



World Class Bearing Technology



Products and Services



Plain bearings for the most demanding applications

70 years of excellence and innovation

Federal-Mogul Deva GmbH is a global leader in maintenance-free, self-lubricating bearings for the most demanding applications. Since the company's world-first introduction of sintered bearings incorporating solid lubricants in 1936, maintenance-free, self-lubricating bearings carrying the DEVA® trademark have helped ensure reliable, efficient operation across many industries worldwide. With world-class products tailor-made to cope with the most demanding tribological conditions – intense pressures underwater, great heat or cold, or in the exceptionally challenging environment of space travel – DEVA's reputation has been established through consistently excellent service and performance.

Today, the company's headquarters at Stadtallendorf in Hessen provides a global centre for innovation and customer service. From the high-precision challenges of tiny journals to the immense scale of bearings for massive building structures, DEVA continues to build on its reputation for providing robust and efficient solutions to the most demanding challenges worldwide.



Building a global reputation

Since the formation of our business, the success of DEVA has been built on a deep understanding of our customers' requirements, combined with a proven ability to develop solutions that work reliably and efficiently, however demanding the challenge.

At the heart of our capability are the DEVA high-performance materials that excel in applications where other types of plain bearings reach their limits. Using the immense flexibility of powder metallurgy to carefully optimise these materials, we can create a combination of performance characteristics that is precisely tailored to every application.

It's that focus on using the right technology to deliver the right solution that has built DEVA's reputation over many generations, and which continues today.





Tailored solutions, optimised for your application

A DEVA solution is never compromised by the need to make it fit an existing product. We do have a proven range of bearings available 'off the shelf' for popular applications, but the majority of our plain bearings are developed and manufactured to provide the best possible performance for challenging, individual requirements.

State-of-the-art production processes allow us to develop and manufacture bearings with diameters from 1 mm for ultra-high-precision applications up to the 3.5 m required for major structures such as lock gates and bridges. The considerable knowledge of the DEVA team, combined with experience working on many of the world's most demanding applications, ensures that every project receives the attention and the expertise it needs to guarantee a world-class solution.

Tough performers: our range of materials

Ensuring a reliable solution at an affordable price means calling on proven families of materials, developed by DEVA over many decades: deva.metal®, deva.bm®, deva.glide® and deva.tex®. Consisting of a matrix into which solid lubricants are integrated, they offer the flexibility needed to ensure smooth, maintenance-free operation across applications that include machines, aircraft and plant.

The flexibility of these families, combined with DEVA's advanced manufacturing processes, allows the combination of performance attributes to be optimised for each application. These can include high wear resistance, low coefficients of friction, resistance to high and low temperatures, resistance to corrosion even in the most aggressive environments, damping noise and vibration, and insensitivity to contaminants. This is all achieved while ensuring a cost-effective, long life.

At DEVA, we are also particularly proud of our commitment to environmental protection, which is reflected in the environmental compatibility of every product we develop. Our self-lubricating bearings, for example, eliminate conventional lubricants that could leak into the environment. The motto "Save resources, protect the environment" is a particular passion of our entire team.



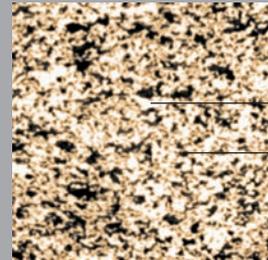
deva.metal[®]

High performance material –
Solid lubricants embedded in metal matrix

maintenance-free



Microsection deva.metal



- 1 Bronze, iron or nickel matrix
- 2 Solid lubricant (Graphite, WS₂, MoS₂ and other)

Where to use

deva.metal is a self-lubricating bearing material manufactured by advanced powder metallurgy. It is fully compacted, unlike oil-impregnated porous bronze materials that are weak by comparison. deva.metal is provided with an evenly distributed solid lubricant throughout its metallic matrix.

deva.metal

- is suitable for dry running at slow sliding speeds and high loads.
- is stick-slip free.
- has high resistance to temperature and corrosion.
- is insensitive to contamination and edge pressures.
- can be easily machined if required.

Reference applications

Iron and steel works, furnace construction, fans, foundry machinery, waste water cleaning plants, water-, steam- and gas-turbines, pumps and compressors, food and beverage industry machinery, packing machinery, apparatus engineering, mechanical handling equipment, etc.

Basic designs (excerpt)



Material properties

deva.metal	
Properties	Value
Max. permitted static load (\bar{p}) – [MPa]	260
Max. permitted dynamic load (\bar{p}) – [MPa]	130
Max. sliding speed (U) – [m/s]	0.4
Max. $\bar{p}U$ -value – [MPa × m/s]	1.5
Friction coefficient – [μ]	0.09 to 0.49
Temperature range – [°C]	-200 to +800
Tolerances	Value
Housing bore	H7
Bearing outer \varnothing	r6
Bearing inner \varnothing	C7 for D8 after inst.
Shaft \varnothing	h7
Counter material hardness	depending on the DEVA material
Shaft surface finish	R _a 0.2 to 0.8 μ m

Tolerances

Other installation tolerances are possible, provided that a safe fit in the housing and the necessary running clearance are maintained.

Installation

The recommended method for installing bushes is supercooling (bronze alloys only) or press-fit.

