iglidur®

Polymer plain bearings

...plastics

Application examples: iglidur®

Tech up ... Cost down

For years the igus® motto has been motion plastics® - high-performance polymers for motion. By this we mean the production of innovative plastic products which reduce maintenance work, achieve technical improvements, at the same time as reducing costs and increasing service life, everything delivered immediately from stock. Our references from the practice show the proven employment from iglidur® plain bearings in a wide variety of applications.

Automated guided vehicle system
iglidur® Z plain bearings are used in the control arms of the autonomous transport vehicles. The bearings ensure that the weight of the robot and its load are distributed evenly. They transmit the axial forces exerted on the suspension bolts and ensure that the entire mechanism moves easily.
(Etisoft Smart Solutions)

Track vehicle
Despite extensive sealing, dirt still sometimes reaches the bearing points. If the bearings then get stuck, the chain could, in the worst case, wear out. To prevent that, the vehicle manufacturers use igutex® TX1 plain bearing bushes on the four oscillating axles and the tensioning axle. igus® manufactured the bushes specifically for Kässbohrer Geländefahrzeug AG in unprecedented dimensions and tested them.
(Kässbohrer Geländefahrzeug AG)

Solar steam system saves CO_2
With iglidur® plain bearings made of the material J UV, the ideal solution was found for the approximately 1,000 bearing points in each plant. The material was specially developed for use in UV radiation and is durable, reliable and maintenance-free even in sunlight.
(ECOTHERM)

Oscillating axles for heavy load transport
The use of iglidur® G plain bearings as well as igutex® TX1 thrust washers made the use of additional lubricants unnecessary and reduced maintenance and servicing to a minimum.
(Demarko)

Plain bearings in farm loaders
igus® plain bearings do not require additional lubrication or sealing, which makes cleaning the unit easier. They are extremely robust and perfectly suited for diverse and fluctuating environmental conditions. At the same time, the high loads are reduced by the vibration-damping properties of the bearings.
(Thaler)

iglidur® plain bearings | Product overview

iglidur® plain bearings: all-rounder

Materials for general purpose

The classic all-rounder: iglidur® G
▶ Page 85

More universal: iglidur® G1
▶ Page 101

The robust all-rounder according to ISO 2795: iglidur® M250
▶ Page 111

Specialist for pivoting, rolling applications and more: iglidur® P210
▶ Page 121

For series: iglidur® P230
▶ Page 129

The cost-effective outdoor all-rounder: iglidur® P
▶ Page 135

Versatile and cost-effective: iglidur® K
▶ Page 145

iglidur® plain bearings: endurance runner

Materials for long service life

Low-cost material for high-volume production: iglidur® GLW
▶ Page 153

The versatile endurance runner: iglidur® J
▶ Page 163

The classic endurance runner up to 30MPa: iglidur® W300
▶ Page 175

Specialist for pivoting and pulsating loads: iglidur® J3
▶ Page 187

Proven long-life material in black: iglidur® J3B
▶ Page 195

Endurance runner with high dimensional stability at high temperature: iglidur® J350
▶ Page 203

Ideal for plastic shafts: iglidur® J260
▶ Page 211

iglidur® plain bearings: endurance runner

Endurance runner up to +180°C: iglidur® W360
▶ Page 219

For fast rotating applications: iglidur® L250
▶ Page 227

For high rotational speeds: iglidur® L350
▶ Page 235

For extreme rotational speeds: iglidur® L500
▶ Page 243

Low-cost: iglidur® R
▶ Page 251

Low-cost with silicone: iglidur® D
▶ Page 259

Specialist for aluminium shafts: iglidur® J200
▶ Page 265

Ideal for pivoting movement: iglidur® E7
▶ Page 271

iglidur® plain bearings: high temperature

Materials for use at high temperatures

New

Extremely wear-resistant: iglidur® E
▶ Page 279

The chemical and temperature specialist: iglidur® X
▶ Page 291

Long service life under extreme conditions: iglidur® Z
▶ Page 301

The high temperature specialists up to +250°C: iglidur® X6
▶ Page 311

For soft shafts and high temperatures: iglidur® V400
▶ Page 319

All-rounder for steam sterilisation: iglidur® HSD350
▶ Page 327

For hot liquids: iglidur® UW500
▶ Page 335

iglidur® plain bearings: high media resistance

Materials with good media resistance

Endurance runner with high media resistance: iglidur® H1
▶ Page 345

Long service life under water: iglidur® H370
▶ Page 353

The classic with high resistance to media and temperature: iglidur® H
▶ Page 363

High temperature endurance runner: iglidur® C500
▶ Page 371

The low cost specialist for chemicals and temperatures: iglidur® H2
▶ Page 379

New

Chemical-resistant: iglidur® H3
▶ Page 385

New

Resistant to temperature and chemicals: iglidur® H5
▶ Page 391

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iglidur® plain bearings | Product overview

iglidur® plain bearings: for contact with food

Materials for contact with food

The universal bearing for food contact:
iglidur® A181
▶ Page 401

The endurance runner at higher temperatures in the food sector: iglidur® A350
▶ Page 409

The media and temperature specialist in the food sector: iglidur® A500
▶ Page 417

The all-rounder for food:
iglidur® A180
▶ Page 425

The "food-classic" for low duty:
iglidur® A200
▶ Page 433

Food bearing with high media resistance up to +90°C: iglidur® A160
▶ Page 443

Suitable for contact with drinking water:
iglidur® UW160
▶ Page 451

iglidur® plain bearings: for contact with food

For the tobacco industry:
iglidur® T220
▶ Page 459

New

Conductive and resistant:
iglidur® AX500
▶ Page 465

iglidur® plain bearings: for harsh environments

Materials for harsh environments

The durable heavy-duty bearing:
iglidur® Q2
▶ Page 477

New

Cost-effective heavy-duty bearing:
iglidur® Q3E
▶ Page 485

The peak of stability:
iglidur® Q
▶ Page 491

iglidur® plain bearings: for harsh environments

Heavy-duty on soft shafts:
iglidur® Q290
▶ Page 499

New

For medium-sized loads:
iglidur® M210
▶ Page 505

New

For heavy duty:
iglidur® M260
▶ Page 511

igutex® plain bearings: for high loads

Materials for heavy-duty applications

The robust all-rounder:
igutex® TX1
▶ Page 521

New

The technical shafts specialist:
igutex® TX2
▶ Page 527

New

The endurance runner for the highest loads:
igutex® TX3
▶ Page 533

iglidur® plain bearings: specialists

Materials for special application areas

Electrically conductive:
iglidur® F
▶ Page 545

ESD-compatible all-rounder:
iglidur® F2
▶ Page 553

The automotive standard:
iglidur® H4
▶ Page 561

For fast rotation under water:
iglidur® UW
▶ Page 569

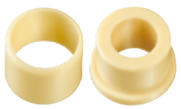
For continuous direct sunlight:
iglidur® J UV
▶ Page 577

The biopolymer:
iglidur® N54
▶ Page 585

Low-cost all-rounder for fire protection:
iglidur® G V0
▶ Page 593

iglidur® plain bearings: specialists

Versatile and cost-effective:
iglidur® J2
▶ Page 601



The first antibacterial iglidur® plain bearing:
iglidur® AB
▶ Page 609

Complies with DIN EN 45545 HL3, R22/R23:
iglidur® RW370
▶ Page 617

The variable one:
iglidur® B
▶ Page 625

Free from PTFE and silicone:
iglidur® C
▶ Page 631

iglidur® plain bearings | Technical properties - quick selection

iglidur®	G	G1	M250	P210	P230	P	K	GLW	J	W300	J3	J3B	J350	J260	W360	L250	L350	L500	R	D
Installation tolerances	E10	E10	D11	E10	E10	E10	E10	E10	E10	E10	E10	E10	F10	E10	E10	E10	F10	F10	E10	E10
Descriptive technical specifications																				
Wear resistance at +23°C	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Wear resistance at +90°C	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Wear resistance at +150°C	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Slide property	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Wear resistance under water	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Media resistance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Resistant to edge pressures	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Resistant to shock and impact loads	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Dirt resistance	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
For high loads (>60MPa)	●	●						●					●		●					
Electrically conductive																				
Approvals and standards																				
Dimensions in accordance with DIN	ISO 3547	ISO 3547	ISO 2795	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	
FDA-compliant																				
EU 10/2011-compliant																				
Fire class in accordance with UL-94	HB	HB	V-2	HB	HB	HB	HB	HB	HB	HB	HB	HB	V-0	V-2	HB	HB	V-0	V-0	HB	HB
Mould test DIN EN ISO 846	●	●							●				●							
Fogging DIN 75201-B	●		●	●				●												
Availabilities / variants																				
Type S, sleeve	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Type F, with flange	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Type T, thrust washer	●		●						●	●										
Bar stock, round material			●	●				●	●	●	●		●	●					●	
Bar stock, plate									●											
Bar stock, tube									●											
Machined parts made from bar stock			●	●					●	●	●		●	●					●	
tribo-tape liner																				
Page	85	101	111	121	129	135	145	153	163	175	187	195	203	211	219	227	235	243	251	259

iglidur® plain bearings | Technical properties - quick selection

iglidur®	J200	E7	E	X	Z	X6	V400	HSD350	UW500
Installation tolerances	E10	E10	E10	F10	F10	F10	F10	F10	F10
Descriptive technical specifications									
Wear resistance at +23°C									
Wear resistance at +90°C									
Wear resistance at +150°C									
Slide property									
Wear resistance under water									
Media resistance									
Resistant to edge pressures									
Resistant to shock and impact loads									
Dirt resistance									
For high loads (>60MPa)				●	●	●			●
Electrically conductive				●		●			●
Approvals and standards									
Dimensions in accordance with DIN		ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547
FDA-compliant									
EU 10/2011-compliant									
Fire class in accordance with UL-94	HB	HB	HB	V-0	V-0	V-0	V-0	V-0	V-0
Mould test DIN EN ISO 846				●	●				
Fogging DIN 75201-B									
Availabilities / variants									
Type S, sleeve		●	●	●	●	●	●	●	●
Type F, with flange		●	●	●	●	●	●	●	●
Type T, thrust washer				●	●				
Bar stock, round material	●	●	●	●				●	
Bar stock, plate									
Bar stock, tube									
Machined parts made from bar stock	●		●	●				●	
tribo-tape liner							●		
Page	265	271	279	291	301	311	319	327	335

iglidur®	H1	H370	H	C500	H2	H3	H5	A181	A350	A500	A180	A200	A160
Installation tolerances	F10	F10	F10	F10	F10	F10	F10	E10	F10	F10	E10	D11	E10
Descriptive technical specifications													
Wear resistance at +23°C													
Wear resistance at +90°C													
Wear resistance at +150°C													
Slide property													
Wear resistance under water													
Media resistance													
Resistant to edge pressures													
Resistant to shock and impact loads													
Dirt resistance													
For high loads (>60MPa)	●	●	●	●	●				●	●			
Electrically conductive		●											
Approvals and standards													
Dimensions in accordance with DIN	ISO 3547	ISO 3547	ISO 3547	ISO 3547		ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 2795	ISO 3547
FDA-compliant								●	●	●	●	●	●
EU 10/2011-compliant								●	●	●	●	●	●
Fire class in accordance with UL-94	V-0	V-0	V-0	V-0	V-0	V-0	V-0	HB	V-0	V-1	HB	V-2	HB
Mould test DIN EN ISO 846	●												
Fogging DIN 75201-B													
Availabilities / variants													
Type S, sleeve	●	●	●	●				●	●	●	●	●	●
Type F, with flange	●	●	●	●				●	●	●	●	●	●
Type T, thrust washer													
Bar stock, round material	●		●	●		●		●	●	●	●		●
Bar stock, plate									●				
Bar stock, tube													
Machined parts made from bar stock	●		●	●		●		●	●	●	●		●
tribo-tape liner													●
Page	345	353	363	371	379	385	391	401	409	417	425	433	443

iglidur® plain bearings | Technical properties - quick selection

iglidur®	UW160	T220	AX500	Q2	Q3E	Q	Q290	M210	M260	TX1
Installation tolerances	E10	E10	F10	E10	E10	E10	D11	D11	D11	D11
Descriptive technical specifications										
Wear resistance at +23°C	■■□	■■□	■□□	■■□	■■□	■■■	■■■	■■■	■■□	■■□
Wear resistance at +90°C	■□□	■□□	■□□	■□□	■□□	■■□	■■□	■■■	■■□	■□□
Wear resistance at +150°C	■□□	■□□	■■□	■□□	■□□	■□□	■□□	■■□	■□□	■□□
Slide property	■□□	■□□	■□□	■■□	■■□	■■■	■■■	■■■	■■■	■■□
Wear resistance under water	■■■■	■■□	■■■□	■□□	■□□	■□□	■□□	■■□	■■□	■■□
Media resistance	■■■■	■■■	■■■■	■■□	■■□	■■□	■■□	■■□	■■□	■■□
Resistant to edge pressures	■■□	■■□	■■□	■■■	■■■	■■□	■■■	■■■	■■□	■■■
Resistant to shock and impact loads	■■□	■■□	■■□	■■■	■■■	■■□	■■■	■■■	■■□	■■■
Dirt resistance	■■□	■■■	■■□	■■■	■■■	■■□	■■■	■■■	■■□	■■■
For high loads (>60MPa)			●	●	●	●	●			●
Electrically conductive										
Approvals and standards										
Dimensions in accordance with DIN	ISO 3547		ISO 3547	ISO 3547		ISO 3547	ISO 3547	ISO 2795	ISO 2795	ISO 2795
FDA-compliant		●	●							
EU 10/2011-compliant			●							
Fire class in accordance with UL-94	HB	HB	V-1	HB	HB	HB	HB	HB	V-2	
Mould test DIN EN ISO 846										
Fogging DIN 75201-B										
Availabilities / variants										
Type S, sleeve	●		●	●	●	●	●	●	●	●
Type F, with flange	●		●	●	●	●	●			
Type T, thrust washer										
Bar stock, round material	●	●								
Bar stock, plate										
Bar stock, tube										
Machined parts made from bar stock	●	●								
tribo-tape liner										
Page	451	459	465	477	485	491	499	505	511	521

