

oBee



Sliding Bearings

NO.OB.S08-I

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1. Types and characteristic of Sliding Bearings

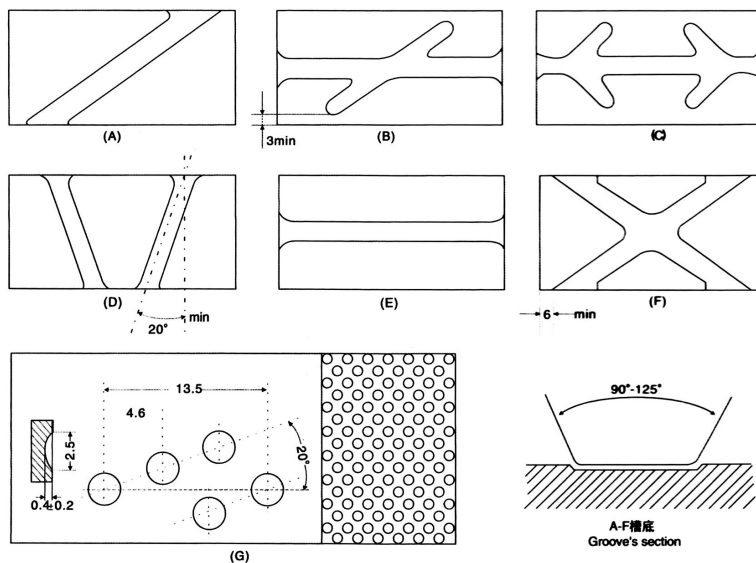
Sliding bearing is mainly divided into two categories: bushing and spherical plain bearings. The form of friction on the working surface of it is sliding friction. In general, the larger contact area of the working surface, the loading capacity will be higher. It is widely applied in the working occasion of low speed and high load.

Bushing

The commonly applied bushings mainly include: BK series non-oil lubrication bearing, DF series bimetal bush, K series copper bush. Material structure layers of non-oil lubrication are made from: 1) PTFE and lead mixture, 2) bronze powder, 3) steel back, 4) electroplated coating at high temperature. The bimetal bush with grooves is based on steel back, the surface of it is sintered of bronze and tin. The K series copper bush is made of high strength brass, the hardness of it is twice as the normal one and the wear-resistance raise by a large percentages. The matrix material is filled with lubrication material, this efficiently prolong its life and lower the noise.

Fig. 1.1 Groove types of bimetal bush

Groove types of DF bimetal bush

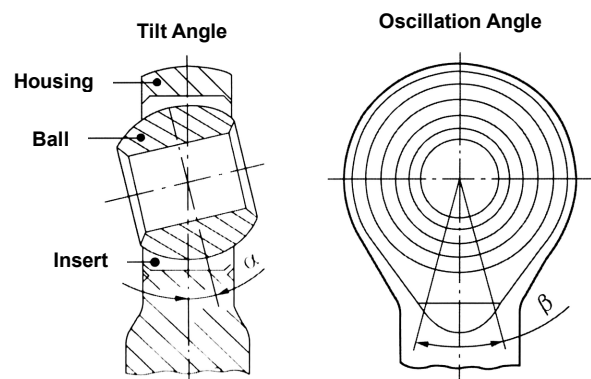


The characteristics of these bush: simple structure, small in size, need less space for assembly, help to reduce the machine volume. Also, the working surface of it has better wear-resistance and load capacity. Bushing has been widely applied in the areas of Auto, motorcycle, packing machinery, printing machinery and food machinery.

Spherical plain bearing

There are mainly four types of spherical plain bearings: radial spherical plain bearing, angular contact spherical plain bearing, thrust spherical plain bearing and rod end. The working surface of them is spherical. It is a self-aligning sliding bearing widely applied in heavy load, repeated fluctuating load and uneven load. According to the working requirements, there are designed two series of lubrication types: oil lubrication and self-lubrication.

Fig. 1.2 Spherical plain bearing structure



2. Sliding Bearing Accuracy

Clearance and torque of spherical plain bearings

Series	I.D. d(mm)		Radial internal clearance CN(μm)		Torque Nm
	over	to	min	max	max
PHS/POS		6	5	50	—
	6	10	7	60	—
	10	18	8	75	—
	18	30	10	90	—
GIR...UK		12	—	28	0.15
GAR...UK	12	20	—	35	0.25
CHS/COS	20	30	—	44	0.40
GE...ES,LO,FO		12	32	68	—
GE...ES-2RS, HO-2RS	12	20	40	82	—
FO-2RS	20	35	50	100	—
GES	35	60	60	120	—
COM	60	90	72	142	—
	90	140	85	165	—
	140	240	100	192	—
	240	320	110	214	—
GE...UK,FW		12	—	28	0.15
	12	17	—	35	0.25
	17	20	—	35	0.25
	20	30	—	44	0.40
GE...UK-2RS	17	20	—	40	1.5
FW-2RS	20	30	—	50	2
	30	35	—	60	2.5
	35	40	—	60	2.5
	40	45	—	60	3.5
	45	50	—	72	4
	50	60	—	72	4.5
	60	70	85	165	5
	70	90	100	192	6
	90	140	110	214	—
	140	250			—
	240	300			—

Clearance

Thickness and clearance of DF bimetal sheet Unit : mm

Nominal thickness	Steel-back thickness	effective thickness of alloy	Wall thickness of machinable bushing
1	0.6	.4	1 ^{+0.25} _{+0.15}
1.5	1	0.5	1.5 ^{+0.25} _{+0.15}
2	1.4	0.6	2 ^{+0.25} _{+0.15}
2.5	1.9	0.6	2.5 ^{+0.25} _{+0.15}
3	2.3	0.7	3 ^{+0.25} _{+0.15}
3.5	2.8	0.7	3.5 ^{+0.25} _{+0.15}
4	3.2	0.8	4 ^{+0.25} _{+0.15}
5	4	10	5 ^{+0.25} _{+0.15}

3. Property and Working Life of Sliding Bearing

Chemical components and physical properties of bushing

Designation	Max load rating			Max PV value		Max sliding speed (with oil lubrication)	Working temperature °C	Friction coefficient μ	Thermal conductivity	expansion coefficient α
	Stat.	Dyn.	oscillating motion	Oil lubrication	dry friction					
BK—1T Special bearings for gear pump	250N/mm ²	140N/mm ²	60N/mm ²	60N/mm ² *m/s	4.3N/mm ² *m/s	10m/s	(-195°C-260°C)	0.03-0.18	13W/MK	11*10 ⁻⁶ *K ⁻¹
BK—1P Bearings in reciprocating motions	250N/mm ²	140N/mm ²	60N/mm ²	50N/mm ² *m/s	1.8N/mm ² *m/s	2.5m/s	(-195°C-270°C)	0.04-0.2	13W/MK	11*10 ⁻⁶ *K ⁻¹
BK—1W Lead free bearings	250N/mm ²	140N/mm ²	60N/mm ²	50N/mm ² *m/s	3.6N/mm ² *m/s	5.0m/s	(-195°C-270°C)	0.04-0.2	13W/MK	11*10 ⁻⁶ *K ⁻¹
BK—1B Bronze-based bearings	250N/mm ²	140N/mm ²	60N/mm ²	60N/mm ² *m/s	4.3N/mm ² *m/s	5.0m/s	(-195°C-300°C)	0.04-0.18	18W/MK	21*10 ⁻⁶ *K ⁻¹
BK—1D Special bearings for hydraulic	250N/mm ²	140N/mm ²	60N/mm ²	50N/mm ² *m/s	3.8N/mm ² *m/s	3.0m/s	(-195°C-270°C)	0.04-0.2	16W/MK	15*10 ⁻⁶ *K ⁻¹
BK—1SS Powdered stainless steel bearings	250N/mm ²	140N/mm ²	60N/mm ²	40N/mm ² *m/s	3.0N/mm ² *m/s	2.5m/s	(-195°C-270°C)	0.05-0.25	13W/MK	15*10 ⁻⁶ *K ⁻¹