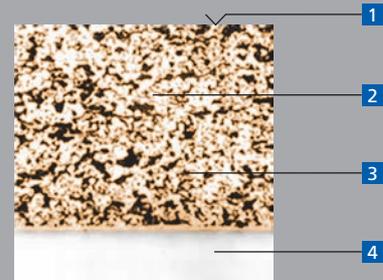
deva.bm[®]

High performance material –
Metal based backing with deva.metal
sliding layer

maintenance-free



Microsection deva.bm



- 1 Sliding surface
- 2 Sliding layer (bronze)
- 3 Solid lubricant (graphite)
- 4 Backing

Where to use

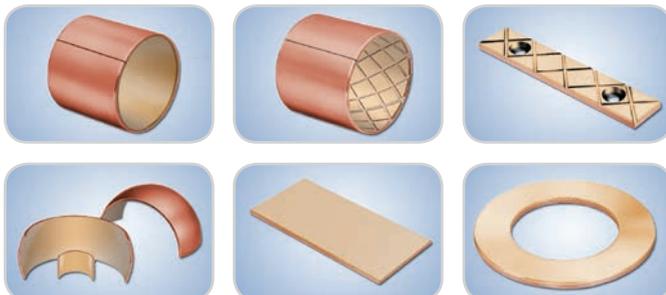
deva.bm is a thin-walled self-lubricating composite sliding material. It consists of a backing made of standard steel, stainless steel or bronze with a deva.metal[®] layer applied in a combined rolling/sintering process.

deva.bm offers basically the same bearing characteristics as deva.metal but is capable of handling even higher loads and offers an economic solution to many bearing problems.

Reference applications

Water turbines, injection molding machinery, food and beverage industry machinery, packing machinery, printing machinery, apparatus engineering, shut-off valves, tire molds, etc.

Basic designs (excerpt)



Material properties

deva.bm	
Properties	Value
Max. permitted static load (\bar{p}) – [MPa]	280
Max. permitted dynamic load (\bar{p}) – [MPa]	150
Max. sliding speed (U) – [m/s]	1.0
Max. $\bar{p}U$ -value – [MPa × m/s]	1.5
Friction coefficient – [μ]	0.10 to 0.18
Temperature range – [°C]	-150 to +280
Tolerances	Value
Housing bore	H7
Bearing inner \emptyset	H8/H9 after inst.
Shaft \emptyset	d7/e7
Counter material hardness	> 180HB
Shaft surface finish	R _a 0.2 to 0.8 μ m

Tolerances

Other installation tolerances are possible, provided that a safe fit in the housing and the necessary running clearance are maintained.

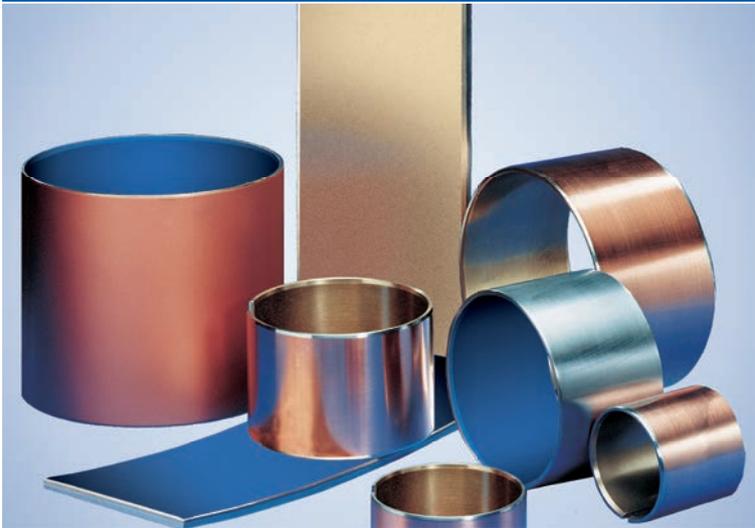
Installation

Press-fit installation or supercooling.

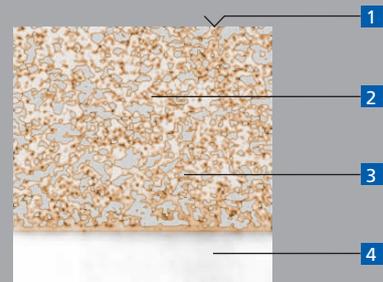
deva.bm[®]/9P

High performance material –
Stainless steel backing and PTFE as lubricant

maintenance-free



Microsection deva.bm/9P



- 1 Sliding surface
- 2 Sliding layer (bronze)
- 3 Solid lubricant (PTFE)
- 4 Backing

Where to use

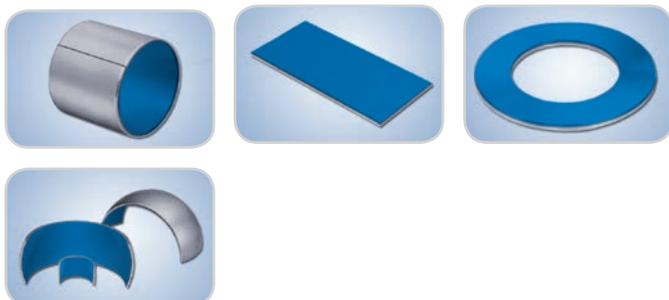
deva.bm/9P is a thin-walled, self-lubricating composite sliding material. The sliding layer is applied to a stainless steel backing in a combined rolling/sintering process. PTFE serves as lubricant and offers very low friction and wear rates.

An optional running-in film can extend the bearing lifetime under certain operating conditions.

Reference applications

Iron and steel works, furnace construction, fans, foundry machinery, waste water cleaning plants, water-, steam- and gas-turbines, pumps and compressors, food and beverage industry machinery, packing machinery, apparatus engineering, mechanical handling equipment, etc.

