Technical manual

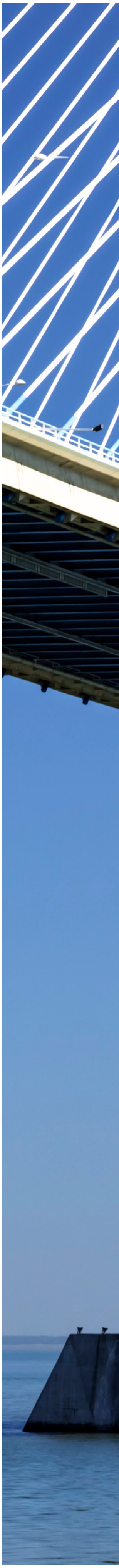
deva.tex®

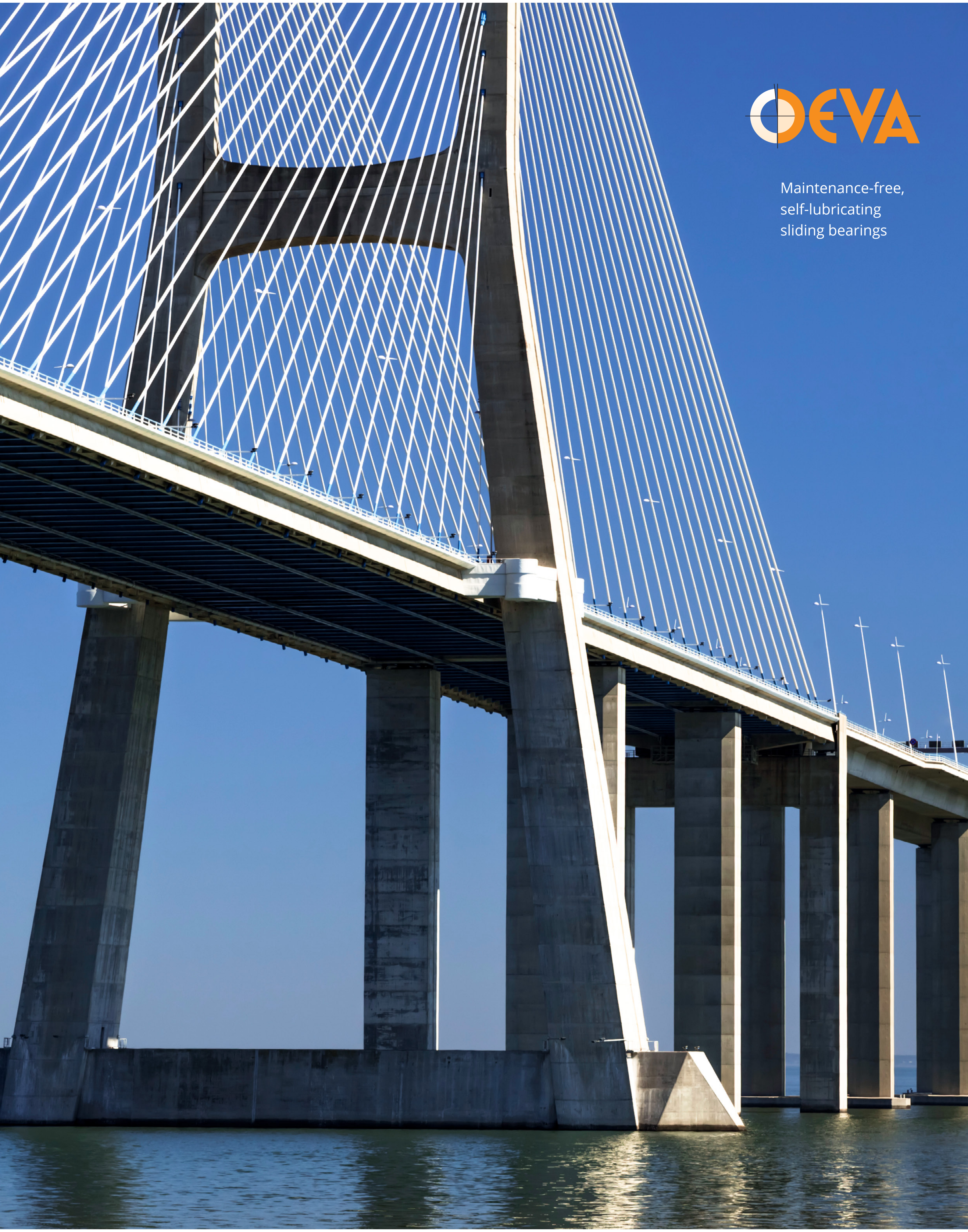
TENNECO

Your challenges are our fascination.

Self-lubricating fiber composite sliding bearings
Contemporary designs pose major challenges for modern sliding materials. Maintenance-free operation is often expected even under difficult operating conditions with extremely high loads.

Constant cost pressure forces increasing availability of machines and systems, even though no restrictions can be accepted with regard to their reliability. With maintenance-free, self-lubricating high-performance sliding materials from the DEVA® product range, it is now possible to implement sliding bearing concepts that operate reliably over long periods of time.




Maintenance-free,
self-lubricating
sliding bearings

A long service life is our standard for your application.

deva.tex® materials are suitable for applications with high, long-lasting static and dynamic loads, at relatively low sliding speeds in any direction of movement. They are also suitable for use where conventional lubrication is not possible or where other resistance requirements exist, e.g., wear, specific operating and environmental influences, impact stress, edge pressure, vibrations, etc..

Typical applications for deva.tex® fiber composite sliding bearings can be found in these industries:

- Hydro-Civil engineering
- Bridges and steel construction
- Mechanical engineering
- Injection molding and tire molding
- Food and packaging machines
- Shipbuilding and offshore industry
- Onshore and offshore wind turbines
- Railway vehicles
- Agricultural and construction machines

Technical manual deva.tex®

Table of Contents

deva.tex® sliding bearings

Material properties

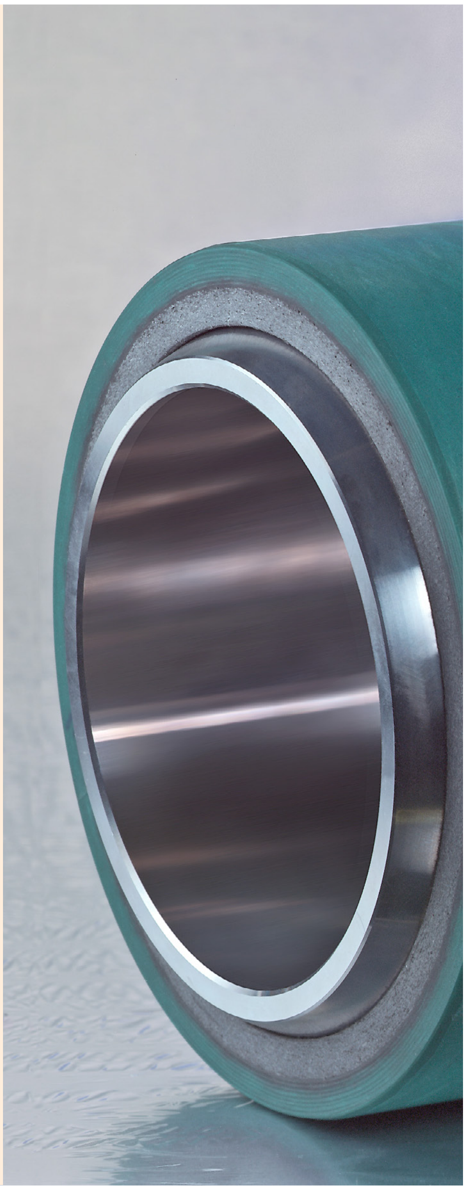
Maintenance-free and self-lubricating high-performance sliding material
All deva.tex® materials consist of a highly dimensional and temperature stable epoxy resin with fillers and additional fiber reinforcement. Depending on the grade, deva.tex® is either a single-layer material as a pure sliding material or a two-layer material consisting of a sliding layer and a strength-optimized load-bearing layer.

The composition of the individual material grade determines its physical, mechanical and chemical properties and is therefore the basis for the selection of materials for a specific application.

A total of 7 material grades are available to choose from according to the application requirements.

Performance promise Our deva.tex®

- Enables maintenance-free operation without lubrication
- Has a high static and dynamic load capacity
- Has good sliding properties with a negligible stick-slip effect
- Has very good edge load properties
- Can be used in corrosive environments
- Does not swell in water and is therefore well suited for use in seawater and many industrial fluids where high dimensional stability is required
- Is usable for translational, rotational and oscillating movements with cylindrical guidance or for plain surface applications (Movements can occur individually or in combination)
- Can be used in dusty environments
- Is applied where conventional lubrication is not possible



deva.tex® sliding bearings

Sliding bearing materials

Fiber-reinforced epoxy resin matrix with homogeneous solid lubricant incorporation

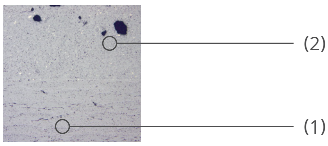
The various deva.tex® materials are differentiated by the selected raw materials, the manufacturing process and the associated material structure. The fillers in the resin matrix as well as the fiber reinforcements in the sliding layer serve to optimize the tribological properties in order to minimize friction and wear. The glass-fiber reinforced backing layer provides highest material strength for the two-layer materials.

2.1 Microstructure and texture

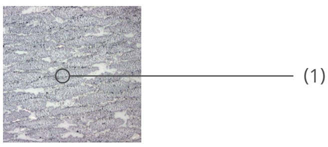
The manufacturing process as well as the selection of the ingredients determine the micro- and macrostructure of the deva.tex® materials. This results in 4 basic structures and in a total of 7 deva.tex® materials by varying the additives and raw materials.