Designation	Experiment time	Experiment conditions			Friction coefficient μ	Final temperature °C	Final wear amount mm
		Lubrication	Speed	Pressure intensity			
BK—1T Special bearings for gear pump	3hr	dry	0.4m/s	3.5 N/mm ²	0.185	93	0.015
BK—1P Bearings in reciprocating motions	3hr	dry	0.4m/s	3.5 N/mm ²	0.193	100	0.015
BK—1W Lead free bearings	3hr	dry	0.4m/s	3.5 N/mm ²	0.156	93	0.009
BK—1B Bronze-based bearings	3hr	dry	0.4m/s	3.5 N/mm ²	0.151	83	0.014
BK—1D Special bearings for hydraulic	3hr	dry	0.4m/s	3.5 N/mm ²	0.175	98	0.012
BK—1SS Powdered stainless steel bearings	3hr	dry	0.4m/s	3.5 N/mm ²	0.103	66	0.005

Designation	Experiment time	Experiment conditions			Friction coefficient μ	Final temperature °C	Final wear amount mm
		Lubrication	Speed	Pressure intensity			
BK—1T Special bearings for gear pump	3hr	Oil	0.4m/s	3.5 N/mm ²	0.058	52	0.012
BK—1P Bearings in reciprocating motions	3hr	Oil	0.4m/s	3.5 N/mm ²	0.074	55	0.02
BK—1W Lead free bearings	3hr	Oil	0.4m/s	3.5 N/mm ²	0.056	52	0.01
BK—1B Bronze-based bearings	3hr	Oil	0.4m/s	3.5 N/mm ²	0.058	55	0.012
BK—1D Special bearings for hydraulic	3hr	Oil	0.4m/s	3.5 N/mm ²	0.054	46	0.004
BK—1SS Powdered stainless steel bearings	3hr	Oil	0.4m/s	3.5 N/mm ²	0.066	65	0.005

4. Rating Load of Spherical Plain Bearings

Bearing basic rating load

As an important technical issue, basic rating load of bearings depend on the performance of material. It's applied when choosing rod ends or spherical plain bearings under certain condition. It may decrease under different operating conditions.

Basic Static Load Rating (Cor)

- Cor is defined as the maximum static load on the weakest part of rod ends without plastic deformation. The Cor Values are obtained by tensile test of several rod ends under the same temperature. In the test, the yield stress only account for 80%, thus the basic static load rating includes 1.25 factor of safety. It's also used for the set of maximum axial load, which is limited by the bending strain created by inner fasten method. Maximum axial load is tested and calculated by the pressure at the biggest tilt angle.

- As for Spherical Plain Bearings, the Cor value is regarded the same as rod end because of the same housing type.

$$F_a = F_r = a \cdot C_{or} \quad [kN]$$

$$a = 0.3$$

As for the housings of spherical plain bearings, the Cor can be considered the same as rod ends.

Basic dynamic load rating of (Cr)

Cr is the load under inclination, oscillation and rotation. The value in below table shows the load of different rod ends under the maximum surface pressure Pzul in multi-direction, with horizontal movement.

pPzul value of various wear-resistance material, see table 1

Pzul	St/Ms	St/Bz	St/St	St/TBz	St/TNY
[N/mm ²]	50	50	50	50	50

Loads of bearings

There are various kind of bearing loads, they could be intermittent, constant value or the variable load under static or dynamic.

Static or Dynamic

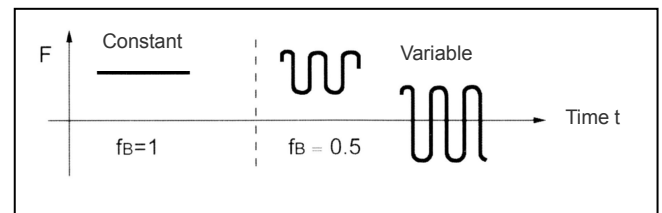


Fig.2 Inspection of load factors

Static load

It is the load of radial direction (Fr) and axial direction (Fa) under motionless

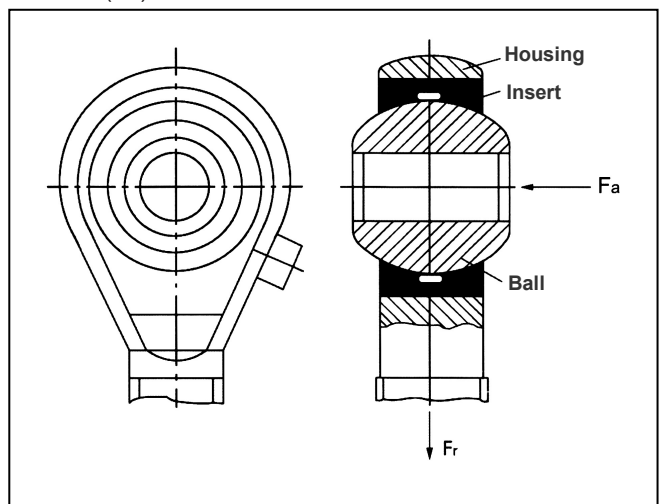


Fig.3 Radial and axial load

Dynamic load

It is the load of steel ball under the existence of the inclined angle, the oscillation angel or both radial and axial stress