Basic designs (excerpt)



Material properties

deva.bm/9P	
Properties	Value
Max. permitted static load (\bar{p}) – [MPa]	280
Max. permitted dynamic load (\bar{p}) – [MPa]	120
Max. sliding speed (U) – [m/s]	1.0
Max. $\bar{p}U$ -value – [MPa × m/s]	2
Friction coefficient – [μ]	0.05 to 0.15
Temperature range – [°C]	-190 to +250
Tolerances	Value
Housing bore	H7
Bearing inner \varnothing	H8/H9 after inst.
Shaft \varnothing	d7/e7
Counter material hardness	> 180HB
Shaft surface finish	R _a 0.2 to 0.8 μ m

Tolerances

Other installation tolerances are possible, provided that a safe fit in the housing and the necessary running clearance are maintained.

Installation

Press-fit installation or supercooling.

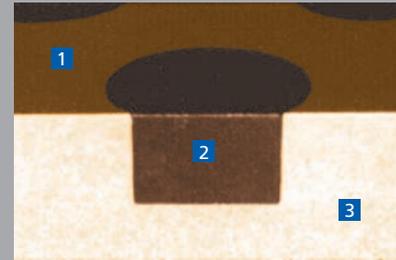
deva.glide®

High performance material –
Bronze bearing with solid lubrication pockets

maintenance-free



Microsection deva.glide



- 1 Sliding surface
- 2 Solid lubricant ingots
- 3 Bearing material (bronze)

Where to use

deva.glide is a self-lubricating bearing material that consists of a high-quality bearing bronze with solid lubricant pockets. A thin film of solid lubricant aids the running-in process if required.

deva.glide allows to replace lubricated bronze bearings with a maintenance-free alternative and deva.metal

- is suitable for large dimensions,
- has a low friction coefficient,
- has a high wear resistance,
- allows a high durability.

Reference applications

Hydrocivil engineering, offshore industry, iron foundries and steel works, heavy machinery, cranes and conveyors, deep and open cast mining machinery, construction and earth-moving machinery, etc.

Basic designs (excerpt)



Material properties

deva.glide	
Properties	Value
Max. permitted static load (\bar{p}) – [MPa]	340
Max. permitted dynamic load (\bar{p}) – [MPa]	180
Max. sliding speed (U) – [m/s]	0.4
Max. $\bar{p}U$ -value – [MPa × m/s]	1.5
Friction coefficient – [μ]	0.10 to 0.15
Temperature range – [°C]	-100 to +250
Tolerances	Value
Housing bore	H7
Bearing outer \varnothing	r6/s6
Bearing inner \varnothing	E7 for H9 after inst.
Shaft \varnothing	c8/d8
Counter material hardness	> 180HB
Shaft surface finish	R _a 0.2 to 0.8 μ m

Tolerances

Other tolerances are possible, provided that a safe fit in the housing and the necessary running clearance are maintained.

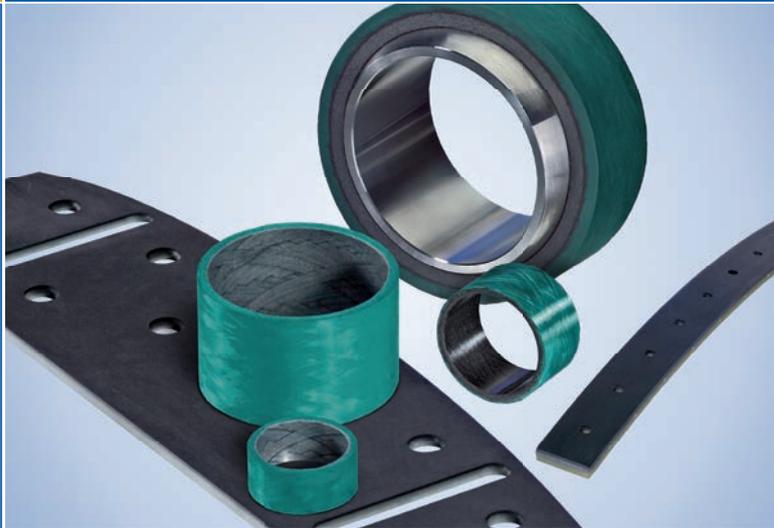
Installation

Press-fit installation or supercooling.

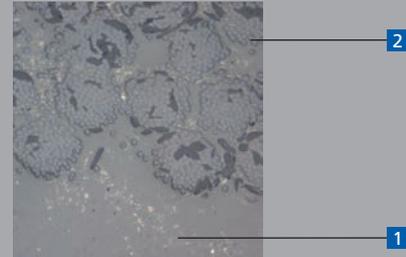
deva.tex[®]

High performance material –
PTFE sliding layer on glass-fibre reinforced
carrying layer

maintenance-free



Microsection deva.tex 552



- 1 Wound glass-fibre embedded in a high temperature epoxy resin matrix
- 2 Sliding layer: High-strength, wound fibres with solid lubricant embedded in a high temperature epoxy resin matrix

Where to use

deva.tex is a high performance self-lubricating sliding material with a glass-fibre reinforced backing layer. The machinable sliding layer consists of fibres which are embedded in epoxy resin. The resin carries PTFE as lubricant for excellent tribological performance.

deva.tex bearings are available in standard dimensions up to 200 mm according to DIN 4379 and are characterized by a very high corrosion and wear resistance. They are insensitive to contamination as well as to vibrations and shock loads. Custom dimensions are also available due to the machinable inner and outer layer.

Reference applications

Water turbines, hydrocivil engineering, agricultural machines, earth moving equipment, railroad vehicles, shut-off valves, chemical industry, apparatus engineering, wind turbines, etc.

