1. iglidur®

Polymer bearings: oil-free solutions for all industries

...plastics

Application Examples: iglidur®

Exciting applications can be viewed online at ▶ **www.igus.co.uk/en/iglidur-applications**

SIX FLAGS THEME PARKS
(Rollercoaster)

Here iglidur® Z bearings led to significant reduction of the costs. This was achieved by eliminating the maintenance work completely during the season. With iglidur® Z bearings it is not necessary to check or relubricate the units and shafts. Also it was possible to reduce the weight.

SURGICAL LIGHT
The motor-powered swiveling LED wings are adjusted with the aid of iglidur® JVFM bearings. Lubrication- and maintenance-free.
(Trumpf iLED Medical Systems Inc.)

WASHING CHAIN BEARINGS
Reduction of the drive power for bottle washing machines by using iglidur® under the most difficult conditions in a 2–3 % caustic soda and temperature of +80 °C. (Krones AG)

SPREADERS
Main reasons for iglidur® bearings: The special design to complement the centrifugal arm results in a significant reduction of manufacturing costs. It is also maintenance-free and has high wear resistance.
(Fella Werke GmbH & Co. KG)

TOOL CHANGER CHAIN
Main reasons for iglidur® bearings: Enormous cost advantages in comparison to standard metallic rolled bearings as well as low coefficient of friction also with soft shaft materials.
(Deckel Maho Seebach GmbH)

AXLE BOX ARRANGEMENT
The edge load is usually a deciding factor for or against the use of bearings. iglidur® G bearings solve this, also giving high wear resistance, low costs, resistance to corrosion and dirt.
(Zunhammer GmbH Gülletechnik)

TUBULAR BAG MACHINES
The continuous operating temperature in the bonding arms frequently reach +160 °C and higher. These requirments are met by iglidur® Z bearings which also offer particularly high resistance to wear.
(Affeldt Verpackungsmaschinen GmbH)

iglidur® – Best Sellers from stock

Best Sellers
▶ from page 61

the most sold iglidur® bearing worldwide – iglidur® G
▶ page 65

Low friction, low wear
iglidur® J
▶ page 93

Excellent vibration dampening
iglidur® M250
▶ page 111

Low wear on all shafts
iglidur® W300
▶ page 135

iglidur® for all kind of applications – Standards and Specialists from stock

General Purpose
▶ from page 175

the most sold iglidur® bearing worldwide – iglidur® G
▶ page 65

Excellent vibration dampening
iglidur® M250
▶ page 111

Low water absorption
iglidur® P
▶ page 179

New!*

Flexible, wear resistant & more
iglidur® P210
▶ page 191

For Long Service Life
▶ from page 216

Low friction, low wear
iglidur® J
▶ page 93

Low wear on all shafts
iglidur® W300
▶ page 135

Ideal for plastic shafts
iglidur® J260
▶ page 221

Runs up to three times longer than iglidur® J
iglidur® J3
▶ page 231

High Temperatures
up to +250 °C
▶ from page 286

High temperatures, chemical resistance
iglidur® X
▶ page 157

Runs up to six times longer than iglidur® X
iglidur® X6
▶ page 291

For soft shafts, up to +200 °C
iglidur® V400
▶ page 301

For high dynamic loads, wear resistant
iglidur® Z
▶ page 311

High Media Resistance
temperatures up to +200 °C
▶ from page 332

High temperatures, chemical resistance
iglidur® X
▶ page 157

Universal
iglidur® H
▶ page 337

Long life operation
iglidur® H1
▶ page 349

For under water
iglidur® H370
▶ page 359

Applications with Food Contact
▶ from page 390

FDA general purpose
iglidur® A180
▶ page 395

FDA-compliant
iglidur® A200
▶ page 405

Temperature and wear resistant, FDA-compliant
iglidur® A350
▶ page 421

Temperature and chemical resistance, FDA-compliant
iglidur® A500
▶ page 431

Special Application Areas
▶ from page 458

Electrically conductive
iglidur® F
▶ page 463

The automotive standard
iglidur® H4
▶ page 475

For high loads
iglidur® Q
▶ page 485

New!*

For extreme loads
iglidur® Q2
▶ page 499

* in this catalog

High temperatures, chemical resistance
iglidur® X
▶ page 157

iglidur® Specialists on request

Versatile

iglidur® K
▶ page 199

Low-cost material for high quantities
iglidur® GLW
▶ page 209

high temperatures, versatile
iglidur® J350
▶ page 241

For high speeds
iglidur® L250
▶ page 251

Low-cost
iglidur® R
▶ page 261

Low-cost material with silicone
iglidur® D
▶ page 271

Specially for aluminum shafts
iglidur® J200
▶ page 279

For hot liquids

iglidur® UW500
▶ page 325

New!*

Up to 250 °C, wear resistant
iglidur® C500
▶ page 373

Low-cost

iglidur® H2
▶ page 383

Robust

iglidur® A290
▶ page 441

For the tobacco industry

iglidur® T220
▶ page 451

For fast rotation under water
iglidur® UW
▶ page 509

New!*

The biopolymer

iglidur® N54
▶ page 519

New!*

V0 rating according to UL94, universal
iglidur® G V0
▶ page 529

High elasticity

iglidur® B
▶ page 539

Free from PTFE and silicone
iglidur® C
▶ page 547

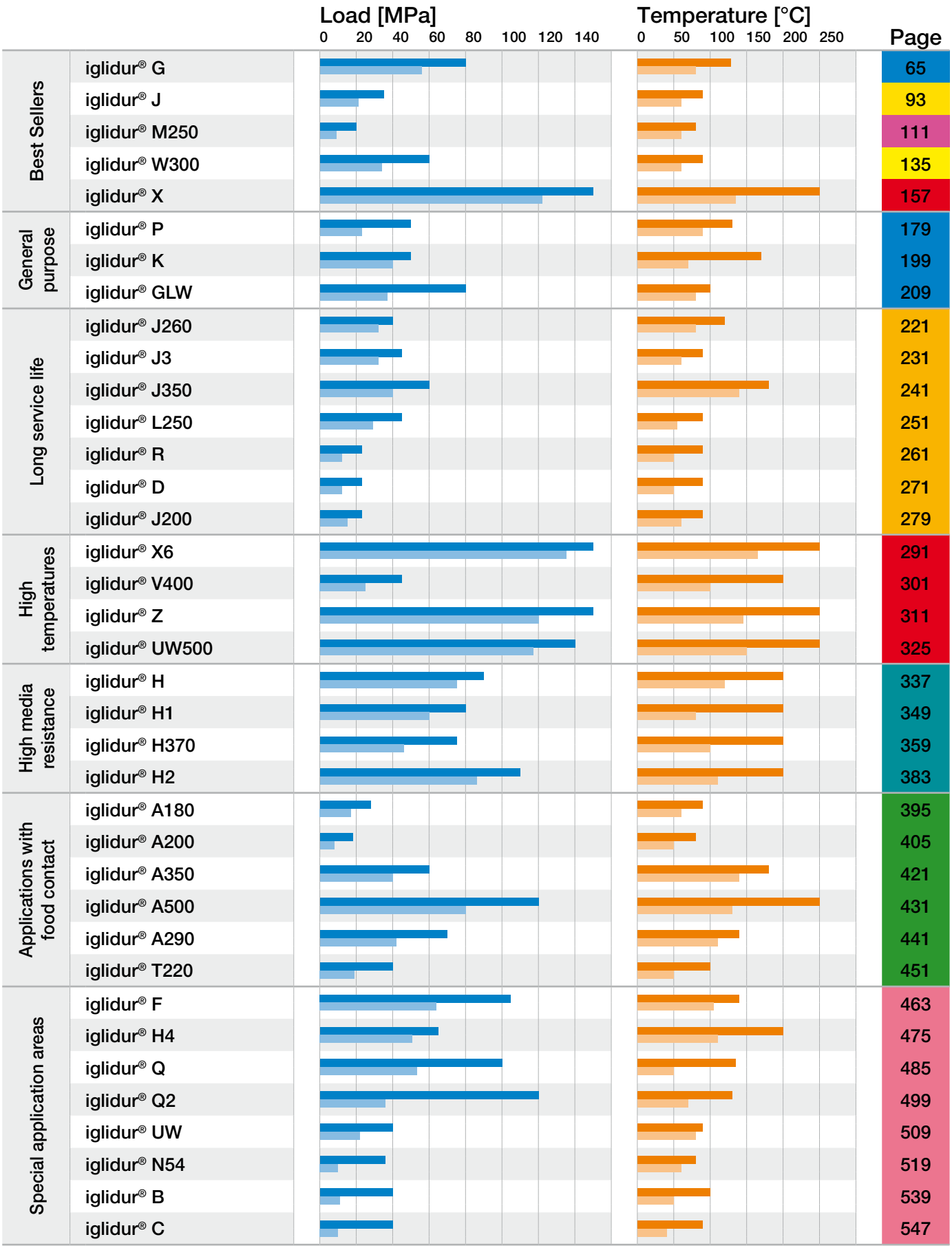
iglidur® | Selection According To Main Criteria