Radical Spherical Plain Bearings

requiring maintenance

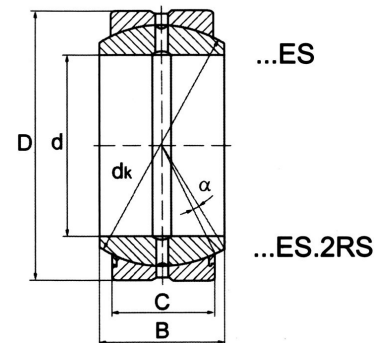
ISO 12240-1, dimension series E

Sliding contact surface: Steel/steel

Series: GE...E

GE...ES

GE...ES.2RS



Designation		Dimensions (mm)					Basic load rating (kN)		Degree	Mass
Without seals	With seals	d	D	B	C	dk	Dyn. C _r	Stat. C _{0r}	α°	≈kg
GE 6 E		6	14	6	4	10	3.40	17.0	13	0.004
GE 8 E		8	16	8	5	13	5.50	27.5	15	0.007
GE 10 E		10	19	9	6	16	8.15	40.5	12	0.011
GE 12 E		12	22	10	7	18	10.80	54.0	10	0.016
GE 15 ES		15	26	12	9	22	17.00	85.0	8	0.025
GE 17 ES		17	30	14	10	25	21.20	106.0	10	0.041
GE 20 ES	2RS	20	35	16	12	29	30.00	146.0	9	0.061
GE 25 ES	2RS	25	42	20	16	35	48.00	240.0	7	0.110
GE 30 ES	2RS	30	47	22	18	40	62.00	310.0	6	0.140
GE 35 ES	2RS	35	55	25	20	47	80.00	400.0	6	0.220
GE 40 ES	2RS	40	62	28	22	53	100.00	500.0	7	0.300
GE 45 ES	2RS	45	68	32	25	60	127.00	640.0	7	0.400
GE 50 ES	2RS	50	75	35	28	66	156.00	780.0	6	0.540
GE 60 ES	2RS	60	90	44	36	80	245.00	1220.0	6	1.000
GE 70 ES	2RS	70	105	49	40	92	315.00	1560.0	6	1.500
GE 80 ES	2RS	80	120	55	45	105	400.00	2000.0	6	2.200
GE 90 ES	2RS	90	130	60	50	115	490.00	2450.0	5	2.700
GE 100 ES	2RS	100	150	70	55	130	610.00	3050.0	7	4.300
GE 110 ES	2RS	110	160	70	55	140	655.00	3250.0	6	4.700
GE 120 ES	2RS	120	180	85	70	160	950.00	4750.0	6	8.000
GE 140 ES	2RS	140	210	90	70	180	1080.00	5400.0	7	11.000
GE 160 ES	2RS	160	230	105	80	200	1370.00	6800.0	8	13.500
GE 180 ES	2RS	180	260	105	80	225	1530.00	7650.0	6	18.500
GE 200 ES	2RS	200	290	130	100	250	2120.00	10600.0	7	28.000
GE 220 ES	2RS	220	320	135	100	275	2320.00	11600.0	8	35.500
GE 240 ES	2RS	240	340	140	100	300	2550.00	12700.0	8	40.000
GE 260 ES	2RS	260	370	150	110	325	3050.00	15300.0	7	50.000

Radical Spherical Plain Bearings

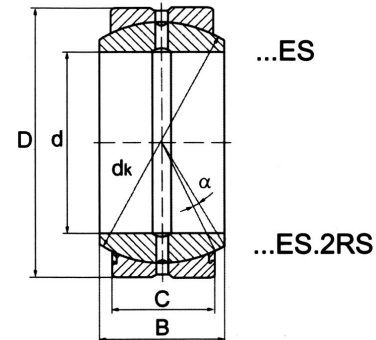
requiring maintenance

Sliding contact surface: Steel/steel

As series GE...ES, but with inch dimensions

Series: GEZ...ES

GEZ...ES.2RS



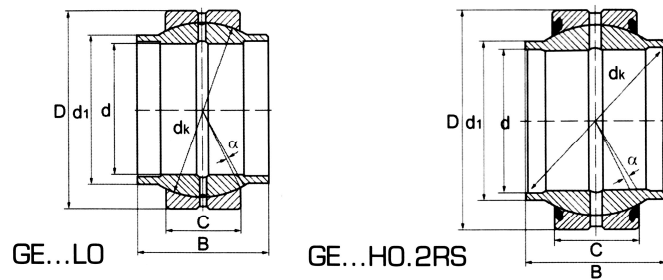
Designation		Dimensions (mm)					Basic load rating		Degree	Mass
Without seals	With seals	d	D	C	B	dk	Dyn. C _r	Stat. Co _r	α°	≈kg
GE Z12 ES		12.700	22.225	9.525	11.100	18.3	14.78	73.9	6	0.022
GE Z15 ES		15.875	26.988	11.913	13.894	22.8	23.11	115.5	6	0.036
GE Z19 ES		19.050	31.750	14.275	16.662	27.4	33.29	166.5	6	0.053
GE Z22 ES		22.225	36.513	16.662	19.431	31.9	45.29	226.5	6	0.085
GE Z25 ES	2RS	25.400	41.275	19.050	22.225	36.5	59.16	295.8	6	0.121
GE Z31 ES	2RS	31.750	50.800	23.800	27.762	45.6	92.29	461.4	6	0.232
GE Z34 ES	2RS	34.925	55.563	26.187	30.150	49.2	109.55	547.8	6	0.351
GE Z38 ES	2RS	38.100	61.913	28.575	33.325	54.7	132.9	664.5	6	0.422
GE Z44 ES	2RS	44.540	71.438	33.325	38.887	63.5	179.96	899.8	6	0.641
GE Z50 ES	2RS	50.800	80.963	38.100	44.450	82.0	298.72	1493.6	6	0.932
GE Z57 ES	2RS	57.150	90.488	42.850	50.013	73.0	236.39	1181.9	6	1.330
GE Z63 ES	2RS	63.500	100.013	47.625	55.550	91.2	369.09	1845.5	6	1.850
GE Z69 ES	2RS	69.850	111.125	52.375	61.112	100.3	446.41	2232.0	6	2.420
GE Z76 ES	2RS	76.200	120.650	57.150	66.675	109.5	532.08	2660.4	6	3.100
GE Z82 ES	2RS	82.550	130.175	61.900	72.238	118.7	624.59	3122.9	6	3.820
GE Z88 ES	2RS	88.900	139.7	66.675	77.775	128.0	725.59	3627.9	6	4.790
GE Z95 ES	2RS	95.250	149.225	71.425	83.337	137.0	831.56	4157.8	6	5.780
GEZ 101 ES	2RS	101.600	158.750	76.200	88.900	146.0	945.57	4727.9	6	6.990
GEZ 107 ES	2RS	107.950	168.275	80.950	94.463	155.0	1066.03	5330.2	6	8.410
GEZ 114 ES	2RS	114.300	177.800	85.725	100.013	164.5	1198.56	5992.8	6	9.790
GEZ 120 ES	2RS	120.650	187.325	90.475	105.562	173.4	1333.72	6668.6	6	11.500
GEZ 127 ES	2RS	127.000	196.850	95.250	111.125	182.6	1478.42	7392.1	6	13.500
GEZ 152 ES	2RS	152.400	222.250	104.775	120.650	207.2	1845.66	9228.3	5	17.500
GEZ 165 ES	2RS	165.100	247.650	103.175	123.825	222.8	1953.77	9768.8	7	22.900
GEZ 177 ES	2RS	177.800	266.700	11.125	133.350	239.9	2266.61	11333.0	7	28.600
GEZ 190 ES	2RS	190.500	285.750	119.050	142.875	257.0	2601.28	13006.4	7	35.100
GEZ 203 ES	2RS	203.200	304.800	127.000	152.400	274.2	2960.46	14802.3	7	42.600
GEZ 215 ES	2RS	215.900	323.850	134.925	161.925	291.3	3341.30	16706.5	7	51.100