The 4 deva.tex® microstructures

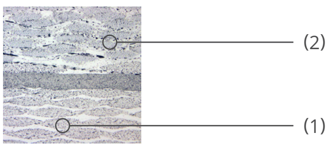
Combined cast and laminate structure
(1) The backing layer consists of a glass fiber fabric embedded in a high-temperature epoxy resin
(2) The sliding layer consists of a special epoxy resin with embedded solid lubricants



One-layer laminate structure
(1) The material consists of a special synthetic fabric, embedded in epoxy resin with solid lubricants



Two-layer laminate structure
(1) The backing layer consists of a glass fiber fabric embedded in a high-temperature epoxy resin
(2) The sliding layer consists of a special synthetic fabric embedded in epoxy resin with solid lubricants



Two-layer filament structure
(1) The backing layer consists of continuously wound glass fibers embedded in a high-temperature epoxy resin
(2) The sliding layer consists of special, continuously wound, high-strength and tribologically optimized synthetic fibers embedded in a high-temperature epoxy resin with solid lubricants

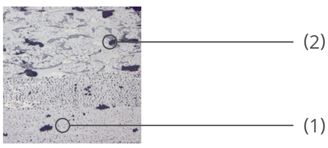


Figure 2.1.1

2.2 Surface condition

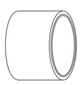
Due to the fiber structure, it is not possible to provide surface roughness data in accordance with DIN 4768 or DIN 4771. Details on our drawings are for orientation only, but are not guaranteed values. The surfaces can vary within a product, depending on the selected tolerance design. Bushings with standard tolerance D11 are unmachined and have a smoother surface than machined precision bearings.

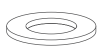
2.3 Overview of deva.tex® materials

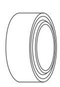
You can find detailed material properties including Young's modulus, chemical resistance, etc. in our material data sheets available on request.

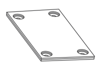
deva.tex®	Macrostructure	Max. permissible stat. load $\bar{p}_{stat/max}$ | [MPa]	Max. permissible dyn. load $\bar{p}_{dyn/max}$ | [MPa]	Max. Sliding speed (dry) U_{max} | [m/s]	Max. pU value (dry) pU_{max} | [MPa × m/s]	Application temperature range T | [°C]	Friction coefficient depending on Operating conditions (dry) μ	Friction coefficient depending on Operating conditions (water) μ	Minimum hardness of mating material [HB]	Recommended surface roughness of mating material Ra | [µm]	Operating conditions and special features	Available designs
532	Sliding plates of combined cast and laminated structure 	100	60	0.1	0.9	−40 to 75	0.03 to 0.15	0.05 to 0.16	180	0.4 to 1.0	• General for dry running and water lubricated applications	(b) (d) (e)
541	One-layer laminate structure 	150 [a] 150 [b] [d–f] 150 [c]	90 [a] 75 [b] [d–f] 80 [c]	0.1	1.2	−60 to 100	0.05 to 0.18	0.08 to 0.20	180	0.4 to 1.0	• General for dry running and water lubricated applications • Tested according to DIN EN 45545-2:2016-02 (R23) (fire protection in rail vehicles)	(a) (b) (c) (d) (e) (g)
542	Two-layer laminate structure 	200 [a] 150 [b] [d–f] 140 [c]	100 [a] 75 [b] [d–f] 80 [c]	0.1	1.2	−60 to 100	0.05 to 0.18	0.08 to 0.20	180	0.4 to 1.0	• General for dry running and water lubricated applications	(a) (b) (c) (d) (e) (f)
544	Two-layer laminate structure 	200 [a] 150 [b] [d–f] 140 [c]	100 [a] 75 [b] [d–f] 80 [c]	0.1	1.2	−60 to 100	0.05 to 0.18	0.08 to 0.20	180	0.4 to 1.0	• General for dry running • Tested according to DIN EN 45545-2:2016-02 (R23) (fire protection in rail vehicles)	(a) (b) (c) (d) (e) (f)
545	Sliding plates two-layer laminate structure 	150	75	0.1	1.2	−60 to 80	0.06 to 0.19	–	180	0.4 to 1.0	• General for dry running • Grease lubrication permissible	(b) (d) (e) (f)

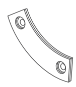
Available designs

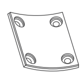
(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

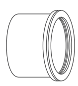
(g) 

Table 2.3.1

deva.tex®	Macrostructure	Max. permissible stat. load $\bar{p}_{stat/max}$ | **[MPa]**	Max. permissible dyn. load $\underline{p}_{stat/max}$ | **[MPa]**	Max. Sliding speed (dry) U_{max} | **[m/s]**	Max. pU value (dry) pU_{max} | **[MPa × m/s]**	Application temperature range **T** | **[°C]**	Friction coefficient depending on Operating conditions (dry) **μ**	Friction coefficient depending on Operating conditions (water) **μ**	Minimum hardness of mating material **[HB]**	Recommended surface roughness of mating material **Ra** | **[μm]**	Operating conditions and special features	Available designs
552	Two-layer filament structure 	230 [(a)] 140 [(c)]	140 [(a)] 90 [(c)]	0.2	1.5	−60 to 160	0.03 to 0.17	0.04 to 0.18	180	0.4 to 1.0	• General for dry running and water lubricated applications • DNV approved for offshore applications	(a) (c) (g)*
558	Two-layer filament structure 	230	140	0.2	1.5	−60 to 130	0.03 to 0.17	0.04 to 0.18	180	0.4 to 1.0	• General for dry running and water lubricated applications • Especially for higher quantities • Only available in standard tolerance D11 according to table 6.1.2	(a)

Available designs

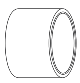
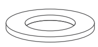
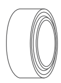
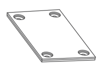
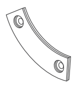
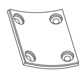
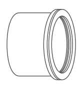
(a) 
(b) 
(c) 
(d) 
(e) 
(f) 
(g) 

Table 2.3.1

* Flange out of deva.tex® 542 by joining process

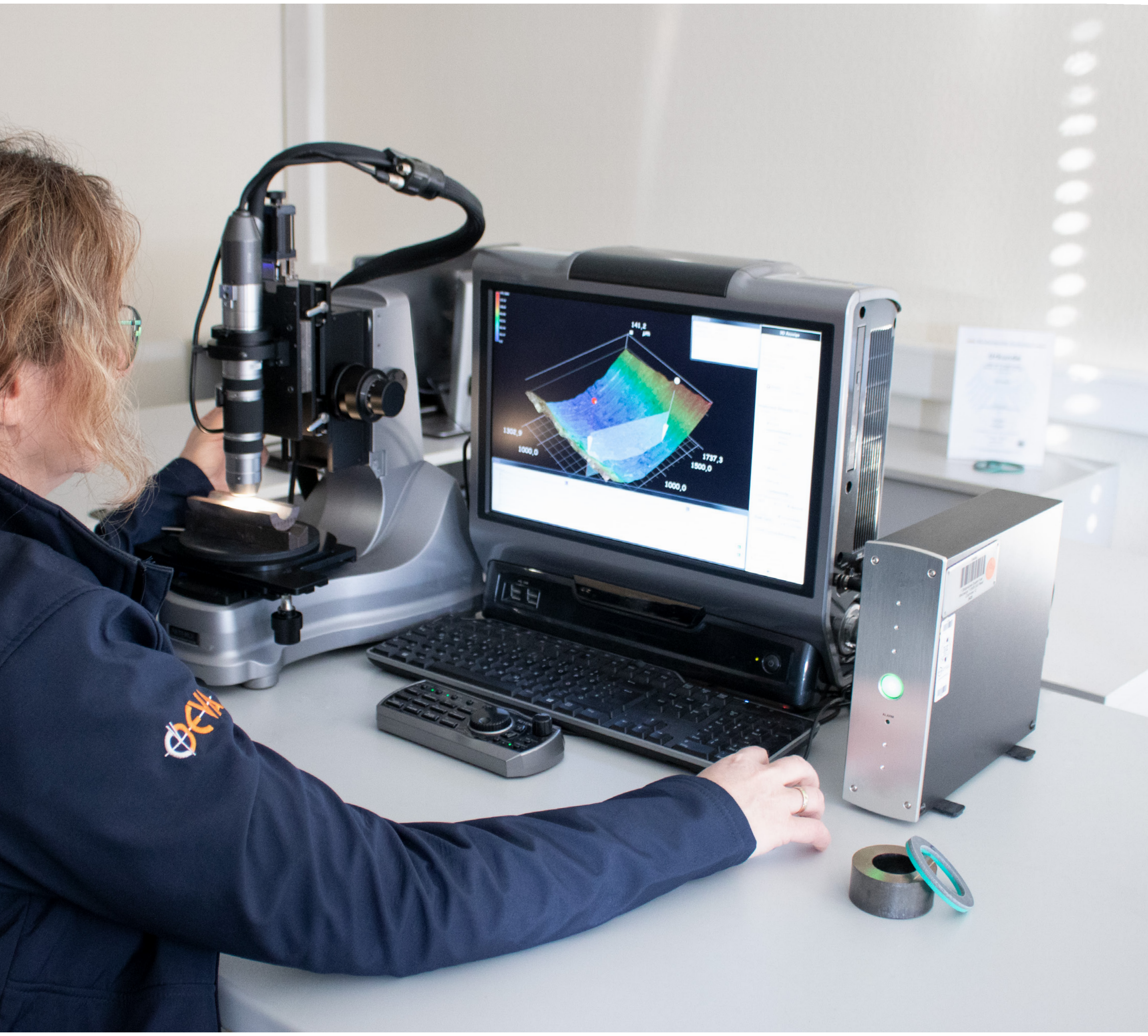
deva.tex® sliding bearings

Quality and certificates

Environmental protection and production safety

We attach great importance to qualitative, environmentally conscious and safe production. We are committed to this through the application of a variety of internationally recognized standards for quality assurance, emission control and workplace safety.