Basic designs (excerpt)



Material properties

deva.tex		
Properties	Sliding plate	Bushing
Max. permitted static load (\bar{p}) – [MPa]	150	230
Max. permitted dynamic load (\bar{p}) – [MPa]	75	140
Max. sliding speed (U) – [m/s]	0.1	0.2
Max. $\bar{p}U$ -value – [MPa × m/s]	1.2	1.5
Friction coefficient – [μ]	0.06 to 0.25	0.03 to 0.12
Temperature range – [°C]	-40 to +130	-40 to +160
Tolerances	Sliding plate	Bushing
Housing bore	–	H7
Bearing inner \emptyset	–	H8/D11 after inst.
Shaft \emptyset	–	e7 or d7 / h8
Counter material hardness	> 180HB	> 180HB
Shaft surface finish	R _a 0.4 to 1.0 μ m	R _a 0.4 to 1.0 μ m

Tolerances

As the outer and inner diameters are machinable, other tolerances are possible.

Installation

Press-fit installation. Supercooling in liquid nitrogen possible for inner diameters above 150 mm.

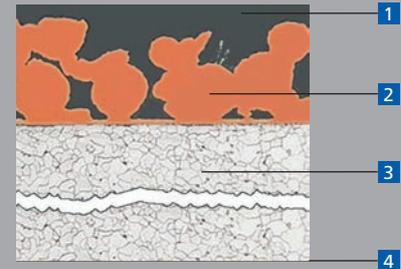
GLYCODUR® F

High performance material –
Dry-running material with PTFE sliding layer

maintenance-free



Microsection GLYCODUR F



- 1 Polytetrafluorethylene (PTFE)
- 2 Tin bronze
- 3 Sheet steel layer
- 4 Tin layer

Where to use

GLYCODUR F sliding bearings consist of a 0.2 to 0.4 mm porous tin bronze layer sintered onto a copper plated steel base. The pores of this layer are filled during a rolling process with PTFE and other friction and wear reducing additives. A 5 to 30 μm top layer made of the same material forms the running-in layer.

GLYCODUR F sliding bearings combine the mechanical properties of the sintered bronze with the sliding and lubrication properties of a PTFE mixture.

The structure of this composite material results in good dimensional stability and good thermal conductivity.

Reference applications

General dry running applications, shock absorbers, hydraulics, pneumatic cylinders, medical equipment, textile machines, agricultural machinery, office applications, etc.

Basic designs (excerpt)



Material properties

GLYCODUR F	
Properties	Value
Max. permitted static load (\bar{p}) – [MPa]	250
Max. permitted dynamic load (\bar{p}) – [MPa]	80
Max. sliding speed (U) – [m/s]	2
Max. $\bar{p}U$ -value – [MPa \times m/s]	on request
Friction coefficient – [μ]	0.03 to 0.25
Temperature range – [°C]	-200 to +260
Tolerances	Value
Housing bore	H7
Bearing outer \varnothing	see catalogue
Bearing inner \varnothing	see catalogue
Shaft \varnothing	f7 \leq 75; h8 > 75
Counter material hardness	> 50HRC
Shaft surface finish	$R_a \leq 0.3 \mu\text{m}$

Tolerances

For tolerances please refer to the GLYCODUR catalogue.

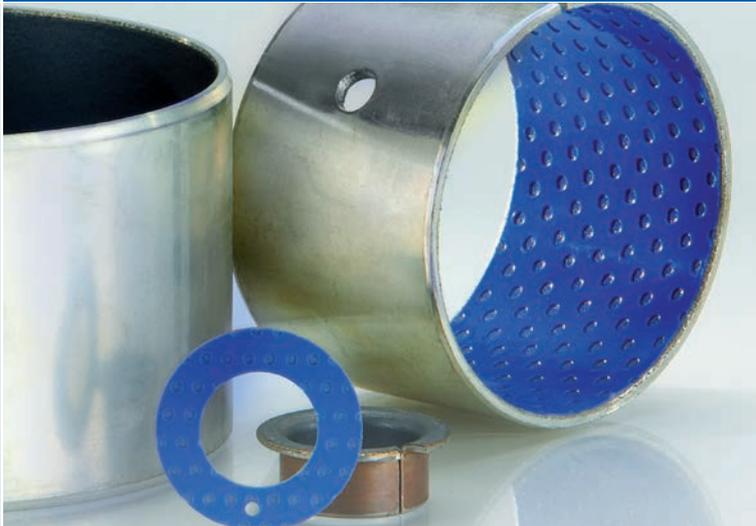
Installation

Installation by press-fitting or gluing. For details see GLYCODUR catalogue.

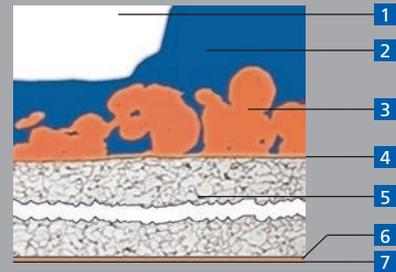
GLYCODUR® A

High performance material –
POM sliding layer with lubrication pockets

marginal maintenance



Microsection GLYCODUR A



- 1 Polyoxymethylene (POM)
- 2 Lubrication indentation
- 3 Tin bronze
- 4 Copper layer
- 5 Sheet steel backing
- 6 Copper layer
- 7 Tin layer

Where to use

GLYCODUR A dry sliding bearings have a copper-plated steel base and a 0.2 to 0.4 mm sintered tin bronze layer. The major characteristic of these bearings is the POM top layer on the sintered bronze. This surface layer has a thickness of 0.3 mm and features pockets for lubricant. GLYCODUR A bearings are insensitive to misalignment and subsequent edge load.

GLYCODUR AB sliding bearings have a similar composition to GLYCODUR A sliding bearings, but they have a 0.35 mm top layer made of POM. This allows final machining of the sliding surface on installed bushings by boring or turning, or in exceptional cases by rubbing, in order to eliminate possible misalignments, or to achieve small operating clearance.