Radical Spherical Plain Bearings

requiring maintenance

ISO 12240-1, dimension series W

Sliding contact surface: Steel/steel



Series: GE...LO

Designation	Dimensions (mm)						Basic load rating (kN)		Degree	Mass
	d	D	B	C	d _k	d ₁	Dyn. C _r	Stat. Co _r	α°	≈kg
GE 12 LO	12	22	12	7	18	15.5	10.8	54	4	0.020
GE 16 LO	16	28	16	9	23	20.0	17.6	88	4	0.030
GE 20 LO	20	35	20	12	29	25.0	30.0	146	4	0.070
GE 25 LO	25	42	25	16	35	30.0	48.0	240	4	0.120
GE 30 LO	30	47	30	18	40	34.0	62.0	310	4	0.168
GE 32 LO	32	52	32	18	44	37.0	67.0	335	4	0.200
GE 35 LO	35	55	35	20	47	40.0	79.0	399	4	0.253
GE 40 LO	40	62	40	22	53	46.0	100.0	500	4	0.340
GE 50 LO	50	75	50	28	66	57.0	156.0	780	4	0.560
GE 63 LO	63	95	63	36	83	71.5	255.0	1270	4	1.200
GE 70 LO	70	105	70	40	92	78.0	315.0	1560	4	1.700
GE 80 LO	80	120	80	45	105	91.0	400	2000	4	2.400
GE 90 LO	90	130	90	50	115	99.0	490.0	2450	4	3.200
GE 100 LO	100	150	100	55	130	113.0	610.0	3050	4	4.800
GE 110 LO	110	160	110	55	140	124.0	655.0	3250	4	5.800
GE 125 LO	125	180	125	70	160	138.0	950.0	4750	4	8.500
GE 160 LO	160	230	160	80	200	177.0	137.0	6800	4	16.500
GE 200 LO	200	290	200	100	250	221.0	2120	10600	4	32.000

Series: GE...HO.2RS

Designation	Dimensions (mm)						Basic load rating (kN)		Degree	Mass
	d	D	B	C	d _k	d ₁	Dyn. C _r	Stat. Co _r	α°	≈kg
GE 17 HO-2RS	17	30	21	10	25	21.0	21.2	106	3	0.400
GE 20 HO-2RS	20	35	24	12	29	24.0	30.0	146	6	0.057
GE 25 HO-2RS	25	42	29	16	35	29.0	48.0	240	4	0.100
GE 30 HO-2RS	30	47	30	18	40	33.5	62.0	310	4	0.140
GE 35 HO-2RS	35	55	35	2	47	39.5	80.0	400	4	0.240
GE 40 HO-2RS	40	62	38	22	53	45.0	100.0	500	4	0.290
GE 45 HO-2RS	45	68	40	25	60	51.0	127.0	640	4	0.430
GE 50 HO-2RS	50	75	43	28	66	57.0	156.0	780	4	0.540
GE 60 HO-2RS	60	90	54	36	80	68.0	245.0	1220	3	1.100
GE 70 HO-2RS	70	105	65	40	92	78.0	315.0	1560	4	1.600
GE 80 HO-2RS	80	120	74	45	105	89.0	400.0	2000	4	2.400

Radical Spherical Plain Bearings

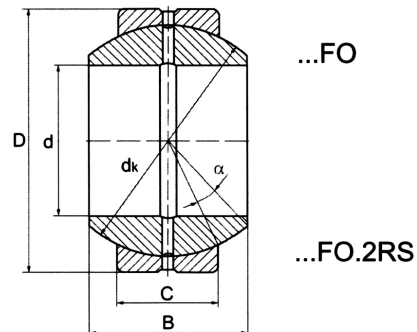
requiring maintenance

ISO 12240-1, dimension series G

Sliding contact surface: Steel/steel

Series: GE...FO

GE...FO.2RS



Designation		Dimensions (mm)					Basic load rating (kN)		Degree	Mass
Without seals	With seals	d	D	B	C	d_k	Dyn. C_r	Stat. Co_r	α^0	$\approx$ kg
GE 6 FO		6	16	9	5	13	5.50	27.5	21	0.008
GE 8 FO		8	19	11	6	16	8.15	40.5	21	0.014
GE 10 FO		10	22	12	7	18	10.80	54.0	18	0.020
GE 12 FO		12	26	15	9	22	17.00	85.0	18	0.034
GE 15 FO	2RS	15	30	16	10	25	21.20	106.0	16	0.046
GE 17 FO	2RS	17	35	20	12	29	30.00	146.0	19	0.078
GE 20 FO	2RS	20	42	25	16	35	48.00	240.0	17	0.150
GE 25 FO	2RS	25	47	28	18	40	62.00	310.0	17	0.190
GE 30 FO	2RS	30	55	32	20	47	80.00	400.0	17	0.290
GE 35 FO	2RS	35	62	35	22	53	100.00	500.00	16	0.390
GE 40 FO	2RS	40	68	40	25	60	127.00	640.00	17	0.520
GE 45 FO	2RS	45	75	43	28	66	156.00	780.0	15	0.680
GE 50 FO	2RS	50	90	56	36	80	245.00	1220.0	17	1.400
GE 60 FO	2RS	60	105	63	40	92	315.00	1560.0	17	2.000
GE 70 FO	2RS	70	120	70	45	105	400.00	2000.0	16	2.900
GE 80 FO	2RS	80	130	75	50	115	490.00	2450.0	14	3.500
GE 90 FO	2RS	90	150	85	55	130	610.00	3050.0	15	5.400
GE 100 FO	2RS	100	160	85	55	140	655.00	3250.0	14	5.900
GE 110 FO	2RS	110	180	100	70	160	950.00	4750.0	12	9.700
GE 120 FO	2RS	120	210	115	70	180	1080.0	5400.0	16	15.00
GE 140 FO	2RS	140	230	130	80	200	1370.0	6800.0	16	18.500
GE 160 FO	2RS	160	260	135	80	225	1530.00	7650.0	16	25.00
GE 180 FO	2RS	180	290	155	100	250	2120.00	10600.0	14	35.500
GE 200 FO	2RS	200	320	165	100	275	2320.00	11600.0	15	45.000

Radical Spherical Plain Bearings

Maintenance-free

ISO 12240-1, dimension series E

Sliding surface of the inner ring treated with hard chromium plating

Series:

GE...UK

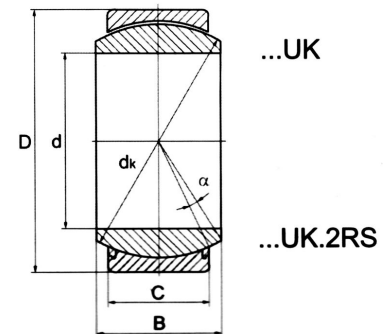
Sliding contact surface: Steel/PTFE composite material

Outer ring pressed around the inner ring;

GE...UK.2RS

Sliding contact surface: Steel/PTFE fabric

With seals on both sides



Designation		Dimensions (mm)					Basic load rating (kN)		Degree	Mass
Without seals	With seals	d	D	B	C	dk	Dyn. Cr	Stat. Co _r	α°	≈kg
GE 6 UK		6	14	6	4	10	3.6	9	13	0.004
GE 8 UK		8	16	8	5	13	5.85	14.6	15	0.007
GE 10 UK		10	19	9	6	16	8.65	21.6	12	0.011
GE 12 UK		12	22	10	7	18	11.4	28.5	10	0.016
GE 15 UK		15	26	12	9	22	17.6	44	8	0.025
GE 17 UK	2RS	17	30	14	10	25	22.40 30.0	56 60	10	0.038
GE 20 UK	2RS	20	35	16	12	29	34.5 41.5	78 83	9	0.061
GE 25 UK	2RS	25	42	20	16	35.5	51.00 68.0	127 137	7	0.110
GE 30 UK	2RS	30	47	22	18	40.7	65.50 68.0	166 176	6	0.140
	GE35UK2RS	35	55	25	20	47	112	224	6	0.200
	GE40UK2RS	40	62	28	22	53	140	280	7	0.300
	GE45UK2RS	45	68	32	25	60	180	360	7	0.400
	GE50UK2RS	50	75	35	28	66	220	440	6	0.540
	GE60UK2RS	60	90	44	36	80	345	695	6	1.000
	GE70UK2RS	70	105	49	40	92	440	880	6	1.500
	GE80UK2RS	80	120	55	45	105	570	1140	6	2.200
	GE90UK2RS	90	130	60	50	115	695	1370	5	2.700
	GE100UK2RS	100	150	70	55	130	865	1730	7	4.300
	GE110UK2RS	110	160	70	55	140	930	1860	6	4.700
	GE120UK2RS	120	180	85	70	160	1340	2700	6	8.000
	GE140UK2RS	140	210	90	70	180	1500	3000	7	11.000
	GE160UK2RS	160	230	105	80	200	1930	3800	8	13.500
	GE180UK2RS	180	260	105	80	225	2160	4300	6	18.500
	GE200UK2RS	200	290	130	100	250	3000	6000	7	28.000
	GE220UK2RS	220	320	135	100	275	3350	6500	8	35.500
	GE240UK2RS	240	340	140	100	300	3600	7200	8	40.000
	GE260UK2RS	260	370	150	110	325	4300	8650	7	50.000