iglidur®	TX2	TX3	F	F2	H4	UW	J UV	N54	G V0	J2	AB	RW370	B	C
Installation tolerances	D11	D11	D11	E10	F10	E10	E10	E10	E10	E10	E10	F10	D11	D11
Descriptive technical specifications														
Wear resistance at +23°C	■■□	■■□	■□□	■□□	■□□	■□□	■■■	■□□	■□□	■□□	■□□	■■□	■□□	■□□
Wear resistance at +90°C	■□□	■□□	■□□	■□□	■□□	■□□	■■■	■□□	■□□	■□□	■□□	■■□	■□□	■□□
Wear resistance at +150°C	■□□	■□□	■□□	■□□	■□□	■□□	■□□	■□□	■□□	■□□	■□□	■■□	■□□	■□□
Slide property	■■□	■■□	■□□	■□□	■□□	■□□	■■■	■■□	■■□	■■□	■■□	■■■	■□□	■□□
Wear resistance under water	■■□	■■□	■□□	■□□	■■□	■■■	■■□	■□□	■□□	■□□	■□□	■□□	■□□	■□□
Media resistance	■■□	■■□	■□□	■□□	■■□	■■□	■■□	■□□	■■□	■■□	■■□	■■□	■■□	■■□
Resistant to edge pressures	■■■	■■■	■■□	■■□	■■□	■□□	■■□	■□□	■■□	■■□	■■□	■■■	■■■	■■□
Resistant to shock and impact loads	■■■	■■■	■■□	■■□	■■□	■■□	■■□	■■□	■■■	■■□	■■□	■■■	■■■	■■□
Dirt resistance	■■■	■■■	■■□	■■□	■■□	■■□	■■□	■■□	■■□	■■□	■■□	■■□	■■□	■■□
For high loads (>60MPa)	●	●	●	●	●				●			●		
Electrically conductive			●	●										
Approvals and standards														
Dimensions in accordance with DIN	ISO 2795	ISO 2795	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	
FDA-compliant														
EU 10/2011-compliant														
Fire class in accordance with UL-94			HB	HB	V-0	HB	HB	HB	V-0	HB	HB	V-0	HB	HB
Mould test DIN EN ISO 846									●					
Fogging DIN 75201-B														
Availabilities / variants														
Type S, sleeve	●	●	●	●	●	●	●	●	●		●	●		
Type F, with flange			●	●	●	●	●	●	●		●	●		
Type T, thrust washer														
Bar stock, round material				●						●	●	●		
Bar stock, plate														
Bar stock, tube														
Machined parts made from bar stock				●						●	●	●		
tribo-tape liner														
Page	527	533	545	553	561	569	577	585	593	601	609	617	625	631

iglidur®	Unit	G	G1	M250	P210	P230	P	K	GLW	J	W300	J3	J3B	J350	J260	W360	L250	L350	L500	R	D	J200	E7	E
General properties																								
Density	[g/cm³]	1.46	1.58	1.14	1.40	1.57	1.58	1.52	1.36	1.49	1.24	1.42	1.42	1.44	1.35	1.34	1.5	1.54	1.53	1.39	1.4	1.72	1.05	1.50
Colour																								
Max. moisture absorption at +23°C and 50% relative humidity	[% weight]	0.7	0.2	1.4	0.3	0.1	0.2	0.1	1.3	0.3	1.3	0.3	0.3	0.3	0.2	0.2	0.7	0.4	0.1	0.2	0.3	0.2	0.1	0.2
Max. moisture absorption	[% weight]	4.0	1.7	7.6	0.5	0.3	0.4	0.6	5.5	1.3	6.5	1.3	1.3	1.6	0.4	1.6	3.9	1.4	0.3	1.1	1.1	0.7	0.1	1.7
Coefficient of sliding friction, dynamic against steel	[µ]	0.08 - 0.15	0.08 - 0.15	0.18 - 0.40	0.07 - 0.19	0.06 - 0.21	0.06 - 0.21	0.06 - 0.21	0.10 - 0.24	0.06 - 0.18	0.08 - 0.23	0.06 - 0.20	0.09 - 0.23	0.10 - 0.20	0.06 - 0.20	0.07 - 0.21	0.08 - 0.19	0.15 - 0.20	0.19 - 0.26	0.09 - 0.25	0.08 - 0.26	0.11 - 0.17	0.08 - 0.17	0.08 - 0.23
pv value, max. (dry)	[MPa·m/s]	0.42	0.60	0.12	0.4	0.30	0.39	0.3	0.3	0.34	0.23	0.5	0.5	0.45	0.35	0.35	0.4	3.0	4.0	0.27	0.27	0.3	0.22	0.25
Mechanical properties																								
Flexural modulus	[MPa]	7,800	11,486	2,700	2,500	6,532	5,300	3,500	7,700	2,400	3,500	2,700	2,895	2,000	2,200	3,829	1,950	15,882	12,015	1,950	2,000	2,800	1,477	2,975
Flexural strength at +20°C	[MPa]	210	178	112	70	173	120	80	235	73	125	70	65	55	60	119	67	210	201	70	72	58	22	79
Compressive strength	[MPa]	78	115	52	50	101	66	60	74	60	61	60	n.s.	60	50	n.s.	47	210	70	68	70	43	18	n.s.
Max. permissible surface pressure at +20°C	[MPa]	80	91	20	50	60	50	50	80	35	60	45	44	60	40	75	45	59	70	23	23	23	18	37
Shore D hardness		81	81	79	75	80	75	72	78	74	77	73	76	80	77	n.s.	68	80	81	77	78	70	61	78
Physical and thermal properties																								
Max. continuous operating temperature	[°C]	+130	+180	+80	+100	+110	+130	+170	+100	+90	+90	+90	+90	+180	+120	+180	+90	+180	+250	+90	+90	+90	+70	+90
Max. short-term operating temperature	[°C]	+220	+220	+170	+160	+180	+200	+240	+160	+120	+180	+120	+110	+220	+140	+200	+180	+210	+315	+110	+110	+120	+90	+120
Min. continuous operating temperature	[°C]	-40	-40	-40	-40	-30	-40	-40	-40	-50	-40	-50	-50	-100	-100	-40	-40	-100	-100	-50	-50	-50	-50	-50
Thermal conductivity	[W/m · K]	0.24	0.46	0.24	0.25	0.34	0.25	0.25	0.24	0.25	0.24	0.25	0.30	0.24	0.24	0.24	0.24	0.61	0.45	0.25	0.25	0.24	0.24	0.25
Coefficient of thermal expansion at +23°C	[$K^{-1} \cdot 10^{-5}$]	9	3.5	10	8	5	4	3	17	10	9	13	12.7	7	13	6	10	7	6	11	11	8	25	10
Electrical properties																								
Specific contact resistance	[Ωcm]	> 10^{13}	> 10^{9}	> 10^{13}	> 10^{12}	> 10^{12}	> 10^{13}	> 10^{12}	> 10^{11}	> 10^{13}	> 10^{13}	> 10^{12}	> 10^{12}	> 10^{13}	> 10^{12}	> 10^{13}	> 10^{10}	> 10^{5}	> 10^{10}	> 10^{12}	> 10^{14}	> 10^{8}	> 10^{9}	> 10^{12}
Surface resistance	[Ω]	> 10^{11}	> 10^{11}	> 10^{11}	> 10^{11}	> 10^{12}	> 10^{12}	> 10^{12}	> 10^{11}	> 10^{12}	> 10^{12}	> 10^{12}	> 10^{12}	> 10^{10}	> 10^{10}	> 10^{12}	> 10^{11}	> 10^{5}	> 10^{12}	> 10^{12}	> 10^{14}	> 10^{8}	> 10^{9}	> 10^{12}
Page		85	101	111	121	129	135	145	153	163	175	187	195	203	211	219	227	235	243	251	259	265	271	279

iglidur® plain bearings | Material properties

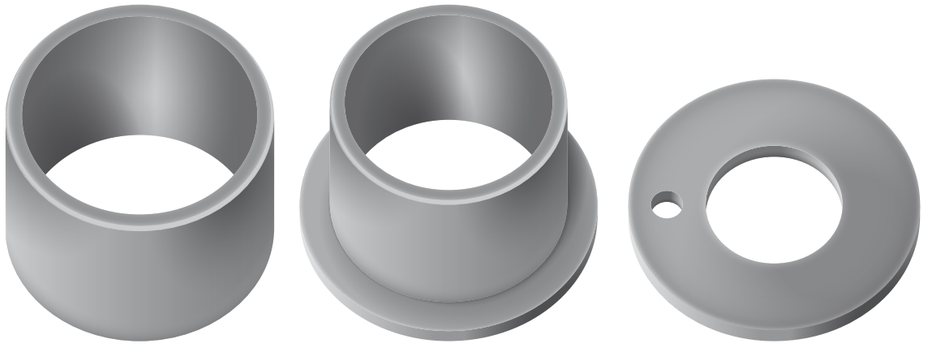
iglidur®	Unit	X	Z	X6	V400	HSD350	UW500	H1	H370
General properties									
Density	[g/cm³]	1.44	1.4	1.53	1.51	1.39	1.49	1.53	1.66
Colour									
Max. moisture absorption at +23°C and 50% relative humidity	[% weight]	0.1	0.3	0.1	0.1	0.6	0.1	0.1	0.1
Max. moisture absorption	[% weight]	0.5	1.1	0.5	0.2	1.2	0.5	0.3	0.1
Coefficient of sliding friction, dynamic against steel	[µ]	0.09 - 0.27	0.06 - 0.14	0.09 - 0.25	0.15 - 0.20	0.07 - 0.23	0.20 - 0.36	0.06 - 0.20	0.07 - 0.17
pv value, max. (dry)	[MPa·m/s]	1.32	0.84	1.35	0.5	0.3	0.35	0.80	0.74
Mechanical properties									
Flexural modulus	[MPa]	8,100	2,400	16,000	4,500	2,150	16,000	2,800	11,100
Flexural strength at +20°C	[MPa]	170	95	290	95	67	260	55	135
Compressive strength	[MPa]	100	65	190	47	44	140	78	79
Max. permissible surface pressure at +20°C	[MPa]	150	150	150	45	30	140	80	75
Shore D hardness		85	81	89	74	77	86	77	82
Physical and thermal properties									
Max. continuous operating temperature	[°C]	+250	+250	+250	+200	+180	+250	+200	+200
Max. short-term operating temperature	[°C]	+315	+310	+315	+240	+210	+300	+240	+240
Min. continuous operating temperature	[°C]	-100	-100	-100	-50	-40	-100	-40	-40
Thermal conductivity	[W/m · K]	0.60	0.62	0.55	0.24	0.24	0.6	0.24	0.5
Coefficient of thermal expansion at +23°C	[$K^{-1} \cdot 10^{-5}$]	5	4	1.1	3	7	4	6	5
Electrical properties									
Specific contact resistance	[Ωcm]	$< 10^5$	$> 10^{11}$	$< 10^5$	$> 10^{12}$	$> 10^{13}$	$< 10^9$	$> 10^{12}$	$< 10^5$
Surface resistance	[Ω]	$< 10^3$	$> 10^{11}$	$< 10^3$	$> 10^{12}$	$> 10^{14}$	$< 10^9$	$> 10^{11}$	$< 10^5$
Page		291	301	311	319	327	335	345	353

H	C500	H2	H3	H5	A181	A350	A500	A180	A200	A160	UW160	T220	AX500
1.71	1.37	1.72	1.41	1.41	1.38	1.42	1.28	1.46	1.14	1.00	1.04	1.28	1.52
0.1	0.3	0.1	0.2	0.1	0.2	0.6	0.3	0.2	1.5	0.1	0.1	0.3	0.3
0.3	0.5	0.2	0.5	0.7	1.3	1.9	0.5	1.3	7.6	0.1	0.1	0.5	0.5
0.07 - 0.20	0.07 - 0.19	0.07 - 0.30	0.08 - 0.17	0.08 - 0.24	0.10 - 0.21	0.10 - 0.20	0.26 - 0.41	0.05 - 0.23	0.10 - 0.40	0.09 - 0.19	0.17 - 0.31	0.20 - 0.32	0.08 - 0.22
1.37	0.7	0.58	0.7	0.7	0.31	0.40	0.28	0.31	0.09	0.25	0.22	0.28	0.9
12,500	3,300	10,300	2,760	6,400	1,913	2,000	3,600	2,300	2,500	1,151	1,349	1,800	6,170
175	100	210	68	150	48	110	140	88	116	19	22	65	115
81	110	109	n.s.	n.s.	60	78	118	78	54	37	32	55	n.s.
90	80	110	40	80	31	60	120	28	18	14	20	40	69
87	80	88	75	72	76	76	83	76	81	60	60	76	81
+200	+250	+200	+200	+200	+90	+180	+250	+90	+80	+90	+90	+100	+250
+240	+300	+240	+240	+240	+110	+210	+300	+110	+170	+100	+100	+160	+300
-40	-100	-40	-40	-40	-50	-100	-100	-50	-40	-50	-50	-40	-100
0.6	0.24	0.24	0.25	0.25	0.25	0.24	0.24	0.25	0.24	0.30	0.50	0.24	0.26
4	9	4	6	7	11	8	9	11	10	11	18	11	9
$< 10^5$	$> 10^{14}$	$> 10^{15}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{11}$	$> 10^{14}$	$> 10^{12}$	$> 10^{13}$	$> 10^{12}$	$> 10^{12}$	$> 10^{10}$	$> 10^5$ - $> 10^{11}$
$< 10^2$	$> 10^{13}$	$> 10^{14}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{11}$	$> 10^{13}$	$> 10^{11}$	$> 10^{12}$	$> 10^{12}$	$> 10^{12}$	$> 10^{10}$	$> 10^5$ - $> 10^{11}$
363	371	379	385	391	401	409	417	425	433	443	451	459	465