Reference applications

With oil or grease lubrication such as slowly rotating gears or aligning movements.

Basic designs (excerpt)



Material properties

GLYCODUR A	
Properties	Value
Max. permitted static load (\bar{p}) – [MPa]	250
Max. permitted dynamic load (\bar{p}) – [MPa]	120
Max. sliding speed (U) – [m/s]	2.5
Max. $\bar{p}U$ -value – [MPa × m/s]	on request
Friction coefficient – [μ]	0.02 to 0.2
Temperature range – [°C]	-40 to +110
Tolerances	Value
Housing bore	H7
Bearing outer \varnothing	see catalogue
Bearing inner \varnothing	see catalogue
Shaft \varnothing	h8
Counter material hardness	> 50HRC
Shaft surface finish	$R_a \leq 0.3 \mu\text{m}$

Tolerances

As the outer and inner diameters are machinable, other tolerances are possible.

Installation

Press-fit installation. Supercooling in liquid nitrogen possible for inner diameters above 150 mm.

DEVA® Engineering



It is not just the design of the bearing that must be right for the application; the specification of the requirement must be precise and appropriate as well. Our engineering team is available to help at all stages, from the very first discussion of bearing integration and characteristics through to the final assembly and testing, to ensure that the finished product provides you with the very best performance and durability.

Our specialists are constantly learning, honing their expertise and building on decades of experience. But a long heritage of excellence doesn't mean that our approach is not thoroughly up-to-date and constantly evolving as technologies and requirements develop. At DEVA, rigorous training, attendance at technical conferences, participation in international organisations and many other prestigious

and educational activities keep our team at the cutting edge of world-class technology and delivery.

This considerable expertise is supported by state-of-the-art design and validation processes, allowing solutions to be designed, developed and proven in the minimum timescales, with maximum robustness, while providing our customers with the data they need.

For challenging tribological and demanding usage conditions, our years of technical expertise becomes even more valuable for your applications. When applied alongside the wide range of unique, highly flexible DEVA materials, the result is the best possible solution for any plain-bearing application, however challenging the requirement.

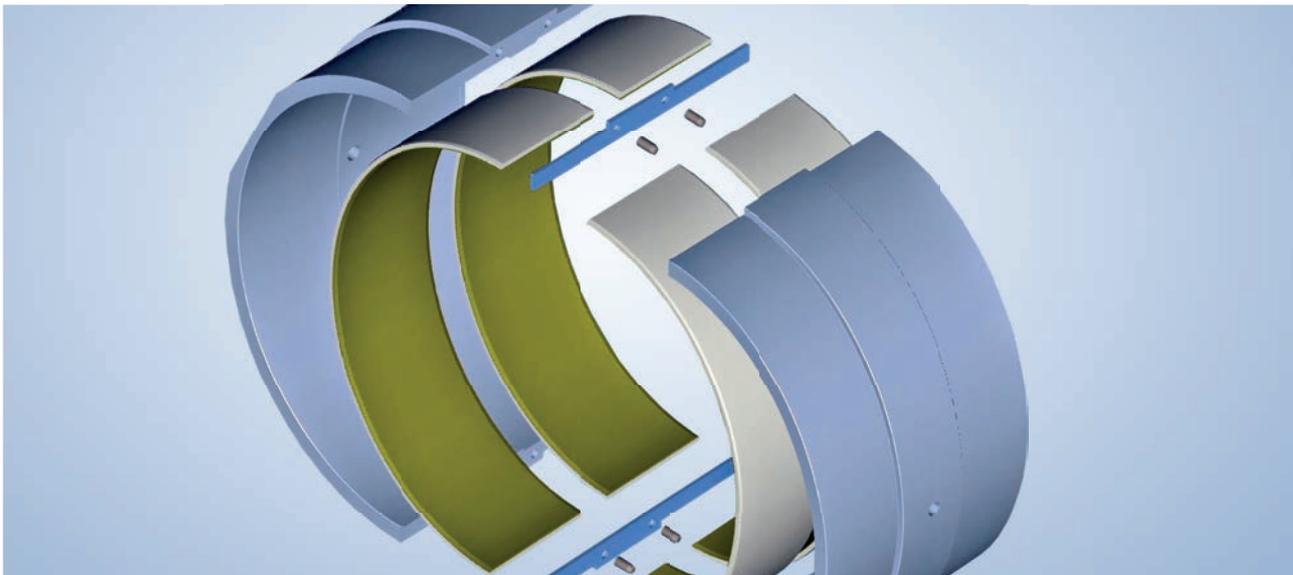
DEVA Engineering



Technology Group Know-How

As part a multinational technology group, DEVA® has access to specialist expertise and resources from sister businesses that also have bearings expertise, or expertise in complementary sectors. Our close partnership with colleagues at GLYCODUR®, for example, brings technology transfer that is of great value to our customers, as well as product ranges that extend the range of solutions that we can offer.

Although part of a larger organisation, with the many benefits that brings, DEVA has retained its operational independence, allowing us to stay highly responsive to our customers' needs. Our team is fast and flexible, delivering the right solution within the timescales you need.