- RoHS and REACH compliant
- Certificate of origin
- Acceptance test certificates DIN EN 10204–2.1; 2.2; 3.1 and 3.2
- Certified according to ISO 9001; ISO 14001 and ISO 45001



deva.tex® sliding bearings

Load cases

The four cases of bearing load

DEVA® differentiates between four load cases. We do this to take into account the fatigue influences under dynamic load. The percentage values refer to the limit values given in the material data sheets and technical manuals.

The specifications should be understood as guide values. With alternation of loads in particular, the frequency and the number of cycles need to be considered with regard to the fatigue properties. Please contact us for a detailed analysis in a personal discussion.

Load case 0

The acting normal force is constant or can be assumed to be constant without frequent or rapid load changes or load alternations. There is no sliding movement.

Permissible limit load: 100% of the max. permissible static load according to material data sheet

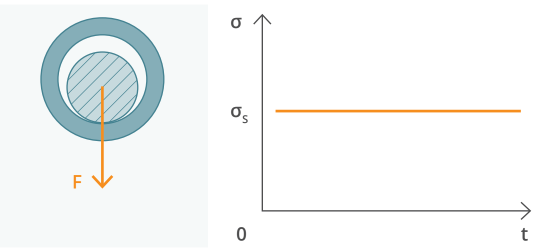


Diagram 4.1.1

Load case 1

The acting normal force changes frequently or quickly or oscillates strongly around a nominal force. There is no sliding movement.

Permissible limit load: 80% of the max. permissible static load according to material data sheet

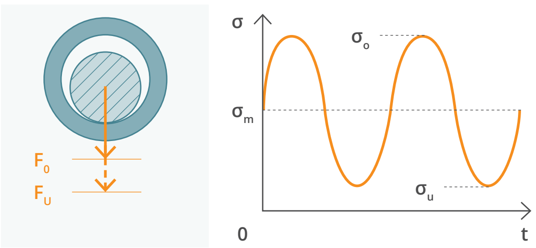


Diagram 4.1.2

Load case 2

The acting normal force is constant or can be assumed to be constant without frequent or rapid load changes or load alternations. In addition, a sliding movement takes place.

Permissible limit load: 100% of the max. permissible dynamic load according to the material data sheet

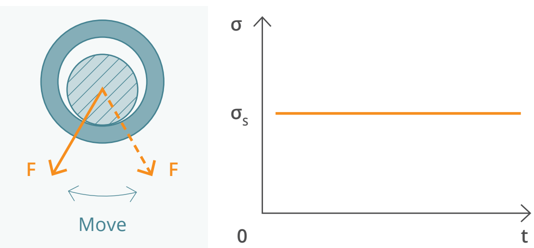


Diagram 4.1.3

Load case 3

The acting normal force changes frequently or quickly or oscillates strongly around a nominal force. In addition, a sliding movement takes place.

Permissible limit load: 100% of the max. permissible dynamic load according to the material data sheet

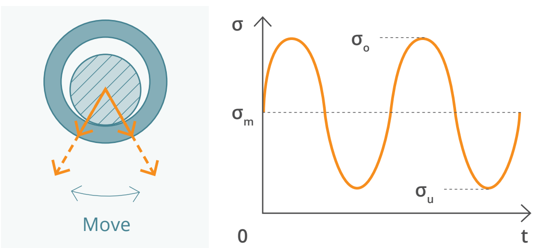


Diagram 4.1.4

deva.tex® sliding bearings

Mating materials

Roughness and surface finish

The deva.tex® sliding materials require the use of a mating material with a hardness of at least 180 HB. A hardened surface should be used in the event of abrasive particles from the environment. When using deva.tex®, the surface roughness is ideally Ra = 0.4 to 1.0 µm, produced by grinding. Depending on the operating conditions, greater surface roughness can also be accepted.

With regard to the surface finish, it is also possible to use protective sleeves with corresponding hardness. Overlay welding or other protective coatings (hard chrome-plated, electroless nickel, etc.) can also be used under certain conditions. The corrosion requirements met by the material must be determined based on the individual operating conditions.

Roughness of the mating materials

Influence of the surface roughness of the mating material on the microwear of the sliding material
(Model representation from various investigations)

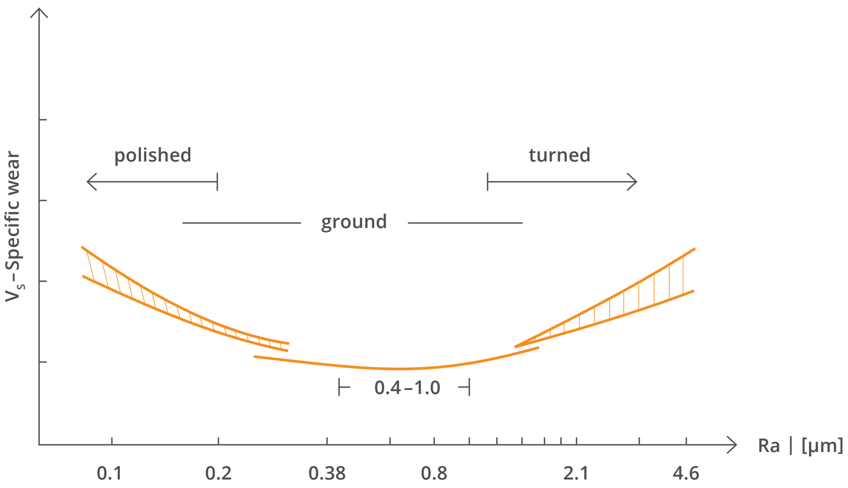


Diagram 5.1.1

Suggested materials

The following table gives an overview of some possible mating materials.

Material number	DIN designation	Comparable standards		
		USA – ANSI	GB – BS 970	F – AFNOR
Mating materials for normal applications				
1.0543	ZSt 60-2	Grade 65	55C	A60-2
1.0503	C45	1045	080M46	CC45
1.7225	42CrMo4	4140	708M40	42CD4

Table 5.1.1

Mating materials for corrosive environment

1.4021	X20Cr13	420	420S37	Z20C13
1.4057	X17CrNi-16-2	431	432S29	Z15CN16.02
1.4112	X90CrMoV18	440B	–	(Z70CV17)
1.4122	X35CrMo17	–	–	–
1.4418	X4CrNiMo16-5-1	S165M	–	Z6CND16-05-01

Table 5.1.2

Mating materials for use in seawater

1.4462	X2CrNiMoN22-5-3	UNS531803	318513	Z3CND24-08
1.4501	X2CrNiMoCuWN25-7-4	UNSS32760	–	Z3CND25.06Az
2.4856	Inconel 625	–	–	–

Table 5.1.3

deva.tex® sliding bearings

Cylindrical sliding bearings

6.1 Recommended standard dimensions

The sizes listed in the following table 6.1.2 are available in deva.tex® 541, 542, 544, 552 and 558 (deva.tex® 558 only up to D_1= 120 mm). Larger diameters, special dimensions and deviating tolerances for special applications are available on request. All bearings can be manufactured to customer specifications. Other dimensions and machining allowances for precision bearings are available on request.

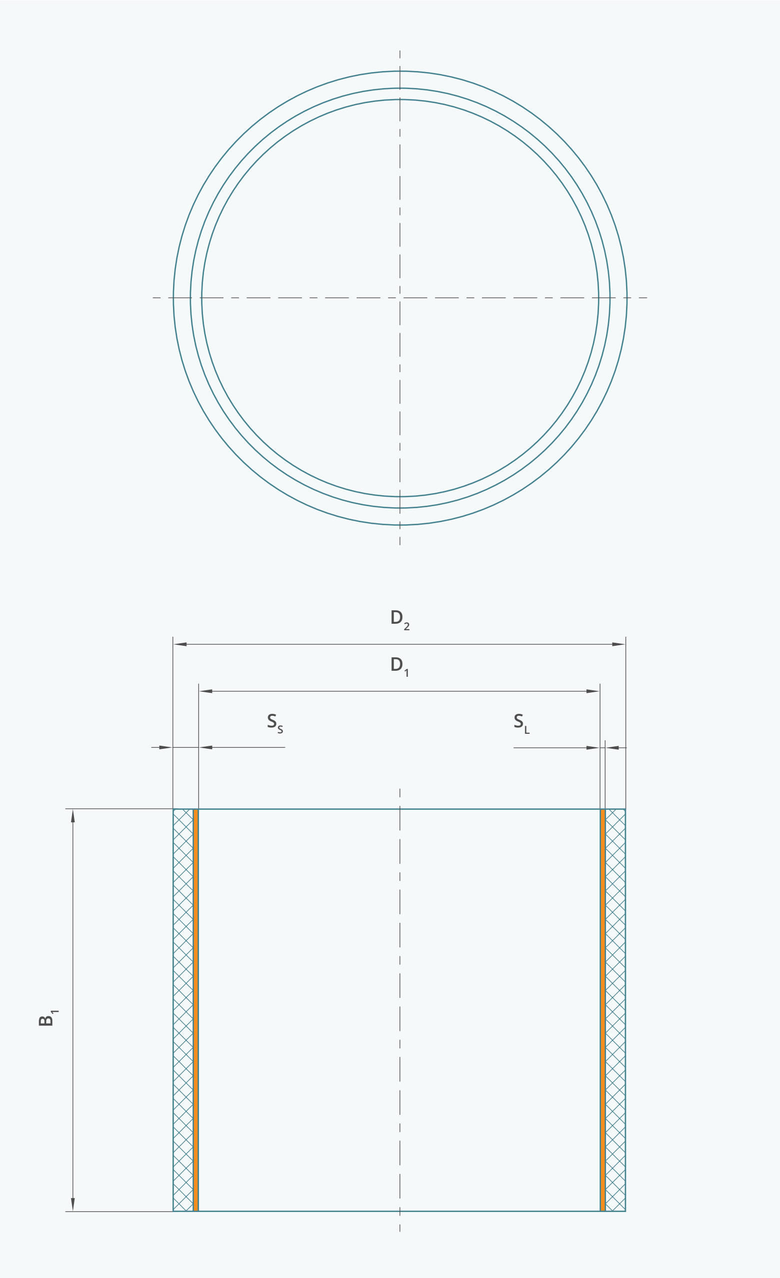


Figure 6.1.1

B_1 – Bearing width

D_1 – Inner diameter
D_2 – Outer diameter

S_S – Wall thickness
S_L – Sliding layer thickness

Standard dimensions for sliding layer thicknesses

D_1 [mm]	S_L [mm] deva.tex® 542/544/552	S_L [mm] deva.tex® 558
Standard dimensions for sliding layers		
≤ 50	0.6	0.4
≤ 100	1.0	0.7
≤ 200	1.5	1.0
≤ 300	1.75	–
≤ 400	2.0	–
≤ 500	2.5	–

Table 6.1.1

Deburring and chamfering

Deburring of the radial bearings is carried out by vibratory grinding as standard.

