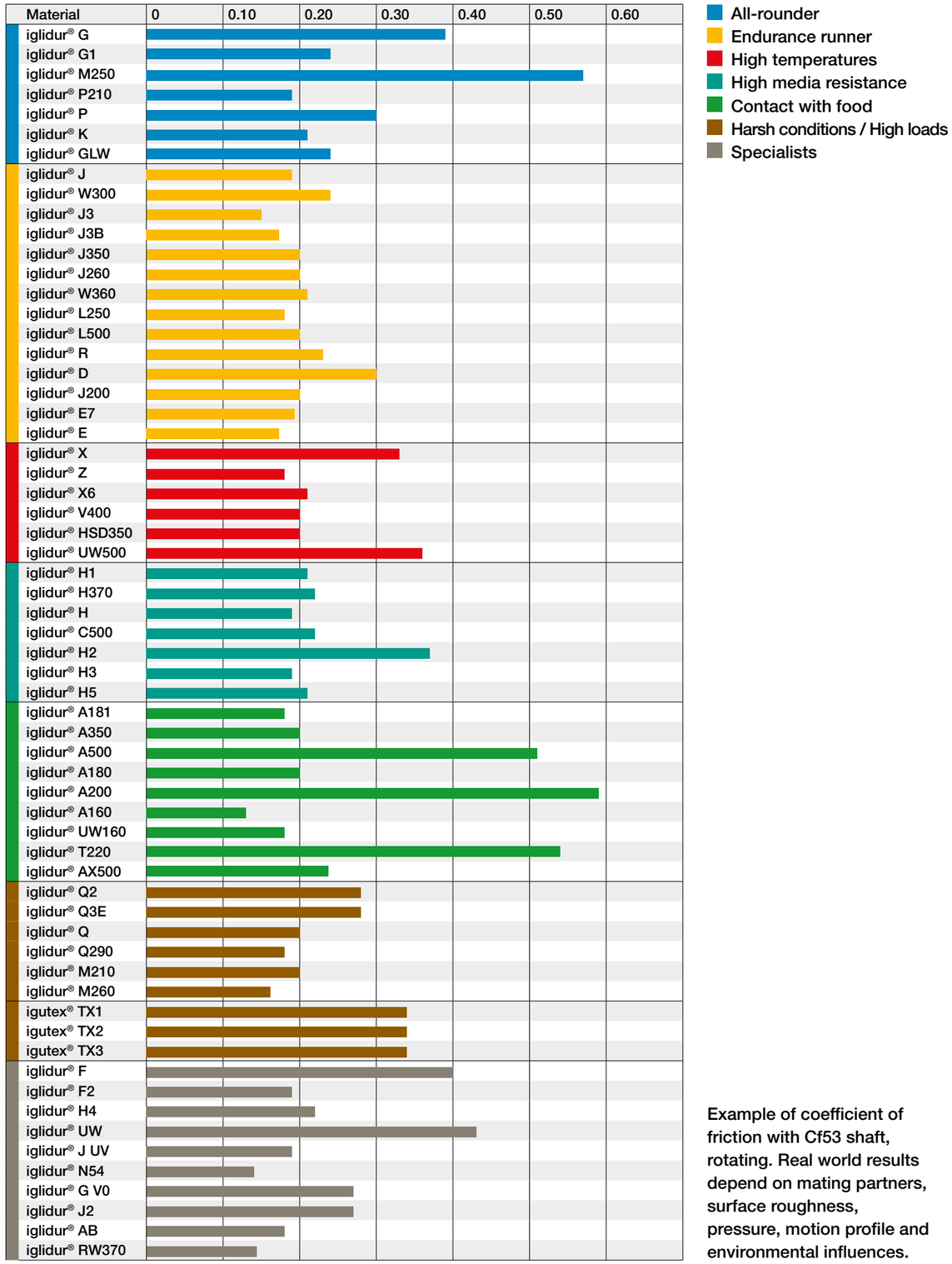
Coefficient of friction

iglidur® plain bearings are self-lubricating with the addition of solid lubricants. The solid lubricants lower the coefficient of friction of the plain bearings and thus increase the wear resistance. The coefficient of friction μ is proportional to the normal force and describes which force is needed to move a body in relation to another. Depending on whether an application is starting from a stationary position or the movement is in progress and needs to be maintained, a distinction is made between a static coefficient of friction and a dynamic coefficient of friction.

Coefficient of friction and surfaces

Shown here is the relationship between coefficient of friction and surface finish of shaft materials. It is clearly shown that the amount of friction is composed of different factors.
If the shaft is too rough, abrasion levels play an important role. Small areas of unevenness that can interlock with each other must be worn off the surface.

When the surfaces are too smooth, however, higher adhesion results, i.e. the surfaces stick to each other. Higher forces are necessary to overcome the adhesion, which results from an increased coefficient of friction.
Stick-slip can be the result of a large difference between static and dynamic friction and of a higher adhesive tendency of mating surfaces. Stick-slip also occurs due to intermittent running behaviour and can result in loud squeaking. Over and over again, it is observed that these noises do not occur or can be eliminated with rough shafts. Thus for applications that have a great potential for stick-slip - slow movements, large resonance of the housing - attention must be paid to the optimal surface finish of the shafts.



Example of coefficient of friction with Cf53 shaft, rotating. Real world results depend on mating partners, surface roughness, pressure, motion profile and environmental influences.

Wear resistance

The wear of components depends on many different factors, therefore it is difficult to make general statements about the wear behaviour. In many experiments and tests, the measurement of the wear is a primary factor. In testing, it has become clear what variances are possible between different material pairings. For given loads and surface speeds, the wear resistance can easily vary by a factor of 10 between material pairings that run well together.

Wear under load
Different loads greatly influence the bearing wear. Among the iglidur® plain bearings, certain materials are optimised for low loads, while others are suitable for use with high or extremely high loads.

Wear and temperature
Within wide temperature ranges, the wear resistance of the iglidur® plain bearings shows little change. In the maximum temperature range, however, the temperature increases and the wear of the plain bearing increases. One particular exception is represented by iglidur® X. The wear resistance of iglidur® X greatly increases as temperature increases and reaches the optimum wear resistance at a temperature of +160°C. Then resistance decreases again, gradually.

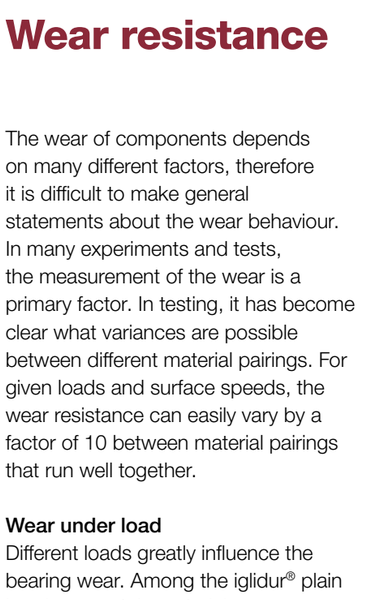
Wear during abrasive dirt accumulation
Special wear problems frequently occur if abrasive dirt particles get into the bearing. iglidur® plain bearings can clearly improve the operating time of machines and systems in these situations. The high wear resistance of the materials and the dry operation result in the highest service life. As no oil or grease is on the bearing, dirt particles cannot adhere or penetrate as easily into the bearing. Most debris simply falls away from the bearing thus limiting potential damage. If however, a hard particle penetrates into the bearing area, then an iglidur® plain bearing can absorb this particle. The foreign body becomes embedded in the wall of the plain bearing. Up to a certain point, operation can be maintained at optimal levels even when there is extreme dirt accumulation.

However, it is not just hard particles that can damage bearings and shafts. Soft dirt particles such as for example, textile or paper fibres, are frequently the cause for increased wear. In this instance, the dry operation capability and the dust resistance of the iglidur® plain bearings go into action. In the past, this helped save costs in many applications.