Radical Spherical Plain Bearings

Maintenance-free

ISO 12240-1, dimension series G

Sliding surface of the inner ring treated with hard chromium plating

Series:

GE...FW

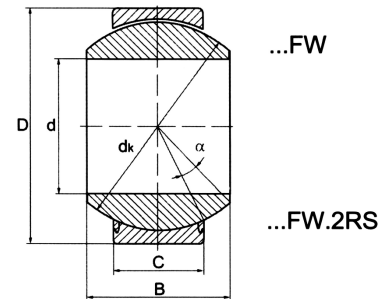
Outer ring pressed around the inner ring;

Sliding contact surface: Steel/PTFE composite material

GE...FW.2RS

Sliding contact surface: Steel/PTFE fabric

With seals on both sides



Designation		Dimensions (mm)					Basic load rating (kN)		Degree	Mass
Without seals	With seals	d	D	B	C	dk	Dyn. Cr	Stat. Co _r	α°	≈kg
GE 6 FW		6	16	9	5	13	5.85	14.6	21	0.008
GE 8 FW		8	19	11	6	16	8.65	21.6	21	0.014
GE 10 FW		10	22	12	7	18	11.40	28.5	18	0.020
GE 12 FW		12	26	15	9	22	17.60	44.0	18	0.034
GE 15 FW		15	30	16	10	25	22.40	56.0	16	0.046
GE 17 FW		17	35	20	12	29	31.50	78.0	19	0.078
GE 20 FW	2RS	20	42	25	16	35	51 67	127 135	17	0.150
GE 25 FW	2RS	25	47	28	18	40	65.5 86.4	166 174	17	0.190
	GE30FW2RS	30	55	32	20	47	112.00	224.0	17	0.290
	GE35FW2RS	35	62	35	22	53	140.00	280.0	16	0.390
	GE40FW2RS	40	68	40	25	60	180.00	360.0	17	0.520
	GE45FW2RS	45	75	43	28	66	220.00	440.0	15	0.680
	GE50FW2RS	50	90	56	36	80	345.00	695.0	17	1.400
	GE60FW2RS	60	105	63	40	92	440.00	880.0	17	2.000
	GE70FW2RS	70	120	70	45	105	570.00	1140.0	16	2.900
	GE80FW2RS	80	130	75	50	115	695.00	1370.0	14	3.500
	GE90FW2RS	90	150	85	55	130	865.00	1730.0	15	5.400
	GE100FW2RS	100	160	85	55	140	930.00	1860.0	14	5.900
	GE110FW2RS	110	180	100	70	160	1340.00	2700.0	12	9.700
	GE120FW2RS	120	210	115	70	180	1500.00	3000.0	16	15.000
	GE140FW2RS	140	230	130	80	200	1930.00	3800.0	16	18.500
	GE160FW2RS	160	260	135	80	225	2160.00	4300.0	16	25.000
	GE180FW2RS	180	290	155	100	250	3000.00	6000.0	14	35.500
	GE200FW2RS	200	320	165	100	275	3350.00	6550.0	15	45.000

Radical Spherical Plain Bearings

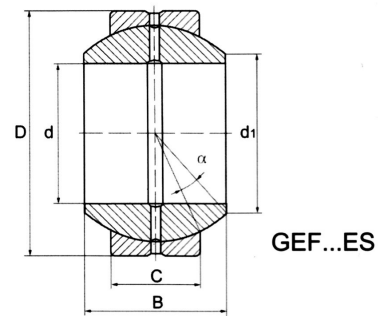
the outer ring is split at two points

ISO 12240-1, dimension series E

Sliding contact surface: Steel/ steel

As series GE...ES

Series: GEF...ES



Designation	Dimensions (mm)					Basic load rating (kN)		Degree	Mass
	d	D	B	C	d ₁	Dyn. C _r	Stat. Co _r	α°	≈kg
GEF 12 ES	12	22	11	9	14.0	13	68	7	0.019
GEF 15 ES	15	26	13	11	17.5	12	102	6	0.028
GEF 20 ES	20	32	16	14	23.0	33	166	4	0.053
GEF 22 ES	22	37	19	16	25.5	43	217	6	0.085
GEF 25 ES	25	42	21	18	29.0	55	275	5	0.116
GEF 30 ES	30	50	27	23	36.0	87	439	6	0.225
GEF 35 ES	35	55	30	26	40.0	110	552	5	0.302
GEF 40 ES	40	62	33	28	44.0	130	654	6	0.375
GEF 45 ES	45	72	36	31	50.5	163	816	5	0.598
GEF 50 ES	50	80	42	36	58.5	220	1100	5	0.869
GEF 55 ES	55	90	47	40	64.5	272	1360	6	1.260
GEF 60 ES	60	100	53	45	72.5	344	1720	6	1.720
GEF 65 ES	65	105	55	47	76.5	375	1877	5	2.050
GEF 70 ES	70	110	58	50	81.5	425	2125	5	2.230
GEF 75 ES	75	120	64	55	89.5	510	2570	5	3.010
GEF 80 ES	80	130	70	60	97.5	910	3060	5	3.980
GEF 85 ES	85	135	74	63	100.5	669	3340	6	4.310
GEF 90 ES	90	140	76	65	105.5	718	3590	5	4.720
GEF 95 ES	95	150	82	70	113.5	833	4165	5	6.050
GEF 100 ES	100	160	88	75	121.5	956	4780	5	7.430
GEF 110 ES	110	170	93	80	130.0	1080	5440	5	8.540
GEF 115 ES	115	180	98	85	132.5	1190	5960	5	10.300
GEF 120 ES	120	190	105	90	140.0	1330	6690	5	12.400
GEF 130 ES	130	200	110	95	148.5	1490	7460	5	13.800
GEF 150 ES	150	220	120	105	166.0	1820	9140	5	17.100