On request, additional mechanical processing (e.g., chamfers) can be applied to the inner and outer diameters.

deva.tex®	Nominal dimensions in mm		
	D1	D2	B1
541 / 542 / 544 / 552 / 558	16	20	15
	16	20	20
	20	24	15
	20	24	20
	20	24	25
	22	26	15
	22	26	20
	22	26	25
	25	30	20
	25	30	25
	25	30	30
	25	30	40
	28	34	20
	28	34	30
	28	34	35
	28	34	40
	30	36	25
	30	36	30
	30	36	35
	30	36	40
	35	41	30
	35	41	35
	35	41	40
	35	41	50
	40	48	20
	40	48	30
	40	48	40
	40	48	50
	45	53	35
	45	53	45
	45	53	50
	45	53	55
	45	53	60
	50	58	30
	50	58	40
	50	58	50
	50	58	60
	55	63	40
	55	63	50
	55	63	55
	55	63	70
	60	70	40
	60	70	45
	60	70	50
	60	70	60
	60	70	75
	65	75	50
	65	75	60
	65	75	65
	65	75	80

Table 6.1.2

deva.tex®	Nominal dimensions in mm		
	D1	D2	B1
541 / 542 / 544 / 552 / 558	70	80	40
	70	80	55
	70	80	70
	70	80	85
	75	85	50
	75	85	60
	75	85	75
	75	85	90
	80	90	60
	80	90	70
	80	90	80
	80	90	90
	80	90	100
	85	95	65
	85	95	85
	85	95	100
	85	95	105
	90	105	70
	90	105	80
	90	105	90
	90	105	110
	90	105	120
	95	110	75
	95	110	95
	95	110	100
	95	110	115
	100	115	80
	100	115	90
	100	115	100
	100	115	120
	100	115	130
	110	125	85
	110	125	100
	110	125	110
	110	125	120
	110	125	135
	120	135	90
	120	135	100
	120	135	120
	120	135	130
	120	135	150

Table 6.1.2

deva.tex®	Nominal dimensions in mm		
	D1	D2	B1
541 / 542 / 544 / 552	130	145	100
	130	145	120
	130	145	130
	130	145	150
	130	145	160
	140	155	100
	140	155	110
	140	155	120
	140	155	130
	140	155	140
	140	155	150
	140	155	170
	150	165	100
	150	165	120
	150	165	130
	150	165	150
	150	165	180
	160	180	120
	160	180	130
	160	180	150
	160	180	160
	160	180	180
	180	200	120
	180	200	140
	180	200	180
	180	200	200
	180	200	220
	200	220	180
	200	220	200
	220	240	(1)
	230	250	(1)
	240	260	(1)
	250	270	(1)
	260	280	(1)
	280	300	(1)
	300	330	(1)
	320	350	(1)
	330	360	(1)
	340	370	(1)
	350	380	(1)
	380	410	(1)
	400	430	(1)
	420	450	(1)
	440	480	(1)
	450	490	(1)
	480	520	(1)
	500	540	(1)

Table 6.1.2

(1) Width on request

6.2 Fits

deva.tex® sliding bearings are pressed in with interference fit between housing inside diameter and bearing outside diameter. Bearing outside, bearing inside, shafts and housing inside diameters must be manufactured within the recommended tolerances to ensure trouble-free bearing operation.

Due to the material structure, deva.tex® is elastic and, depending on the wall thickness, not dimensionally stable. The final tolerances only become apparent in the installed state. For this reason, compliance with the housing quality is of great importance. The shape accuracy and fit can only be determined exactly in a ring gauge or in installed condition.

deva.tex® flanged bushing

In the case of deva.tex® flanged sliding bearings, the transition radius between the back of the flange and the outside diameter of the radial sliding bearing must be taken into account by means of a chamfer on the housing.

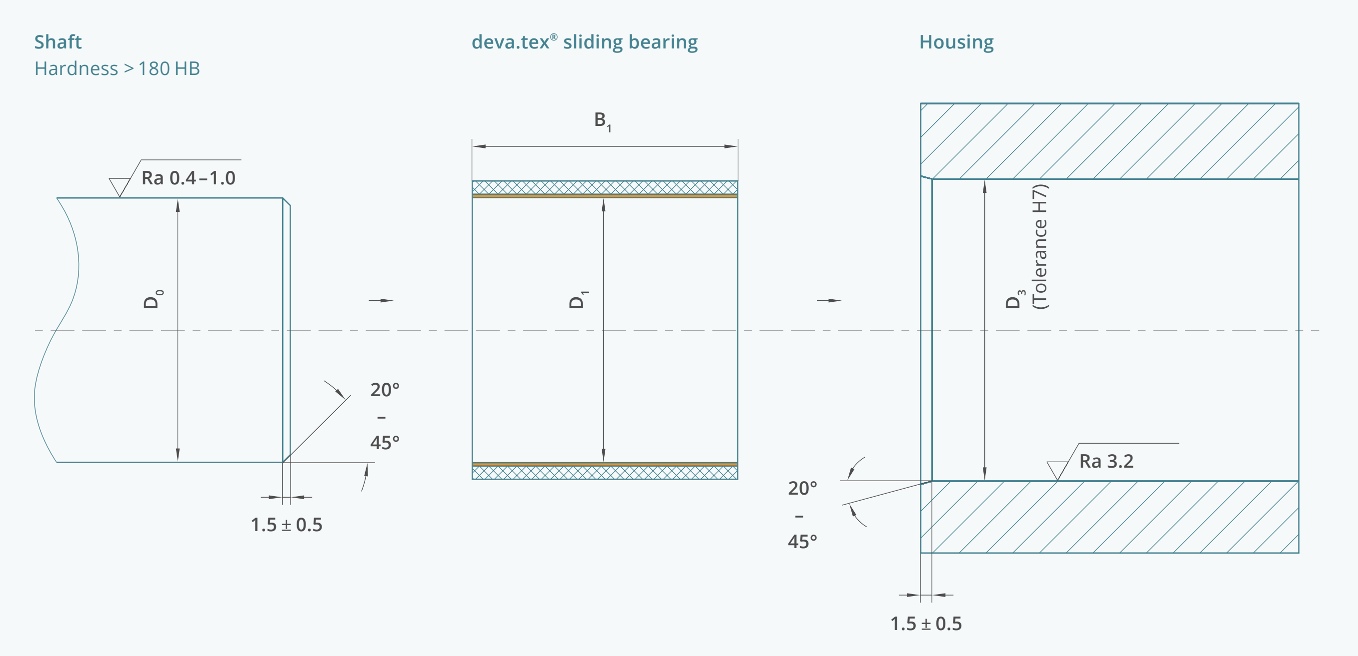


Figure 6.2.1

Bearing bore D_1 (after installation)	Shaft D_0
Standard	
D11	h8

Table 6.2.1

Bearing bore D_1 (after installation)	Shaft D_0
Precision*	
D8	h7
E8	h7
H8	d7, e7

Table 6.2.2

Bearing length B_1 [mm]	Tolerance
≤ 75	− 0.5
> 75	− 1.0

Table 6.2.3

D_3 – Housing bore
D_0 – Shaft outer diameter

* For reduced operating clearance. In case of precision bushes, the sliding surface is machined. Adaptation of the bearing tolerances to deviating shaft tolerances is possible on request

6.3 Special dimensions and fits

In addition to the standard dimensions, customer-specific sliding bearings are also available. In this case dimensions, tolerances, fits and also shape (additional chamfers or recesses) can be adapted. Some recommendations have to be considered for the design. The limitation of the max. possible sliding layer thickness depends in particular on the ratio of sliding layer to backing layer.

We will be pleased to assist you with the dimensioning of your sliding bearing. Please do not hesitate to contact us. You will find your direct contact on our homepage.

Special dimensions – possible sliding layer thicknesses

D_1 [mm]	S_L [mm]
≤ 50	max. 1.5
≤ 100	max. 2.5
≤ 200	max. 3.0
≤ 300	max. 3.5
≤ 500	max. 5.0

Table 6.3.1

Recommendation for minimum wall thickness

Wall thickness = $D_1 \times 0.03 + 0.8$

Machining allowance for high precision bearings

High precision bearings with ID tolerance class IT7 or better must be finish machined in the installed condition. In this case, deva.tex® can be supplied with machining allowance.

6.4 Installation by means of press-fitting

Press-fit is a universally applicable installation method for deva.tex® bushings. deva.tex® radial cylindrical sliding bearings can be mounted with a screw press or a hydraulic press. It is important to ensure that the mounting force is applied centrically. See figure below; installation by press-fitting. As mounting support, it is recommended to use a press-in mandrel.

Installation using an impact tool (hammer) is not permissible, as this can lead to damage to the sliding bearing.

Press-in tools

- Light oiling of the housing bore supports the installation and protects the components from seizure.
- Insert the press-in mandrel into the bushing and position it on the housing bore.
- The force must be applied evenly to the plain bearing via the press-fit mandrel in order to avoid tilting.

We would be pleased to provide you with further information and documentation related to sliding bearing installation. Please contact us!