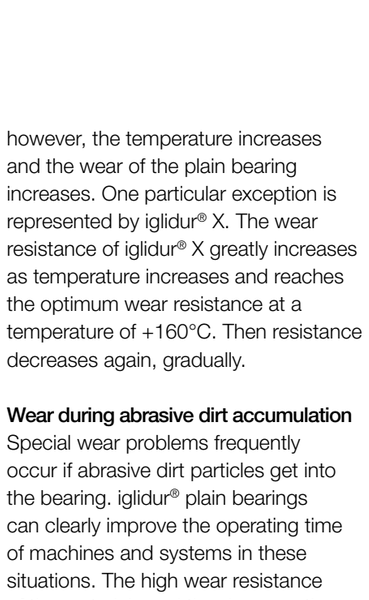
Wear and surfaces
Shaft surfaces are important for the wear of bearing systems. Similar to the considerations for the coefficient of friction, a shaft can be too rough in regard to the bearing wear, but it can also be too smooth. A shaft that is too rough acts like a file and during movement separates small particles from the bearing surface. For shafts that are too smooth, however, higher wear can also occur.

An extreme increase in friction results due to adhesion. The forces that act on the mating surface can be so large that material blow-outs occur. It is significant to note that wear by erosion is non-linear, random and cannot be accurately predicted.

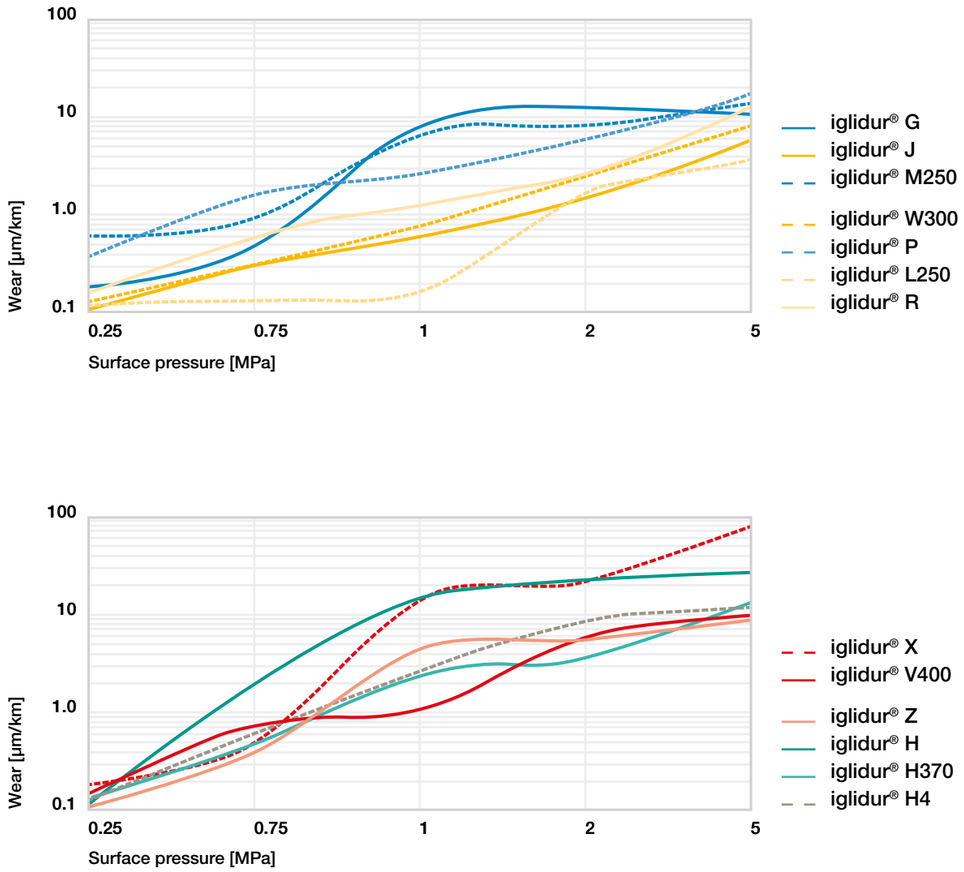
The load of the plain bearing has an effect on the wear of the bearing. The following diagrams show the wear behaviour of the iglidur® bearing materials. It is easily recognised that for each pressure, there is an optimal plain bearing available. The wear is shown as a wear rate in [µm/km].

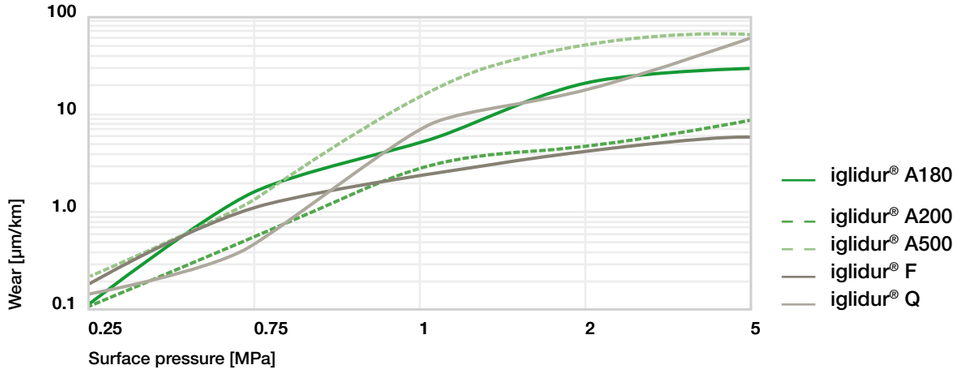


Wear experiments with aluminium shafts

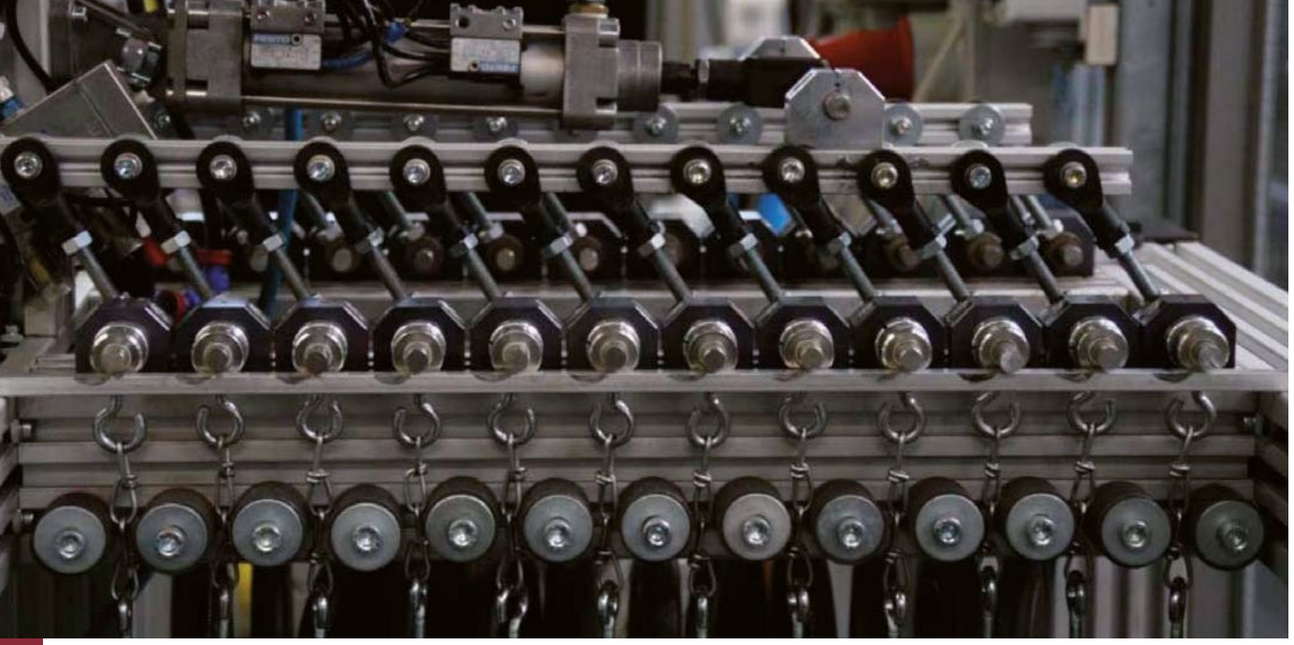


High wear resistance: plain bearing in permanent contact with sand





Wear of iglidur® plain bearings at low loads



Pivoting wear test rig for medium loads

Technical data

Wear and shaft materials

The shaft is, apart from the plain bearing itself, the most important parameter in a bearing system. It is in direct contact with the bearing, and like the bearing, it is affected by relative motion. The shaft will wear in any case. Modern bearing systems however are designed in a way that the wear of the shafts is so small that it cannot be detected with traditional methods of measurement technology. Shafts can be distinguished and classified according to their hardness and according to the surface finish.