Systematic innovation

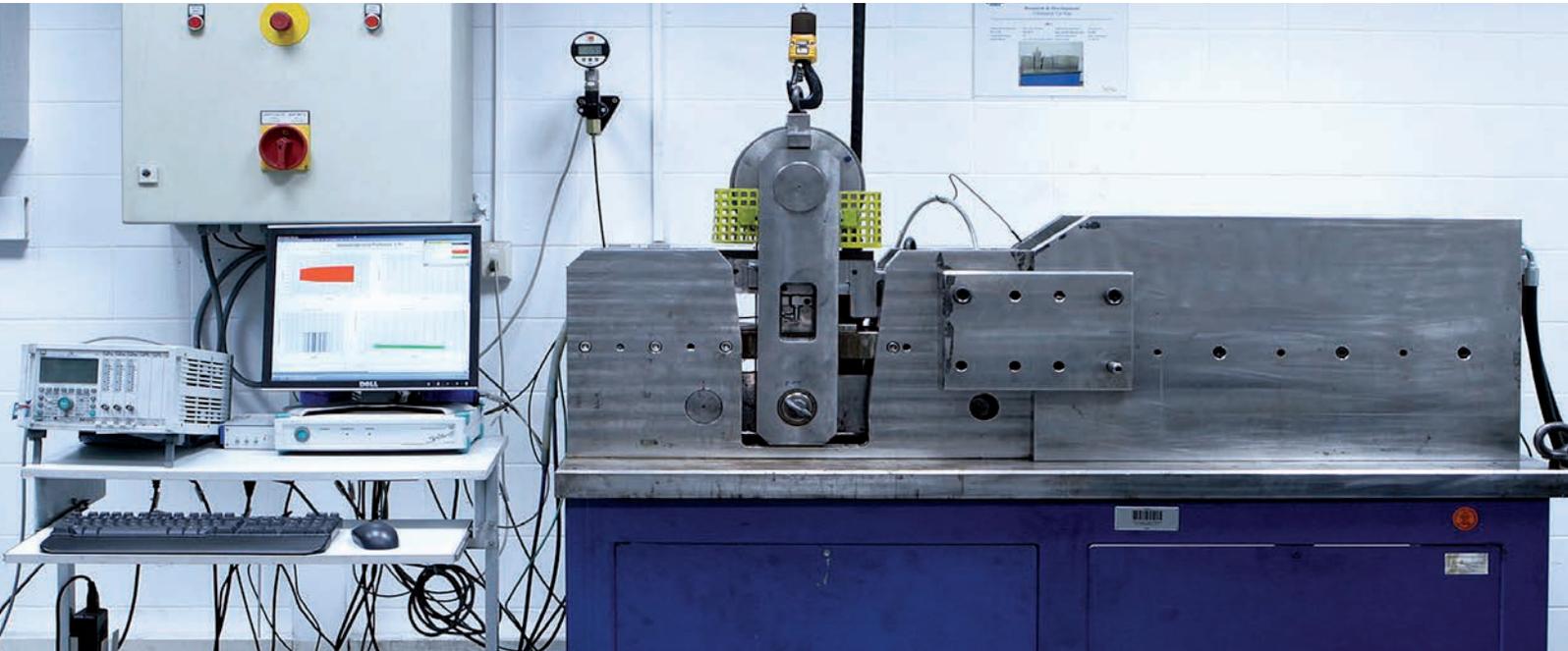
Consistency and accountability are paramount. That's why we operate a rigorous management system focussed on product, process and system quality, working within the requirements laid down by the DIN ISO 9001:2000, DIN EN ISO 14001 and ISO/TS 16949:2002.

It isn't just design and manufacture that is carefully controlled; our extensive test programmes are also managed to the same very high standards to ensure accurate, robust data that guarantees the quality and integrity of every specially-perfected DEVA® plain bearing solution.

DEVA product test benches



Bearing tests and inspections geared to customer projects



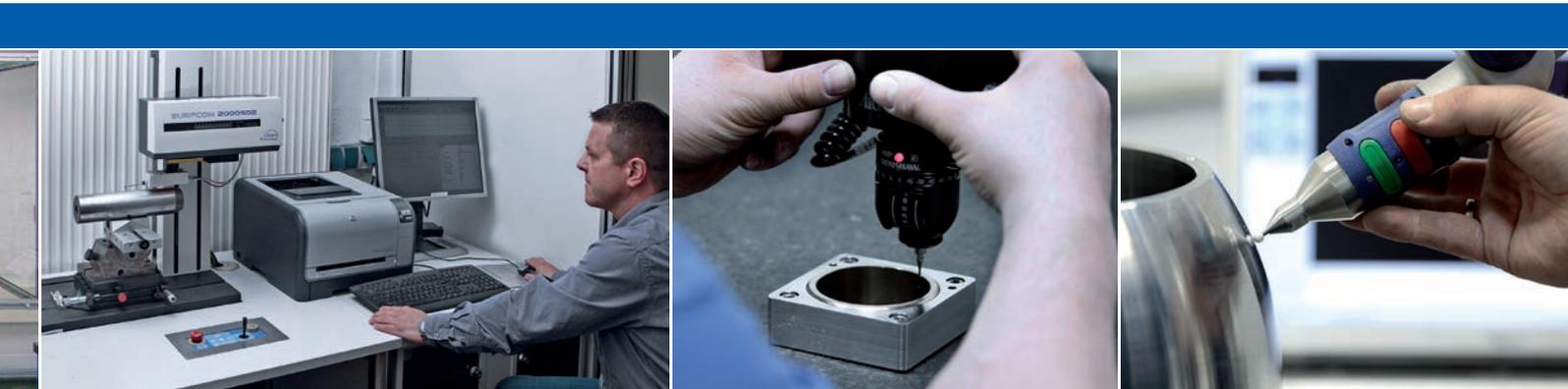
For all types of applications, our development team is ready to assist our customers by jointly developing an optimised programme of simulations and inspections that are tailored to the project. This may include:

- Project-related advice
- Service life calculations based on standard tests or
- Project-related abrasion and wear tests on our test benches
- Tribosystem analyses
- Development and optimization of tribosystems
- Material tests and analyses