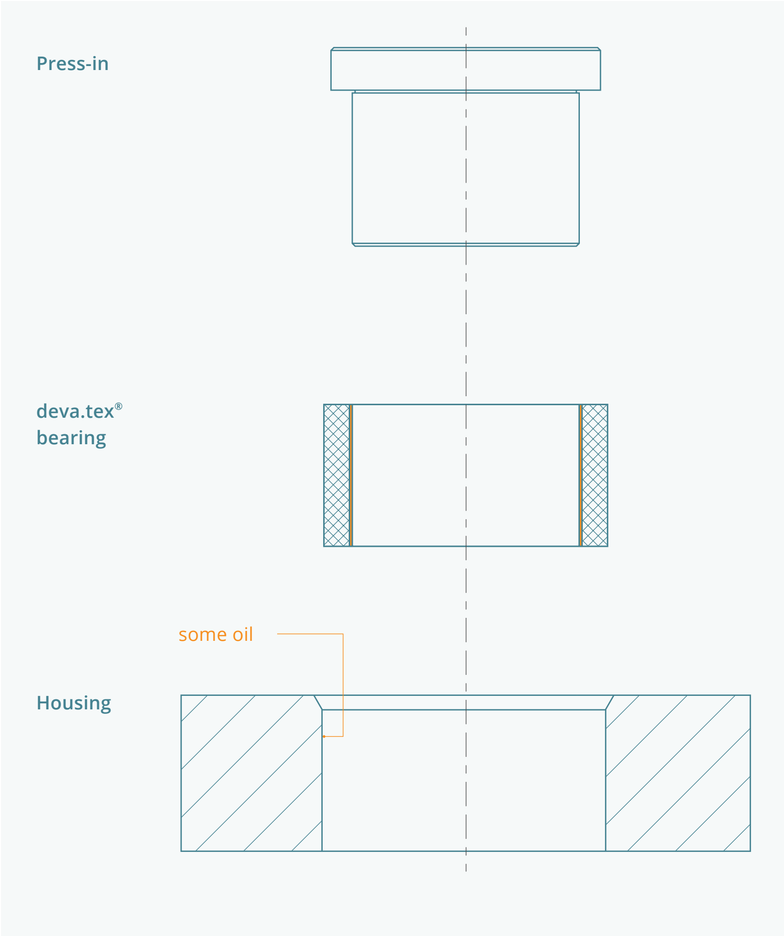
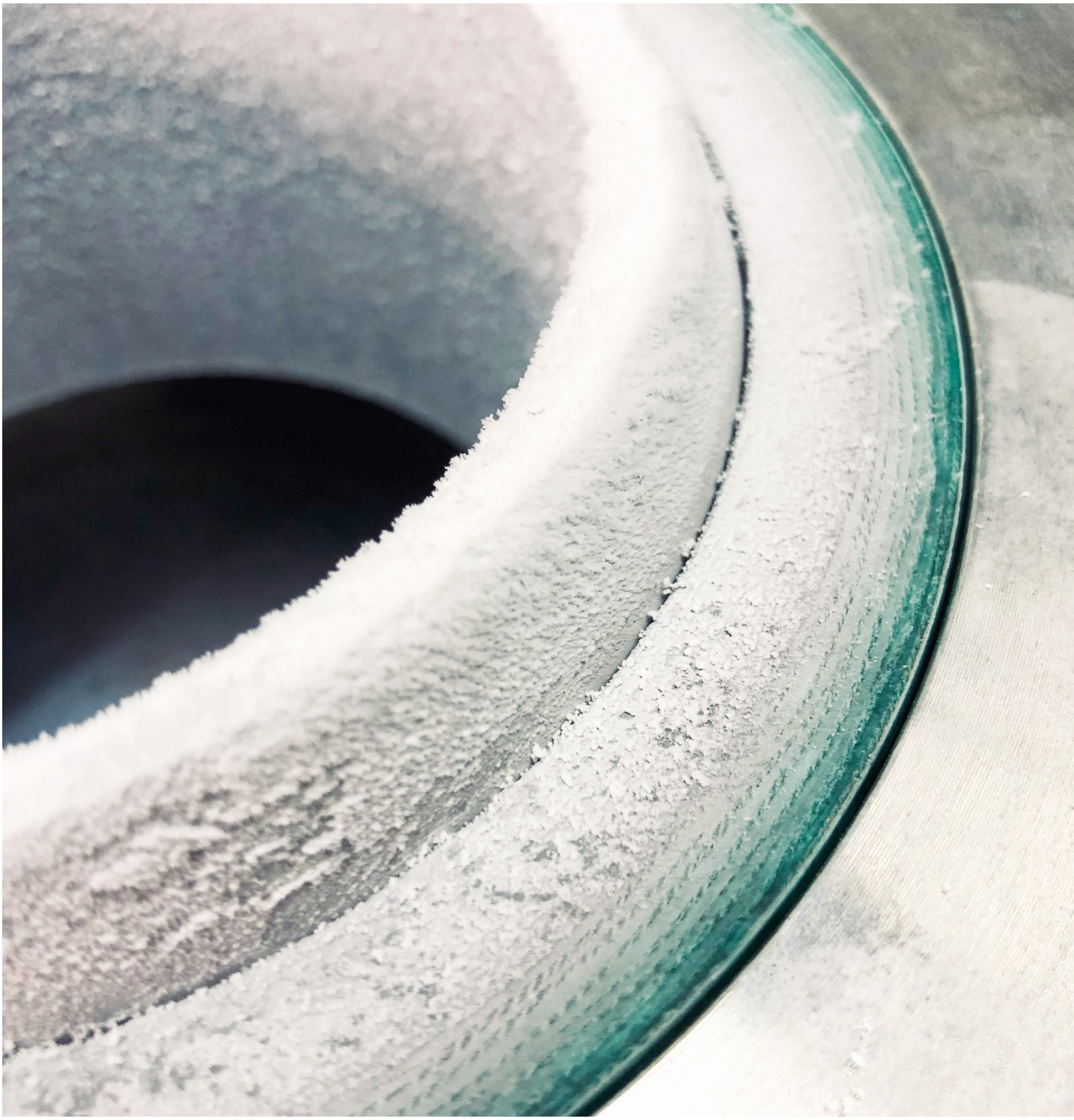


Figure 6.4.1

6.5 Installation by supercooling with liquid nitrogen

deva.tex® sliding bearings with outside diameter D_2 > 150 mm can be installed by supercooling with liquid nitrogen. Detailed mounting instructions are available on request also for dry-ice.



deva.tex® sliding bearings

Sliding plates and segments

7.1 Dimensions of raw plates

Sliding plates are available in deva.tex® 532, 541, 542, 544 and 545. Only finished sliding plates and segments are available. Our raw plates, from which we manufacture the parts, have the following dimensions (see tables). If these dimensions are exceeded, multi-part solutions can be provided.

Dimensions of deva.tex® raw plates in mm

deva.tex® 532 (1)

L	W	S_s	S_L
965 ± 0.1	245 ± 0.1	$4^{+0.1}_{-0.05}$	1
965 ± 0.1	245 ± 0.1	$6^{+0.1}_{-0.05}$	1.5
965 ± 0.1	245 ± 0.1	$8^{+0.1}_{-0.05}$	1.5
965 ± 0.1	245 ± 0.1	$10^{+0.1}_{-0.05}$	2

Table 7.1.1

deva.tex® 542 (1), 544 (1), 545 (1)

L	W	S_s	S_L
1050 ± 0.15	625 ± 0.15	2 to 100 ± 0.1	customized

Table 7.1.2

deva.tex® 541 (1)

L	W	S_s	S_L
1250 ± 0.15	1050 ± 0.15	–	2 to 100 ± 0.2

Table 7.1.3

deva.tex® 532, 542, 544, 545

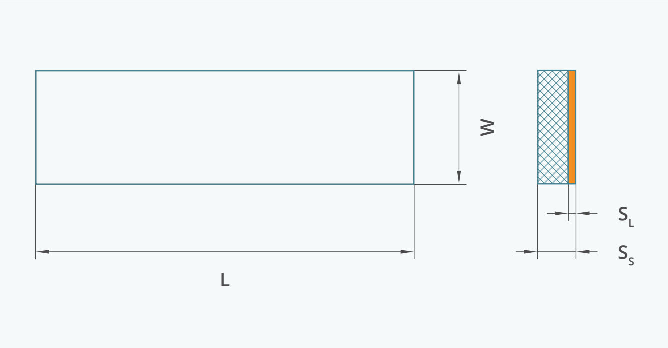


Figure 7.1.1

deva.tex® 541

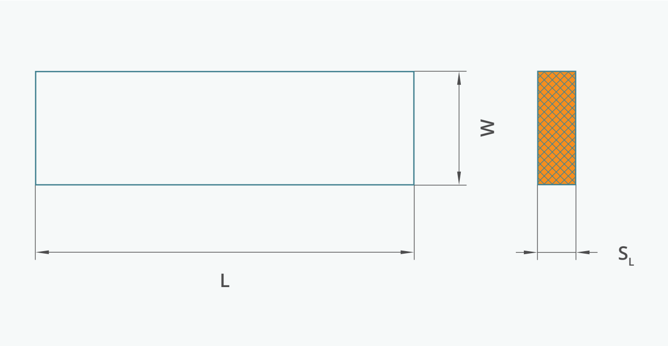


Figure 7.1.2

(1) Other dimensions available upon request

7.2 Installation of sliding plates, segments and thrust washers in general

Sliding plates and segments made of deva.tex® can be fixed with countersunk screws according to DEVA standard DN 1.33, with consideration of the screw head height in relation the plate thickness. However, depending on the load, additional securing by adhesive bonding or form-fitting is recommended. During installation, the screws should be installed with “Loctite 603” or “Loctite 278” screw locking adhesive. The temperature application limits and the manufacturer’s specifications must be observed.