The hardness of the shaft also plays an important role. When the shafts are less hard, the shaft is worn smooth during the break-in phase. Abrasive points are worn off and the surface is rebuilt. For some materials, this effect has positive influences, and the wear resistance of the polymer bearing increases.

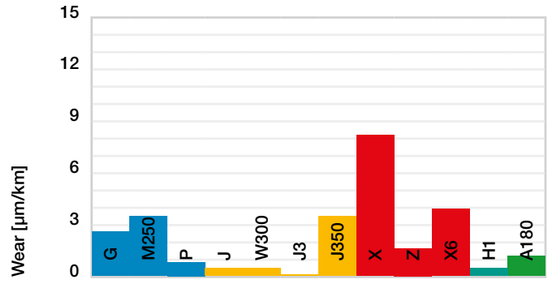
In the following graphs, the most common shaft materials are listed and the iglidur® materials that are best suited are compared. For easier comparison, the scaling of the wear axis is the same in all graphs.

The low wear results of the systems with hard-chromed shafts are especially impressive. This very hard, but also smooth shaft gives excellent results on the wear behaviour with many bearing combinations. The wear of many iglidur® plain bearings is lower on this shaft than on any other shaft material tested. However, it should be pointed out that because of the low surface roughness, the danger of stick-slip on hard-chromed shafts is especially high.

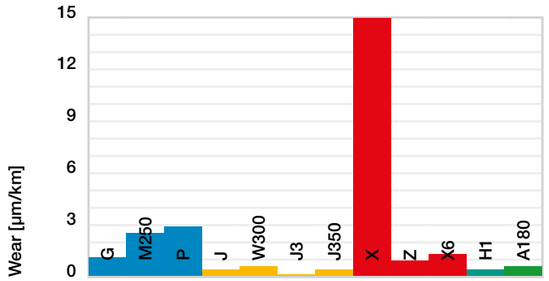
With high-grade steel, a similarly good result is obtained. Cf53 standard shafts give very good results, too. With other shaft materials, the wear results vary considerably.

For example, in tests with 304 stainless steel shafts at low loads, extremely positive results can be found with the right bearing material. It must be said on the other side, that no other shaft material shows a bigger variation of wear results with different bearing materials. Therefore, the choice of the most suitable bearing material is particularly important with the shaft materials 304 stainless steel and HR carbon steel.

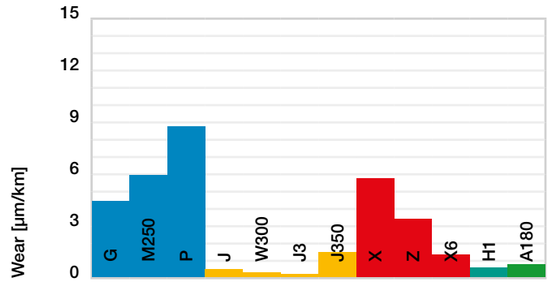
The test results give only a sample of the existing data. All of the results shown were made with same loads and speeds.



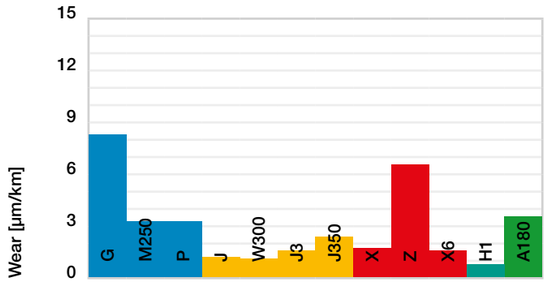
Wear with Cf53 shaft,
p = 1MPa, v = 0.30m/s, Ra = 0.20µm



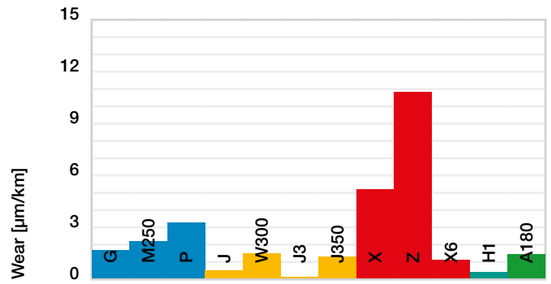
Wear with hard-anodised aluminium shaft,
p = 1MPa, v = 0.30m/s, Ra = 0.20µm



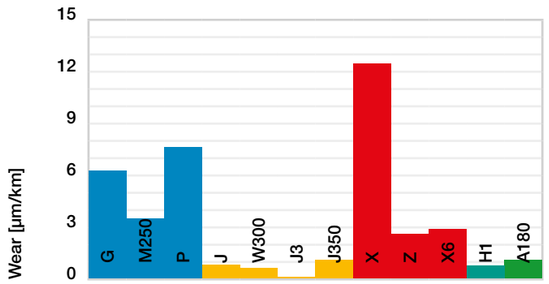
Wear with 304 stainless steel shaft,
p = 1MPa, v = 0.30m/s, Ra = 0.20µm



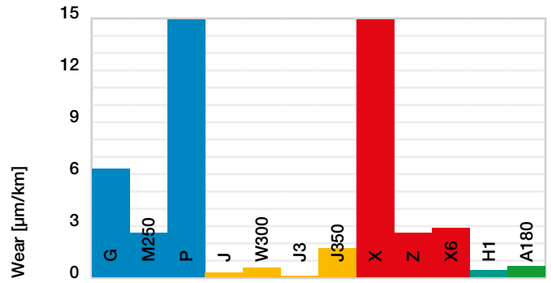
Wear with free cutting steel shaft,
p = 1MPa, v = 0.30m/s, Ra = 0.20µm



Wear with HR carbon steel shaft,
p = 1MPa, v = 0.30m/s, Ra = 0.20µm



Wear with high grade steel shaft,
p = 1MPa, v = 0.30m/s, Ra = 0.20µm



Wear with Cf53 hard-chromed shaft, p = 1MPa,
v = 0.30m/s, Ra = 0.20µm

Temperatures

The temperature resistance of high-performance polymer plain bearings is usually underestimated. Data is often found in the literature about the continuous operating temperature. The continuous operating temperature is the highest temperature, which the plastic can withstand for a period of time without a reduction in the tensile strength of the material above or below a prespecified value. This standardised test however yields only a less relevant characteristic value, as bearings are almost always subjected to a load. The application temperatures of the materials are more revealing.

Application temperatures

The minimum application temperature is the temperature below which the material is so rigid and hard that it becomes too brittle for standard applications. The maximum continuous application temperature is the temperature the material can endure for a longer period of time without the properties changing considerably.

The maximum, short-term application temperature is the temperature above which the material becomes so soft, that it can only withstand small external loads. "Short term" is defined as a period of a few minutes.

If the plain bearings are moved axially or axial forces occur, there is more opportunity for the bearing to lose press-fit. In these cases, axial securing of the bearing is necessary in addition to the press-fit. The table shows the temperature at which additional securing of the iglidur® plain bearing is required, even under low axial loads. The greater the forces, the more reasons to engage such a fastening.