iglidur®	Unit	Q2	Q3E	Q	Q290	M210	M260	TX1	TX2	TX3	F	F2	H4	UW	J UV	N54	G V0	J2	AB	RW370	B	C
General properties																						
Density	[g/cm³]	1.46	1.46 - 1.69	1.4	1.27	1.4	1.35	2.1	1.77	1.9	1.25	1.52	1.79	1.52	1.49	1.13	1.53	1.44	1.11	1.34	1.15	1.1
Colour																						
Max. moisture absorption at +23°C and 50% relative humidity	[% weight]	1.1	1.5	0.9	3.0	0.3	0.2	0.2	1.0	0.1	1.8	0.2	0.1	0.2	0.3	1.6	0.7	0.2	0.8	0.25	1.0	1.0
Max. moisture absorption	[% weight]	4.6	5.0	4.9	9.3	0.5	0.4	0.5	1.3	0.1	8.4	0.4	0.2	0.8	1.3	3.6	4.0	1.3	1.6	1.2	6.3	6.9
Coefficient of sliding friction, dynamic against steel	[µ]	0.22 - 0.42	0.22 - 0.42	0.05 - 0.15	0.14 - 0.26	0.08 - 0.20	0.08 - 0.16	0.09 - 0.37	n.s.	n.s.	0.10 - 0.39	0.16 - 0.22	0.08 - 0.25	0.15 - 0-35	0.08 - 0.19	0.15 - 0.23	0.07 - 0.20	0.11 - 0.27	0.18 - 0.31	0.13 - 0.17	0.18 - 0.28	0.17 - 0.25
pv value, max. (dry)	[MPa·m/s]	0.7	0.7	0.55	0.70	0.5	0.35	0.89	0.2	0.2	0.34	0.31	0.70	0.11	0.30	0.5	0.5	0.23	0.25	1.2	0.15	0.10
Mechanical properties																						
Flexural modulus	[MPa]	8,370	n.s.	4,500	3,074	2,200	2,200	12,000	n.s.	n.s.	11,600	7,418	7,500	9,600	2,400	1,800	7,900	3,605	1,850	2,997	1,800	1,900
Flexural strength at +20°C	[MPa]	240	235	120	97	65	60	55	n.s.	n.s.	260	93	120	90	72	70	140	101	50	100	55	60
Compressive strength	[MPa]	130	n.s.	89	68	50	50	220	180	n.s.	98	61	50	70	n.s.	30	100	77	40	129	20	30
Max. permissible surface pressure at +20°C	[MPa]	120	135	100	55	50	40	200	180	180	105	47	65	40	34	36	75	46	25	75	40	40
Shore D hardness		80	80	83	80	75	77	94	91	91	84	72	80	78	74	74	80	n.s.	70	80	69	72
Physical and thermal properties																						
Max. continuous operating temperature	[°C]	+130	+100	+135	+140	+100	+120	+120	+130	+130	+140	+120	+200	+90	+90	+80	+130	+90	+70	+170	+100	+90
Max. short-term operating temperature	[°C]	+200	+140	+155	+180	+160	+140	+170	+140	+140	+180	+165	+240	+110	+120	+120	+210	+110	+140	+190	+130	+130
Min. continuous operating temperature	[°C]	-40	-30	-40	-40	-40	-100	-60	-20	-20	-40	-40	-40	-50	-50	-40	-40	-50	-40	-50	-40	-40
Thermal conductivity	[W/m · K]	0.24	n.s.	0.23	0.24	0.25	0.24	0.24	0.25	0.25	0.65	0.61	0.24	0.6	0.3	0.24	0.25	0.25	0.24	0.22	0.24	0.24
Coefficient of thermal expansion at +23°C	[$K^{-1} \cdot 10^{-5}$]	8	n.s.	5	7	8	13	3	n.s.	n.s.	12	5	5	6	10	9	9	7	10	5	12	15
Electrical properties																						
Specific contact resistance	[Ωcm]	> 10^{13}	> 10^{12}	> 10^{15}	> 10^{12}	> 10^{11}	> 10^{10}	> 10^{11}	insula-ting	insula-ting	< 10^{3}	< 10^{9}	> 10^{13}	< 10^{5}	> 10^{13}	> 10^{13}	> 10^{12}	> 10^{13}	> 10^{12}	> 10^{12}	> 10^{10}	> 10^{10}
Surface resistance	[Ω]	> 10^{11}	> 10^{12}	> 10^{12}	> 10^{12}	> 10^{11}	> 10^{10}	> 10^{13}	insula-ting	insula-ting	< 10^{2}	< 10^{9}	> 10^{12}	< 10^{5}	> 10^{13}	> 10^{11}	> 10^{11}	> 10^{12}	> 10^{12}	> 10^{12}	> 10^{9}	> 10^{9}
Page		477	485	491	499	505	511	521	527	533	545	553	561	569	577	585	593	601	609	617	625	631

dry-tech® bearing technology | Lubrication-free made easy

Proven. Predictable. Performance.



Proven.

Since 1983, igus® has been manufacturing plain bearings from specifically developed iglidur® high-performance plastics. Over 50 different polymer compounds have been developed and tested since then. In order to make the selection of the best material for wear-resistant parts in various environments as easy and safe as possible, igus® tests these materials in over 15,000 application-oriented test series per year. The collected findings flow into unique online selection tools and the know-how of our global network of iglidur® application consultants.

Predictable.

Plain bearings are wear-resistant parts. And wear-resistant parts wear out. But when? When is the wear limit reached and when does the plain bearing have to be replaced? The iglidur® expert system answers this question. Based on more than 15,000 wear tests per year, the iglidur® expert system offers designers the possibility of not only determining the iglidur® plain bearing with the best price-performance ratio within a few minutes, but also to get an exact report on the predicted service life in the application. Easy. Online calculation available.

Performance.

Since 1983, iglidur® plain bearings have successfully established themselves in various applications all over the world. They are not only cost-effective but also maintenance-free, lubrication-free and versatile. They are suitable for large or small volume production, in the automotive sector, in special machine construction, underwater applications or for the food and packaging industry. More than 200,000 customers worldwide successfully use iglidur® plain bearings and thereby reduce the costs and increase the service life of their bearing points.

Picture 01: igus® test lab: 15,000 tribological tests (friction and wear) in 300 test set-ups in the industry's largest laboratory (3,800m²). View inside bearing laboratory in Cologne

iglidur® | High-performance polymers

Properties and design

iglidur® plain bearings made from high-performance polymers

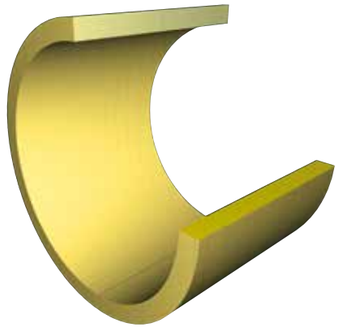
Wear-resistant tribo-polymers improved by precise additions of strengthening materials and solid lubricants, tested thousands of times and proven millions of times - that is iglidur®. igus® engineers develop and test more than 267 new plastic compounds every year. The finely tuned combination of plastic matrix, strengthening components and solid lubricants in every single tribo-polymer results in an individual properties profile in each case. In more than 15,000 individual tests a year on over 200 test rigs in the igus® test laboratory, all materials are thoroughly tested. The findings go into a unique knowledge database on the tribology of maintenance-free plastic plain bearings. This database enables us to select the ideal iglidur® plain bearing for our customers depending on the application and to calculate its anticipated service life. If necessary, it is also possible to develop an application-specific material, exactly adapted to the thermal, mechanical and tribological requirements, which goes beyond the existing iglidur® product range. In addition, freely accessible and user-friendly online tools enable every user to select his personal plain bearing from the iglidur® product range. Whether iglidur® product finder or iglidur® service life calculation, piston ring or bar stock configurator: with a few clicks and application-related information a suitable bearing is quickly found.

▶ www.igus.eu/online-tools

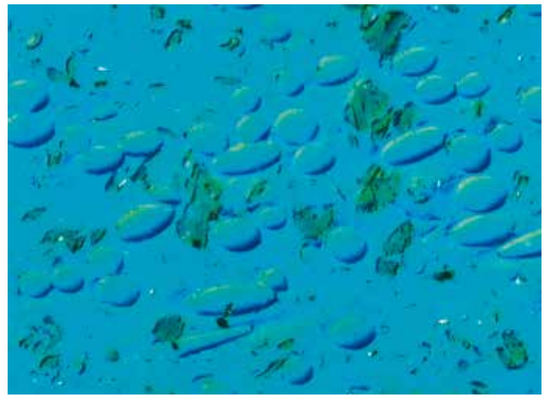
General properties of iglidur® plain bearings

- Lubrication-free
- Corrosion-resistant
- Good media resistance
- High compressive strength
- High mechanical dampening
- Low coefficient of friction
- Maintenance-free
- High resistance to contamination
- Lightweight
- High wear resistance
- Excellent price-performance ratio

Over and above the general properties, each iglidur® bearing material possesses a series of special properties and strengths, which make it specially suitable for certain applications and requirements. You can find a comprehensive description of the materials in the respective chapters before the dimensions tables.



Picture 02: Injection-moulded iglidur® plain bearings are homogeneously structured. Base polymer, bonding materials and solid lubricants mutually complement each other.



Picture 03: Base polymers with fibres and solid lubricants, magnified 200 times, dyed

Properties and design

The traditional solution

Hard shells with soft coating. Every lubricated bearing works according to this principle, and also a number of maintenance-free bearings that are equipped with special sliding layers. However, this soft sliding layer is not strong enough. For high loads, edge pressure or oscillations, it is easily removed.

Base polymers and technical fibres

The radial pressure with which the bearings are loaded is received by the polymer material. In the contact area, this material provides a support to the shaft. The polymer base material ensures that the lubricants do not receive a surface pressure that is too high. The base material is also reinforced by technical fibres or filling materials. These additional materials stabilise the bearing especially in cases of continuous load.

Incorporated self-lubrication

The solid lubricants are, as microscopic particles, embedded in millions of tiny chambers of the material. From these chambers, the plain bearings release tiny amounts of solid lubricants during movement. This is adequate to sufficiently lubricate the immediate surrounding area. The lubricants help to reduce the iglidur® bearing's coefficient of friction. They are not indispensable for the bearing's function, but have a supporting effect. Since they are embedded in the tiny chambers, they cannot be forced out. They are always there as soon as the bearing or the shaft is set in motion.

Picture 04: Polymer granulate; basis compound of the lubrication-free and predictable iglidur® plain bearings

The iglidur® solution: the self-lubricating effect

The high-performance polymers of the iglidur® plain bearings consist of:

- Base polymer
- Fibres and filling material
- Solid lubricants

These components are **not applied in layers**, but instead are mixed together homogeneously. The advantage of this design is clear when the requirements on the bearings surface are studied:

1. The coefficient of friction, which is determined especially by the surface of the bearing, should be as low as possible.
2. The surface cannot be removed by forces that act on the bearing.
3. The wearing force acts especially on the surface of the bearing, for this the bearing must be capable of high resistance.

One universal material, which can fulfil all these tasks equally well, unfortunately does not exist yet. That is why iglidur® plain bearings work differently. Different components of the iglidur® materials give the bearings their properties:

- The **base polymers** are responsible for the resistance to wear.
- **Fibres and filling materials** reinforce the bearing so that high forces or edge loads are possible.
- **Solid lubricants** lubricate the bearing independently and prevent friction of the system.

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.

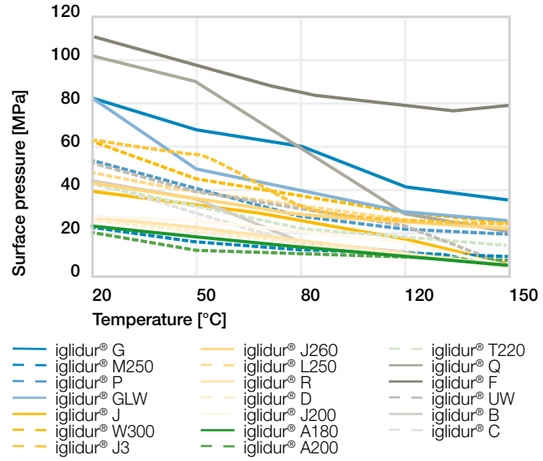
▶ Material properties, **page 60**

Load and temperature

Diagram 02 and 03 show the maximum recommended static surface pressure of the iglidur® plain bearing as a function of temperature. With increasing temperature, this value decreases continuously. Take advantage of the opportunity presented by the predictability of the iglidur® plain bearing to record these effects in advance, or determine the effective temperatures in the test.

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. This relationship is shown by the pv graph that is the first in the respective chapter for each iglidur® material.