Special case with low plate thickness

Special solutions due to insufficient plate thickness and lack of additional fixing options (as in Figure 7.2.1) are available upon request.

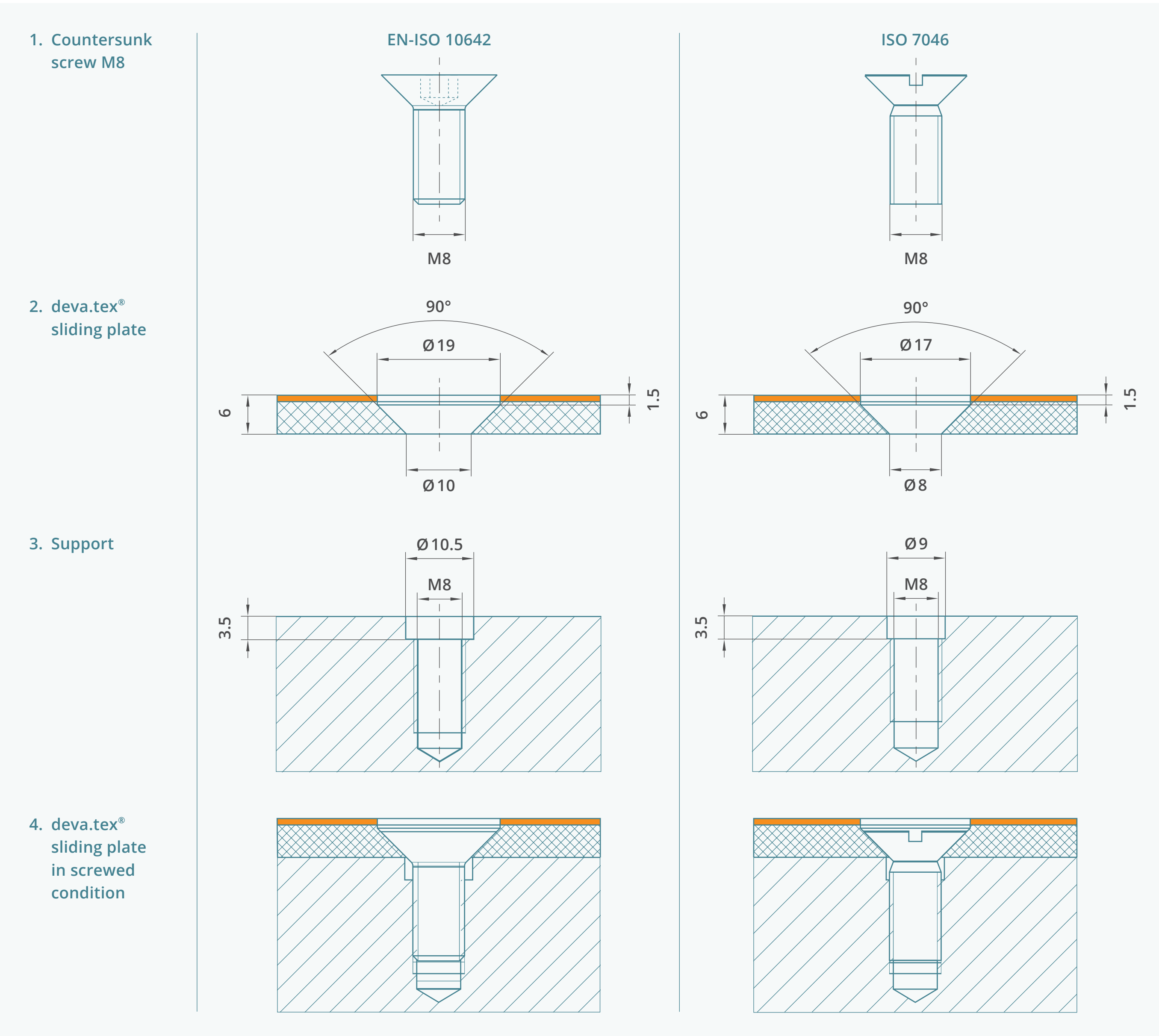


Figure 7.2.1

7.3 Installation of sliding plates, segments and thrust washers with fixing device

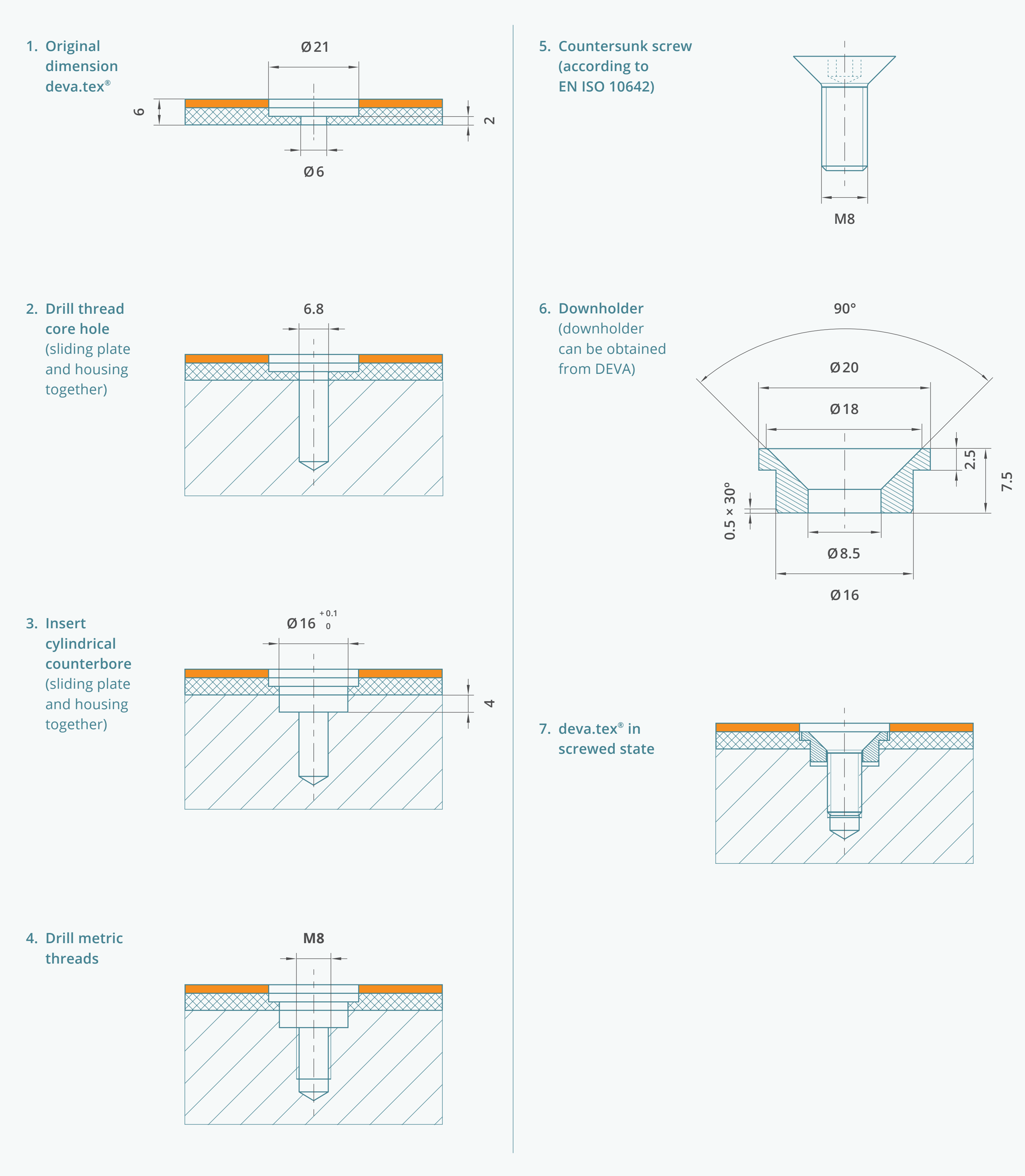
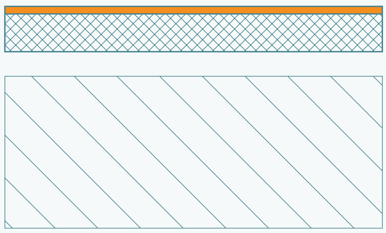


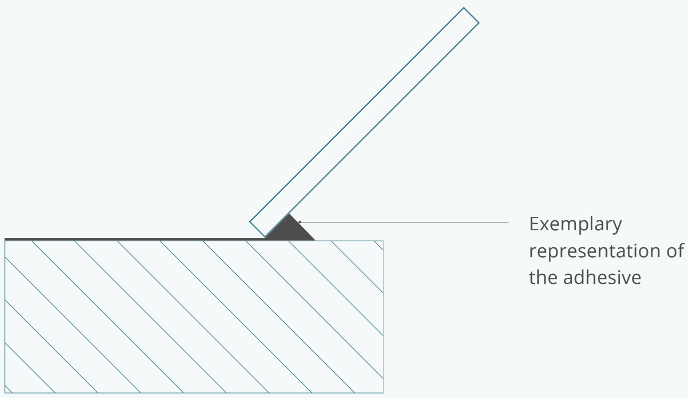
Figure 7.3.1

7.4 Installation of sliding plates by adhesive bonding

1. **Preparation**
   Roughen the joint surfaces (e.g., sandpaper, grain size 120).
   Thoroughly clean the mating surfaces.



2. **Application of the adhesive**
   Apply the adhesive using a notched trowel (0.5 – 1 mm).



3. **Installation**
   Join surfaces under slight pressure and allow to cure.