Temperature and load

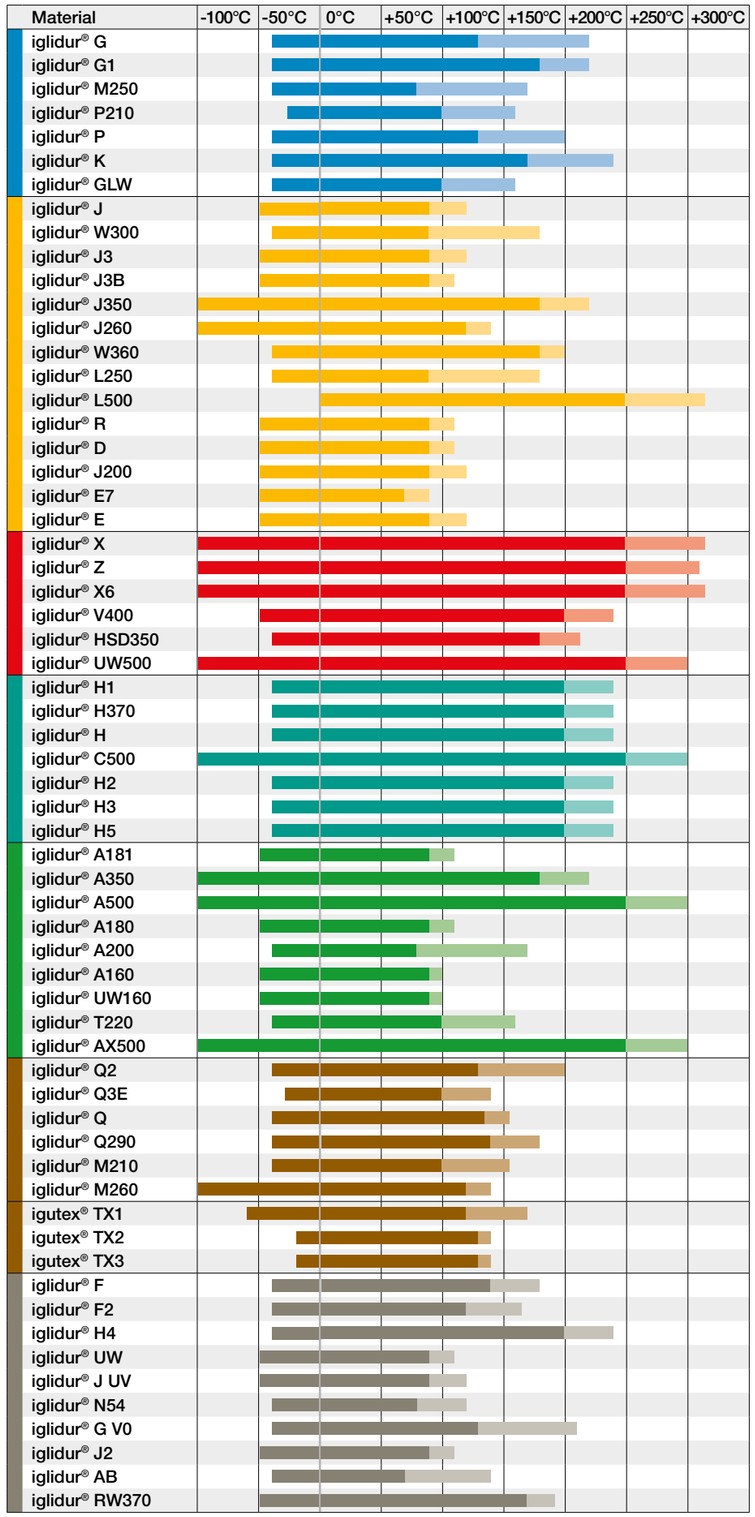
With increasing temperature, the maximum recommended surface pressure [p] decreases continuously. With plain bearings it is important to note that, due to the friction, the bearing temperature may be higher than the ambient temperature.

Coefficient of thermal expansion

The thermal expansion of polymers is approximately 10 to 20 times higher than metals. In contrast to metal, this expansion is non-linear in plastics. The coefficient of thermal expansion of the iglidur® plain bearing is a significant reason for the bearing clearance. At the given application clearance, seizing of the bearing to the shaft does not occur at high temperatures.

Material	Temperature [°C]
iglidur® G	+80
iglidur® G1	+120
iglidur® M250	+60
iglidur® P210	+50
iglidur® P	+90
iglidur® K	+70
iglidur® GLW	+80
iglidur® J	+60
iglidur® W300	+60
iglidur® J3	+60
iglidur® J3B	+60
iglidur® J350	+140
iglidur® J260	+80
iglidur® W360	+90
iglidur® L250	+55
iglidur® L500	+135
iglidur® R	+50
iglidur® D	+50
iglidur® J200	+60
iglidur® E7	+30
iglidur® E	+60
iglidur® X	+135
iglidur® Z	+145
iglidur® X6	+165
iglidur® V400	+100
iglidur® HSD350	+130
iglidur® UW500	+150
iglidur® H1	+80
iglidur® H370	+100
iglidur® H	+120
iglidur® C500	+130
iglidur® H2	+110
iglidur® H3	+80
iglidur® H5	+80
iglidur® A181	+60
iglidur® A350	+140
iglidur® A500	+130
iglidur® A180	+60
iglidur® A200	+50
iglidur® A160	+60
iglidur® UW160	+70
iglidur® T220	+50
iglidur® AX500	+130
iglidur® Q2	+70
iglidur® Q3E	+75
iglidur® Q	+50
iglidur® Q290	+80
iglidur® M210	+50
iglidur® M260	+80
igutex® TX1	+100
igutex® TX2	+100
igutex® TX3	+100
iglidur® F	+105
iglidur® F2	+70
iglidur® H4	+110
iglidur® UW	+80
iglidur® J UV	+60
iglidur® N54	+60
iglidur® G V0	+100
iglidur® J2	+60
iglidur® AB	+50
iglidur® RW370	+120

Temperature at which additional securing of the iglidur® plain bearing is required



Comparison of the continuous and short-term upper application temperature limits

Technical data

Chemical resistance

iglidur® plain bearings can come into contact with many chemicals during their use. This contact can lead to changes of the structural properties. The behaviour of plastics towards a certain chemical is dependent on the temperature, the length of exposure, and the type and amount of the mechanical stress.

If iglidur® plain bearings are resistant to a chemical, they can be used in these media. Sometimes, the surrounding media can even take on the role of a lubricant. Therefore plain bearings may also be used lubricated. However, in dirty environments, a traditional lubricant can decrease the wear resistance when compared to dry operation. The following overview demonstrates this.

Applications in the food industry
The iglidur® product range with specially developed bearing materials is prepared for the special requirements in machines and equipment for the food industry. The materials of the iglidur® A series and of iglidur® T220 are made according to the requirements of the American Food and Drugs Administration (FDA) for the repeated contact with food.

Material	Hydrocarbons	Greases, oils without additives	Diluted acids	Diluted alkalines
iglidur® G	+	+	0 up to –	+
iglidur® G1	+	+	0 up to –	+
iglidur® M250	+	+	0 up to –	+
iglidur® P210	–	–	0	–
iglidur® P	–	+	0	–
iglidur® K	+	+	0 up to –	+
iglidur® GLW	+	+	0 up to –	+
iglidur® J	+	+	0 up to –	+
iglidur® W300	+	+	0 up to –	+
iglidur® J3	+	+	0 up to –	+
iglidur® J3B	+	+	0 up to –	+
iglidur® J350	+ up to 0	+	+	+
iglidur® J260	+	0 up to –	–	+ up to 0
iglidur® W360	+	+	0 up to –	+
iglidur® L250	+	+	0 up to –	+
iglidur® L500	+	+	+	+
iglidur® R	+	+	0 up to –	+
iglidur® D	+	+	0 up to –	+
iglidur® J200	+	+	0 up to –	+
iglidur® E7	+	+	0 up to –	+
iglidur® E	+	+	0 up to –	+
iglidur® X	+	+	+	+
iglidur® Z	+	+	+	+
iglidur® X6	+	+	+	+
iglidur® V400	+	+	+	+
iglidur® HSD350	+	+	+	+
iglidur® UW500	+	+	+	+
iglidur® H1	+	+	+ up to 0	+
iglidur® H370	+	+	+ up to 0	+
iglidur® H	+	+	+ up to 0	+
iglidur® C500	+	+	+	+
iglidur® H2	+	+	+ up to 0	+
iglidur® H3	+	+	+ up to 0	+
iglidur® H5	+	+	+ up to 0	+
iglidur® A181	+	+	0 up to –	+
iglidur® A350	+ up to 0	+	+	+
iglidur® A500	+	+	+	+
iglidur® A180	+	+	0 up to –	+
iglidur® A200	+	+	0 up to –	+
iglidur® A160	+	+	+	+
iglidur® UW160	+	+	+	+
iglidur® T220	–	+	0	–
iglidur® AX500	+	+	+	+
iglidur® Q2	+	+	0 up to –	+
iglidur® Q3E	+	+	0 up to –	+
iglidur® Q	+	+	0 up to –	+
iglidur® Q290	+	+	0 up to –	+
iglidur® M210	–	–	0	–
iglidur® M260	+	0 up to –	–	+ up to 0
igutex® TX1	+	+	+	+
igutex® TX2	+	+	+	+
igutex® TX3	+	+	+	+
iglidur® F	+	+	0 up to –	+
iglidur® F2	–	+	0	–
iglidur® H4	+	+	+ up to 0	+
iglidur® UW	+	+	0 up to –	+
iglidur® J UV	+	+	0 up to –	+
iglidur® N54	+	+	0 up to –	+
iglidur® G V0	+	+	0 up to –	+
iglidur® J2	+	+	0 up to –	+
iglidur® AB	+	+	0 up to –	+
iglidur® RW370	–	+	+	+