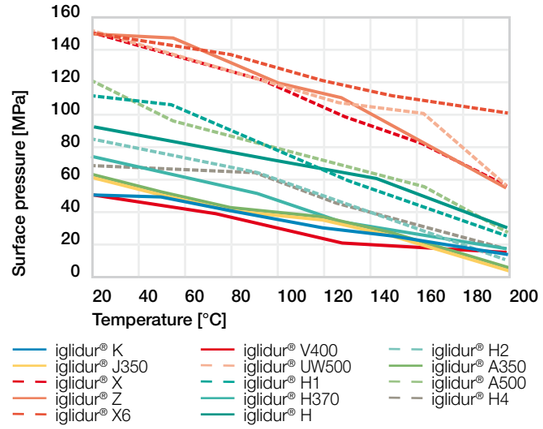


Diagram 02-03: Maximum recommended surface pressure as a function of temperature

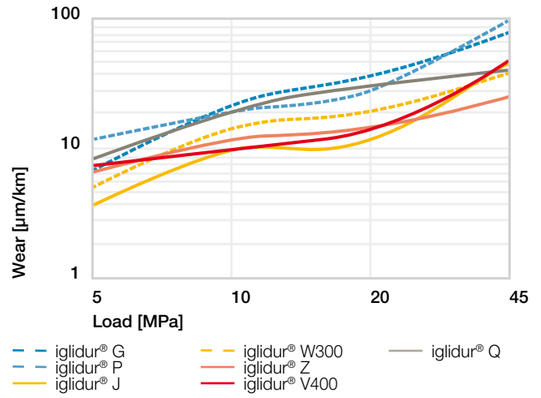
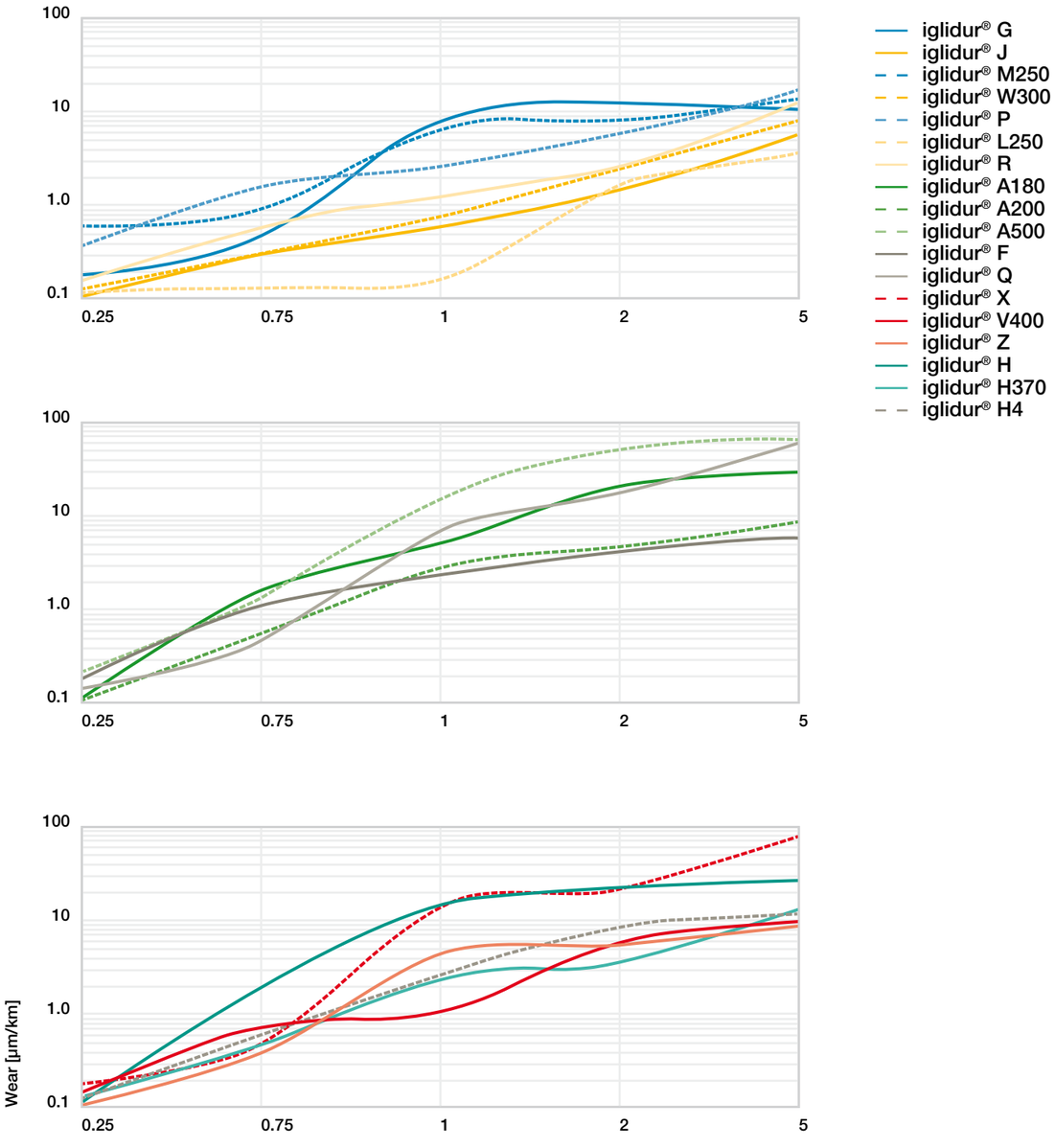


Diagram 04: Wear of iglidur® plain bearings under medium and high pressures

Pressure and wear

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].



Diagrams 05-07: Wear of iglidur® plain bearings under low pressures

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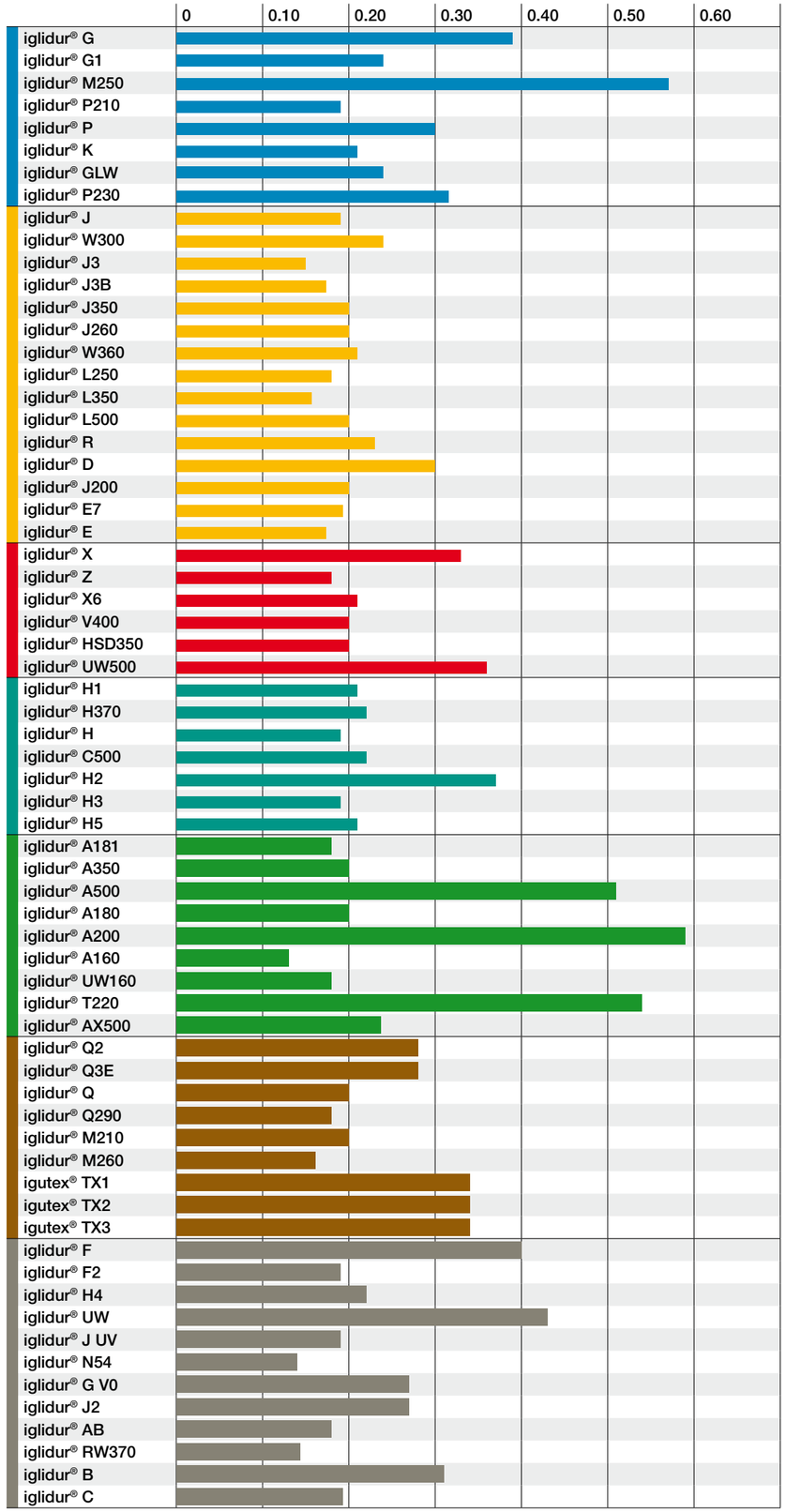
iglidur® | Technical data

Pressure and coefficient of friction



With increasing load, the coefficient of friction of the plain bearing typically decreases. In this context, shaft materials and the surface finish are also significant.

▶ Coefficient of friction, **page 51**

Diagram 08: Coefficient of friction of iglidur® materials with Cf53 shaft, rotating

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Surface Speed

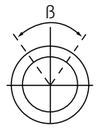
The peripheral speed is always significant in plain bearings. The absolute speed is not crucial, but the relative speed between the shaft and the bearing. The surface speed is expressed in meters per second [m/s] and calculated from the speed n [rpm] with the following formula.
With varying speeds for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

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. Table 01 shows the permissible surface speed of iglidur® plain bearings for rotating, pivoting, and linear movements. These surface speeds are limit values assuming minimal pressure loading of the bearing. In practice, these limit values are rarely reached due to an inverse relationship between load and speed. 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. Diagram 08 shows this relationship by using the example of a steel shaft (Cf53) with a load of 0.7MPa.

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. You'll find a detailed list of chemical resistances in the rear of the catalogue.

▶ Chemical table, **page 1170**

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	Hydro-carbons	Greases, oils, without additives	Weak acids	Weak 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® P230	+	+	+	+
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® L350	+ up to 0	+	+	+
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	+	+	+	+

Material	Hydro-carbons	Greases, oils, without additives	Weak acids	Weak alkalines
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	–	+	+	+
iglidur® B	–	–	0 up to –	–
iglidur® C	+	+	0 up to –	+

Table 05: Chemical resistance of iglidur® materials
+ resistant 0 conditionally resistant – not resistant
All data given at room temperature [+20°C]

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 service time.

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 operating time and dwell times. The different curves of diagram 09 represent different ratios (3x means that the dwell time is three times longer than the operating time).

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. Table 02 shows the correction factors for **pv value** using lubrication.

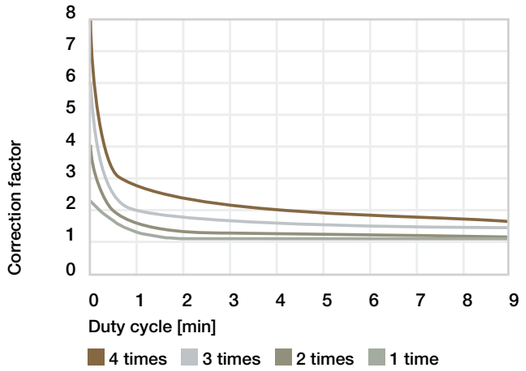


Diagram 09: Correction factor for p · v

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

Table 02: Correction of the tolerated pv value by means of lubrication

Material	Thermal conductivity [W/m · k]
Steel	46
Aluminium	204
Grey cast iron	58
304 stainless steel	16
Ceramics	1.4
Polymer	0.24

Table 03: Heat conductivity values of shaft or housing materials

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.

pv value

$$pv_{perm.} = \left(\frac{[K1 \cdot \pi \cdot \lambda k \cdot \Delta T]}{\mu \cdot s} + \frac{[K2 \cdot \pi \cdot \lambda s \cdot \Delta T]}{\mu \cdot b1 \cdot 2} \right) \cdot 10^{-3}$$

In these equations:

K1, K2	=	Constant for heat dissipation (K1 = 0.5, K2 = 0.042)
s	=	Bearing wall thickness mm
b1	=	Bearing length mm
μ	=	Coefficient of friction
λs	=	Thermal conductivity of the shaft
λk	=	Thermal conductivity of the bearing
ΔT	=	$(T_a - T_u)$
T_u	=	Ambient temperature [°C]
T_a	=	Max. application temperature [°C]

Picture 05: More cost-effective products - a crucial component: the largest test laboratory in the industry. 3,800m² laboratory, over 12,000 tests and two billion test strokes a year.

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.

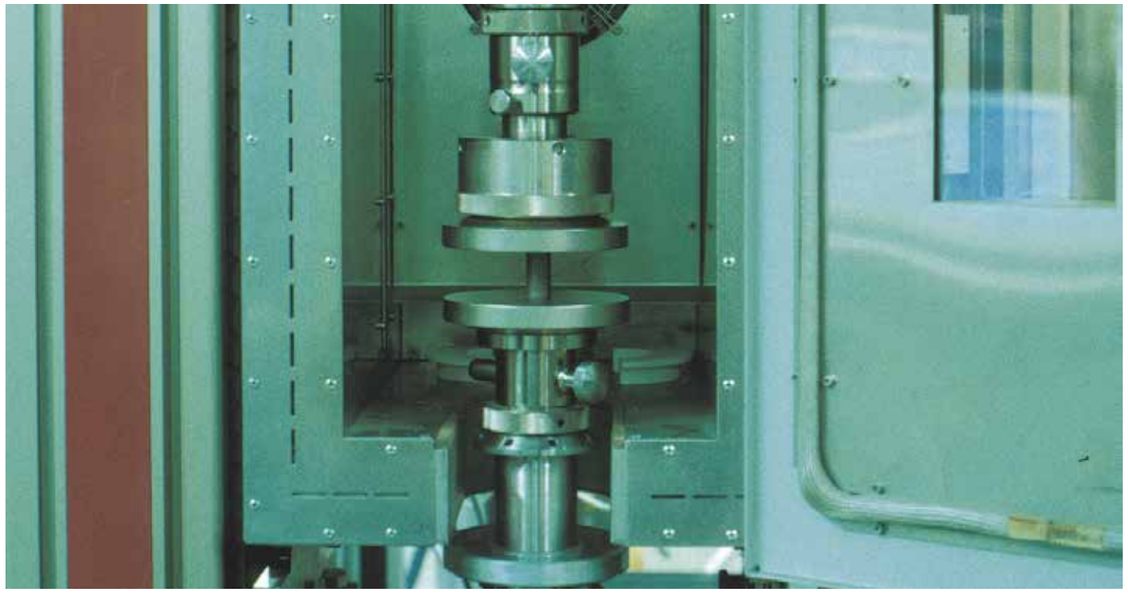
If the plain bearings are moved axially or axial forces occur, there is more opportunity for the bearing to lose press-fit. In these cases, axial securing of the bearing is necessary in addition to the press-fit. The table 04 shows the temperature at which additional securing of the iglidur® plain bearing is required, even under low axial loads. The greater the forces, the more reasons to engage such a fastening.