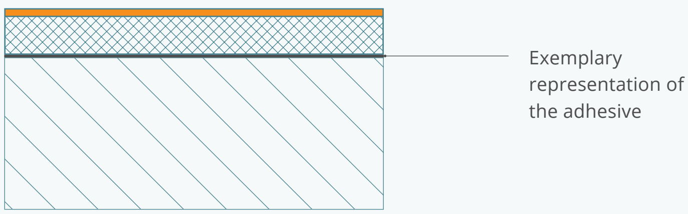


Figure 7.4.1

Adhesive recommendation

Two component adhesive
e.g., Loctite 3425

(observe the manufacturer's instructions)

deva.tex® sliding bearings

Chemical resistance

deva.tex® and various contact media

Table 8.1.1. gives information about the chemical resistance of deva.tex® materials. Definitive statements about the actual behavior can only be made by carrying out operational tests.

Medium/ chemical substance	Concentration [%]	Temperature [°C]	deva.tex® alloys 532	541	542/544/545	552/558
Alcohols						
Allyl alcohol			×	×	×	×
Amyl alcohol			●	●	●	●
Butyl alcohol			×	×	×	×
Ethyl alcohol			●	●	●	●
Ethylene glycol			●	●	●	●
Hydroxyacetone			●	●	●	●
Isobutyl alcohol			●	●	●	●
Isopropyl alcohol			●	●	●	●
Methyl alcohol			●	●	●	●
Propyl alcohol			●	●	●	●
Solvents						
Acetone*	100	23	○	○	○	○
Benzene			×	×	×	×
Methyl			●	×	●	●
Methyl ethyl			×	●	×	×
Naphthalene			●	●	●	●
Toluene			●	●	●	●
Trichloroethane			×	×	×	×
Fuels						
Petrol			●	●	●	●
Diesel			●	●	●	●
Kerosene			●	●	●	●
Oils						
Cottonseed oil			●	●	●	●
Petrol			●	●	●	●
Gear oil			●	●	●	●
Hydraulic oil			●	●	●	●
Linseed oil			●	●	●	●
Engine oils			●	●	●	●

Table 8.1.1

Medium/ chemical substance	Concentration [%]	Temperature [°C]	deva.tex® alloys 532	541	542/544/545	552/558
Gases						
Acetylene			●	●	●	●
Ether			●	●	●	●
Bromine			×	×	×	×
Butane			●	●	●	●
Chlorine			×	×	×	×
Natural gas			●	●	●	●
Sulfur dioxide			●	●	●	●
Fluorine			×	×	×	×
Carbon dioxide			●	●	●	●
Ozone			●	●	●	●
Propane			●	●	●	●
Nitrogen			●	●	●	●
Hydrogen			●	●	●	●
Salts						
Ammonium chloride			●	●	●	●
Ammonium nitrate			●	●	●	●
Ammonium sulfate			●	●	●	●
Ferric chloride			●	●	●	●
Magnesium chloride			●	●	●	●
Magnesium carbonate			●	●	●	●
Magnesium sulfate			●	●	●	●
Natriumacetat			●	●	●	●
Sodium acetate			●	●	●	●
Sodium			●	●	●	●

Table 8.1.1

* Tested according to DIN EN ISO 175:2010

Medium/ chemical substance	Concentration [%]	Temperature [°C]	deva.tex® alloys			
			532	541	542/544/545	552/558
Acids						
Arsenic acid	10		×	×	×	×
Boric acid	10		●	●	●	●
Aacetic acid	10		●	●	●	●
Hydrofluoric acid	10		×	×	×	×
Phosphoric acid*	10	23	●	●	●	●
	10	70	●	○	●	●
Nitric acid*	10	23	○	○	○	○
	10	70	×	×	×	×
Carbonic acid	10		×	×	×	×
Hydrochloric acid*	10		●	●	●	●
Citric acid	10		●	●	●	●
Sulfuric acid*	10	23	●	○	●	○
	10	70	○	×	○	×
Hydrogen peroxide*	35	23	●	●	●	○
	35	70	○	/	○	×
Bases						
Ammonium hydroxide			●	●	●	●
Calcium hydroxide			●	●	●	●
Potassium hydroxide*	5	23	×	×	×	○
	55	70	×	×	×	×
Magnesium hydroxide			●	●	●	●
Sodium hydroxide*	5	23	●	●	●	×
	5	70	○	○	○	×
Sodium hypochlorite*	15	23	○	○	○	○
	1	70	×	×	×	×

Table 8.1.1

Medium/ chemical substance	Concentration [%]	Temperature [°C]	deva.tex® alloys			
			532	541	542/544/545	552/558
Other						
Ammonia			×	×	×	×
Freon			●	●	●	●
Formaldehyde			●	●	●	●
Inhibitor Glycol based e.g., Dowcal N*			●	●	●	●
Inhibitor Potassium hydroxide based e.g., Performax CL1300*			●	●	●	●
Calcium Oxide			●	●	●	●
Sodium nitrate			●	●	●	●
Water*	100	23	●	●	●	●
	100	70	●	●	●	●
	100	100	×	×	×	×
Steam > 100 °C			×	×	×	×
Zinc sulfate			●	●	●	●

Table 8.1.1

● Resistant

○ Conditionally resistant, depending on environmental conditions

× Not recommended

/ No data available

deva.tex® sliding bearings

Design examples and applications

deva.tex® radial and axial segments

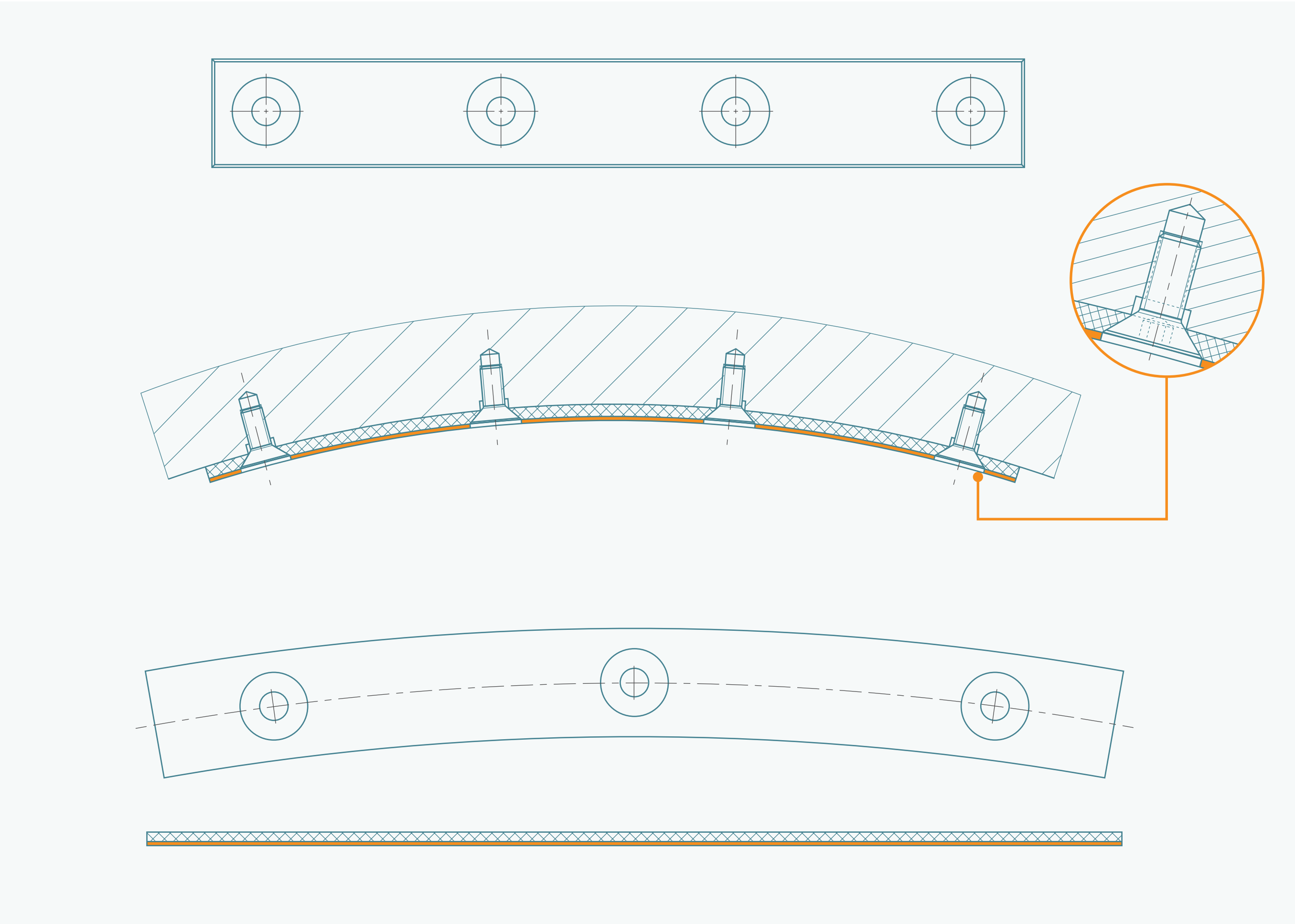
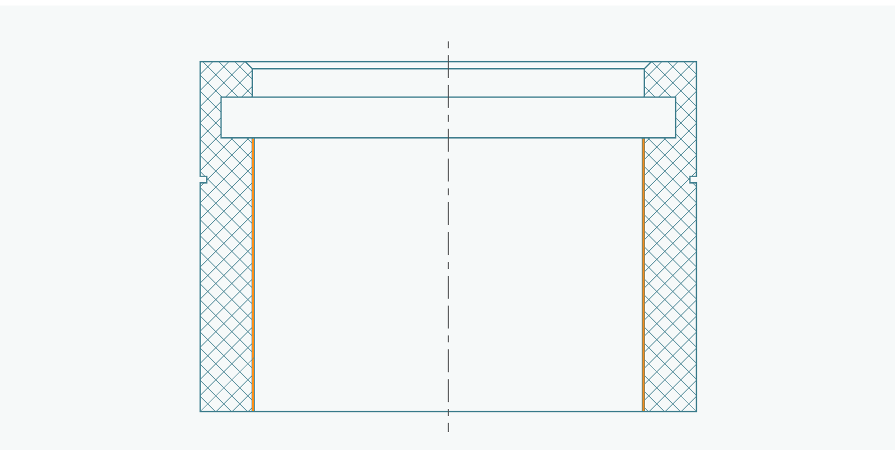