Chemical resistance of iglidur® materials
+ resistant
0 conditionally resistant
- not resistant
All data given at room temperature [+20°C]

Injection-moulded clamping star wheels in Krones bottlers save setup times

Universal grippers for bottle transport increase the productivity of filling systems

Grippers for curve-controlled bottle transport usually have to be changed daily for new bottle sizes or shapes. In order to save these setup times, Krones is now working with grippers that cover various bottle sizes. This saves time and increases efficiency. The clamps and rollers are special parts, while the plain bearings in the gripping mechanism are made of iglidur® X material. All components have been specially developed for dry clean, continuous operation and glass handling.

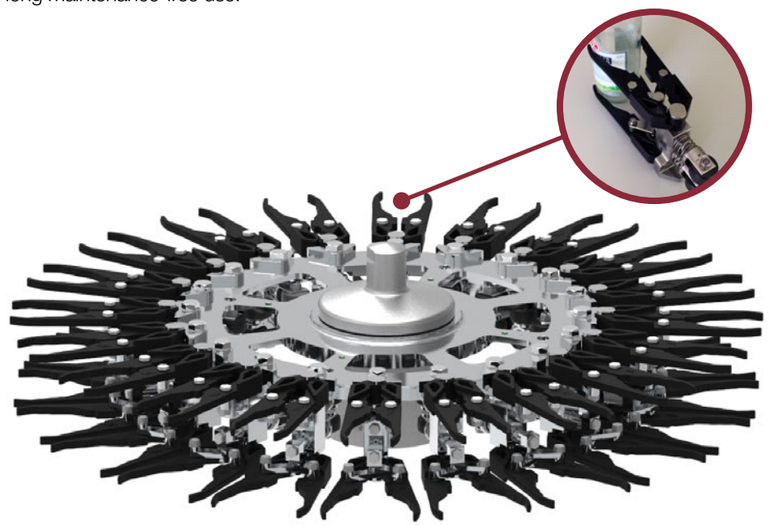
While bottle transport involving fillers in Krones systems has so far been implemented with pocket stars, a new solution is now coming into play. Why? When different bottle shapes or sizes are used, the tools of the bottle stars have so far had to be converted. Such an exchange, which is usually carried out once a day in bottling plants, takes around two hours: there is immense potential for optimisation here.
The goal was therefore obvious: a universal gripping mechanism had to be created that could safely transport bottles of various sizes and shapes to their destination.
For the implementation, Krones AG was now faced with the task of finding suitable material for the grippers for filling systems and the right rollers and plain bearings for the mechanism.

The answer for implementing the new gripping mechanism: a new clamp developed by Krones that is also based on the completely new material iglidur® X. The grippers are made of RN367 material, which was developed for the special challenges of bottle handling. Hygienic design requirements and chemical cleaning were also taken into account during development. This keeps the level of bacterial contamination in the grippers as low as possible. Support rollers at the rear of the clamps and plain bearings are made of iglidur® X, which is also suitable for chemical cleaning, has low coefficient of friction and allows long maintenance-free use.

Last but not least, drylin® R liners made of iglidur® E7 material are used for the linear movement of the clamps, which are attached to the carousel via springs. However, the new grippers have even more advantages. Thanks to the universal solution and the durability of the solution, spare and conversion parts are saved, and a whole 2.5 tons of material are eliminated.

And in the end, the market response also speaks for itself: customer enquiries for Krones increased dramatically .

igus.eu/krones



The MultiGuide Base clamps can grip bottles with different shapes and sizes.

Specifications, approvals and standards

Material	Wear resistance at +23°C	Wear resistance at +90°C	Wear resistance at +150°C
iglidur® G	●●●○○	●●●○○	●●○○○
iglidur® G1	●●●●○	●●●●○	●●●○○
iglidur® M250	●●○○○	●●●○○	●○○○○
iglidur® P210	●●●●○	●●●●○	●●●○○
iglidur® P	●●●○○	●●●○○	●○○○○
iglidur® K	●●●○○	●●●○○	●●○○○
iglidur® GLW	●●○○○	●●○○○	●○○○○
iglidur® J	●●●●●	●●●●●	●○○○○
iglidur® W300	●●●●●	●●●●●	●○○○○
iglidur® J3	●●●●●	●●●●●	●○○○○
iglidur® J3B	●●●●●	●●●●●	●○○○○
iglidur® J350	●●●●○	●●●●●	●●●●○
iglidur® J260	●●●○○	●●●○○	●●○○○
iglidur® W360	●●●●○	●●●○○	●●○○○
iglidur® L250	●●●○○	●●●○○	●●○○○
iglidur® L500	●●●○○	●●●●○	●●●●●
iglidur® R	●●●○○	●○○○○	●○○○○
iglidur® D	●●●○○	●○○○○	●○○○○
iglidur® J200	●●●○○	●●●○○	●●○○○
iglidur® E7	●●●●●	●●●●●	●○○○○
iglidur® E	●●●●●	●●●●●	●○○○○
iglidur® X	●●○○○	●●●○○	●●●●●
iglidur® Z	●●●●○	●●●●○	●●●●○
iglidur® X6	●●●○○	●●●●○	●●●●●
iglidur® V400	●●●●○	●●●●●	●●●●●
iglidur® HSD350	●●●●○	●●●●○	●●●○○
iglidur® UW500	●●●○○	●●●●○	●●●●●
iglidur® H1	●●●●●	●●●●●	●●●●●
iglidur® H370	●●○○○	●●●○○	●●●●○
iglidur® H	●●○○○	●●○○○	●●●○○
iglidur® C500	●●●●○	●●●●○	●●●●○
iglidur® H2	●○○○○	●●○○○	●●○○○
iglidur® H3	●●●●○	●●●●○	●●●●○
iglidur® H5	●●●●●	●●●●●	●●●●●
iglidur® A181	●●●●○	●●○○○	●○○○○
iglidur® A350	●●●○○	●●●○○	●●●○○
iglidur® A500	●●○○○	●●○○○	●●●○○
iglidur® A180	●●●○○	●○○○○	●○○○○
iglidur® A200	●●○○○	●○○○○	●○○○○
iglidur® A160	●●●○○	●○○○○	●○○○○
iglidur® UW160	●●●○○	●○○○○	●○○○○
iglidur® T220	●●●○○	●○○○○	●○○○○
iglidur® AX500	●●○○○	●●○○○	●●●○○
iglidur® Q2	●●●○○	●●○○○	●●○○○
iglidur® Q3E	●●●○○	●●○○○	●●○○○
iglidur® Q	●●●●○	●●●○○	●●○○○
iglidur® Q290	●●●●○	●●●○○	●●○○○
iglidur® M210	●●●●○	●●●●○	●●●○○
iglidur® M260	●●●○○	●●●○○	●●○○○
igutex® TX1	●●●○○	●●○○○	●○○○○
igutex® TX2	●●●○○	●●○○○	●○○○○
igutex® TX3	●●●○○	●●○○○	●○○○○
iglidur® F	●●○○○	●●○○○	●○○○○
iglidur® F2	●●●○○	●●●○○	●○○○○
iglidur® H4	●●●○○	●●●○○	●●●○○
iglidur® UW	●●●○○	●●●○○	●○○○○
iglidur® J UV	●●●●●	●●●●●	●○○○○
iglidur® N54	●●○○○	●○○○○	●○○○○
iglidur® G V0	●●●○○	●●●○○	●●○○○
iglidur® J2	●●○○○	●○○○○	●○○○○
iglidur® AB	●●●○○	●○○○○	●○○○○
iglidur® RW370	●●●○○	●●●○○	●●●○○