		Standard catalog range	Stock Bar	speedi-mold material	Long life dry running	For high loads	For high temperatures	Low friction/ high speed	Dirt resistant
Best Sellers	iglidur® G	●		●	●	●			●
	iglidur® J	●	●	●	●			●	
	iglidur® M250	●		●	●				●
	iglidur® W300	●	●	●	●			●	●
	iglidur® X	●	●	●	●	●	●		
General purpose	iglidur® P	●		●	●				●
	iglidur® K	●			●			●	
	iglidur® GLW								●
Long service life	iglidur® J260	●			●			●	
	iglidur® J3	●			●			●	
	iglidur® J350	●	●		●	●	●	●	
	iglidur® L250	●			●			●	
	iglidur® R	●	●		●			●	
	iglidur® D							●	
	iglidur® J200				●			●	●
High temperatures	iglidur® X6	●			●	●	●	●	
	iglidur® V400	●			●		●	●	
	iglidur® Z	●			●	●	●	●	
	iglidur® UW500						●		
High media resistance	iglidur® H	●		●			●		
	iglidur® H1	●			●	●	●	●	
	iglidur® H370	●					●	●	
	iglidur® H2			●			●		
Applications with food contact	iglidur® A180	●	●	●	●			●	
	iglidur® A200	●							●
	iglidur® A350	●	●		●		●	●	
	iglidur® A500	●				●	●		
	iglidur® A290	●				●			
	iglidur® T220		●						
Special application areas	iglidur® F	●				●			
	iglidur® H4	●			●	●	●	●	
	iglidur® Q	●			●	●		●	
	iglidur® Q2	●			●				●
	iglidur® UW	●							
	iglidur® N54	●							
	iglidur® B								
	iglidur® C								

iglidur® | Selection According To Main Criteria

	Chemical resistant	Low water absorption	Food suitable	Vibrations dampening	Edge pressure	For under water use	Economic	Page
iglidur® G							●	65
iglidur® J		●			●		●	93
iglidur® M250				●	●		●	111
iglidur® W300					●		●	135
iglidur® X	●	●				●		157
iglidur® P							●	179
iglidur® K		●					●	199
iglidur® GLW							●	209
iglidur® J260		●						221
iglidur® J3		●			●		●	231
iglidur® J350	●	●			●			241
iglidur® L250					●			251
iglidur® R		●			●		●	261
iglidur® D		●			●		●	271
iglidur® J200		●			●			279
iglidur® X6	●	●						291
iglidur® V400	●	●			●			301
iglidur® Z	●	●			●			311
iglidur® UW500	●	●				●		325
iglidur® H	●	●				●		337
iglidur® H1	●	●				●		349
iglidur® H370	●	●				●		359
iglidur® H2	●	●				●		383
iglidur® A180		●	●		●		●	395
iglidur® A200			●	●	●			405
iglidur® A350	●	●	●		●	●		421
iglidur® A500	●	●	●		●	●		431
iglidur® A290								441
iglidur® T220								451
iglidur® F								463
iglidur® H4	●	●			●	●	●	475
iglidur® Q								485
iglidur® Q2				●	●		●	499
iglidur® UW		●				●	●	509
iglidur® N54								519
iglidur® B				●	●			539
iglidur® C					●			547

iglidur® | Selection According To Main Criteria

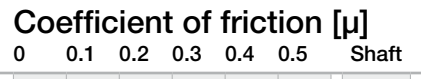


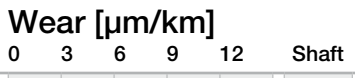
		Page
Best Sellers	iglidur® G	65
	iglidur® J	93
	iglidur® M250	111
	iglidur® W300	135
	iglidur® X	157
General purpose	iglidur® P	179
	iglidur® K	199
	iglidur® GLW	209
Long service life	iglidur® J260	221
	iglidur® J3	231
	iglidur® J350	241
	iglidur® L250	251
	iglidur® R	261
	iglidur® D	271
	iglidur® J200	279
High temperatures	iglidur® X6	291
	iglidur® V400	301
	iglidur® Z	311
	iglidur® UW500	325
High media resistance	iglidur® H	337
	iglidur® H1	349
	iglidur® H370	359
	iglidur® H2	383
Applications with food contact	iglidur® A180	395
	iglidur® A200	405
	iglidur® A350	421
	iglidur® A500	431
	iglidur® A290	441
	iglidur® T220	451
Special application areas	iglidur® F	463
	iglidur® H4	475
	iglidur® Q	485
	iglidur® Q2	499
	iglidur® UW	509
	iglidur® N54	519
	iglidur® B	539
	iglidur® C	547

Maximum permissible radial load of iglidur® bearings at
- +20 °C
- +80 °C

Important temperatur limits of iglidur® bearings
- Maximum permissible application temperature, continuous
- Temperature where bearings need to be secured against radial or axial movement in the housing

iglidur® | Selection According To Main Criteria





	Shaft	Shaft	Page	
iglidur® G	3	3	65	Best Sellers
iglidur® J	5	3	93	
iglidur® M250	3	5	111	
iglidur® W300	7	7	135	
iglidur® X	3	4	157	
iglidur® P	3	1	179	General purpose
iglidur® K	3	3	199	
iglidur® GLW	1	2	209	
iglidur® J260	6	3	221	Long service life
iglidur® J3	7	3	231	
iglidur® J350	2	7	241	
iglidur® L250	4	6	251	
iglidur® R	6	1	261	
iglidur® D	7	7	271	
iglidur® J200	6	7	279	
iglidur® X6	6	5	291	High temperatures
iglidur® V400	7	3	301	
iglidur® Z	1	3	311	
iglidur® UW500	3	6	325	
iglidur® H	3	5	337	High media resistance
iglidur® H1	7	3	349	
iglidur® H370	2	2	359	
iglidur® H2	6	7	383	
iglidur® A180	5	3	395	Applications with food contact
iglidur® A200	4	3	405	
iglidur® A350	6	2	421	
iglidur® A500	3	2	431	
iglidur® A290	3	7	441	
iglidur® T220	3	3	451	
iglidur® F	6	1	463	Special application areas
iglidur® H4	3	5	475	
iglidur® Q	6	3	485	
iglidur® Q2	4	4	499	
iglidur® UW	3	6	509	
iglidur® N54	1	3	519	
iglidur® B	3	1	539	
iglidur® C	6	2	547	

Coefficients of friction of iglidur® bearings sliding against steel, p = 1 MPa, v = 0.3 m/s

- Average coefficient of all the seven sliding combinations tested
- Coefficient of friction of best combination

Wear of iglidur® bearings sliding against steel, p = 1 MPa

- Average wear of all the seven sliding combination tested
- Wear of best combination

Shaft material:

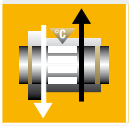
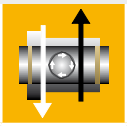
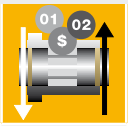
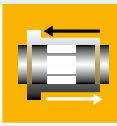
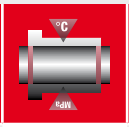
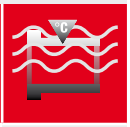
1 = Cf53
2 = Cf53, Hard chromed
3 = Alu. hc
4 = Free-cutting Steel
5 = St37
6 = V2A
7 = X90

iglidur® | Material Properties Table

If you are unsure which material you need, please go back to relevant selection tables, or call us,
According to main properties,
▶ page 36
According to performance,
▶ page 38

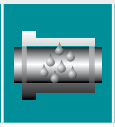
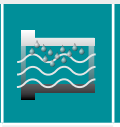
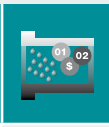
		Best Sellers					General purpose			
		iglidur® G	iglidur® J	iglidur® M250	iglidur® W300	iglidur® X	iglidur® P	iglidur® P210	iglidur® K	iglidur® GLW
General properties	**Density** [g/cm³]	1.46	1.49	1.14	1.24	1.44	1.58	1.40	1.52	1.36
	Colour	dark grey	yellow	charcoal	yellow	black	black	yellow	yellow-beige	black
	Max, moisture absorption at +23 °C/50 % r, h, [% weight]	0.7	0.3	1.4	1.3	0.1	0.2	0.3	0.1	1.3
	Max, moisture absorption [% weight]	4.0	1.3	7.6	6.5	0.5	0.4	0.5	0.6	5.5
	Coefficient of sliding friction, dynamic against steel [µ]	0.08–0.15	0.06–0.18	0.18–0.40	0.08–0.23	0.09–0.27	0.06–0.21	0.07–0.19	0.06–0.21	0.10–0.24
	pv value, max, (dry) [MPa · m/s]	0.42	0.34	0.12	0.23	1.32	0.39	0.4	0.3	0.3
Mechanical properties	**Modulus of elasticity** [MPa]	7,800	2,400	2,700	3,500	8,100	5,300	2,500	3,500	7,700
	Tensile strenght at +20 °C [MPa]	210	73	112	125	170	120	70	80	235
	Compressive strength [MPa]	78	60	52	61	100	66	50	60	74
	Max, permissible static surface pressure (+20 °C) [MPa]	80	35	20	60	150	50	50	50	80
	Shore-D-hardness	81	74	79	77	85	75	75	72	78
Physical and thermal properties	**Max, long term application temperature** [°C]	+130	+90	+80	+90	+250	+130	+100	+170	+100
	Max, short term application temperature [°C]	+220	+120	+170	+180	+315	+200	+160	+240	+160
	Min, application temperature [°C]	–40	–50	–40	–40	–100	–40	–40	–40	–40
	Thermal conductivity [W/m · K]	0.24	0.25	0.24	0.24	0.60	0.25	0.25	0.25	0.24
	Coefficient of thermal expansion (+23 °C) [$K^{-1} \cdot 10^{-5}$]	9	10	10	9	5	4	8	3	17
Electrical properties	**Specific volume resistance** [Ωcm]	> 10^{13}	> 10^{13}	> 10^{13}	> 10^{13}	< 10^{5}	> 10^{13}	> 10^{12}	> 10^{12}	> 10^{11}
	Surface resistance [Ω]	> 10^{11}	> 10^{12}	> 10^{11}	> 10^{12}	< 10^{3}	> 10^{12}	> 10^{11}	> 10^{12}	> 10^{11}
	Page	65	93	111	135	157	179	199	199	209

iglidur® | Material Properties Table

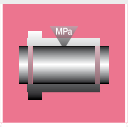
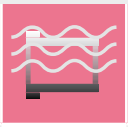
Long service life							High temperatures			
										
iglidur® J260	iglidur® J3	iglidur® J350	iglidur® L250	iglidur® R	iglidur® D	iglidur® J200	iglidur® X6	iglidur® V400	iglidur® Z	iglidur® UW500
1.35	1.42	1.44	1.5	1.39	1.4	1.72	1.53	1.51	1.4	1.49
yellow	yellow	yellow	beige	dark red	green	dark grey	dark blue	white	brown	black
0.2	0.3	0.3	0.7	0.2	0.3	0.2	0.1	0.1	0.3	0.1
0.4	1.3	1.6	3.9	1.1	1.1	0.7	0.5	0.2	1.1	0.5
0.06–0.20	0.06–0.20	0.10–0.20	0.08–0.19	0.09–0.25	0.08–0.26	0.11–0.17	0.09–0.25	0.15–0.20	0.06–0.14	0.20–0.36
0.35	0.5	0.45	0.4	0.27	0.27	0.3	1.35	0.5	0.84	0.35
2,200	2,700	2,000	1,950	1,950	2,000	2,800	16,000	4,500	2,400	16,000
60	70	55	67	70	72	58	290	95	95	260
50	60	60	47	68	70	43	190	47	65	140
40	45	60	45	23	23	23	150	45	150	140
77	73	80	68	77	78	70	89	74	81	86
+120	+90	+180	+90	+90	+90	+90	+250	+200	+250	+250
+140	+120	+220	+180	+110	+110	+120	+315	+240	+310	+300
–100	–50	–100	–40	–50	–50	–50	–100	–50	–100	–100
0.24	0.25	0.24	0.24	0.25	0.25	0.24	0.55	0.24	0.62	0.6
13	13	7	10	11	11	8	1,1	3	4	4
$> 10^{12}$	$> 10^{12}$	$> 10^{13}$	$> 10^{10}$	$> 10^{12}$	$> 10^{14}$	$> 10^{8}$	$< 10^{5}$	$> 10^{12}$	$> 10^{11}$	$< 10^{9}$
$> 10^{10}$	$> 10^{12}$	$> 10^{10}$	$> 10^{11}$	$> 10^{12}$	$> 10^{14}$	$> 10^{8}$	$< 10^{3}$	$> 10^{12}$	$> 10^{11}$	$< 10^{9}$
221	231	241	251	261	271	279	291	301	311	325

iglidur® | Material Properties Table

If you are unsure which material you need, please go back to relevant selection tables, or call us,
According to main properties,
▶ page 36
According to performance,
▶ page 38