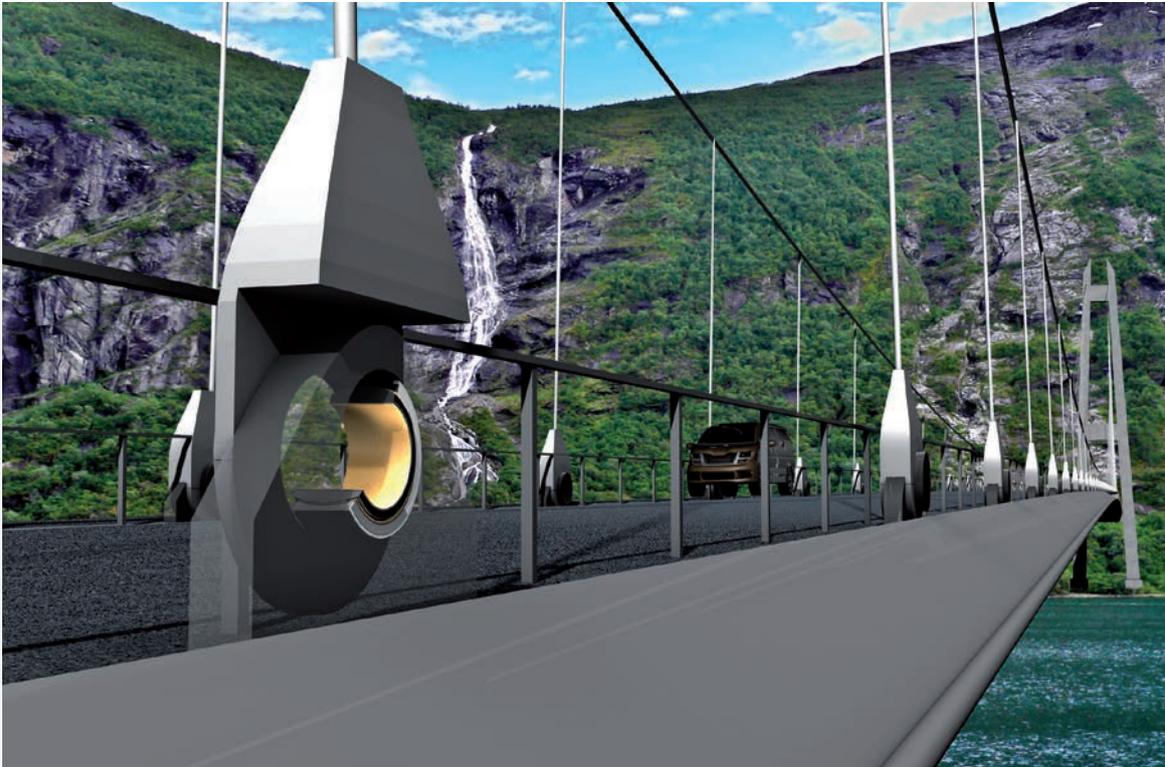
- Two tribo test benches for abrasion tests on plate-type bearings involving linear-oscillating movement
- A digital microscope
- A scanning electron microscope
- DMA (dynamic-mechanical analysis)
- DIL (dilatometer)
- DSC (differential scanning calorimetry)
- One stationary and one transportable surface roughness tester
- One stationary and one transportable hardness tester
- Compression and tensile testing machine
- Chemical lab for metallographic and chemical analyses

Our well-equipped, modern laboratories provide a wide range of test procedures, including:

- Three tribo test benches for abrasion tests on sleeves involving angular movement
- Two tribo test benches for abrasion tests on sleeves involving rotational movement



Deva engineering solutions – example: Hardanger Suspension Bridge



The challenge

The first element of the complex challenge confronting the bridge over the Hardangerfjord is the great loads that have to be cushioned by the special design of the suspension bridge, combined with the vibrations caused by the traffic passing over the bridge. The latter leads to micro-movements at the bearing points, which is why rolling-contact bearings are unsuitable for such applications. This challenge is compounded by the pressures from frequently high wind velocities in this demanding location.

The engineering solution

DEVA® developed a bespoke solution, tailored to these demanding requirements. The unique design specified the use of 120 spherical bearings with a pin diameter of 160 mm, with eight spherical plain bearings with a 300 mm pin diameter for the main retention cables, directly adjacent to the two bridge towers. All the joint balls are made of stainless steel, into which a deva.bm plain bearing is pressed. A two-component spherical ring forms the bearing cartridge, which is also lined with deva.bm®. The thrust washers, designed to absorb axial forces, are made of deva.metal®.



deva.bm® spherical bearing - floating bearing version

Customized design

The combination of specialist sliding and backing materials fulfils not only the specific performance requirements of this challenging application; it also meets the very high requirements for fail-safe operation. Should the sliding layers be damaged or completely destroyed due to loads exceeding the values specified, the structure of the swivel bearing and its functionality will still be maintained in a reduced form.

Deva engineering solutions – Example: Deepwater Pipeline S-Lay System



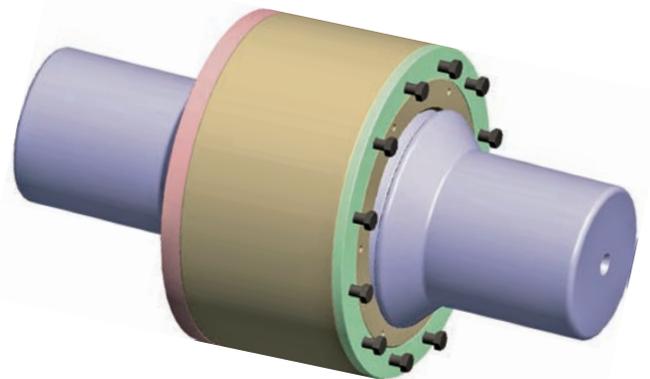
The challenge

2013 saw the launch of a project designed to develop a self-lubricating swivel bearing for the heavy lift and pipe-lay vessel “Derrick Lay Vessel 2000”, which was brought into service in 2016 by McDermott International Inc... Our design team worked closely with the customer to develop an innovative bearing design that would allow the “stinger” to be undocked from the vessel’s stern for pipe laying operations. The 100 m long stinger enables pipes with diameters from 11 to 150 cm to be laid in waters of great depth.