Material	Radiation resistance	Electrically conductive	Compliant with food requirements	Fire class in accordance with UL-94	Mould test DIN EN ISO 846	Fogging DIN 75201-B
iglidur® G	$3 \cdot 10^2$ Gy			HB	●	●
iglidur® G1	$3 \cdot 10^2$ Gy			HB	●	
iglidur® M250	$1 \cdot 10^4$ Gy			V-2		●
iglidur® P210	$3 \cdot 10^2$ Gy			HB		●
iglidur® P	$5 \cdot 10^2$ Gy			HB		
iglidur® K	$5 \cdot 10^2$ Gy			HB		
iglidur® GLW	$3 \cdot 10^2$ Gy			HB		●
iglidur® J	$3 \cdot 10^2$ Gy			HB	●	
iglidur® W300	$3 \cdot 10^2$ Gy			HB		
iglidur® J3	$1 \cdot 10^4$ Gy			HB		
iglidur® J3B	$3 \cdot 10^2$ Gy			HB		
iglidur® J350	$2 \cdot 10^2$ Gy			V-0	●	
iglidur® J260	$3 \cdot 10^2$ Gy			V-2		
iglidur® W360	$2 \cdot 10^2$ Gy			HB		
iglidur® L250	$3 \cdot 10^4$ Gy			HB		
iglidur® L500	$3 \cdot 10^2$ Gy			V-0		
iglidur® R	$3 \cdot 10^2$ Gy			HB		
iglidur® D	$3 \cdot 10^2$ Gy			HB		
iglidur® J200	$3 \cdot 10^2$ Gy			HB		
iglidur® E7	$3 \cdot 10^2$ Gy			HB		
iglidur® E	$3 \cdot 10^2$ Gy			HB		
iglidur® X	$1 \cdot 10^5$ Gy	●		V-0	●	
iglidur® Z	$1 \cdot 10^5$ Gy			V-0	●	
iglidur® X6	$2 \cdot 10^5$ Gy	●		V-0		
iglidur® V400	$2 \cdot 10^4$ Gy			V-0		
iglidur® HSD350				V-0		
iglidur® UW500	$1 \cdot 10^5$ Gy	●		V-0		
iglidur® H1	$2 \cdot 10^2$ Gy			V-0	●	
iglidur® H370	$2 \cdot 10^2$ Gy	●		V-0		
iglidur® H	$2 \cdot 10^2$ Gy			V-0		
iglidur® C500	$3 \cdot 10^2$ Gy			V-0		
iglidur® H2	$2 \cdot 10^2$ Gy			V-0		
iglidur® H3	$2 \cdot 10^2$ Gy			V-0		
iglidur® H5	$2 \cdot 10^2$ Gy			V-0		
iglidur® A181	$2 \cdot 10^2$ Gy		●	HB		
iglidur® A350	$2 \cdot 10^2$ Gy		●	V-0		
iglidur® A500	$2 \cdot 10^5$ Gy		●	V-1		
iglidur® A180	$3 \cdot 10^2$ Gy		●	HB		
iglidur® A200	$1 \cdot 10^4$ Gy		●	V-2		
iglidur® A160	$1 \cdot 10^5$ Gy		●	HB		
iglidur® UW160	$3 \cdot 10^2$ Gy			HB		
iglidur® T220	$3 \cdot 10^2$ Gy		●	HB		
iglidur® AX500	$3 \cdot 10^2$ Gy		●	V-1		
iglidur® Q2	$3 \cdot 10^2$ Gy			HB		
iglidur® Q3E	$3 \cdot 10^2$ Gy			HB		
iglidur® Q	$3 \cdot 10^2$ Gy			HB		
iglidur® Q290	$3 \cdot 10^2$ Gy			HB		
iglidur® M210	$3 \cdot 10^2$ Gy			HB		
iglidur® M260	$3 \cdot 10^2$ Gy			V-2		
igutex® TX1						
igutex® TX2						
igutex® TX3						
iglidur® F	$3 \cdot 10^2$ Gy	●		HB		
iglidur® F2	$3 \cdot 10^2$ Gy	●		HB		
iglidur® H4	$2 \cdot 10^2$ Gy			V-0		
iglidur® UW	$3 \cdot 10^2$ Gy			HB		
iglidur® J UV	$3 \cdot 10^2$ Gy			HB		
iglidur® N54	$1 \cdot 10^4$ Gy			HB		
iglidur® G V0	$3 \cdot 10^2$ Gy			V-0	●	
iglidur® J2	$3 \cdot 10^2$ Gy			HB		
iglidur® AB	$3 \cdot 10^2$ Gy			HB		
iglidur® RW370				V-0		

Material properties

Material	General properties					Mechanical properties				
	Density [g/cm³]	Max. moisture absorption at +23°C and 50% relative humidity [% weight]	Max. total moisture absorption [% weight]	Coefficient of sliding friction, dynamic against steel [µ]	pv value, max. (dry) [MPa · m/s]	Flexural modulus [MPa]	Flexural strength at +20°C [MPa]	Compressive strength [MPa]	Max. permissible surface pressure at 20°C [MPa]	Shore D hardness
iglidur® G	1.46	0.7	4.0	0.08-0.15	0.42	7,800	210	78	80	81
iglidur® G1	1.58	0.2	1.7	0.08-0.15	0.60	11,486	178	115	91	81
iglidur® M250	1.14	1.4	7.6	0.18-0.40	0.12	2,700	112	52	20	79
iglidur® P210	1.40	0.3	0.5	0.07-0.19	0.40	2,500	70	50	50	75
iglidur® P	1.58	0.2	0.4	0.06-0.21	0.39	5,300	120	66	50	75
iglidur® K	1.52	0.1	0.6	0.06-0.21	0.30	3,500	80	60	50	72
iglidur® GLW	1.36	1.3	5.5	0.10-0.24	0.30	7,700	235	74	80	78
iglidur® J	1.49	0.3	1.3	0.06-0.18	0.34	2,400	73	60	35	74
iglidur® W300	1.24	1.3	6.5	0.08-0.23	0.23	3,500	125	61	60	77
iglidur® J3	1.42	0.3	1.3	0.06-0.20	0.50	2,700	70	60	45	73
iglidur® J3B	1.42	0.3	1.3	0.09-0.23	0.50	2,895	65		44	76
iglidur® J350	1.44	0.3	1.6	0.10-0.20	0.45	2,000	55	60	60	80
iglidur® J260	1.35	0.2	0.4	0.06-0.20	0.35	2,200	60	50	40	77
iglidur® W360	1.34	0.2	1.6	0.07-0.21	0.35	3,829	119		75	
iglidur® L250	1.50	0.7	3.9	0.08-0.19	0.40	1,950	67	47	45	68
iglidur® L500	1.53	0.1	0.3	0.19-0.26	4.00	12,015	201	70	70	81
iglidur® R	1.39	0.2	1.1	0.09-0.25	0.27	1,950	70	68	23	77
iglidur® D	1.40	0.3	1.1	0.08-0.26	0.27	2,000	72	70	23	78
iglidur® J200	1.72	0.2	0.7	0.11-0.17	0.30	2,800	58	43	23	70
iglidur® E7	1.05	0.1	0.1	0.08-0.17	0.22	1,477	22	18	18	61
iglidur® E	1.50	0.2	1.7	0.08-0.23	0.25	2,975	79		37	78
iglidur® X	1.44	0.1	0.5	0.09-0.27	1.32	8,100	170	100	150	85
iglidur® Z	1.40	0.3	1.1	0.06-0.14	0.84	2,400	95	65	150	81
iglidur® X6	1.53	0.1	0.5	0.09-0.25	1.35	16,000	290	190	150	89
iglidur® V400	1.51	0.1	0.2	0.15-0.20	0.50	4,500	95	47	45	74
iglidur® HSD350	1.39	0.6	1.2	0.07-0.23	0.30	2,150	67	44	30	77
iglidur® UW500	1.49	0.1	0.5	0.20-0.36	0.35	16,000	260	140	140	86
iglidur® H1	1.53	0.1	0.3	0.06-0.20	0.80	2,800	55	78	80	77
iglidur® H370	1.66	0.1	0.1	0.07-0.17	0.74	11,100	135	79	75	82
iglidur® H	1.71	0.1	0.3	0.07-0.20	1.37	12,500	175	81	90	87
iglidur® C500	1.37	0.3	0.5	0.07-0.19	0.70	3,300	100	110	80	80
iglidur® H2	1.72	0.1	0.2	0.07-0.30	0.58	10,300	210	109	110	88
iglidur® H3	1.41	0.2	0.5	0.08-0.17	0.70	2,760	68		40	75
iglidur® H5	1.41	0.1	0.7	0.08-0.24	0.70	6,400	150		80	72
iglidur® A181	1.38	0.2	1.3	0.10-0.21	0.31	1,913	48	60	31	76
iglidur® A350	1.42	0.6	1.9	0.10-0.20	0.40	2,000	110	78	60	76
iglidur® A500	1.28	0.3	0.5	0.26-0.41	0.28	3,600	140	118	120	83
iglidur® A180	1.46	0.2	1.3	0.05-0.23	0.31	2,300	88	78	28	76
iglidur® A200	1.14	1.5	7.6	0.10-0.40	0.09	2,500	116	54	18	81
iglidur® A160	1.00	0.1	0.1	0.09-0.19	0.25	1,151	19	37	14	60
iglidur® UW160	1.04	0.1	0.1	0.17-0.31	0.22	1,349	22	32	20	60
iglidur® T220	1.28	0.3	0.5	0.20-0.32	0.28	1,800	65	55	40	76
iglidur® AX500	1.52	0.3	0.5	0.08-0.22	0.90	6,170	115		69	81
iglidur® Q2	1.46	1.1	4.6	0.22-0.42	0.70	8,370	240	130	120	80
iglidur® Q3E	1.46-1.69	1.5	5.0	0.22-0.42	0.70		235		135	80
iglidur® Q	1.40	0.9	4.9	0.05-0.15	0.55	4,500	120	89	100	83
iglidur® Q290	1.27	3.0	9.3	0.14-0.26	0.70	3,074	97	68	55	80
iglidur® M210	1.40	0.3	0.5	0.08-0.20	0.50	2,200	65	50	50	75
iglidur® M260	1.35	0.2	0.4	0.08-0.16	0.35	2,200	60	50	40	77
igutex® TX1	2.10	0.2	0.5	0.09-0.37	1.25	12,000	55	220	200	94
igutex® TX2	1.77	1.0	1.3		2.80			180	180	91
igutex® TX3	1.90	0.1	0.1		2.80				180	91
iglidur® F	1.25	1.8	8.4	0.10-0.39	0.34	11,600	260	98	105	84
iglidur® F2	1.52	0.2	0.4	0.16-0.22	0.31	7,418	93	61	47	72
iglidur® H4	1.79	0.1	0.2	0.08-0.25	0.70	7,500	120	50	65	80
iglidur® UW	1.52	0.2	0.8	0.15-0.35	0.11	9,600	90	70	40	78
iglidur® J UV	1.49	0.3	1.3	0.08-0.19	0.30	2,400	72		34	74
iglidur® N54	1.13	1.6	3.6	0.15-0.23	0.50	1,800	70	30	35	74
iglidur® G V0	1.53	0.7	4.0	0.07-0.20	0.50	7,900	140	100	75	80
iglidur® J2	1.44	0.2	1.3	0.11-0.27	0.23	3,605	101	77	46	
iglidur® AB	1.11	0.8	1.6	0.18-0.31	0.25	1,850	50	40	25	70
iglidur® RW370	1.34	0.3	1.2	0.13-0.17	1.20	2,997	100	129	75	80