Angular Contact Spherical Plain Bearings

requiring maintenance

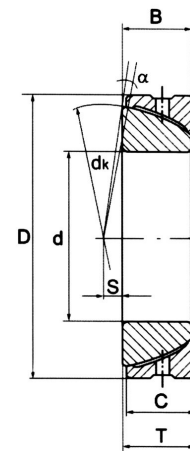
Sliding contact surface: steel/steel

The rings are of separable design

Outer ring: equipped with lubrication grooves
and lubrication holes

Surface: phosphate treatment

Series: GE...SX



GE...SX

Designation	Dimensions (mm)							Basic load rating (kN)		Degree	Mass
	d	D	T	dk	B	C	S	Dyn. Cr	Stat. Cor	α^0	≈kg
GE 25 SX	25	47	15	42.5	14	14	1	47.5	236	3.5	0.148
GE 28 SX	28	52	16	47	15	15	1	60.0	300	3.0	0.180
GE 30 SX	30	55	17	50	16	16	2	63.0	315	3.0	0.208
GE 35 SX	35	62	18	56	17	17	2	76.5	390	3.0	0.268
GE 40 SX	40	68	19	60	18	18	1.5	90.0	450	3.0	0.327
GE 45 SX	45	75	20	66	19	19	1.5	106	530	3.0	0.4160
GE 50 SX	50	80	20	74	19	19	4	118	585	3.0	455
GE 55 SX	55	90	23	80	22	22	4	146	735	3.0	0.645
GE 60 SX	60	95	23	86	22	22	5	160	800	3.0	0.714
GE 65 SX	65	100	23	92	22	22	5	173	865	2.5	0.759
GE 70 SX	70	110	25	102	24	24	7	208	1,040	2.5	1.040
GE 80 SX	80	125	29	115	27	27	10	250	1,250	2.5	1.540
GE 90 SX	90	140	32	130	30	30	11	320	1,600	2.5	2.090
GE 100 SX	100	150	32	140	30	30	12	345	1,760	2.0	2.340
GE 110 SX	110	170	38	160	36	36	15	475	2,360	2.0	3.680
GE 120 SX	120	180	38	170	36	36	17	510	2,550	2.0	3.970
GE 130 SX	130	200	45	190	42	42	20	640	3,200	1.0	5.920
GE 140 SX	140	210	45	200	42	42	20	680	3,450	1.0	6.330
GE 150 SX	150	225	48	213	45	45	21	780	3,900	1.0	8.010
GE 160 SX	160	240	51	225	48	48	21	900	4,500	1.0	9.420
GE 170 SX	170	260	57	250	54	54	27	1,100	5,500	1.0	12.300
GE 180 SX	180	280	64	260	61	61	21	1,320	6,700	1.0	17.400
GE 190 SX	190	290	64	275	61	61	29	1,370	6,950	1.5	18.200
GE 200 SX	200	310	70	290	66	66	26	1,560	7,800	1.0	22.500

Angular Contact Spherical Plain Bearings

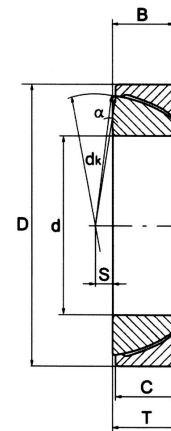
Maintenance-free

Sliding contact surface: steel/PTFE fabric

The rings are of separable design

Sliding surface of the inner ring treated with hard chromium plating

Series: GE...SW



GE...SW

Designation	Dimensions (mm)							Basic load rating (kN)		Degree	Mass
	d	D	T	dk	B	C	S	Dyn. Cr	Stat. Cor	α^0	≈kg
GE 25 SW	25	47	15	42.5	14	14	1	71.0	140	3.5	0.148
GE 28 SW	28	52	16	47	15	15	1	95.0	190	3.0	0.180
GE 30 SW	30	55	17	50	16	16	2	102	204	3.0	0.208
GE 35 SW	35	62	18	56	17	17	2.5	116	232	3.0	0.268
GE 40 SW	40	68	19	60	18	18	2	134	270	3.0	0.327
GE 45 SW	45	75	20	66	19	19	1.5	160	320	3.0	0.416
GE 50 SW	50	80	20	74	19	19	1.5	176	355	3.0	0.455
GE 55 SW	55	90	23	80	22	22	4	220	440	3.0	0.645
GE 60 SW	60	95	23	86	22	22	4	240	480	3.0	0.714
GE 65 SW	65	100	23	92	22	22	5	260	520	2.5	0.759
GE 70 SW	70	110	25	102	24	24	5	315	630	2.5	1.040
GE 80 SW	80	125	29	115	27	27	7	375	750	2.5	1.540
GE 90 SW	90	140	32	130	30	30	10	480	965	2.5	2.090
GE 100 SW	100	150	32	140	30	30	11	520	1,040	2.0	2.340
GE 110 SW	110	170	38	160	36	36	12	710	1,430	2.0	3.680
GE 120 SW	120	180	38	170	36	36	15	765	1,530	2.0	3.970
GE 130 SW	130	200	45	190	42	42	17	965	1,930	1.0	5.920
GE 140 SW	140	210	45	200	42	42	20	1,020	2,040	1.0	6.330
GE 150 SW	150	225	48	213	45	45	21	1,180	2,360	1.0	8.010
GE 160 SW	160	240	51	225	48	48	21	1,340	2,700	1.0	9.420
GE 170 SW	170	260	57	250	54	54	27	1,660	3,350	1.0	12.300
GE 180 SW	180	280	64	260	61	61	21	2,000	4,000	1.0	17.400
GE 190 SW	190	290	64	275	61	61	29	2,080	4,150	1.5	18.200
GE 200 SW	200	310	70	290	66	66	26	2,360	4,750	1.0	22.500

Thrust Spherical Plain Bearings

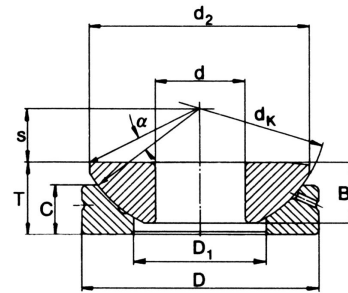
Sliding contact surface: steel/steel

The rings are of separable design

Outer ring: equipped with lubrication grooves
and lubrication holes

Surface: phosphate treatment

Series: GE...AX



GE...AX

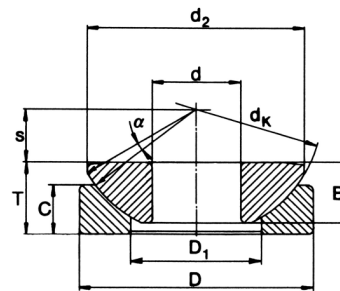
Designation	Dimensions (mm)									Basic load rating (kN)		Degree	Mass
	d	D	T	B	C	dk	D1	d2	s	Dyn. Cr	Stat. Co _r	α°	≈kg
GE 10 AX	10	30	9.5	7.9	6	32	16.5	27.5	7.0	24.0	120	10	0.039
GE 12 AX	12	35	13.0	9.3	9	37	19.5	32	8.0	32.5	163	9	0.071
GE 15 AX	15	42	15.0	10.7	11	45	24	38.9	10.0	52.0	260	7	0.12
GE 17 AX	17	47	16.0	11.5	11.5	50	28	43.4	11.0	58.5	300	6	0.16
GE 20 AX	20	55	20.0	14.3	13	60	33.5	50	12.5	75.0	375	6	0.26
GE 25 AX	25	62	22.5	16	17	66	34.5	57.5	14.0	129	640	7	0.39
GE 30 AX	30	75	26.0	18	19.5	80	44	69	17.5	170	850	6	0.64
GE 35 AX	35	90	28.0	22	20	98	52	84	22.0	260	1290	6	1
GE 40 AX	40	105	32.0	27	22	114	59	98	24.5	375	1860	6	1.7
GE 45 AX	45	120	36.5	31	25	130	68	112	27.5	490	2450	6	2.5
GE 50 AX	50	130	42.5	33.5	32	140	69	122.5	30.0	655	3250	5	3.4
GE 60 AX	60	150	45.0	37	33	160	86	140	35.0	730	3650	7	4.7
GE 70 AX	70	160	50.0	40	36	170	95	149.5	35.0	800	4050	6	5.7
GE 80 AX	80	180	50.0	42	36	194	108	168	42.5	1040	5200	6	7.2
GE 100 AX	100	210	59.0	50	42	220	133	195.5	45.0	1200	6000	7	10.9
GE 120 AX	120	230	64.0	52	45	245	154	214	52.5	1250	6200	8	13
GE 140 AX	140	260	72.0	61	50	272	176	244	52.5	1630	8150	6	18.6
GE 160 AX	160	290	77.0	65	52	310	199	272	65.0	1900	9500	7	23.9
GE 180 AX	180	320	86.0	70	60	335	224	300	67.5	2120	10600	8	31.6
GE 200 AX	200	340	87.0	74	60	358	246	321	70.0	2360	11800	8	35