This vessel is a major supplement to the McDermott fleet and is particularly suitable for installation, maintenance and decommissioning projects in offshore fields.

The engineering solution

The two specially-developed swivel bearings, based on the deva.glide® material series, have an outer diameter of 1,270 mm, an overall length of 2,300 mm and weigh 11 tonnes. This makes these plain bearings the heaviest that have been manufactured and put into operation in DEVA®’s history to date.



Customized design

This project relied not only on our comprehensive know-how but also on our ability to manage complex assignments. The exceptionally demanding requirements lead to the specification of deva.glide as this advanced material will maintain its basic characteristics even in the extreme offshore conditions under which the DLV2000 is deployed. The fact that this material can withstand great stresses and is maintenance-free was the basic prerequisite for its use in this project.

100% quality – for all products and production stages



Process reliability is something we have guaranteed for many years, based on systematic quality management and our employees' everyday concern for high standards. The range of certificates and customer awards received by DEVA® is evidence of the team's success in maintaining these consistently very high levels of quality. These certificates can be downloaded directly from our website: www.deva.de/de/zertifikate (certificates).

We also offer a means of inspecting your materials audit certificates online. After entering the following data: "order number", "order item" and "certificate registration number", as printed on your certificate, you will automatically receive the inspection results

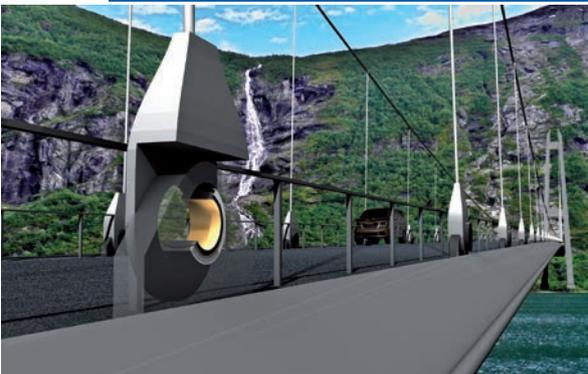


Quality and service extends to our customers' premises



Large bearings, in particular, require a great deal of experience if they are to be installed without any problems. To ensure this is achieved every time, we offer on-site support from our highly-experienced engineers. Depending on your requirements and the order you place, our specialists will install the bearings for you, train your own staff or provide installation assistance. Our team is at your service – worldwide – to provide:

- Customer-oriented project management
- Assistance in installing or removing bearings
- Training courses relating to the installation of bearings



Proximity to your application



With 40 branch offices worldwide, the DEVA® service network provides access to our expertise and resources close to where our customers need it. Through this network, our highly-qualified specialists provide advice in all matters relating to plain bearings, from the selection of materials to inspections and on-going care. And, of course, we are also pleased to provide training that will give our customers' staff the skills they need to implement and operate sophisticated plain bearing applications.

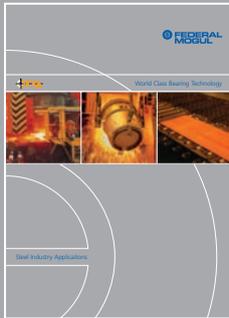
You can explore DEVA's materials systems and learn more about their application by visiting our website – www.deva.de – which can be read in any of eight

languages. Additional information is available in our manual, which can be ordered or downloaded from the website.

If you would like information and advice specific to your project, we have a carefully constructed form that steps through the gathering of information needed to determine the optimum solution. For standard components, we can deliver from our warehouse within 24 hours of an order being placed.



Portfolio



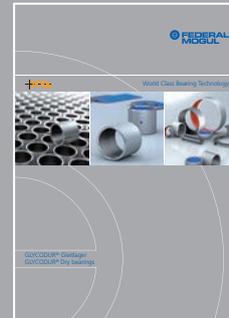
DEVA in the Steel Industry



DEVA in Marine/Offshore

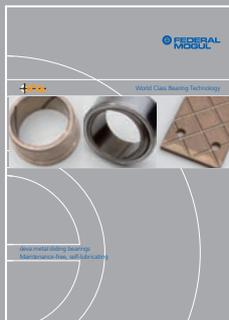


DEVA in Heavy-duty



GLYCODUR® Dry Bearings

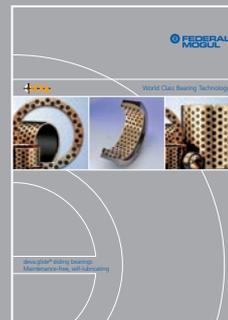
Industry Solutions



deva.metal®



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deva.tex®



Spherical Bearings

Product Information

Disclaimer

The present technical documentation has been prepared with care and all the information verified for its correctness. No liability, however, can be accepted for any incorrect or incomplete information. The data given in the documentation are intended as an aid for assessing the suitability of the material. They are derived from our own research as well as generally accessible publications.

The sliding friction and wear values stated by us or appearing in catalogues and other technical documentation do not constitute a guarantee of the specified properties. They have been determined in our test facilities under conditions that do not necessarily reflect the actual application of our products and their service environment or permit comprehensive simulation in relation to them.

We provide guarantees only after written agreement of the test procedures and parameters and of all the relevant characteristics which the product is required to have.

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