Material	Physical and thermal properties					Electrical properties	
	Max. long-term application temperature [°C] [°C]	Max. short-term application temperature [°C] [°C]	Minimum application temperature [°C]	Thermal conductivity [W/m · K]	Coefficient of thermal expansion at +23°C [K⁻¹ · 10⁻⁵]	Specific contact resistance [Ωcm]	Surface resistance [Ω]
iglidur® G	+130	+220	-40	0.24	9.0	$>10^{13}$	$>10^{11}$
iglidur® G1	+180	+220	-40	0.46	3.5	$>10^{9}$	$>10^{11}$
iglidur® M250	+80	+170	-40	0.24	10.0	$>10^{13}$	$>10^{11}$
iglidur® P210	+100	+160	-40	0.25	8.0	$>10^{12}$	$>10^{11}$
iglidur® P	+130	+200	-40	0.25	4.0	$>10^{13}$	$>10^{12}$
iglidur® K	+170	+240	-40	0.25	3.0	$>10^{12}$	$>10^{12}$
iglidur® GLW	+100	+160	-40	0.24	17.0	$>10^{11}$	$>10^{11}$
iglidur® J	+90	+120	-50	0.25	10.0	$>10^{13}$	$>10^{12}$
iglidur® W300	+90	+180	-40	0.24	9.0	$>10^{13}$	$>10^{12}$
iglidur® J3	+90	+120	-50	0.25	13.0	$>10^{12}$	$>10^{12}$
iglidur® J3B	+90	+110	-50	0.30	12.7	$>10^{12}$	$>10^{12}$
iglidur® J350	+180	+220	-100	0.24	7.0	$>10^{13}$	$>10^{10}$
iglidur® J260	+120	+140	-100	0.24	13.0	$>10^{12}$	$>10^{10}$
iglidur® W360	+180	+200	-40	0.24	6.0	$>10^{13}$	$>10^{12}$
iglidur® L250	+90	+180	-40	0.24	10.0	$>10^{10}$	$>10^{11}$
iglidur® L500	+250	+315	-100	0.45	6.0	$>10^{10}$	$>10^{12}$
iglidur® R	+90	+110	-50	0.25	11.0	$>10^{12}$	$>10^{12}$
iglidur® D	+90	+110	-50	0.25	11.0	$>10^{14}$	$>10^{14}$
iglidur® J200	+90	+120	-50	0.24	8.0	$>10^{8}$	$>10^{8}$
iglidur® E7	+70	+90	-50	0.24	25.0	$>10^{9}$	$>10^{9}$
iglidur® E	+90	+120	-50	0.25	10.0	$>10^{12}$	$>10^{12}$
iglidur® X	+250	+315	-100	0.60	5.0	$<10^{5}$	$<10^{3}$
iglidur® Z	+250	+310	-100	0.62	4.0	$>10^{11}$	$>10^{11}$
iglidur® X6	+250	+315	-100	0.55	1.1	$>10^{5}$	$>10^{3}$
iglidur® V400	+200	+240	-50	0.24	3.0	$>10^{12}$	$>10^{12}$
iglidur® HSD350	+180	+210	-40	0.24	7.0	$>10^{13}$	$>10^{14}$
iglidur® UW500	+250	+300	-100	0.60	4.0	$<10^{9}$	$<10^{9}$
iglidur® H1	+200	+240	-40	0.24	6.0	$>10^{12}$	$>10^{11}$
iglidur® H370	+200	+240	-40	0.50	5.0	$<10^{5}$	$<10^{5}$
iglidur® H	+200	+240	-40	0.60	4.0	$<10^{5}$	$<10^{2}$
iglidur® C500	+250	+300	-100	0.24	9.0	$>10^{14}$	$>10^{13}$
iglidur® H2	+200	+240	-40	0.24	4.0	$>10^{15}$	$>10^{14}$
iglidur® H3	+200	+240	-40	0.25	6.0	$>10^{12}$	$>10^{12}$
iglidur® H5	+200	+240	-40	0.25	7.0	$>10^{12}$	$>10^{12}$
iglidur® A181	+90	+110	-50	0.25	11.0	$>10^{12}$	$>10^{12}$
iglidur® A350	+180	+210	-100	0.24	8.0	$>10^{11}$	$>10^{11}$
iglidur® A500	+250	+300	-100	0.24	9.0	$>10^{14}$	$>10^{13}$
iglidur® A180	+90	+110	-50	0.25	11.0	$>10^{12}$	$>10^{11}$
iglidur® A200	+80	+170	-40	0.24	10.0	$>10^{13}$	$>10^{12}$
iglidur® A160	+90	+100	-50	0.30	11.0	$>10^{12}$	$>10^{12}$
iglidur® UW160	+90	+100	-50	0.50	18.0	$>10^{12}$	$>10^{12}$
iglidur® T220	+100	+160	-40	0.24	11.0	$>10^{10}$	$>10^{10}$
iglidur® AX500	+250	+300	-100	0.26	9.0	$>10^{5}$->10^{11}	$>10^{5}$->10^{11}
iglidur® Q2	+130	+200	-40	0.24	8.0	$>10^{13}$	$>10^{11}$
iglidur® Q3E	+100	+140	-30			$>10^{12}$	$>10^{12}$
iglidur® Q	+135	+155	-40	0.23	5.0	$>10^{15}$	$>10^{12}$
iglidur® Q290	+140	+180	-40	0.24	7.0	$>10^{12}$	$>10^{12}$
iglidur® M210	+100	+160	-40	0.25	8.0	$>10^{11}$	$>10^{11}$
iglidur® M260	+120	+140	-100	0.24	13.0	$>10^{10}$	$>10^{10}$
igutex® TX1	+120	+170	-60	0.24	3.0	$>10^{11}$	$>10^{13}$
igutex® TX2	+130	+140	-20	0.25		Insulating	Insulating
igutex® TX3	+130	+140	-20	0.25		Insulating	Insulating
iglidur® F	+140	+180	-40	0.65	12.0	$<10^{3}$	$<10^{2}$
iglidur® F2	+120	+165	-40	0.61	5.0	$<10^{9}$	$<10^{9}$
iglidur® H4	+200	+240	-40	0.24	5.0	$>10^{13}$	$>10^{12}$
iglidur® UW	+90	+110	-50	0.60	6.0	$<10^{5}$	$<10^{5}$
iglidur® J UV	+90	+120	-50	0.30	10.0	$>10^{13}$	$>10^{13}$
iglidur® N54	+80	+120	-40	0.24	9.0	$>10^{13}$	$>10^{11}$
iglidur® G V0	+130	+210	-40	0.25	9.0	$>10^{12}$	$>10^{11}$
iglidur® J2	+90	+110	-50	0.25	7.0	$>10^{13}$	$>10^{12}$
iglidur® AB	+70	+140	-40	0.24	10.0	$>10^{12}$	$>10^{12}$
iglidur® RW370	+170	+190	-50	0.22	5	$>10^{12}$	$>10^{12}$