Thrust Spherical Plain Bearings

Maintenance-free

Sliding contact surface: steel/PTFE fabric

Series: GE...AW



GE...AW

Designation	Dimensions (mm)									Basic load rating (kN)		Degree	Mass
	d	D	T	B	C	dk	D1	d2	s	Dyn. Cr	Stat. Co _r	α^0	≈kg
GE 10 AW	10	30	9.5	7.9	6	32	16.5	27.5	7.0	49	98	10	0.038
GE 12 AW	12	35	13.0	9.3	9	37	19.5	32	8.0	65	130	9	0.07
GE 15 AW	15	42	15.0	10.7	11	45	24	38.9	10.0	105	210	7	0.12
GE 17 AW	17	47	16.0	11.5	11.5	50	28	43.4	11.0	118	236	6	0.16
GE 20 AW	20	55	20.0	14.3	13	60	33.5	50	12.5	150	300	6	0.26
GE 25 AW	25	62	22.5	16	17	66	34.5	57.5	14.0	258	516	7	0.39
GE 30 AW	30	75	26.0	18	19.5	80	44	69	17.5	340	680	6	0.65
GE 35 AW	35	90	28.0	22	20	98	52	84	22.0	520	1040	6	1
GE 40 AW	40	105	32.0	27	22	114	59	98	24.5	745	1490	6	1.6
GE 45 AW	45	120	36.5	31	25	130	68	112	27.5	970	1940	6	2.5
GE 50 AW	50	130	42.5	33.5	32	140	69	122.5	30.0	1300	2600	5	3.4
GE 60 AW	60	150	45.0	37	33	160	86	140	35.0	1470	2940	7	4.7
GE 70 AW	70	160	50.0	40	36	170	95	149.5	35.0	1600	3200	6	5.7
GE 80 AW	80	180	50.0	42	36	194	108	168	42.5	2050	4100	6	7.2
GE 100 AW	100	210	59.0	50	42	220	133	195.5	45.0	2400	4800	7	10.9
GE 120 AW	120	230	64.0	52	45	245	154	214	52.5	2500	5000	8	13
GE 140 AW	140	260	72.0	61	50	272	176	244	52.5	3250	6500	6	18.3
GE 160 AW	160	290	77.0	65	52	310	199	272	65.0	3800	5700	7	23.8
GE 180 AW	180	320	86.0	70	60	335	224	300	67.5	4250	6400	8	31.5
GE 200 AW	200	340	87.0	74	60	358	246	321	70.0	4700	7100	8	34.7
GE 220 AW	220	370		82	67	388	265	350	75.5	5700	8800	7	44.7
GE 240 AW	240	400		87	73	420	294	382	77.5	6850	10400	6	56.9
GE 260 AW	260	430		95	80	449	317	409	82.5	7200	10800	7	71.3
GE 280 AW	280	460		100	85	480	337	445	80.0	11400	17000	4	84
GE 300 AW	300	480		100	90	490	356	460	80.0	11500	17300	3.5	88.5
GE 320 AW	320	520		105	91	540	380	500	95.0	14100	21200	4	111
GE 340 AW	340	540		105	91	550	380	510	95.0	15800	23600	4	117
GE 360 AW	360	560		115	95	575	400	535	95.0	17000	25500	4	132

Rod Ends

requiring maintenance

ISO12240-4, dimension series K

Sliding contact surface: steel/bronze

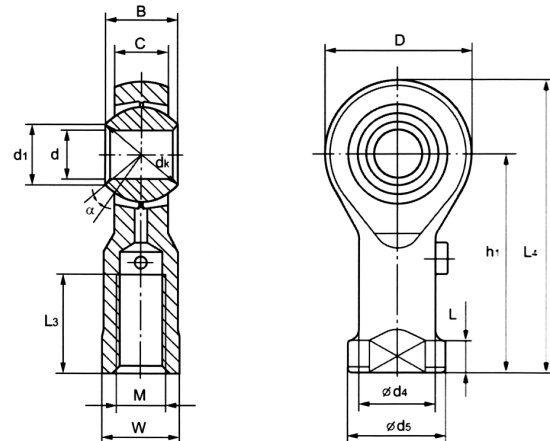
Series:

PHS

PHS...1

PHS (stainless steel series)

(specification is available)



Designation	Dimensions (mm)														Basic load rating (kN)		Degr ee α^0	Mass ≈kg	Fin thread	
	d	B	C max	d ₁	D max	h ₁	L ₄	L ₃	d ₅ max	d ₄	L	W	d _k	M 6H	Dyn. C _r	Stat. C _{0r}			Designati -on	M 6H
PHS 5	5	8	6	7.7	18	27	36	8	11	9	4	9	11.1	M5	2.5	9.9	13	16	PHS 5-1	M4
PHS 6	6	9	6.75	8.9	20	30	40	9	13	10	5	11	12.7	M6	3.2	11.9	13	22	PHS 6-1	M6
PHS 8	8	12	9	10.3	24	36	48	12	16	12.5	5	14	15.8	M8	5.4	17.1	14	47	PHS 8-1	M8
PHS 10	10	14	10.5	12.9	28	43	57	15	19	15	6.5	17	19.0	M10	7.5	21.4	13	77	PHS10-1	M10×1.25
PHS 12	12	16	12	15.4	32	50	66	18	22	17.5	6.5	19	22.2	M12	10.0	27.1	13	100	PHS 12-1	M12×1.25
PHS 14	14	19	13.5	16.8	36	57	75	21	26	20	8	22	25.4	M14	12.9	24.5	16	160	PHS 14-1	M14
PHS 16	16	21	15	19.3	42	64	85	24	28	22	8	22	28.5	M16	16.1	37.1	15	220	PHS 16-1	M16×1.5
PHS 18	18	23	16.5	21.8	46	71	94	27	31	25	10	27	31.7	M18 ×1.5	19.6	43.1	15	320	PHS 18-1	M18×1.5
PHS 20	20	25	18	24.3	50	77	102	30	35	27.5	10	30	34.9	M20 ×1.5	23.6	49.5	14	420	PHS 20-1	M20×1.5
PHS 22	22	28	20	25.8	54	84	111	33	38	30	12	32	38.1	M22 ×1.5	28.6	57.3	15	540	PHS 22-1	M22×1.5
PHS 25	25	31	22	29.5	60	94	124	36	42	33.5	12	36	42.8	M24 ×2	35.4	67.8	15	730	PHS 25-1	M24×2
PHS 28	28	35	24	32.2 9	66	103	136	41	46	37	14	41	47.6	M27 ×2	47.1	68	15	949	PHS 28-1	M27×2
PHS 30	30	37	25	34.8	70	110	145	45	50	40	15	41	50.8	M30 ×2	52.6	68	17	1100	PHS 30-1	M27×2