		High media resistance					Applications with food contact			
										
		iglidur® H	**iglidur® H1**	**iglidur® H370**	**iglidur® C500**	**iglidur® H2**	**iglidur® A180**	**iglidur® A200**	**iglidur® A350**	**iglidur® A500**
General properties	**Density** [g/cm³]	1.71	1.53	1.66	1.37	1.72	1.46	1.14	1.42	1.28
	Colour	grey	cream	grey	magenta	brown	white	white	blue	brown
	Max, moisture absorption at +23 °C/50 % r, h, [% weight]	0.1	0.1	0.1	0.3	0.1	0.2	1.5	0.6	0.3
	Max, moisture absorption [% weight]	0.3	0.3	0.1	0.5	0.2	1.3	7.6	1.9	0.5
	Coefficient of sliding friction, dynamic against steel [µ]	0.07–0.20	0.06–0.20	0.07–0.17	0.07–0.19	0.07–0.30	0.05–0.23	0.10–0.40	0.10–0.20	0.26–0.41
	pv value, max, (dry) [MPa · m/s]	1.37	0.80	0.74	0.7	0.58	0.31	0.09	0.40	0.28
Mechanical properties	**Modulus of elasticity** [MPa]	12,500	2,800	11,100	3,000	10,300	2,300	2,500	2,000	3,600
	Tensile strenght at +20 °C [MPa]	175	55	135	100	210	88	116	110	140
	Compressive strength [MPa]	81	78	79	110	109	78	54	78	118
	Max, permissible static surface pressure (+20 °C) [MPa]	90	80	75	110	110	28	18	60	120
	Shore-D-hardness	87	77	82	81	88	76	81	76	83
Physical and thermal properties	**Max, long term application temperature** [°C]	+200	+200	+200	+250	+200	+90	+80	+180	+250
	Max, short term application temperature [°C]	+240	+240	+240	+300	+240	+110	+170	+210	+300
	Min, application temperature [°C]	–40	–40	–40	–100	–40	–50	–40	–100	–100
	Thermal conductivity [W/m · K]	0.6	0.24	0.5	0.24	0.24	0.25	0.24	0.24	0.24
	Coefficient of thermal expansion (+23 °C) [$K^{-1} \cdot 10^{-5}$]	4	6	5	9	4	11	10	8	9
Electrical properties	**Specific volume resistance** [Ωcm]	$< 10^5$	$> 10^{12}$	$< 10^5$	$> 10^{14}$	$> 10^{15}$	$> 10^{12}$	$> 10^{13}$	$> 10^{11}$	$> 10^{14}$
	Surface resistance [Ω]	$< 10^2$	$> 10^{11}$	$< 10^5$	$> 10^{13}$	$> 10^{14}$	$> 10^{11}$	$> 10^{12}$	$> 10^{11}$	$> 10^{13}$
	Page	337	349	359	373	383	395	405	421	431

iglidur® | Material Properties Table

		Special application areas								
										
iglidur® A290	iglidur® T220	iglidur® F	iglidur® H4	iglidur® Q	iglidur® Q2	iglidur® UW	iglidur® N54	iglidur® G V0	iglidur® B	iglidur® C
1.41	1.28	1.25	1.79	1.4	1.46	1.52	1.13	1.53	1.15	1.1
white	white	black	brown	black	beige-brown	black	green	black	grey	white
1.7	0.3	1.8	0.1	0.9	1.1	0.2	1.6	0.7	1.0	1.0
7.3	0.5	8.4	0.2	4.9	4.6	0.8	3.6	4.0	6.3	6.9
0.13–0.40	0.20–0.32	0.10–0.39	0.08–0.25	0.05–0.15	0.22–0.42	0.15–0.35	0.15–0.23	0.07–0.20	0.18–0.28	0.17–0.25
0.23	0.28	0.34	0.70	0.55	0.7	0.11	0.5	0.5	0.15	0.10
8,800	1,800	11,600	7,500	4,500	8,370	9,600	1,800	7,900	1,800	1,900
250	65	260	120	120	240	90	70	140	55	60
91	55	98	50	89	130	70	30	100	20	30
70	40	105	65	100	120	40	36	75	40	40
88	76	84	80	83	80	78	74	80	69	72
+140	+100	+140	+200	+135	+130	+90	+80	+130	+100	+90
+180	+160	+180	+240	+155	+200	+110	+120	+210	+130	+130
–40	–40	–40	–40	–40	–40	–50	–40	–40	–40	–40
0.24	0.24	0.65	0.24	0.23	0.24	0.6	0.24	0.25	0.24	0.24
7	11	12	5	5	8	6	9	9	12	15
$> 10^{11}$	$> 10^{10}$	$< 10^{3}$	$> 10^{13}$	$> 10^{15}$	$> 10^{13}$	$< 10^{5}$	$> 10^{13}$	$> 10^{12}$	$> 10^{10}$	$> 10^{10}$
$> 10^{11}$	$> 10^{10}$	$< 10^{2}$	$> 10^{12}$	$> 10^{12}$	$> 10^{11}$	$< 10^{5}$	$> 10^{11}$	$> 10^{11}$	$> 10^{9}$	$> 10^{9}$
441	**451**	**463**	**475**	**485**	**499**	**509**	**519**	**529**	**539**	**547**

iglidur® | plastics for longer life®

Picture 01: iglidur® plain bearings, the right solution for every application

Picture 02: Example of a tribological test in the igus® laboratory

iglidur® – Plain Bearings Made of High Performance Polymers

Highly wear-resistant tribopolymers improved by precisely harmonized additions of strengthening materials and solid lubricants, tested a thousand times and proved a million times – that is iglidur®. igus® engineers develop and test more than 100 new plastic compounds every year. The finely harmonized combination of plastic matrix, strengthening components and solid lubricants in every single tribopolymer results in an individual properties profile in each case. In more than 10,000 individual tests a year on over 200 test stands in the igus® test laboratory, all existing and potential iglidur® materials, as well as other 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® range. In addition, freely accessible online tools simply to use enable every user to select his personal sliding bearing from iglidur® programme. Whether iglidur® product finder or iglidur® lifetime calculation, piston ring or bar stock configurqator: with few clicks and applications related information a suitable bearing is quickly found.

▶ page 1132 or www.igus.co.uk/en/online-tools

Picture 03: igus® polymer bearings, over 40 years of knowledge and progressive innovation for longer life solutions in all industries

General Properties of iglidur® Plain Bearings

- Lubrication-free
- Corrosion resistance
- Good media resistance
- High compressive strength
- High mechanical dampening
- Low coefficients of friction
- Maintenance-free
- Low weight
- High wear resistance
- very good 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.

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 slide layers. However, this soft slide layer is not strong enough. For high loads, edge pressure or oscillations, it is easily removed.

The iglidur® Solution: The Self-Lubricating Effect

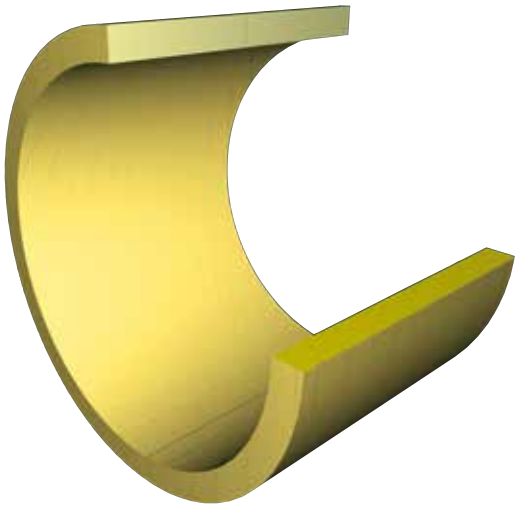
The high performance polymers of the iglidur® plain bearing are composed of:

- Base polymer
- Fibres and filling materials
- 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 fulfill all these tasks equally well, unfortunately does not exist yet. That is why iglidur® plain bearings work differently. Each task fulfilled by the bearing is represented by a component in the iglidur® materials:



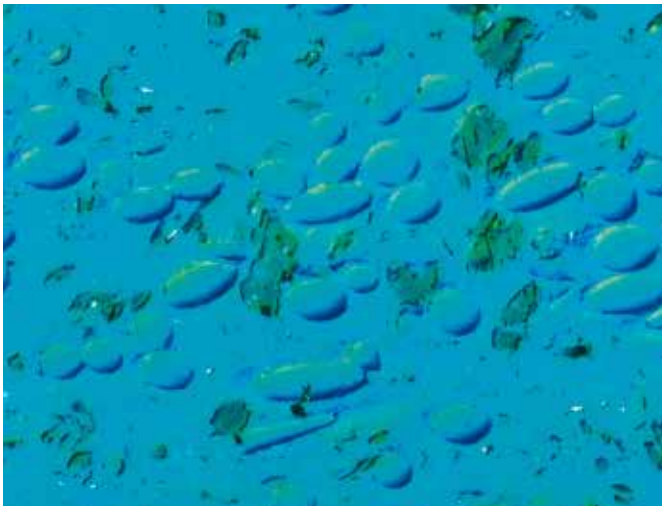
Picture 04: Injection molded iglidur® plain bearings are homogeneously structured. Base polymer, bonding materials and solid lubricants mutually complement each other.

- 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.

Base Polymers and Technical Fibres

The radial pressure with which the bearings are loaded is received by the polymer base 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 stabilize the bearing especially in cases of continuous load.

Picture 05: Polymer granulate, basis compund of the lubrication-free and predictable iglidur® bearings



Picture 06: Base polymers with fibres and solid lubricants, magnified 200 times, dyed.

Incorporated Self-Lubrication

The solid lubricants are, as microscopically small particles, embedded in millions of tiny chambers of the mostly fibre reinforced material. From these chambers, the plain bearings release tiny amounts of solid lubricants during movement. The solid lubricants help to lower the coefficient of friction of the iglidur® bearing. Since they are embedded in the tiny chambers, they cannot be pressed out. They are always there as soon as the bearing or the shaft is set in motion.