Figure 9.1.1

deva.tex® guide vane bearing, water turbine



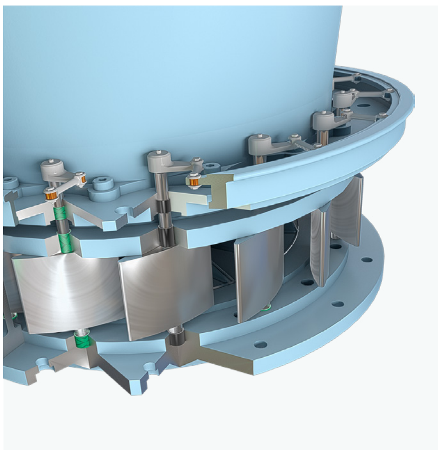
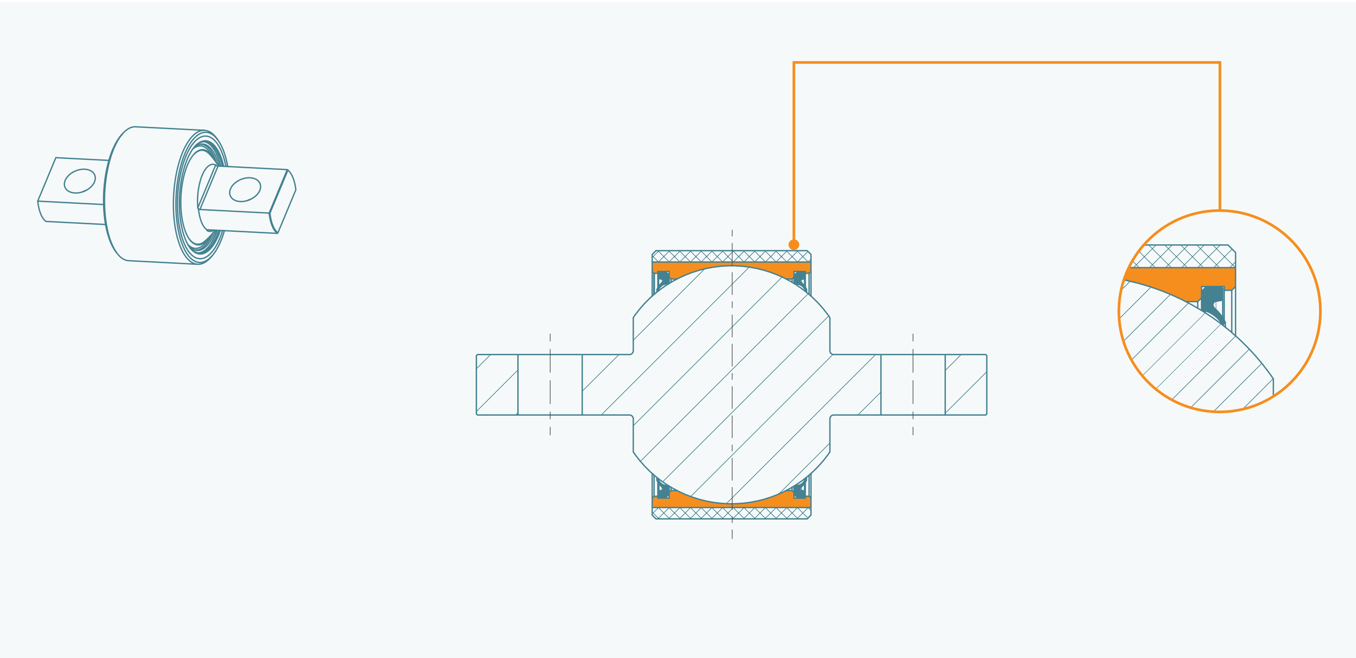


Figure 9.1.2

deva.tex® special spherical bearing



deva.tex® sliding slewing rings in rail vehicles

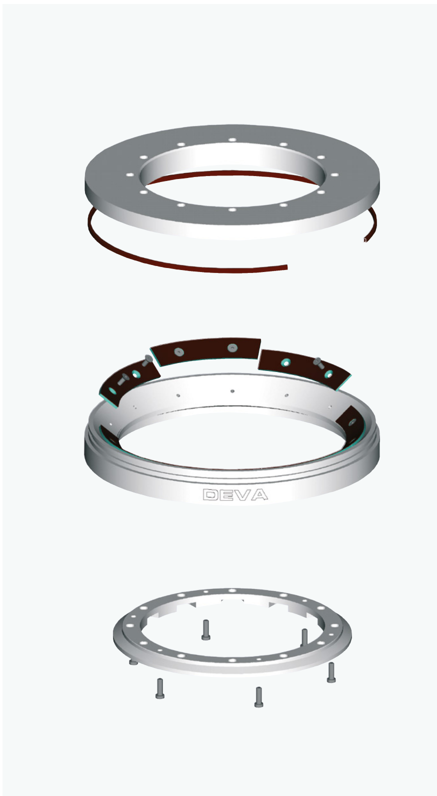


Figure 9.1.3

deva.tex® sliding bearings

Data for the design of DEVA® sliding bearings

Personal data

Company name ____________________

Project number ____________________

Address ____________________

____

Contact person ____________________

Phone ____________________

Fax ____________________

Mobile phone ____________________

Email ____________________

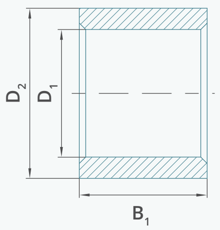
Description of the application

- ○ New design
- ○ Existing design
- ○ Steel industry
- ○ Wind energy
- ○ Rubber and plastics industry
- ○ Steam and Gas Turbines
- ○ Offshore and Marine
- ○ Heavy-duty Vehicles
- ○ Railway
- ○ Hydro Power
- ○ Other

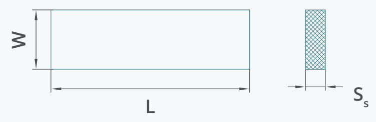
Bearing type

- ○ Shaft rotates
- ○ Bearing rotates
- ○ Angular motion
- ○ Axial motion

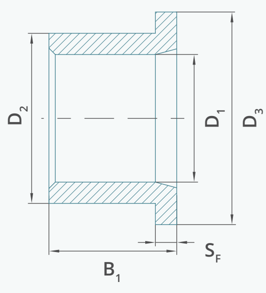
○ Bushing



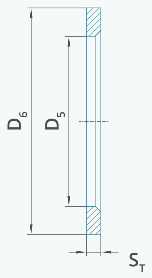
○ Sliding plate



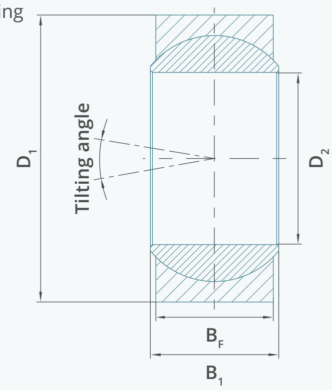
○ Flanged bushing bearing



○ Thrust washer



○ Spherical bearing
- ○ Floating bearing
- ○ Fixed bearing



	Pos. 1	Pos. 2	Pos. 3
Quantity			

Dimensions [mm]			
Inner diameter D_1 (D_5)			
Outer diameter D_2 (D_6)			
Bearing width B_1			
Outer ring width B_F			
Flange outer diameter D_3			
Flange thickness S_F			
Wall thickness S_T			
Plate length L			
Panel width W			
Plate thickness S_S			

Load			
Static	○	○	○
Dynamic	○	○	○
Alternating	○	○	○
Shock loads	○	○	○
Radial load **[kN]**			
Axial load **[kN]**			
Surface pressure			
Radial **[MPa]**			
Axial **[MPa]**			

Mating material			
Material no./type			
Hardness **[HB/HRC]**			
Roughness R_a **[µm]**			

Housing material			
Material no./type			

	Pos. 1	Pos. 2	Pos. 3
Lubrication			
Dry run	○	○	○
Permanent lubrication	○	○	○
Medium lubrication	○	○	○
Medium			
Lubricant			
Initial lubrication	○	○	○
Hydrodynamic lubrication	○	○	○
Dynamic viscosity			

Move			
Speed **[rpm]**			
Sliding speed **[m/s]**			
Stroke length **[mm]**			
Double strokes **[/min]**			
Rotation angle **[°]**			
Frequency **[n/min]**			
Tilt angle (spherical bearing) **[°]**			

Operating time			
Continuous operation			
Intermittent operation			
Duty operation **[%/h]**			
Days/Year			
Frictional distance **[km]**			

Fits/Tolerances			
Shaft			
Bearing housing			

Environmental conditions			
Temperature at bearing			
Contact medium			
Other influences			

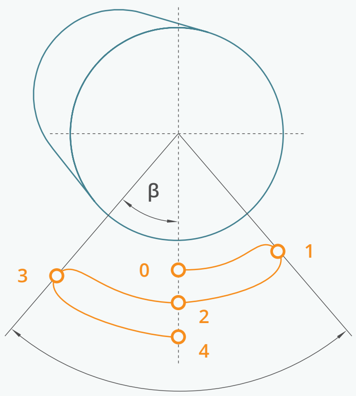
Lifetime			
Desired operating time **[h]**			
Permissible wear **[mm]**			

Comments

- ○ Certificate required (e.g., 3.1)
- ○ Acceptance procedure (e.g., 3.2)

Angle
The angle β is defined by the movement from the middle position to one end point.

Cycle
A cycle is four times the angle β. The calculation of the expected friction distance is based on this.



Example
Bushing $D_1 = 50$ mm and angle $\beta = 5°$
1 cycle shows a friction distance of 8.73 mm

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.

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