Temperature and load

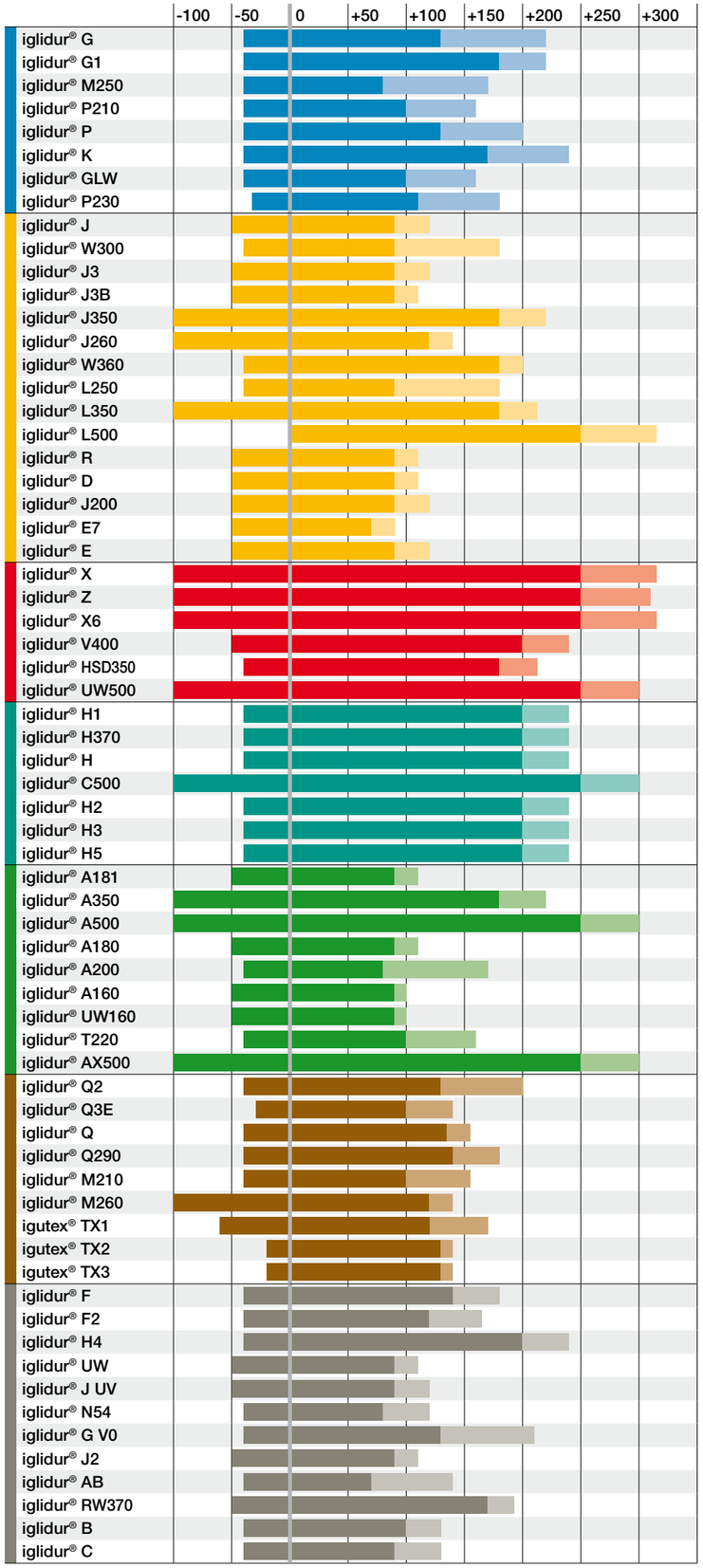
The diagrams 02 and 03 (▶ **Page 45**) show the maximum recommended surface pressure [p] of the iglidur® plain bearings as a function of temperature. With increasing temperature, this value decreases continuously. With plain bearings it is important to note that, due to the friction, the bearing temperature 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. The coefficient of thermal expansion of iglidur® plain bearings was examined for significant temperature ranges and the results are given in the individual materials tables, at the start of each chapter.



Picture 06: Material tests are possible up to +250°C



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® P230	+100
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® L350	+140
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
iglidur® B	+50
iglidur® C	+40

Diagram 10 (left): Comparison of the continuous and short-term upper application temperature limits [°C].
Table 04 (right): Temperature at which additional securing of the iglidur® plain bearing is required

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.

▶ Shaft materials, **page 56**

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.

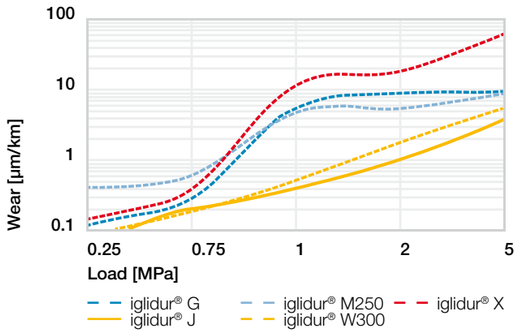


Diagram 11: Wear of iglidur® plain bearings under low pressures, Cf53 shaft, v = 0.1m/s

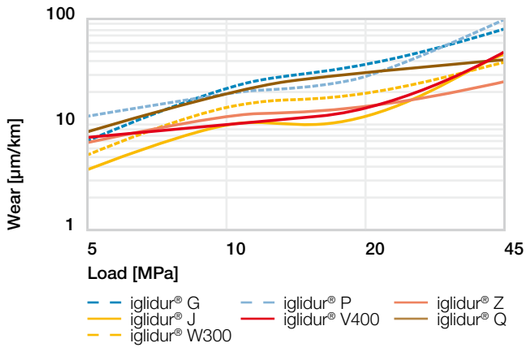


Diagram 12: Wear of iglidur® plain bearings at medium and high pressures, shaft: Cf53, v = 0.1m/s

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.

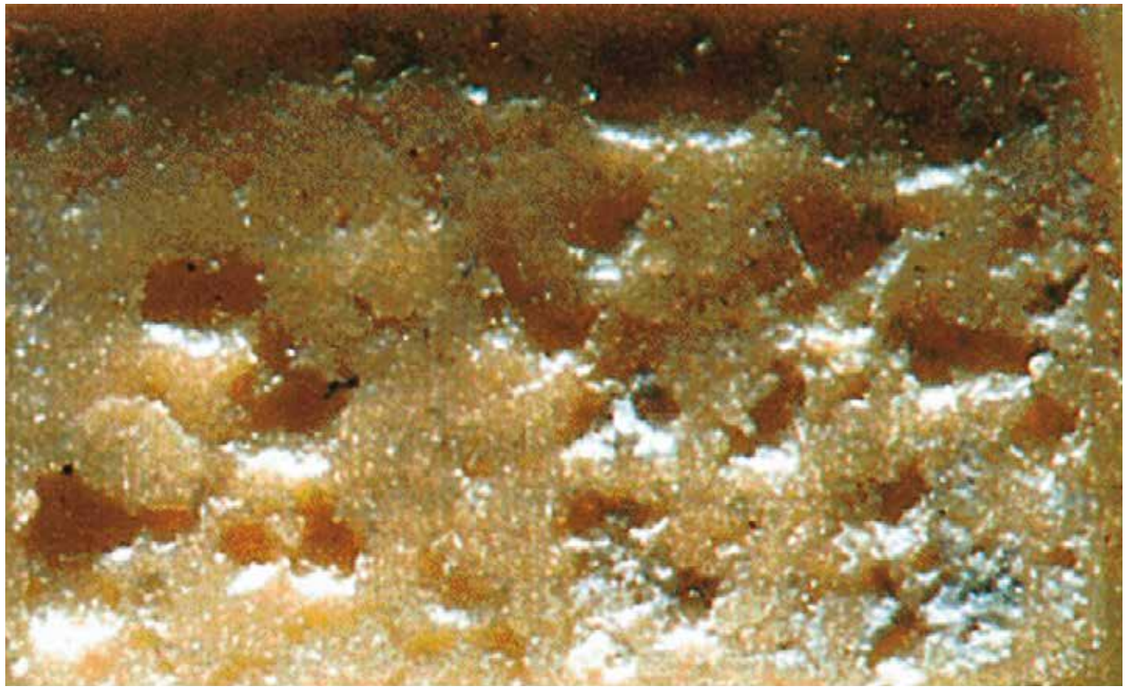
Wear and surfaces

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.

Picture 07: High wear resistance: plain bearing in permanent contact with sand

Picture 8: Wear experiments with aluminium shafts



Picture 9: Erosion damage due to shafts that are too smooth

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.

▶ Coefficient of friction, **page 51**
▶ Wear resistance, **page 54**

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.

Picture 10: Pivoting wear test rig for testing the wear in pivoting movements at low loads

Picture 11: Pivoting wear test rig for testing the wear in pivoting movements at medium loads

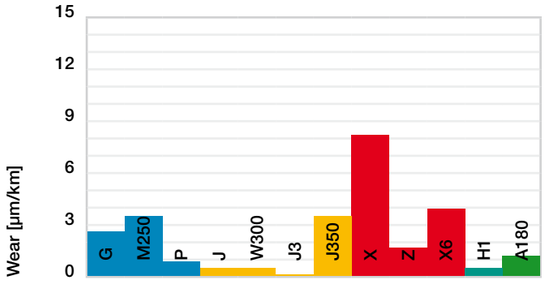


Diagram 13: Wear with Cf53 shaft, p = 1MPa, v = 0.30m/s, Ra = 0.20µm

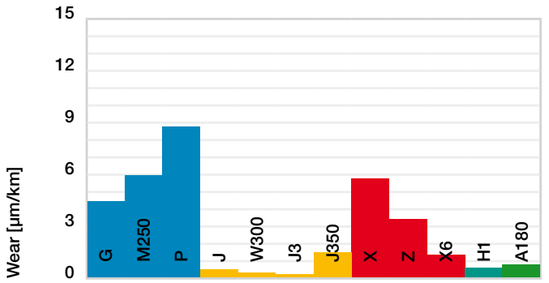


Diagram 14: Wear with 304 stainless steel shaft, p = 1MPa, v = 0.30m/s, Ra = 0.20µm

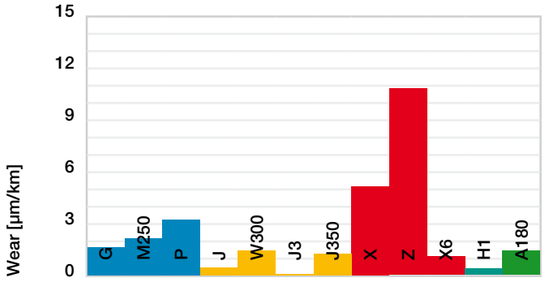


Diagram 15: Wear with HR carbon steel shaft, p = 1MPa, v = 0.30m/s, Ra = 0.20µm

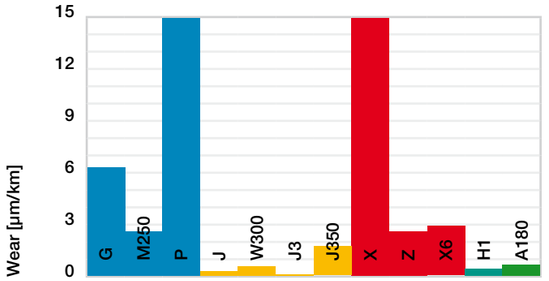


Diagram 16: Wear with Cf53 hard-chromed shaft, p = 1MPa, v = 0.30m/s, Ra = 0.20µm

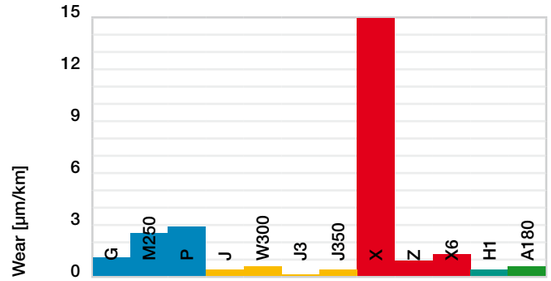


Diagram 17: Wear with hard-anodised aluminium shaft, p = 1MPa, v = 0.30m/s, Ra = 0.20µm

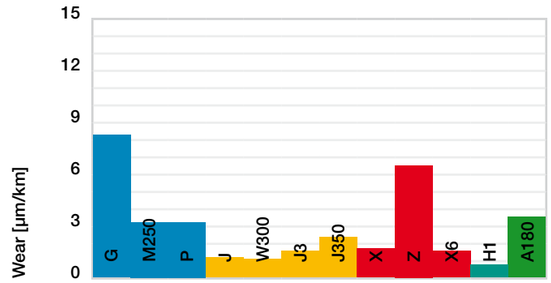


Diagram 18: Wear with free cutting steel shaft, p = 1MPa, v = 0.30m/s, Ra = 0.20µm

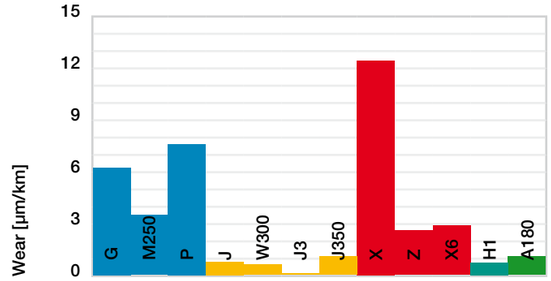


Diagram 19: Wear with high grade steel shaft, p = 1MPa, v = 0.30m/s, Ra = 0.20µm

Resistance to weathering

Radioactive radiation

A comparison of the resistance to radioactive radiation is shown in table 06. iglidur® X, UW500 and Z are by far the most resistant materials.