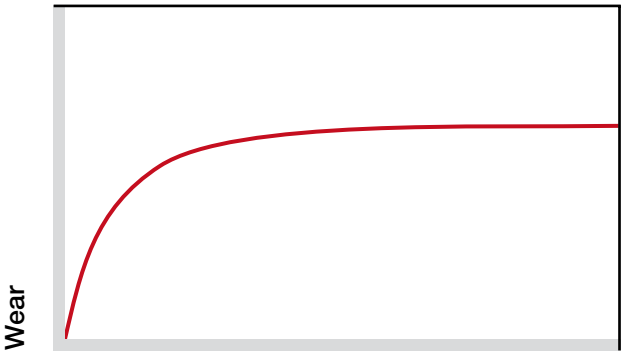
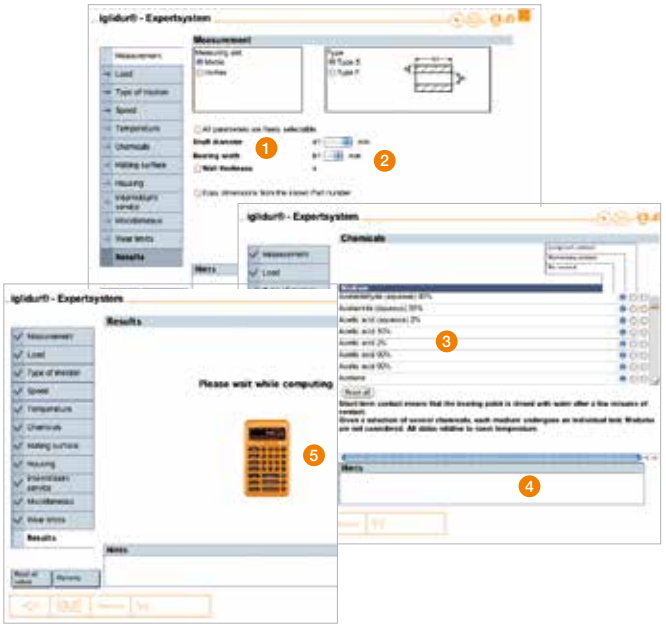


Diagram 01: During the start-up phase, the wear rate drops significantly, and then stabilises.

The Start-Up Phase

In the starting phase, the shaft and the iglidur® plain bearing engage with each other. During this phase, the surfaces of both materials are adjusted to each other. The specific pressure of the system drops since the contact surfaces of the shaft and bearing expand during the start-up. At the same time, the rate of wear decreases and approaches a linear curve. In this phase, the coefficients of friction are changing until finally reaching a value that to a large extent is constant.



Picture 07: The iglidur® expert system – Service life calculation in only a few clicks

Predictable service life – online

Reliable information on the service life of iglidur® polymer plain bearings can be made on the basis of the igus® database. With the iglidur® expert system you can easely calculate the service life of the iglidur® maintenance-free bearings in your application.

Select the measuring unit and the bearing type ❶. Select the required dimensions ❷ or enter the part number. Please enter the relevant information page for page ❸. You will find instructions at the bottom of each page ❹. The results are specified as service life in hours ❺.

▶ www.igus.co.uk/iglidur-expert

Surface Pressure

The load of a plain bearing is expressed by the surface pressure [p] in MPa. For this purpose, the radial load is determined on the projected surface of the bearing.

Radial bearing:

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

For thrust bearings, the load is produced accordingly.

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 recommended maximum static surface pressure [p] 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 0.01 m/s are tolerated under this pressure. Higher pressures than those indicated are possible if the duration of the load is short. Please call us if you have questions.

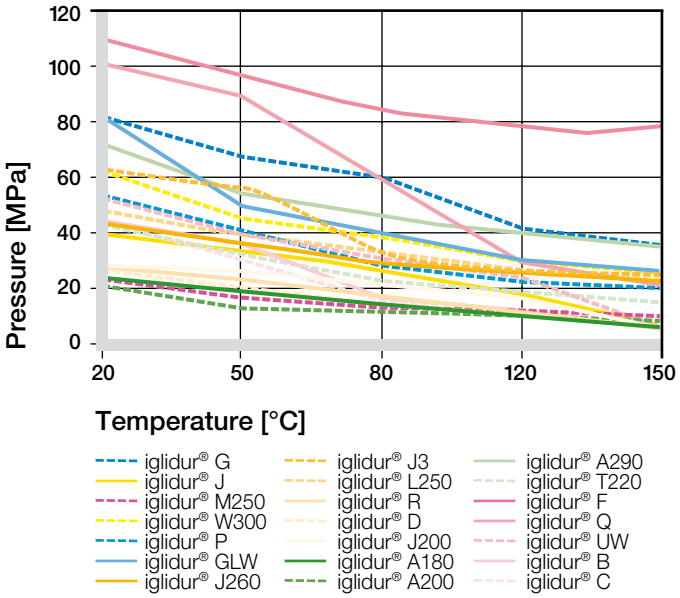
▶ Material Table, **page 40**

Load and Temperature

Diagram 02 and 03 shows the recommended maximum static surface pressure [p] of the iglidur® plain bearing as a function of temperature. When using the plain bearing, the bearing temperature can be higher than the ambient temperature, due to friction. 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] can be understood as a measurement for the frictional heat of the bearing. This relationship is shown by the pv diagram that is the first in the respective chapter for each iglidur® material.



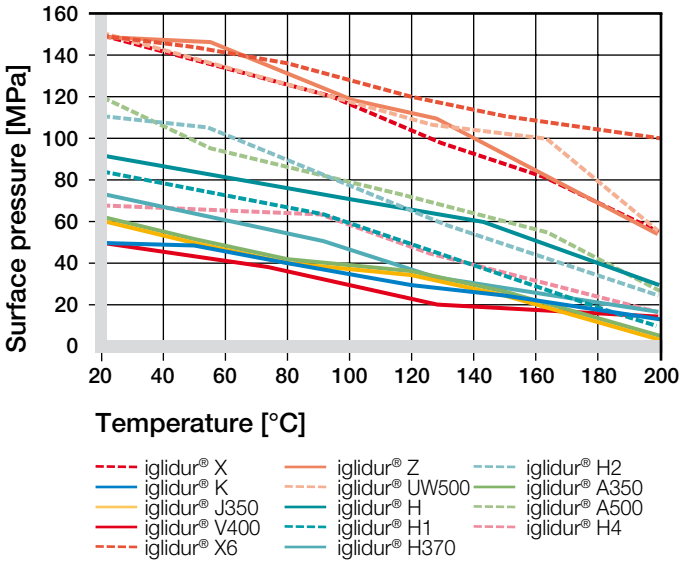


Diagram 02 and 03: Recommended maximum surface pressure of iglidur® plain bearings as a function of temperature

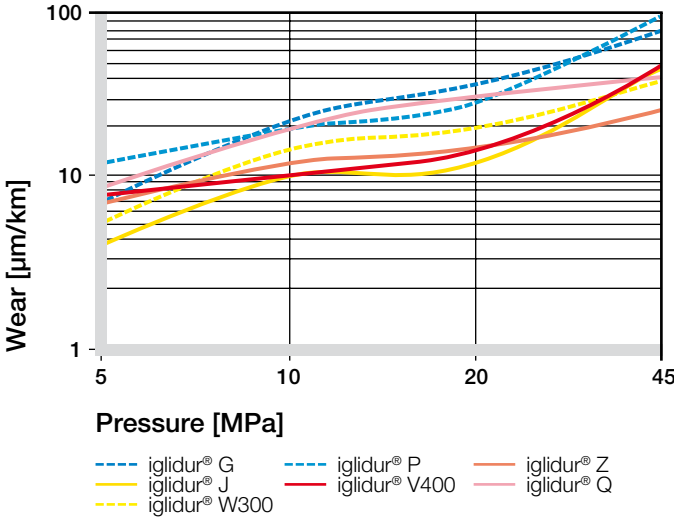
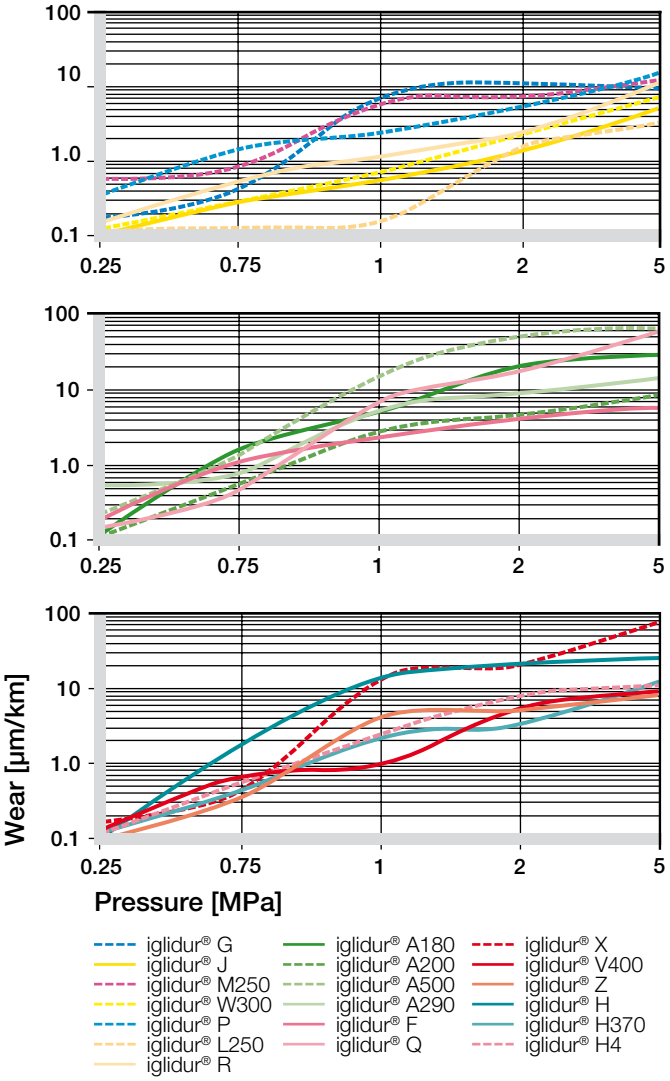


Diagram 04: Wear of iglidur® plain bearings under medium and high pressures

Pressure and Wear

The load of the plain bearing has an effect on the wear of the bearing. The following diagrams show the wear behaviour of the iglidur® bearing materials. It is easily recognized 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