Tolerances and measurement system

Installation tolerances
iglidur® plain bearings are standard bearings for shafts with h-tolerance (recommended minimum h9). The bearings are designed for press-fit into a housing machined to a H7 tolerance. After being assembled into a nominal size housing, in standard cases the inner diameter automatically adjusts to the correct tolerances. In the case of certain dimensions, the tolerance differs depending on the wall thickness.

Tolerances and measurement system
The installation dimensions and tolerances of the iglidur® plain bearings are a function of the material and wall thicknesses. For each material, the moisture absorption and the thermal expansion are decisive factors. Plain bearings with low moisture absorption can be designed with a minimal amount of bearing clearance. The rule for wall thickness: the thicker the wall of the bearings, the larger the clearances must be. Thus, different tolerance classes exist for iglidur® plain bearings.
Within these tolerances, iglidur® plain bearings can operate in the permissible temperature range and in humidity conditions up to 70% according to the installation recommendations. Should higher air moisture levels be present, or the bearing is used under water, we provide advice with regard to applications, in order to help you use your bearings correctly.

Measuring of the inner diameter of a press-fitted bearing

ISO tolerances for iglidur® plain bearings [mm]

Diameter d1	Housing H7	Shaft h9
up to 3	+0.000 +0.010	-0.025 +0.000
> 3 up to 6	+0.000 +0.012	-0.030 +0.000
> 6 up to 10	+0.000 +0.015	-0.036 +0.000
> 10 up to 18	+0.000 +0.018	-0.043 +0.000
> 18 up to 30	+0.000 +0.021	-0.052 +0.000
> 30 up to 50	+0.000 +0.025	-0.062 +0.000
> 50 up to 80	+0.000 +0.030	-0.074 +0.000
> 80 up to 120	+0.000 +0.035	-0.087 +0.000
> 120 up to 180	+0.000 +0.040	-0.100 +0.000

Diameter d1	Tolerances according to ISO 3547-1				
	E10	E11	F10	F11	D11
up to 3	+0.014 +0.054	+0.014 +0.074	+0.006 +0.046	+0.006 +0.066	+0.020 +0.080
> 3 up to 6	+0.020 +0.068	+0.020 +0.095	+0.010 +0.058	+0.010 +0.085	+0.030 +0.105
> 6 up to 10	+0.025 +0.083	+0.025 +0.115	+0.013 +0.071	+0.013 +0.103	+0.040 +0.130
> 10 up to 18	+0.032 +0.102	+0.032 +0.142	+0.016 +0.086	+0.016 +0.126	+0.050 +0.160
> 18 up to 30	+0.040 +0.124	+0.040 +0.170	+0.020 +0.104	+0.020 +0.150	+0.065 +0.195
> 30 up to 50	+0.050 +0.150	+0.050 +0.210	+0.025 +0.125	+0.025 +0.185	+0.080 +0.240
> 50 up to 80	+0.060 +0.180	+0.060 +0.250	+0.030 +0.150	+0.030 +0.220	+0.100 +0.290
> 80 up to 120	+0.072 +0.212	+0.072 +0.292	+0.036 +0.176	+0.036 +0.256	+0.120 +0.340
> 120 up to 180	+0.085 +0.245	+0.085 +0.335	+0.043 +0.203	+0.043 +0.293	+0.145 +0.395

Material	Installation tolerances	Dimensions in accordance with DIN
iglidur® G	E10	ISO 3547
iglidur® G1	F10	ISO 3547
iglidur® M250	D10	ISO 2795
iglidur® P210	E10	ISO 3547
iglidur® P	E10	ISO 3547
iglidur® K	E10	ISO 3547
iglidur® GLW	E10	ISO 3547
iglidur® J	E10	ISO 3547
iglidur® W300	E10	ISO 3547
iglidur® J3	E10	ISO 3547
iglidur® J3B	E10	ISO 3547
iglidur® J350	F10	ISO 3547
iglidur® J260	E10	ISO 3547
iglidur® W360	E10	ISO 3547
iglidur® L250	E10	ISO 3547
iglidur® L500	F10	ISO 3547
iglidur® R	E10	ISO 3547
iglidur® D	E10	
iglidur® J200	E10	
iglidur® E7	E10	ISO 3547
iglidur® E	E10	ISO 3547
iglidur® X	F10	ISO 3547
iglidur® Z	F10	ISO 3547
iglidur® X6	F10	ISO 3547
iglidur® V400	F10	ISO 3547
iglidur® HSD350	F10	ISO 3547
iglidur® UW500	F10	ISO 3547
iglidur® H1	F10	ISO 3547
iglidur® H370	F10	ISO 3547
iglidur® H	F10	ISO 3547
iglidur® C500	F10	ISO 3547
iglidur® H2	F10	
iglidur® H3	F10	ISO 3547
iglidur® H5	F10	ISO 3547
iglidur® A181	E10	ISO 3547
iglidur® A350	F10	ISO 3547
iglidur® A500	F10	ISO 3547
iglidur® A180	E10	ISO 3547
iglidur® A200	D11	ISO 2795
iglidur® A160	E10	ISO 3547
iglidur® UW160	E10	ISO 3547
iglidur® T220	E10	
iglidur® AX500	F10	ISO 3547
iglidur® Q2	E10	ISO 3547
iglidur® Q3E	E11	
iglidur® Q	E10	ISO 3547
iglidur® Q290	E11	ISO 3547
iglidur® M210	D11	ISO 2795
iglidur® M260	D11	ISO 2795
igutex® TX1	F11	ISO 2795
igutex® TX2	F11	ISO 2795
igutex® TX3	F11	ISO 2795
iglidur® F	D11	ISO 3547
iglidur® F2	E10	ISO 3547
iglidur® H4	F10	ISO 3547
iglidur® UW	E10	ISO 3547
iglidur® J UV	E10	ISO 3547
iglidur® N54	E10	ISO 3547
iglidur® G V0	E10	ISO 3547
iglidur® J2	E10	ISO 3547
iglidur® AB	E10	ISO 3547
iglidur® RW370	F10	ISO 3547