Resistance to weathering

The UV resistance is an important measure that states whether a material is affected by UV radiation. The effects can extend from slight changes in colour to brittleness of the material. A comparison of the materials to each other is shown in table 08. The results show that iglidur® plain bearings are suitable for outside use. Only for a few iglidur® materials are any changes expected.

Vacuum

iglidur® plain bearings can be used in a vacuum to a limited extent. Only a small amount of outgassing takes place. In most iglidur® plain bearings, the outgassing does not change the material properties. Generally, materials with low moisture absorption are recommended.

Electrical properties

In the product range of the maintenance-free, self-lubricating iglidur® plain bearings, there are both insulating as well as electrically conductive materials. The electrical properties are given in detail in the individual material descriptions. Table 07 compares the surface resistance of "conductive" iglidur® plain bearings. The iglidur® plain bearings not mentioned here are usually electrically insulating. Please observe that for some materials the properties can be changed by the absorption of moisture. In experiments, it should be tested whether the required properties are also stable when the conditions are changing.

Material	Surface resistance [Ω]
iglidur® X	$< 10^3$
iglidur® X6	$< 10^5$
iglidur® UW500	$< 10^9$
iglidur® H	$< 10^2$
iglidur® H370	$< 10^5$
iglidur® F	$< 10^2$
iglidur® F2	$< 10^9$
iglidur® UW	$< 10^5$
iglidur® AX500	10^5 - 10^{11}

Table 07: Electrical properties of conductive iglidur® plain bearings

Material	Radiation resistance
X, Z, UW500, A160	$1 \cdot 10^5$ Gy
X6, A500	$2 \cdot 10^5$ Gy
M250, J3, A200, N54	$1 \cdot 10^4$ Gy
L250	$3 \cdot 10^4$ Gy
V400, C	$2 \cdot 10^4$ Gy
P, K	$5 \cdot 10^2$ Gy
G, G1, J, W300, P210, P230, J260, J200, R, D, C500, A180, UW160, T220, F, F2, Q, Q2, UW, G V0, J2, B, GLW, L500, Q290, AB, J UV, Q3E, E7, J3B, E, AX500, M210, M260	$3 \cdot 10^2$ Gy
J350, H, H1, H370, H2, H4, A181, A350, W360, H3, H5	$2 \cdot 10^2$ Gy

Table 06: Comparison of the radiation resistance of iglidur® plain bearings

Material	Resistance to weathering
iglidur® G	4
iglidur® G1	n.s.
iglidur® M250	2
iglidur® P210	5
iglidur® P	5
iglidur® K	4
iglidur® GLW	4
iglidur® P230	n.s.
iglidur® J	4
iglidur® W300	3
iglidur® J3	4
iglidur® J3B	n.s.
iglidur® J350	5
iglidur® J260	5
iglidur® W360	4
iglidur® L250	3
iglidur® L350	n.s.
iglidur® L500	5
iglidur® R	4
iglidur® D	5
iglidur® J200	4
iglidur® E7	5
iglidur® E	4
iglidur® X	5
iglidur® Z	5
iglidur® X6	5
iglidur® V400	5
iglidur® HSD350	5
iglidur® UW500	5
iglidur® H1	5
iglidur® H370	5
iglidur® H	5

Material	Resistance to weathering
iglidur® C500	4
iglidur® H2	5
iglidur® H3	5
iglidur® H5	5
iglidur® A181	4
iglidur® A350	5
iglidur® A500	2
iglidur® A180	1
iglidur® A200	1
iglidur® A160	5
iglidur® UW160	5
iglidur® T220	4
iglidur® AX500	2
iglidur® Q2	5
iglidur® Q3E	n.s.
iglidur® Q	4
iglidur® Q290	1
iglidur® M210	5
iglidur® M260	5
iglidur® F	3
iglidur® F2	4
iglidur® H4	5
iglidur® UW	3
iglidur® J UV	5
iglidur® N54	4
iglidur® G V0	4
iglidur® J2	3
iglidur® AB	3
iglidur® RW370	5
iglidur® B	3
iglidur® C	3

Table 08: UV resistance of iglidur® plain bearings, 1 low resistance, 5 highest resistance
Determination of bending specifications according to DIN EN ISO 178 after weathering with double stroke 4 of ASTM G154. Two alternating statuses (total time: 2,000hrs). Status 1: Irradiation with UVA-340, irradiance 1.55W/m2/nm and 70°C for 8hrs. Status 2: no irradiation, condensation at 50°C for 4hrs.

Assembly instructions

iglidur® plain bearings are press-fit bearings. The inner diameter adjusts only after press-fit in the proper housing hole with a recommended (H7) tolerance. The press-fit excess dimension can be up to 2% of the inner diameter. This ensures the secure press-fitting of the bearing. Axial or radial movement in the housing are also prevented this way. The hole in the housing should be made with the recommended tolerance (H7) for all bearings and be smooth, flat and chamfered. The bearing should be press-fitted using a flat press. The use of centring or calibrating pins can cause damage to the bearings and bring a greater amount of clearance.

Picture 12: The bearing should be press-fitted using a flat press

Adhesion

It is not usually necessary to use an adhesive to fit the bearing. If a bearing is likely to lose its firm fit on account of high temperatures, a more temperature-resistant plain bearing should be used. If, however, there are plans to secure the bearings with adhesive, it will be necessary to perform suitable tests in each case. It is not possible to simply transfer the successful results seen in other applications.

Machining

iglidur® plain bearings are delivered ready-to-fit. The extensive product line makes it possible to use a standard dimension in most cases. If for some reason, a subsequent machining of the plain bearing is necessary, the adjacent table shows the machining standard values. The subsequent machining of the sliding surfaces is to be avoided if possible. Higher wear rate is most often the result.
An exception is iglidur® M250 which is suitable for subsequent machining. In other iglidur® plain bearings, disadvantages of a sliding surface machining can be counteracted by lubrication during installation.

Process	Turning	Drilling	Milling
Tool material	Stainless steel	Stainless steel	Stainless steel
Feed [mm]	0.1…0.5	0.1…0.5	up to 0.5
Clearance angle	5…15	10…12	3
Rake angle	0…10	3…5	
Cutting speed [m/min]	200…500	50…100	up to 1,000

Table 09: Guidelines for machining

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 imperative. Plain bearings with low moisture absorption can be designed with a minimal amount of bearing clearance. For wall thickness, the rule is: the thicker the bearings are, the larger the tolerances 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.

Picture 13: measurement of the inner diameter of a press-fit plain bearing

Testing methods

iglidur® plain bearings are press-fit bearings for housings with a H7 standard hole. This press-fitting of the bearing fixes the bearing in the housing, and the inner diameter of the plain bearing is also formed upon press-fit.
The bearing size test is performed when the bearing is installed in a hole with the minimum specified dimension; both using a dial gauge and a plug gauge:

- The "Go-Side" of the plug gauge, pressed into the hole, must pass easily through the bearing
- With the 3 point probe, the inner diameter of the bearing must lie within the prescribed tolerance on the measurement plane (diagram 20)

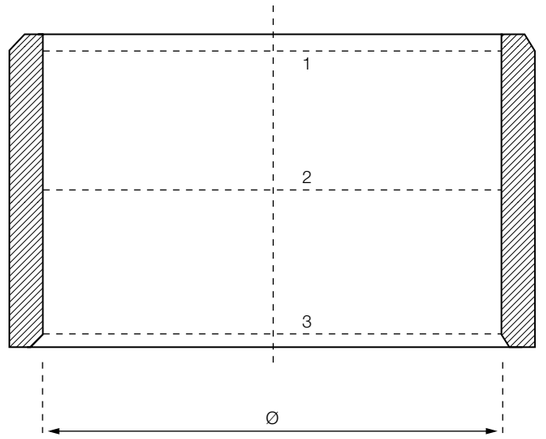


Diagram 20: Positions of the measurement lines

Troubleshooting

In spite of careful manufacturing and assembly of the bearings, differences and questions regarding the recommended installation heights and tolerances can result. For this reason, we have compiled a list of the most frequent reasons for differences. In many cases, with this troubleshooter, the reasons for the differences can be found quickly:

- The hole is not chamfered correctly, so the bearing material is removed upon press-fitting
- A centring pin was used which expanded the inside diameter of the bearing during press-fit
- The hole does not meet the recommended housing hole specifications (usually H7)
- The housing is made out of a soft material that was expanded by the bearing installation
- The shaft is not within recommended tolerances
- The measuring doesn't take place within the measuring lines

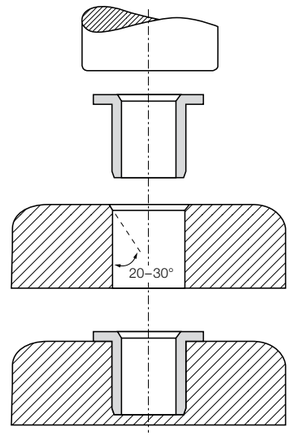


Diagram 21: Press-fit of the bearing (section view)

Tolerances

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 corresponding tolerances. For particular dimensions the tolerance differs depending on the wall thickness.

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

iglidur® | Calculation

Tolerances

Material	E10	E11	F10	D11
iglidur® G	●			
iglidur® G1			●	
iglidur® M250				●
iglidur® P210	●			
iglidur® P	●			
iglidur® K	●			
iglidur® GLW	●			
iglidur® P230	●			
iglidur® J	●			
iglidur® W300	●			
iglidur® J3	●			
iglidur® J3B	●			
iglidur® J350			●	
iglidur® J260	●			
iglidur® W360	●			
iglidur® L250	●			
iglidur® L350			●	
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			●	

Material	E10	E11	F10	D11
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			●	
iglidur® B				●
iglidur® C				●

Table 10: Tolerances of iglidur® plain bearing materials

igus® formulae

Surface pressure

Radial bearing:

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

Thrust bearing:

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

Surface Speed

Rotational movement:

$$v = \frac{n \cdot d1 \cdot \pi}{60 \cdot 1{,}000} \left[\frac{m}{s}\right]$$

Pivoting movement:

$$v = d1 \cdot \pi \cdot \frac{2 \cdot \beta}{360} \cdot \frac{f}{1{,}000} \left[\frac{m}{s}\right]$$

pv value

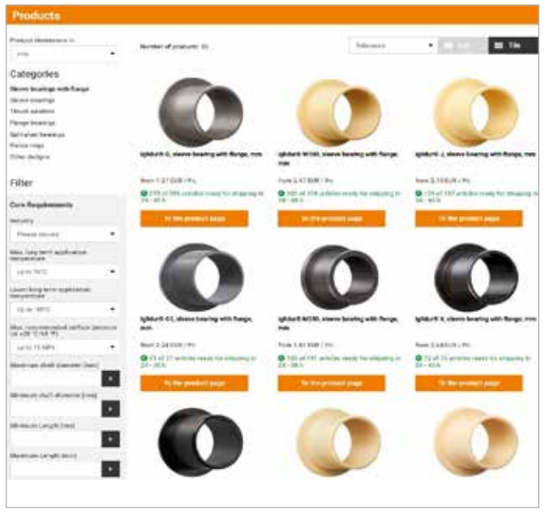
$$pv_{perm.} = \left(\frac{[K1 \cdot \pi \cdot \lambda k \cdot \Delta T]}{\mu \cdot s} + \frac{[K2 \cdot \pi \cdot \lambda s \cdot \Delta T]}{\mu \cdot b1 \cdot 2}\right) \cdot 10^{-3}$$

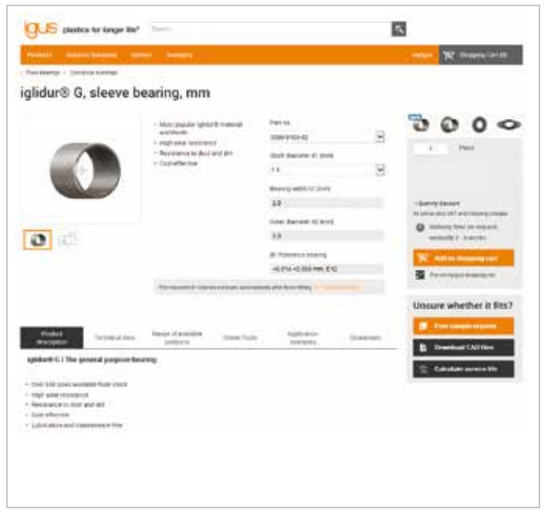
Friction force

$$F_R = \mu \cdot F$$

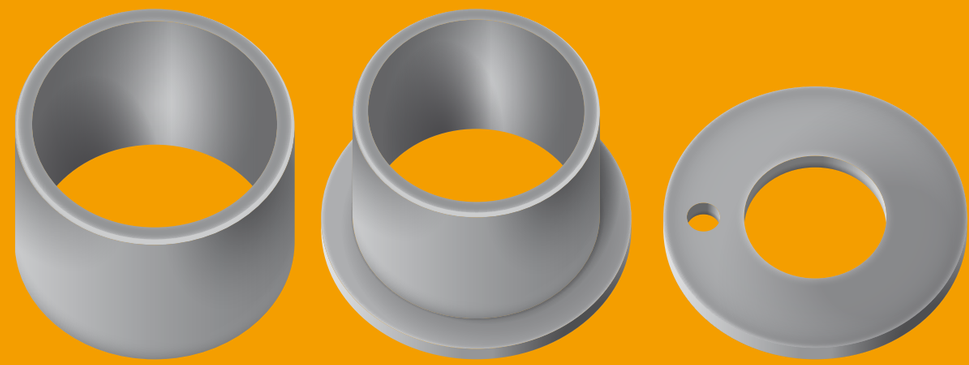
Short cuts and formulae for polymer plain bearings			
F	=	Load	[N]
F_R	=	Friction force	[N]
$d1$	=	Inner diameter of the bearing	[mm]
$b1$	=	Bearing length	[mm]
$d2$	=	Outer diameter of the bearing	[mm]
p	=	Surface pressure	[N/mm²]
v	=	Surface Speed	[m/s]
n	=	Revolutions per minute	
β	=	Angle	[°]
f	=	Frequency in Hertz	
$K1, K2$	=	Constant for heat dissipation	
		(K1 = 0.5 K2 = 0.042)	[N]
s	=	Bearing wall thickness	[mm]
μ	=	Coefficient of friction	
λs	=	Thermal conductivity of the shaft	
λk	=	Thermal conductivity of the bearing	
ΔT	=	$(T_a - T_u)$	
T_u	=	Ambient temperature	[°C]
T_a	=	Max. Application temperature	[°C]