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 52**

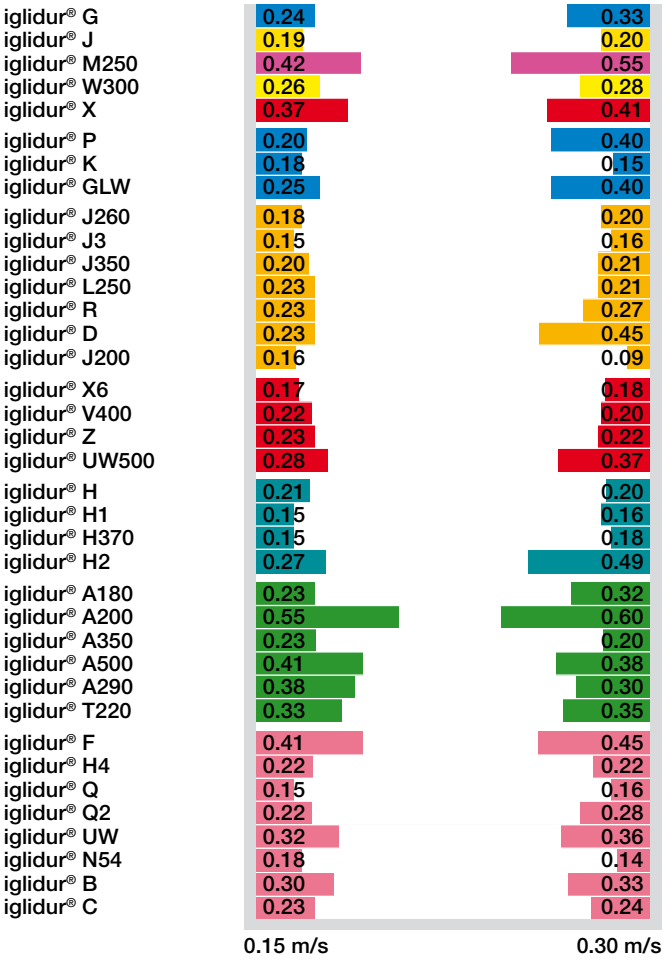


Diagram 08: Coefficients of friction of iglidur® materials for different surface speeds (shaft Cf53)

Surface Speed

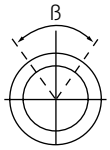
With increasing load, the coefficient of friction of the plain bearing typically decreases. In this context, shaft materials and the surface finish are also significant.

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

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

In these equations

d1 = Shaft diameter [mm]
f = frequency in Hertz
ß = angle of motion per cycle [°]
n = rpm



With varying speed like seen for example with oscillating movements, the value needed is the average speed (see above formula)

Permissible Surface Speeds

iglidur® plain bearings were primarily developed for low to average running speeds in continuous operation. Table 01 shows the permissible surface speed of iglidur® plain bearings for rotating, oscillating, and linear movements. These surface speeds are limit values assuming minimum pressure loading of the bearing. In practice, these limit values are rarely reached due to an inverse relationship between load and speed. All increases of the pressure leads unavoidably to a reduction of the allowable surface speeds and vice versa. The speed limit is determined by the thermal properties of the bearing. This is also the reason why different running 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 running speeds automatically bring correspondingly high wear rates with them. With higher sliding 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 Cold Rolled Steel shaft (Cf53) with a load of 0.7 MPa.

pv Value

For plain bearings, the product is given a new value depending on the pressure [p] and the surface speed 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 a function of the shaft material of the ambient temperature and the operating time.

Material	Rotating		Oscillating		Linear	
	Conti-nuous	Short term	Conti-nuous	Short term	Conti-nuous	Short term
Standards						
iglidur® G	1	2	0.7	1.4	4	5
iglidur® J	1.5	3	1.1	2.1	8	10
iglidur® M250	0.8	2	0.6	1.4	2.5	5
iglidur® W300	1	2.5	0.7	1.8	4	6
iglidur® X	1.5	3.5	1.1	2.5	5	10
General purpose						
iglidur® P	1	2	0.7	1.4	3	4
iglidur® K	1	2	0.7	1.4	3	4
iglidur® GLW	0.8	1	0.6	0.7	2.5	3
Long service life						
iglidur® J260	1	2	0.7	1.4	3	4
iglidur® J3	1.5	3	1.1	2.1	8	10
iglidur® J350	1.3	3	1	2.3	4	8
iglidur® L250	1	1.5	0.7	1.1	2	3
iglidur® R	0.8	1.2	0.6	1	3.5	5
iglidur® D	1.5	3	1.1	2.1	8	10
iglidur® J200	1	1.5	0.7	1.1	10	15
High temperatures						
iglidur® X6	1.5	3.5	1.1	2.5	5.4	10
iglidur® V400	0.9	1.3	0.6	0.9	2	3
iglidur® Z	1.5	3.5	1.1	2.5	5	6
iglidur® UW500	0.8	1.5	0.6	1.1	2	3
High media resistance						
iglidur® H	1	1.5	0.7	1.1	3	4
iglidur® H1	2	2.5	1	1.5	5	7
iglidur® H370	1.2	1.5	0.8	1.1	4	5
iglidur® H2	0.9	1	0.6	0.7	2.5	3
Applications with food contact						
iglidur® A180	0.8	1.2	0.6	1	3.5	5
iglidur® A200	0.8	1.5	0.6	1.1	2	3
iglidur® A350	1	1.2	0.8	0.9	2.5	3
iglidur® A500	0.6	1	0.4	0.7	1	2
iglidur® A290	1	2	0.7	1.4	3	4
iglidur® T220	0.4	1	0.3	0.7	1	2
Special application areas						
iglidur® F	0.8	1.5	0.6	1.1	3	5
iglidur® H4	1	1.5	0.7	1.1	1	2
iglidur® Q	1	2	0.7	1.4	5	6
iglidur® Q2	1	2	0.7	1.4	4	5
iglidur® UW	0.5	1.5	0.4	1.1	2	3
iglidur® N54	0.8	1.5	0.6	1.1	1	2
iglidur® B	0.7	1	0.5	0.7	2	3
iglidur® C	1	1.5	0.7	1.1	2	3

Table 01: Surface speeds of iglidur® bearings in m/s; continous and short term

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

where

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 coductivity of the shaft
λk = thermal coductivity of the bearing
ΔT = (T_a – T_u)
T_u = ambient temperature [°C]
T_a = max. application temperature [°C]

Material	Thermal conductivity [W/m · k]
Steel	46
Aluminum	204
Grey cast iron	58
303 Stainless	16
Ceramics	1.4
Plastics	0.24

Table 02: Heat conductivity values of shaft or housing materials

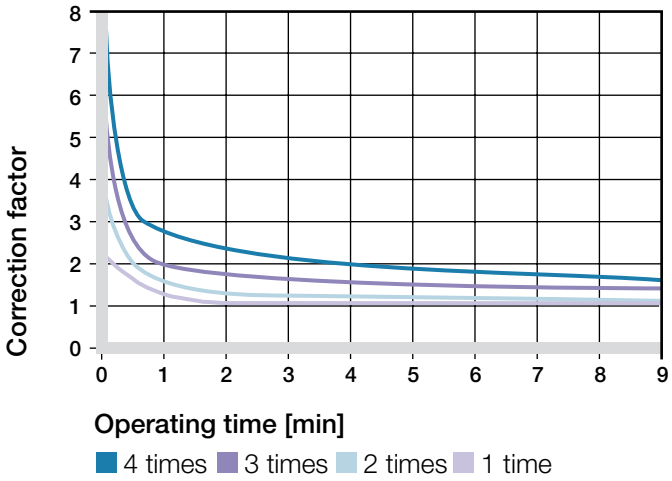


Diagram 09: Correction factor for p · v

Type of lubrication	Correction factor
Dry run	1
During installation	1.3
Continous, grease	2
Continous, water	4
Continous, oil	5

Table 03: Correction of the tolerated p · v value by means of lubrication

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. An important qualifier here is the ratio of the operating time and dwell times. It is known that a longer dwell time makes a greater contribution to re-cooling. The different curves of diagram 09 represent different ratios (3 x means that the dwell time is three times longer than the operating time).

Lubrication

Although iglidur® plain bearings are designed to run dry, 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. For further information, please contact us. Table 03 shows the correction factors for pv value using lubrication

Temperatures

The temperature resistance of high performance polymer plain bearings is usually underestimated. Who would believe that plastic bearings can be used over +300 °C Data is often found in the literature about the continuous use temperature. The continuous use 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. Please note, these standard test results have limited applications, since bearings are almost always under load.

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 which the material can endure 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 pressfit. In these cases, axial securing of the bearing is necessary in addition to the pressfit.

Temperature and Load

The diagrams 02 and 03 (▶ **page 47**) show the maximum recommended pressure [p] of the iglidur® plain bearings as a function of temperature. With increasing temperature, this value rises 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 required play in the bearing. 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 08: Material tests are possible up to +250 °C

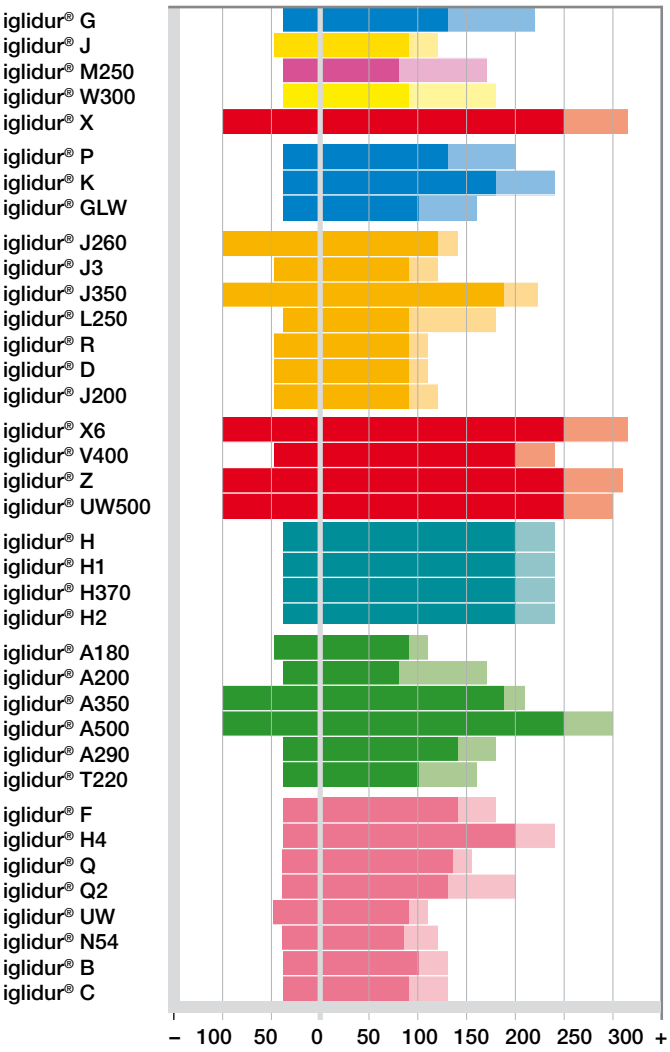


Diagram 10: Comparison of the continous and short term upper application temperature limits [°C]

Material	Temp. [°C]	Material	Temp. [°C]
iglidur® G	+80	iglidur® H	+120
iglidur® J	+60	iglidur® H1	+80
iglidur® M250	+60	iglidur® H370	+100
iglidur® W300	+60	iglidur® H2	+110
iglidur® X	+135	iglidur® A180	+60
iglidur® P	+90	iglidur® A200	+50
iglidur® K	+70	iglidur® A350	+140
iglidur® GLW	+80	iglidur® A500	+130
iglidur® J260	+80	iglidur® A290	+110
iglidur® J3	+60	iglidur® T220	+50
iglidur® J350	+140	iglidur® F	+105
iglidur® L250	+55	iglidur® H4	+110
iglidur® R	+50	iglidur® Q	+50
iglidur® D	+50	iglidur® Q2	+70
iglidur® J200	+60	iglidur® UW	+80
iglidur® X6	+165	iglidur® N54	+60
iglidur® V400	+100	iglidur® B	+50
iglidur® Z	+145	iglidur® C	+40
iglidur® UW500	+150		

Table 04: Temperature at which additional securing of the iglidur® plain bearing is required

Coefficient of Friction

iglidur® plain bearings are self-lubricating by 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 choice is made between static friction coefficient and the dynamic friction coefficient.

Coefficients of Friction and Surfaces

At study here is the relationship between coefficients of friction and surface roughness 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. Stick slip thus represents a cause for malfunction of plain bearings. 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 roughness of the shafts.

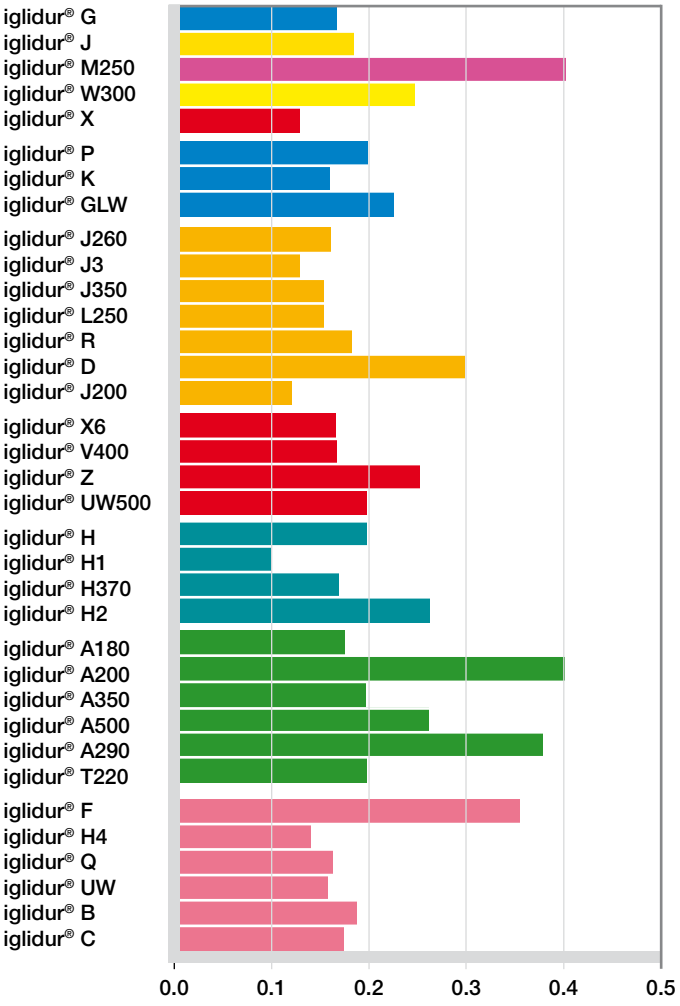


Diagram 11: Coefficients of friction of the iglidur® plain bearings at the recommended shaft surface roughness and low load, p = 0,75 MPa

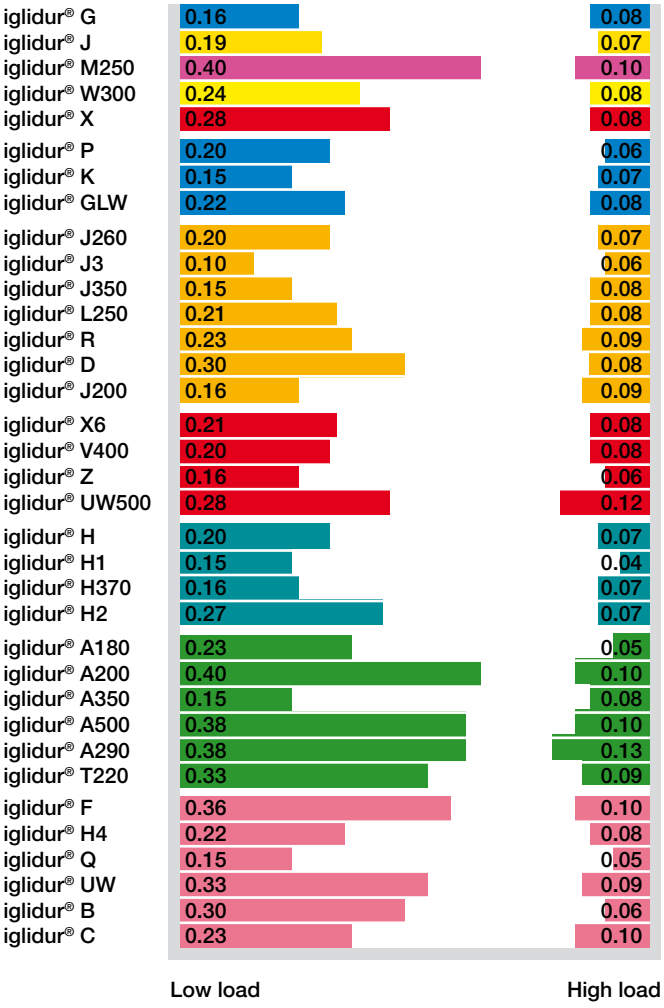


Diagram 12: Frictional values of iglidur® materials under different loads

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 materials pairings that run well together.

▶ Shaft Materials, **page 55**

Wear and Pressure

Different loads greatly influence the bearing wear. Among the iglidur plain bearings, certain materials are optimized for low loads, while others are better suited for high or extremely high loads.

Wear and Temperature

Within wide temperature ranges, the wear resistance of the iglidur® plain bearings shows little change. In the maximum temperature range, however, the temperature increases and the wear of the plain bearing increases. Table 05 compares the “wear limits”. One particular exception is represented by iglidur® X. The wear resistance of iglidur® X increases greatly as temperature increases and reaches the optimum wear resistance at a temperature of +160 °C. Then resistance decreases again, gradually.

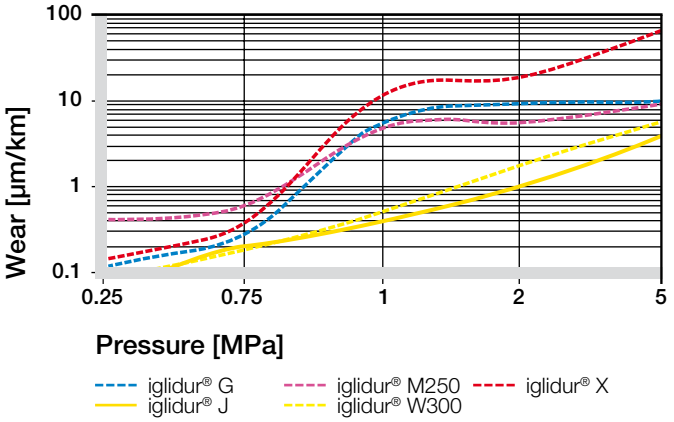


Diagram 13: Wear of iglidur® plain bearings under low pressures

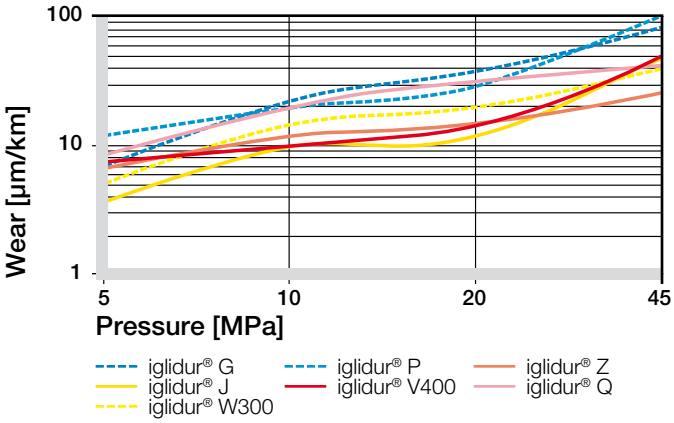


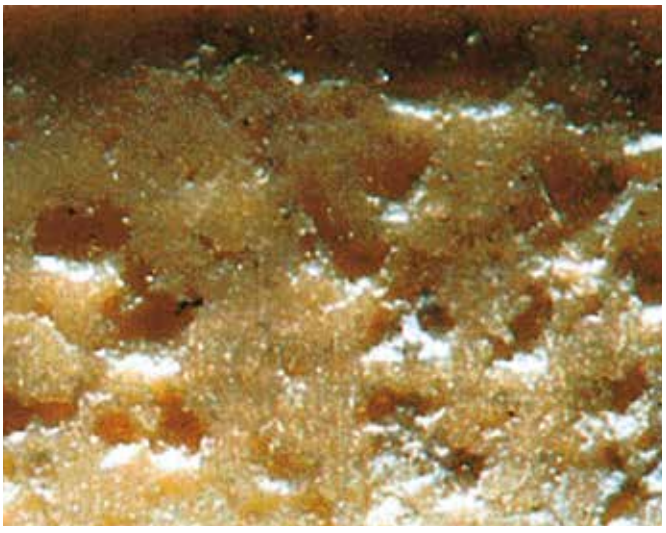
Diagram 14: Wear of iglidur® plain bearings, shaft: Cf53, v = 0,1 m/s