Quicklinks





Quicklinks for more information and additional features on each page. Visit directly your chosen product online, e.g. ▶www.igus.eu/G and you'll find more details, 3D CAD files, DXF files, PDF downloads, application examples and many more for your chosen igus® product.



iglidur® standards: more than 1,900 parts from stock

- Choice of 17 standard iglidur® materials
- For shaft sizes up to 50mm according to ISO 3547-1
- Lubrication and maintenance-free
- Calculate service life online

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iglidur® standards | Materials overview

iglidur® plain bearings: all-rounder

Materials for general purpose

The classic all-rounder: iglidur® G
▶ Page 85

More universal: iglidur® G1
▶ Page 101

The robust all-rounder according to ISO 2795: iglidur® M250
▶ Page 111

Specialist for pivoting, rolling applications and more: iglidur® P210
▶ Page 121

The cost-effective outdoor all-rounder: iglidur® P
▶ Page 135

iglidur® plain bearings: endurance runner

Materials for long service life

The versatile endurance runner: iglidur® J
▶ Page 163

The classic endurance runner up to 30MPa: iglidur® W300
▶ Page 175

Specialist for pivoting and pulsating loads: iglidur® J3
▶ Page 187

Endurance runner with high dimensional stability at high temperature: iglidur® J350
▶ Page 203

iglidur® plain bearings: high temperature

Materials for use at high temperatures

The chemical and temperature specialist: iglidur® X
▶ Page 291

Long service life under extreme conditions: iglidur® Z
▶ Page 301

iglidur® plain bearings: high media resistance

Materials with good media resistance

Endurance runner with high media resistance: iglidur® H1
▶ Page 345

Long service life under water: iglidur® H370
▶ Page 353

iglidur® plain bearings: for contact with food

Materials for contact with food

The universal bearing for food contact: iglidur® A181
▶ Page 401

The endurance runner at higher temperatures in the food sector: iglidur® A350
▶ Page 409

The media and temperature specialist in the food sector: iglidur® A500
▶ Page 417

iglidur® plain bearings: for harsh environments

Materials for harsh environments

The durable heavy-duty bearing: iglidur® Q2
▶ Page 477

The most suitable bearing for any application

The iglidur® standard product range now features standardisation for the main materials with the most common standard dimensions (up to a 50mm shaft diameter) - with or without flange. This means that the standard catalogue range offers more than 1,900 dimensions. Finding, calculating and ordering the most suitable plain bearing for your application that is guaranteed to work has never been easier; for (virtually) any application from high-temperature to salt water, from food to automotive.

- Lubrication and maintenance-free
- Calculate service life online
- No minimum order quantities, no surcharges
- No minimum order quantity
- More than 1,900 dimensions

iglidur® G - the classic all-rounder
Excellent price-performance ratio
▶ Page 85

Temperature [°C] [123]	+130	– +
Surface pressure [MPa] [124]	80	– +
Coefficient of friction [µ] [125]	0.22	– +
Wear [µm/km] [125]	1.75	– +
Price index		– +

iglidur® G1 - more universal
The advanced development of iglidur® G
▶ Page 101

Temperature [°C] [123]	+180	– +
Surface pressure [MPa] [124]	91	– +
Coefficient of friction [µ] [125]	0.11	– +
Wear [µm/km] [125]	0.76	– +
Price index		– +

iglidur® M250 - the robust all-rounder according to ISO 2795
Excellent vibration dampening
▶ Page 111

Temperature [°C] [123]	+80	– +
Surface pressure [MPa] [124]	20	– +
Coefficient of friction [µ] [125]	0.56	– +
Wear [µm/km] [125]	2.10	– +
Price index		– +

iglidur® P210 - specialist for pivoting, rolling applications and more
Low coefficient of friction and wear on almost every shaft ▶ Page 121

Temperature [°C] [123]	+100	– +
Surface pressure [MPa] [124]	50	– +
Coefficient of friction [µ] [125]	0.17	– +
Wear [µm/km] [125]	0.38	– +
Price index		– +

iglidur® P - the cost-effective outdoor all-rounder
No moisture absorption even with high ambient humidity
▶ Page 135

Temperature [°C] [123]	+130	– +
Surface pressure [MPa] [124]	50	– +
Coefficient of friction [µ] [125]	0.24	– +
Wear [µm/km] [125]	1.80	– +
Price index		– +

iglidur® J - the versatile endurance runner
Strong performer on most shafts, very low coefficient of friction
▶ Page 163

Temperature [°C] [123]	+90	– +
Surface pressure [MPa] [124]	35	– +
Coefficient of friction [µ] [125]	0.16	– +
Wear [µm/km] [125]	0.29	- +
Price index		– +

iglidur® W300 - the classic endurance runner up to 30MPa
Excellent wear resistance on (virtually) all shafts
▶ Page 175

Temperature [°C] [123]	+90	– +
Surface pressure [MPa] [124]	60	– +
Coefficient of friction [µ] [125]	0.18	– +
Wear [µm/km] [125]	0.33	– +
Price index		– +

[123] Max. long-term application temperature; [124] Max. permissible surface pressure at +20°C; [125] Best combination for p = 1MPa, v = 0.3m/s, rotating

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iglidur® J3 - the new endurance runner: specialist for pivoting and pulsating loads
Up to 10MPa up to three times more wear-resistant than iglidur® J ▶ Page 187

Temperature [°C] [123]	+90	– +
Surface pressure [MPa] [124]	45	– +
Coefficient of friction [µ] [125]	0.13	– +
Wear [µm/km] [125]	0.07	– +
Price index		– +

iglidur® J350 - endurance runner with high dimensional stability at high temperature
Can be used with many kinds of shafts and loads
▶ Page 203

Temperature [°C] [123]	+180	– +
Surface pressure [MPa] [124]	60	– +
Coefficient of friction [µ] [125]	0.16	– +
Wear [µm/km] [125]	1.14	– +
Price index		– +

iglidur® X - the chemical and temperature specialist
Up to 150MPa
▶ Page 291

Temperature [°C] [123]	+250	– +
Surface pressure [MPa] [124]	150	– +
Coefficient of friction [µ] [125]	0.31	– +
Wear [µm/km] [125]	6.30	– +
Price index		– +

iglidur® Z - long service life under extreme conditions
Resistant to wear and impact even at high loads and temperatures ▶ Page 301

Temperature [°C] [123]	+250	– +
Surface pressure [MPa] [124]	150	– +
Coefficient of friction [µ] [125]	0.18	– +
Wear [µm/km] [125]	1.00	– +
Price index		– +

iglidur® H1 - endurance runner with high media resistance
Excellent coefficient of friction and wear
▶ Page 345

Temperature [°C] [123]	+200	– +
Surface pressure [MPa] [124]	80	– +
Coefficient of friction [µ] [125]	0.17	– +
Wear [µm/km] [125]	0.29	– +
Price index		– +

iglidur® H370 - long service life under water
High media resistance
▶ Page 353

Temperature [°C] [123]	+200	– +
Surface pressure [MPa] [124]	75	– +
Coefficient of friction [µ] [125]	0.17	– +
Wear [µm/km] [125]	1.20	– +
Price index		– +

iglidur® A181 - the universal bearing for food contact
FDA- and EU10/2011-compliant
▶ Page 401

Temperature [°C] [123]	+90	– +
Surface pressure [MPa] [124]	31	– +
Coefficient of friction [µ] [125]	0.18	– +
Wear [µm/km] [125]	0.48	– +
Price index		– +

iglidur® A350 - the endurance runner at higher temperatures in the food sector
FDA- and EU10/2011-compliant, extremely wear-resistant ▶ Page 409

Temperature [°C] [123]	+180	– +
Surface pressure [MPa] [124]	60	– +
Coefficient of friction [µ] [125]	0.17	– +
Wear [µm/km] [125]	1.79	– +
Price index		– +

iglidur® A500 - the media and temperature specialist in the food sector
FDA- and EU10/2011-compliant, extremely wear-resistant for high temperatures ▶ Page 417

Temperature [°C] [123]	+250	– +
Surface pressure [MPa] [124]	120	– +
Coefficient of friction [µ] [125]	0.36	– +
Wear [µm/km] [125]	4.10	– +
Price index		– +

iglidur® Q2 - the durable heavy-duty bearing
Combined wear resistance and compressive strength at high loads
▶ Page 477

Temperature [°C] [123]	+130	– +
Surface pressure [MPa] [124]	120	– +
Coefficient of friction [µ] [125]	0.17	- +
Wear [µm/km] [125]	1.50	– +
Price index		– +

[123] Max. long-term application temperature; [124] Max. permissible surface pressure at +20°C; [125] Best combination for p = 1MPa, v = 0.3m/s, rotating

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iglidur® standards | Technical properties - quick selection

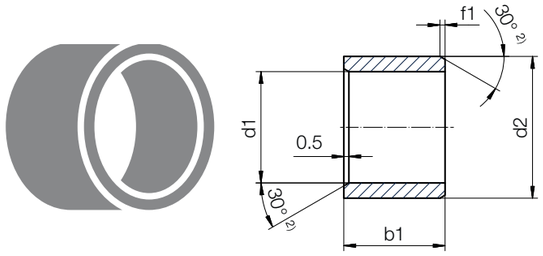
iglidur®	G	G1	M250	P210	P	J	W300	J3	J350	X	Z	H1	H370	A181	A350	A500	Q2
Installation tolerances	E10	E10	D11	E10	E10	E10	E10	E10	F10	F10	F10	F10	F10	E10	F10	F10	E10
Descriptive technical specifications																	
Wear resistance at +23°C																	
Wear resistance at +90°C																	
Wear resistance at +150°C																	
Slide property																	
Wear resistance under water																	
Media resistance																	
Resistant to edge pressures																	
Resistant to shock and impact loads																	
Dirt resistance																	
For high loads (>60MPa)	●	●							●	●	●	●	●		●	●	●
Electrically conductive										●			●				
Approvals and standards																	
Dimensions in accordance with DIN	ISO 3547	ISO 3547	ISO 2795	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547	ISO 3547
FDA- and EU10/2011-compliant														●	●	●	
Fire class in accordance with UL-94	HB	HB	V-2	HB	HB	HB	HB	HB	V-0	V-0	V-0	V-0	V-0	HB	V-0	V-1	HB
Mould test DIN EN ISO 846	●	●				●			●	●		●					
Fogging DIN 75201-B	●		●	●													
Availabilities / variants																	
Type S, sleeve	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Type F, with flange	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Type T, thrust washer	●		●			●	●			●	●						
Bar stock, round bar / tube			●	●		●	●	●	●	●		●		●	●		
Bar stock, plate						●									●		
Machined made from bar stocks			●	●		●	●	●	●	●		●		●	●		