Material	Wear limit [°C]	Material	Wear limit [°C]
iglidur® G	+120	iglidur® H1	+170
iglidur® J	+70	iglidur® H370	+150
iglidur® M250	+80	iglidur® H2	+120
iglidur® W300	+120	iglidur® A180	+70
iglidur® X	+210	iglidur® A200	+80
iglidur® P	+100	iglidur® A350	+120
iglidur® K	+90	iglidur® A500	+190
iglidur® GLW	+100	iglidur® A290	+120
iglidur® J260	+80	iglidur® T220	+90
iglidur® J3	+70	iglidur® F	+130
iglidur® J350	+140	iglidur® H4	+120
iglidur® L250	+120	iglidur® Q	+80
iglidur® R	+70	iglidur® Q2	+120
iglidur® X6	+210	iglidur® UW	+70
iglidur® V400	+130	iglidur® N54	+80
iglidur® Z	+200	iglidur® B	+70
iglidur® UW500	+190	iglidur® C	+70
iglidur® H	+120		

Table 05: Wear limits of iglidur® plain bearings

Picture 09: High wear resistance: Plain bearing in contact with sand

Picture 10: Wear experiments with aluminum shafts



Picture 11: Erosion damage due to shafts that are too smooth

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 self lubrication process result in the highest service life time. As no oil or grease is on the bearing, dirt particles can not 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 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 run 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

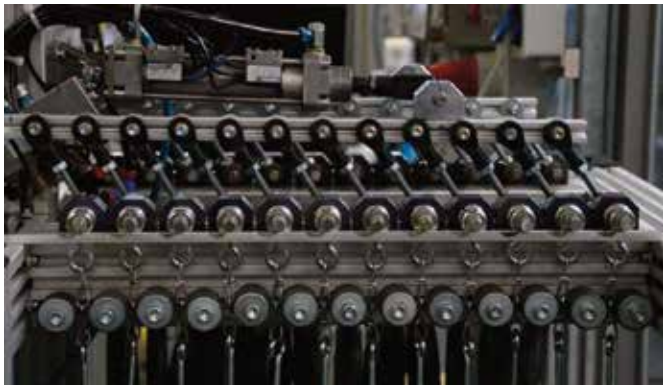
Shaft surfaces are important for the wear of bearing systems. Similar to the considerations for coefficients of friction, a shaft can be too rough in regard to the bearing wear, but it can also be too smooth. A shaft that is too rough acts like a file and during movement separates small particles from 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 surfaces of the sliding face can be so large that regular material blow-outs occur. It is significant to note that wear by erosion is non linear. Moreover, it is random and can not be accurately predicted.

Wear and Shaft Materials

The shaft is, next to 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. Fundamentally, the shaft is also worn, however, modern bearing systems are designed in a way that the wear of the shafts is so small that it can not be detected with traditional methods of measurement technology. Shafts can be distinguished and classified according to their hardness and according to the surface roughness.

▶ Coefficient of Friction, **page 52**
▶ Wear Resistance, **page 53**

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 diagrams, 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 diagrams. The small 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 in many bearing pairs. 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 typically small surface roughness, the danger of stick slip on hard chromed shafts is especially high.



Picture 12: Oscillating wear test rig for testing the wear in oscillating movements at low loads

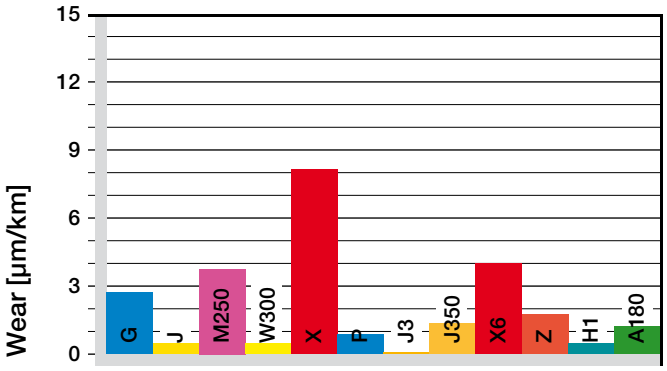


Diagram 15: Wear with Cf53 shaft, p = 1 MPa, v = 0.30 m/s Ra = 0.20 µm

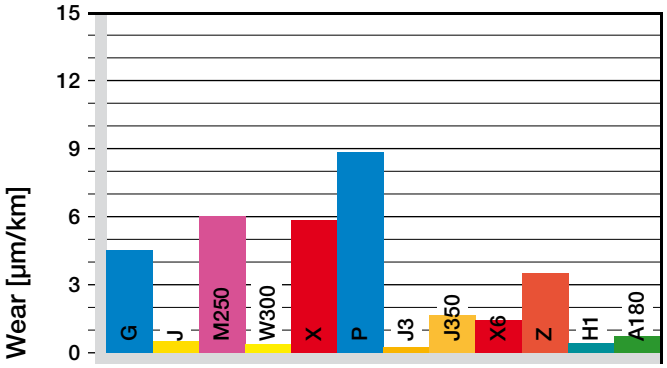


Diagram 16: Wear with V2A shaft, p = 1 MPa, v = 0.30 m/s Ra = 0,20 µm

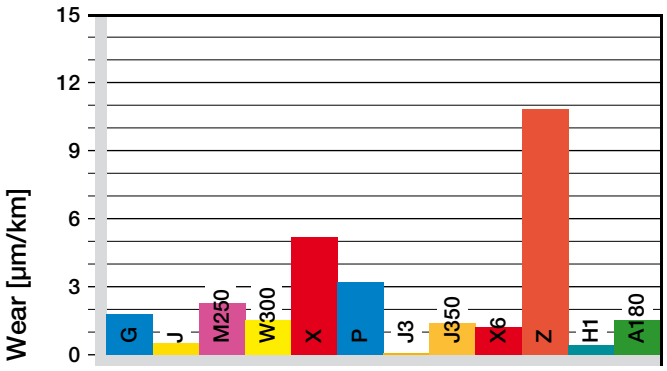


Diagram 17: Wear with St37 shaft, p = 1 MPa, v = 0,30 m/s Ra = 0.20 µm

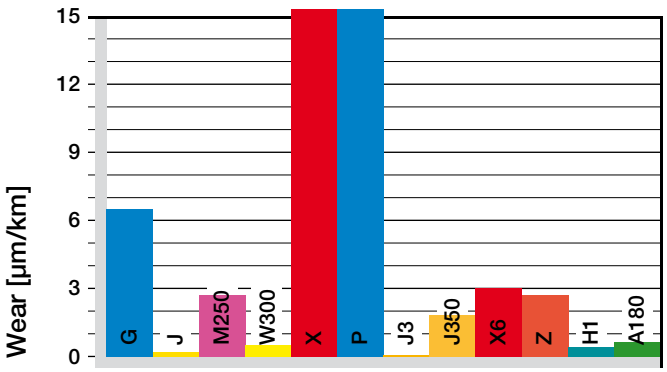


Diagram 18: Wear with hard chromed Cf53 shaft, p = 1 MPa, v = 0.30 m/s Ra = 0.20 µm

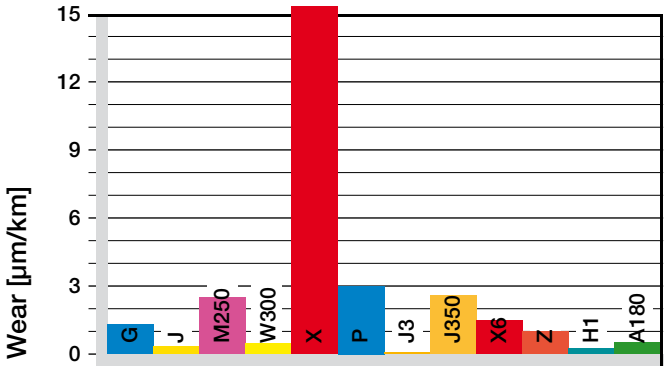


Diagram 19: Wear with hard chromed aluminium shaft, p = 1 MPa, v = 0.30 m/s Ra = 0.20 µm

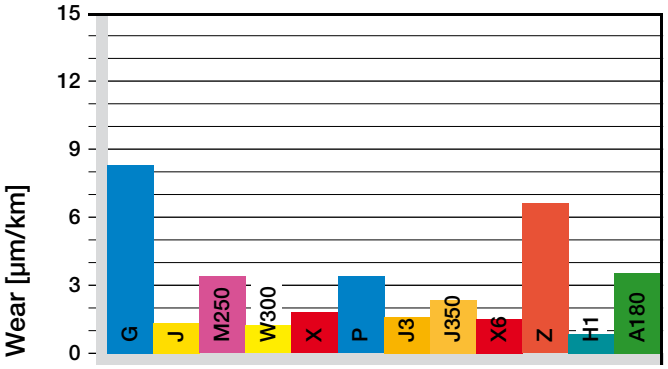


Diagram 20: Wear with a machine steel shaft, p = 1 MPa, v = 0.30 m/s Ra = 0.20 µm

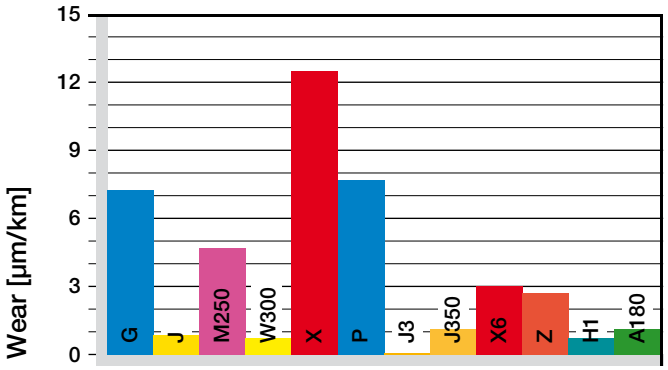


Diagram 21: Wear with X90 shaft, p = 1 MPa, v = 0.30 m/s Ra = 0.20 µm

With high-grade stainless steel 1.4112, a similarly good result is obtained. Case-hardened steel shafts (material key 1.1213) give very good results, too. With other shaft materials, the wear results vary considerably. For example, in tests with soft stainless steel (1.4301) at low load, good to very good 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 soft stainless steel (1.4301) and soft standard steel (1.0037).

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

Picture 13: Oscillating wear test rig for testing the wear in oscillating movements at medium loads

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 loading. If iglidur® plain bearings are resistant against a chemical, they can be used in these media. Sometimes, the surrounding media can even take on the role of a lubricant.

With the most resistant iglidur® material iglidur® X the lubricant can even be hydrochloric acid. All iglidur® plain bearings can be used in diluted acids and diluted alkalines. Differences can result at higher concentrations or higher temperatures. For all iglidur® plain bearings, the resistance against traditional lubricants applies in the same way. Therefore plain bearings may also be used lubricated. However, in dirty environments, a traditional lubricant can decrease the wear resistance when compared to running dry. The following overview should quickly assist you: If it is not completely clear in a design application which of the different chemicals can occur or in which concentration, plain bearings made out of iglidur® X should be used. This has the best resistance and is only attacked by a few concentrated acids. You'll find a detailed list of chemical resistances in the rear of the catalogue.

▶ Table of Chemicals, **page 1118**

Applications in the Food Industry

The iglidur® program with 5 specially developed bearing materials is prepared for the special requirements in machines and equipment for the food industry. iglidur® A180, A200, A350 and A500 materials are made according to the requirements of the American Food and Drugs Administration (FDA). iglidur® A290 material is according to the requirements of the BfR.

Material	Hydro-carbon	Greases, oils without additives	Weak acids	Weak alkaline
Standards				
iglidur® G	+	+	0 to –	+
iglidur® J	+	+	0 to –	+
iglidur® M250	+	+	0 to –	+
iglidur® W300	+	+	0 to –	+
iglidur® X	+	+	+	+
General purpose				
iglidur® P	–	+	0	–
iglidur® K	+	+	0 to –	+
iglidur® GLW	+	+	0 to –	+
Long service life				
iglidur® J260	+	0 to –	–	+ to 0
iglidur® J3	+	+	0 to –	+
iglidur® J350	+ to 0	+	+	+
iglidur® L250	+	+	0 to –	+
iglidur® R	+	+	0 to –	+
iglidur® D	+	+	0 to –	+
iglidur® J200	+	+	0 to –	+
High temperatures				
iglidur® X6	+	+	+	+
iglidur® V400	+	+	+	+
iglidur® Z	+	+	+	+
iglidur® UW500	+	+	+	+
High media resistance				
iglidur® H	+	+	+ to 0	+
iglidur® H1	+	+	+ to 0	+
iglidur® H370	+	+	0 to +	+
iglidur® H2	+	+	+ to 0	+
Application with food contact				
iglidur® A180	+	+	0 to –	+
iglidur® A200	+	+	0 to –	+
iglidur® A350	+ to 0	+	+	+
iglidur® A500	+	+	+	+
iglidur® A290	+	+	0 to –	+
iglidur® T220	–	+	0	–
Special application areas				
iglidur® F	+	+	0 to –	+
iglidur® H4	+	+	+ to 0	+
iglidur® Q	+	+	0 to –	+
iglidur® Q2	+	+	0 to –	+
iglidur® UW	+	+	0 to –	+
iglidur® N54	+	+	0 to +	+
iglidur® B	–	–	0 to –	–
iglidur® C	+	+	0 to –	+

+ resistant 0 conditionally resistant – not resistant
All data given concerns the chemical resistance at room temperature [+20 °C]

Table 06: Chemical resistance of iglidur®

Material	Radiation resistance
iglidur® X, Z, UW500	$1 \cdot 10^5$ Gy
iglidur® X6, A500	$2 \cdot 10^5$ Gy
iglidur® M250, J3, A200, N54	$1 \cdot 10^4$ Gy
iglidur® L250	$3 \cdot 10^4$ Gy
iglidur® V400, C	$2 \cdot 10^4$ Gy
iglidur® P, K	$5 \cdot 10^2$ Gy
iglidur® G, J, W300, P210, J260, J200, R, D, C500, A180, A290, T220, F, Q, Q2, UW, G V0, B, GLW	$3 \cdot 10^2$ Gy
iglidur® J350, H, H1, H370, H2, H4, A350	$2 \cdot 10^2$ Gy

Table 07: Radiation resistance of iglidur® plain bearings

Material	UV resistance	Material	UV resistance
iglidur® G	+++++	iglidur® H1	++
iglidur® J	+++	iglidur® H370	+++++
iglidur® M250	++++	iglidur® H2	+
iglidur® W300	+++	iglidur® A180	+++
iglidur® X	+++++	iglidur® A200	++++
iglidur® P	+++++	iglidur® A350	++++
iglidur® K	++++	iglidur® A500	+++
iglidur® GLW	+++++	iglidur® A290	++++
iglidur® J260	+	iglidur® T220	++
iglidur® J3	+++	iglidur® F	+++++
iglidur® J350	++	iglidur® H4	+
iglidur® L250	+++	iglidur® Q	++
iglidur® R	++++	iglidur® Q2	+++++
iglidur® X6	+++++	iglidur® UW	+++
iglidur® V400	+++	iglidur® N54	++++
iglidur® Z	+++	iglidur® B	+
iglidur® UW500	+++++	iglidur® C	+
iglidur® H	++		

Table 08: UV resistance of iglidur® plain bearings
+ low resistance +++++ high resistance

Material	Surface resistance [Ω]
iglidur® X	$< 10^3$
iglidur® X6	$< 10^3$
iglidur® UW500	$< 10^9$
iglidur® H	$< 10^2$
iglidur® H370	$< 10^5$
iglidur® F	$< 10^2$
iglidur® UW	$< 10^5$

Table 09: Electrical properties of conductive iglidur® plain bearings

Radioactive Radiation

A comparison of the resistance to radioactive radiation is shown in table 07. By a wide margin iglidur® X, UW500, A500 and Z are the most resistant materials.

UV Resistance

Plain bearings can be exposed to constant weathering when they are used outside. The UV resistance is an important measurement and indicates whether a material is attacked 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 the following table. 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.

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 most important electrical properties are given in detail in the individual material descriptions. The adjacent table compares the most important electrical properties 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 desired properties are also stable when the conditions are changing.

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 tolerance. 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.

Testing Methods

iglidur® plain bearings are pressfit bearings for bores machined to our recommendations. This pressfitting of the bearing fixes the bearing in the housing, and the inner diameter of the plain bearing is also formed upon pressfit. The bearing test is performed when the bearing is installed in a bore with the minimum specified dimension; both using an 3 point probe and a Go No-Go gauge.

- The "Go-Side" of the Go-No-Go gauge, pressed into the bore, must pass easily through the bearing
- With the 3 point probe, the inner diameter of the bearing after pressfit must lie within the prescribed tolerance on the measurement plane.

Troubleshooting

In spite of careful manufacturing and assembly of the bearings, differences and questions regarding the recommended installation dimensions 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 bore is not chamfered correctly, so the bearing material is removed upon press-fitting. The correct chamfer should be 25 to 30 degrees.
- A centering pin was used which expanded the inside diameter of the bearing during pressfit.
- The bore does not meet the recommended housing bore 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 bearing is being measured by a different method than the igus® standard.

Picture 14: Measurement of the inner diameter of a pressfit plain bearings

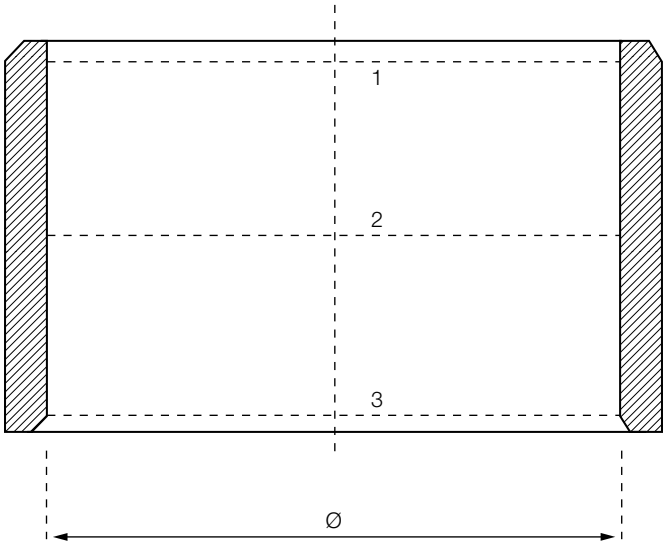


Diagram 22: Positions of the measurement planes

iglidur® | Installation

Picture 15: The bearing should be press fitted using a flat press.

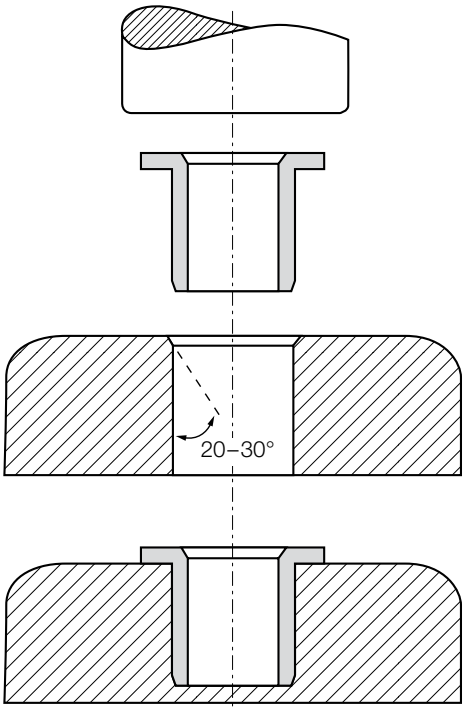


Diagram 23: Section view: pressfit of the bearing

Process	Turning	Boring	Milling
Tool material	SS	SS	SS
Feed [mm]	0.1…0.5	0.1…0.5	to 0.5
Tool relief angle	5…15	10…12	3
Tool rake angle	0…10	3…5	
Cutting speed [m/min]	200…500	50…100	to 1,000

Table 10: Guidelines for machining

Installation

iglidur® plain bearings are produced oversized as standard. The inner diameter adjusts only after pressfit in the proper housing bore with a recommended tolerance. The before pressfit oversized dimension can be up to 2 % of the inner diameter. In this manner, the secure pressfitting of the bearing is achieved. Axial or radial shifts in the housing are also prevented. The bore in the housing should be finished in the recommended tolerance (usually H7) for all bearings and be as smooth, flat, and chamfered when possible with an angle of 25 to 30 degrees.
The bearing should be press fitted using a flat press. The use of centering or calibrating pins can cause damage to the bearing and create a larger amount of clearance.

Adhesion

Using an adhesive to fit an iglidur® bearing is not usually necessary. If the pressfit of the bearing could be lost because of high temperatures, the use of a plain bearing having a higher temperature resistance is recommended. If however, the securing of the bearing by adhesives is planned, individual tests are necessary in each case. The transfer of successful results to other application cases is not possible.

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, table 10 shows the machining standard values. The subsequent machining of the running surfaces is to be avoided if possible. Higher wear rate is most often the result. An exception is the iglidur® M250 which is very suitable for secondary machining. In other iglidur® plain bearings, disadvantages of a sliding surface machining can be counteracted by lubrication during installation. Please also remember that igus® manufacture a range of stock bar materials which are designed for machining.