iglidur® standards | Material properties table

iglidur®	Unit	G	G1	M250	P210	P	J	W300	J3	J350	X	Z	H1	H370	A181	A350	A500	Q2
General properties																		
Density	[g/cm³]	1.46	1.58	1.14	1.40	1.58	1.49	1.24	1.42	1.44	1.44	1.4	1.53	1.66	1.38	1.42	1.28	1.46
Colour																		
Max. moisture absorption at +23°C and 50% relative humidity	[% weight]	0.7	0.2	1.4	0.3	0.2	0.3	1.3	0.3	0.3	0.1	0.3	0.1	0.1	0.2	0.6	0.3	1.1
Max. moisture absorption	[% weight]	4.0	1.7	7.6	0.5	0.4	1.3	6.5	1.3	1.6	0.5	1.1	0.3	0.1	1.3	1.9	0.5	4.6
Coefficient of sliding friction, dynamic against steel	[µ]	0.08 - 0.15	0.08 - 0.15	0.18 - 0.40	0.07 - 0.19	0.06 - 0.21	0.06 - 0.18	0.08 - 0.23	0.06 - 0.20	0.10 - 0.20	0.09 - 0.27	0.06 - 0.14	0.06 - 0.20	0.07 - 0.17	0.10 - 0.21	0.10 - 0.20	0.26 - 0.41	0.22 - 0.42
pv value, max. (dry)	[MPa·m/s]	0.42	0.60	0.12	0.4	0.39	0.34	0.23	0.5	0.45	1.32	0.84	0.80	0.74	0.31	0.40	0.28	0.7
Mechanical properties																		
Flexural modulus	[MPa]	7,800	11,486	2,700	2,500	5,300	2,400	3,500	2,700	2,000	8,100	2,400	2,800	11,100	1,913	2,000	3,600	8,370
Flexural strength at +20°C	[MPa]	210	178	112	70	120	73	125	70	55	170	95	55	135	48	110	140	240
Compressive strength	[MPa]	78	115	52	50	66	60	61	60	60	100	65	78	79	60	78	118	130
Max. permissible surface pressure at +20°C	[MPa]	80	91	20	50	50	35	60	45	60	150	150	80	75	31	60	120	120
Shore D hardness		81	81	79	75	75	74	77	73	80	85	81	77	82	76	76	83	80
Physical and thermal properties																		
Max. continuous operatingtemperature	[°C]	+130	+180	+80	+100	+130	+90	+90	+90	+180	+250	+250	+200	+200	+90	+180	+250	+130
Max. short-term operating temperature	[°C]	+220	+220	+170	+160	+200	+120	+180	+120	+220	+315	+310	+240	+240	+110	+210	+300	+200
Min. continuous operating temperature	[°C]	-40	-40	-40	-40	-40	-50	-40	-50	-100	-100	-100	-40	-40	-50	-100	-100	-40
Thermal conductivity	[W/m · K]	0.24	0.46	0.24	0.25	0.25	0.25	0.24	0.25	0.24	0.60	0.62	0.24	0.5	0.25	0.24	0.24	0.24
Coefficient of thermal expansion at +23°C	[$K^{-1} \cdot 10^{-5}$]	9	3.5	10	8	4	10	9	13	7	5	4	6	5	11	8	9	8
Electrical properties																		
Specific contact resistance	[Ωcm]	> 10^{13}	> 10^{9}	> 10^{13}	> 10^{12}	> 10^{13}	> 10^{13}	> 10^{13}	> 10^{12}	> 10^{13}	< 10^{5}	> 10^{11}	> 10^{12}	< 10^{5}	> 10^{12}	> 10^{11}	> 10^{14}	> 10^{13}
Surface resistance	[Ω]	> 10^{11}	> 10^{11}	> 10^{11}	> 10^{11}	> 10^{12}	> 10^{12}	> 10^{12}	> 10^{12}	> 10^{10}	< 10^{3}	> 10^{11}	> 10^{11}	< 10^{5}	> 10^{12}	> 10^{11}	> 10^{13}	> 10^{11}

iglidur® standards | Product range

Sleeve bearings (form S)



2) Thickness < 0.6mm: chamfer = 20°

Chamfer in relation to d1

d1 [mm]:	Ø 1-6	Ø 6-12	Ø 12-30	Ø > 30
f [mm]:	0.3	0.5	0.8	1.2

Order key

Type	Dimensions [mm]				
☐ S	M	-04	05	-04
iglidur® material	Form S	Metric	Inner Ø d1	Outer Ø d2	Length b1

Choose the suitable material and dimensions for your application

Dimensions according to ISO 3547-1
With the exception of iglidur® M250: ISO 2795

Imperial dimensions available
▶ From page 1096

G	The classic all-rounder
G1	More universal
M(250)	The robust all-rounder according to ISO 2795
P210	Specialist for pivoting, rolling applications and more
P	The cost-effective outdoor all-rounder
J	The versatile endurance runner
W(300)	The classic endurance runner up to 30MPa
J3	The new endurance runner: specialist for pivoting applications and pulsating loads
J350	Endurance runner with high dimensional stability at high temperature
X	The chemical and temperature specialist
Z	Long service life under extreme conditions
H1	Endurance runner with high media resistance
H370	Long service life under water
A181	The universal bearing for food contact
A350	The endurance runner at higher temperatures in the food sector
A500	The media and temperature specialist in the food sector
Q2	The durable heavy-duty bearing

Dimensions [mm]

d1 126)	d2	b1	Part No.
4	5.5	4	☐SM-0405-04
4	5.5	6	☐SM-0405-06
5	7	5	☐SM-0507-05
5	7	10	☐SM-0507-10
6	8	6	☐SM-0608-06
6	8	8	☐SM-0608-08
6	8	10	☐SM-0608-10
8	10	8	☐SM-0810-08
8	10	10	☐SM-0810-10
8	10	12	☐SM-0810-12
10	12	8	☐SM-1012-08
10	12	10	☐SM-1012-10
10	12	12	☐SM-1012-12
10	12	15	☐SM-1012-15
10	12	20	☐SM-1012-20
12	14	10	☐SM-1214-10
12	14	12	☐SM-1214-12
12	14	15	☐SM-1214-15
12	14	20	☐SM-1214-20
13	15	10	☐SM-1315-10
13	15	20	☐SM-1315-20
14	16	15	☐SM-1416-15
14	16	20	☐SM-1416-20
14	16	25	☐SM-1416-25
15	17	15	☐SM-1517-15
15	17	20	☐SM-1517-20
15	17	25	☐SM-1517-25
16	18	15	☐SM-1618-15
16	18	20	☐SM-1618-20
16	18	25	☐SM-1618-25
18	20	15	☐SM-1820-15
18	20	20	☐SM-1820-20
18	20	25	☐SM-1820-25
20	23	10	☐SM-2023-10
20	23	15	☐SM-2023-15
20	23	20	☐SM-2023-20
20	23	25	☐SM-2023-25
20	23	30	☐SM-2023-30
22	25	15	☐SM-2225-15
22	25	20	☐SM-2225-20

126) After being assembled into a nominal size housing, in standard cases the inner diameter automatically adjusts to the tolerances (more information in material specific chapters)

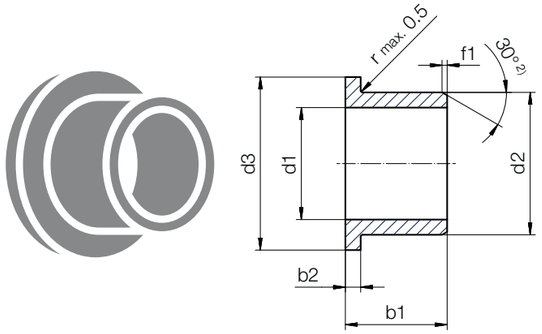
Dimensions [mm]

d1 126)	d2	b1	Part No.
22	25	25	☐SM-2225-25
22	25	30	☐SM-2225-30
24	27	15	☐SM-2427-15
24	27	20	☐SM-2427-20
24	27	25	☐SM-2427-25
24	27	30	☐SM-2427-30
25	28	15	☐SM-2528-15
25	28	20	☐SM-2528-20
25	28	25	☐SM-2528-25
25	28	30	☐SM-2528-30
28	32	20	☐SM-2832-20
28	32	25	☐SM-2832-25
28	32	30	☐SM-2832-30
30	34	20	☐SM-3034-20
30	34	25	☐SM-3034-25
30	34	30	☐SM-3034-30
30	34	40	☐SM-3034-40
32	36	20	☐SM-3236-20
32	36	30	☐SM-3236-30
32	36	40	☐SM-3236-40
35	39	20	☐SM-3539-20
35	39	30	☐SM-3539-30
35	39	40	☐SM-3539-40
35	39	50	☐SM-3539-50
40	44	20	☐SM-4044-20
40	44	30	☐SM-4044-30
40	44	40	☐SM-4044-40
40	44	50	☐SM-4044-50
45	50	20	☐SM-4550-20
45	50	30	☐SM-4550-30
45	50	40	☐SM-4550-40
45	50	50	☐SM-4550-50
50	55	20	☐SM-5055-20
50	55	30	☐SM-5055-30
50	55	40	☐SM-5055-40
50	55	50	☐SM-5055-50
50	55	60	☐SM-5055-60

126) After being assembled into a nominal size housing, in standard cases the inner diameter automatically adjusts to the tolerances (more information in material specific chapters)

iglidur® standards | Product range

Flange bearings (form F)



2) Thickness < 0.6mm: chamfer = 20°

Chamfer in relation to d1

d1 [mm]:	Ø 1-6	Ø 6-12	Ø 12-30	Ø > 30
f [mm]:	0.3	0.5	0.8	1.2

Order key

Type	Dimensions [mm]				
☐ F	M	-06	08	-04	
iglidur® material	Form F	Metric	Inner Ø d1	Outer Ø d2	Length b1

Choose the suitable material and dimensions for your application

Dimensions according to ISO 3547-1
With the exception of iglidur® M250: ISO 2795

Imperial dimensions available
▶ From page 1098

iglidur® standards | Product range

Absolute flexibility: all iglidur® standard sizes available from stock

G	The classic all-rounder
G1	More universal
M(250)	The robust all-rounder according to ISO 2795
P210	Specialist for pivoting, rolling applications and more
P	The cost-effective outdoor all-rounder
J	The versatile endurance runner
W(300)	The classic endurance runner up to 30MPa
J3	The new endurance runner: specialist for pivoting applications and pulsating loads
J350	Endurance runner with high dimensional stability at high temperature
X	The chemical and temperature specialist
Z	Long service life under extreme conditions
H1	Endurance runner with high media resistance
H370	Long service life under water
A181	The universal bearing for food contact
A350	The endurance runner at higher temperatures in the food sector
A500	The media and temperature specialist in the food sector
Q2	The durable heavy-duty bearing

Dimensions [mm]

d1 126)	d2	d3 d13	b1 h13	b2 h13	Part No.
6	8	12	4	1	☐FM-0608-04
6	8	12	8	1	☐FM-0608-08
8	10	15	5.5	1	☐FM-0810-05
8	10	15	7.5	1	☐FM-0810-07
8	10	15	9.5	1	☐FM-0810-09
10	12	18	7	1	☐FM-1012-07
10	12	18	9	1	☐FM-1012-09
10	12	18	12	1	☐FM-1012-12
10	12	18	17	1	☐FM-1012-17
12	14	20	7	1	☐FM-1214-07
12	14	20	9	1	☐FM-1214-09
12	14	20	12	1	☐FM-1214-12
12	14	20	17	1	☐FM-1214-17
14	16	22	12	1	☐FM-1416-12
14	16	22	17	1	☐FM-1416-17
15	17	23	9	1	☐FM-1517-09
15	17	23	12	1	☐FM-1517-12
15	17	23	17	1	☐FM-1517-17

126) After being assembled into a nominal size housing, in standard cases the inner diameter automatically adjusts to the tolerances (more information in material specific chapters)

Dimensions [mm]

d1 126)	d2	d3 d13	b1 h13	b2 h13	Part No.
16	18	24	12	1	☐FM-1618-12
16	18	24	17	1	☐FM-1618-17
18	20	26	12	1	☐FM-1820-12
18	20	26	17	1	☐FM-1820-17
18	20	26	22	1	☐FM-1820-22
20	23	30	11.5	1.5	☐FM-2023-11
20	23	30	16.5	1.5	☐FM-2023-16
20	23	30	21.5	1.5	☐FM-2023-21
25	28	35	11.5	1.5	☐FM-2528-11
25	28	35	16.5	1.5	☐FM-2528-16
25	28	35	21.5	1.5	☐FM-2528-21
30	34	42	16	2	☐FM-3034-16
30	34	42	26	2	☐FM-3034-26
35	39	47	16	2	☐FM-3539-16
35	39	47	26	2	☐FM-3539-26
40	44	52	30	2	☐FM-4044-30
40	44	52	40	2	☐FM-4044-40
45	50	58	50	2	☐FM-4550-50

126) After being assembled into a nominal size housing, in standard cases the inner diameter automatically adjusts to the tolerances (more information in material specific chapters)

Dimensions according to ISO 3547-1 and special dimensions

Imperial dimensions available

Order key

Type	Dimensions [mm]				
☐ T	M	-06	20	-015	
iglidur® material	Form T	Metric	Inner Ø d1	Outer Ø d2	Length b1

G	The classic all-rounder
W(300)	The classic endurance runner up to 30MPa
X	The chemical and temperature specialist

Choose the suitable material and dimensions for your application

Dimensions [mm]

d1 +0.25	d2 -0.25	s -0.05	d4 -0.12 +0.12	d5 +0.375 +0.125	h +0.2 -0.2	d6 +0.12	Part No.
6.0	20.0	1.5	13.0	1.5	1.0	20.0	☐TM-0620-015
8.0	18.0	1.5	13.0	1.5	1.0	18.0	☐TM-0818-015
10.0	18.0	1.0	[4]	[4]	0.7	18.0	☐TM-1018-010
12.0	24.0	1.5	18.0	1.5	1.0	24.0	☐TM-1224-015
14.0	26.0	1.5	20.0	2.0	1.0	26.0	☐TM-1426-015
15.0	24.0	1.5	19.5	1.5	1.0	24.0	☐TM-1524-015
16.0	30.0	1.5	22.0	2.0	1.0	30.0	☐TM-1630-015
18.0	32.0	1.5	25.0	2.0	1.0	32.0	☐TM-1832-015
20.0	36.0	1.5	28.0	3.0	1.0	36.0	☐TM-2036-015
22.0	38.0	1.5	30.0	3.0	1.0	38.0	☐TM-2238-015

[4] Design without fixing hole

Dimensions [mm]

d1 +0.25	d2 -0.25	s -0.05	d4 -0.12 +0.12	d5 +0.375 +0.125	h +0.2 -0.2	d6 +0.12	Part No.
24.0	42.0	1.5	33.0	3.0	1.0	42.0	☐TM-2442-015
26.0	44.0	1.5	35.0	3.0	1.0	44.0	☐TM-2644-015
28.0	48.0	1.5	38.0	4.0	1.0	48.0	☐TM-2848-015
32.0	54.0	1.5	43.0	4.0	1.0	54.0	☐TM-3254-015
38.0	62.0	1.5	50.0	4.0	1.0	62.0	☐TM-3862-015
42.0	66.0	1.5	54.0	4.0	1.0	66.0	☐TM-4266-015
48.0	74.0	2.0	61.0	4.0	1.5	74.0	☐TM-4874-020
52.0	78.0	2.0	65.0	4.0	1.5	78.0	☐TM-5278-020
62.0	90.0	2.0	76.0	4.0	1.5	90.0	☐TM-6290-020

[4] Design without fixing hole