Rod Ends

requiring maintenance

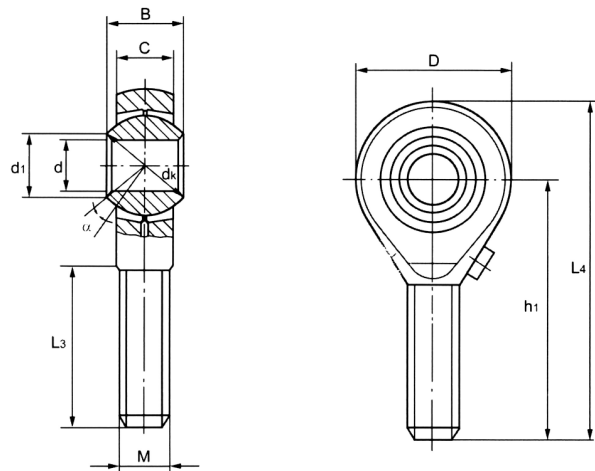
ISO12240-4, dimension series K

Sliding contact surface: steel/bronze

Series: POS

SPOS(stainless steel series)

(Specification is available)



Design- ation	Dimensions (mm)										Basic load rating (kN)		Degree	Mass
	d	B	C	d ₁	D	h ₁	L ₄	L ₃	d _k	M 6g	Dyn. C _r	Stat. Co _r	α°	≈kg
POS 5	5	8	6	7.7	18	33	42	19	11.1	M5	2.5	4.3	13	0.013
POS 6	6	9	6.75	8.9	20	36	46	21	12.7	M6	3.2	6.0	13	0.020
POS 8	8	12	9	10.3	24	42	54	25	15.8	M8	5.4	11.0	14	0.038
POS 10	10	14	10.5	12.9	28	48	62	28	19.0	M10	7.5	17.4	13	0.055
POS 12	12	16	12	15.4	32	54	70	32	22.2	M12	10.0	25.3	13	0.085
POS 14	14	19	13.5	16.8	36	60	78	36	25.4	M14	12.9	24.5	16	0.140
POS 16	16	21	15	19.3	42	66	87	37	28.5	M16	16.1	36.4	15	0.210
POS 18	18	23	16.5	21.8	46	72	95	41	31.7	M18×1.5	19.6	43.1	15	0.280
POS 20	20	25	18	24.3	50	78	103	45	34.9	M20×1.5	23.6	49.5	14	0.380
POS 22	22	28	20	25.8	54	84	111	48	38.1	M22×1.5	28.6	57.3	15	0.480
POS 25	25	31	22	29.5	60	94	124	55	42.8	M24×2	35.4	67.8	15	0.640
POS 28	28	35	24	32.29	66	103	136	62	47.6	M27×2	47.1	68	15	0.949
POS 30	30	37	25	34.8	70	110	145	66	50.8	M30×2	52.6	68	17	1.100

Rod Ends

requiring maintenance

ISO12240-4, dimension series K

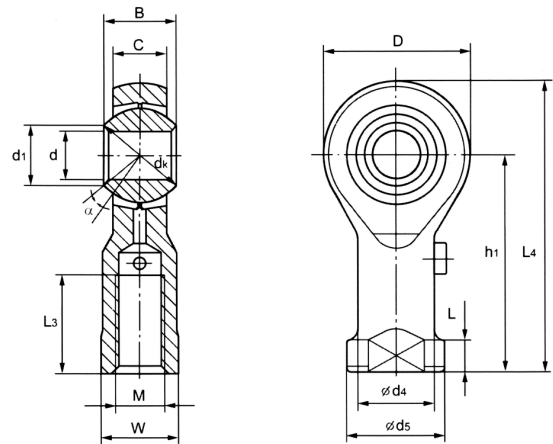
Sliding contact surface: steel/bronze

Series: PHS...HD

PHS...1HD

SPHS...HD(stainless steel series)

(Specification is available)



Designation n	Dimensions (mm)														Basic load rating (kN)		Degr -ee α^0 ≈	Mass ≈kg	Fin thread	
	d	B	C max	d ₁	D max	h ₁	L ₄	L ₃	d ₅ max	D ₄	L	W	d _K	M 6H	Dyn. C _r	Stat. C _{0r}			Designation	M 6H
PHS 5 HD	5	8	6	7.7	18	27	36	8	11	9	4	9	11.1	M5	3.3	8.0	13	0.016	PHS5-1HD	M4
PHS 6 HD	6	9	6.75	8.9	20	30	40	9	13	10	5	11	12.7	M6	4.3	8.9	13	0.022	PHS 6-1 HD	M6
PHS 8 HD	8	12	9	10.3	24	36	48	12	16	12.5	5	14	15.8	M8	7.1	14.1	14	0.047	PHS 8-1 HD	M8
PHS 10 HD	10	14	10.5	12.9	28	43	57	15	19	15	6.5	17	19.0	M10	10.0	19.3	13	0.077	PHS10-1 HD	M10×1.25
PHS 12 HD	12	16	12	15.4	32	50	66	18	22	17.5	6.5	19	22.2	M12	13.3	23.5	13	0.100	PHS 12-1 HD	M12×1.25
PHS 14 HD	14	19	13.5	16.8	36	57	75	21	26	20	8	22	25.4	M14	17.1	20.8	16	0.160	PHS 14-1 HD	M14
PHS 16 HD	16	21	15	19.3	42	64	85	24	28	22	8	22	28.5	M16	21.4	32.0	15	0.220	PHS 16-1 HD	M16×1.25
PHS 18 HD	18	23	16.5	21.8	46	71	94	27	31	25	10	27	31.7	M18×1.5	26.2	38.6	15	0.320	PHS 18-1 HD	M18×1.25
PHS 20 HD	20	25	18	24.3	50	77	102	30	35	27.5	10	30	34.9	M20×1.5	31.4	43.8	14	0.420	PHS 20-1 HD	M20×1.25
PHS 22 HD	22	28	20	25.8	54	84	111	33	38	30	12	32	38.1	M22×1.5	38.1	52.6	15	0.540	PHS 22-1 HD	M22×1.25
PHS 25 HD	25	31	22	29.5	60	94	124	36	42	33.5	12	36	42.8	M24×2	47.1	62.4	15	0.730	PHS 25-1 HD	M24×2
PHS 28 HD	28	35	24	32.29	66	103	136	41	46	37	14	41	47.6	M27×2	59.0	77.0	15	0.949	PHS 28-1 HD	M27×2
PHS 30 HD	30	37	25	34.8	70	110	145	45	50	40	15	41	50.8	M30×2	63.5	81.6	17	1.100	PHS 30-1 HD	M27×2

Rod Ends

requiring maintenance

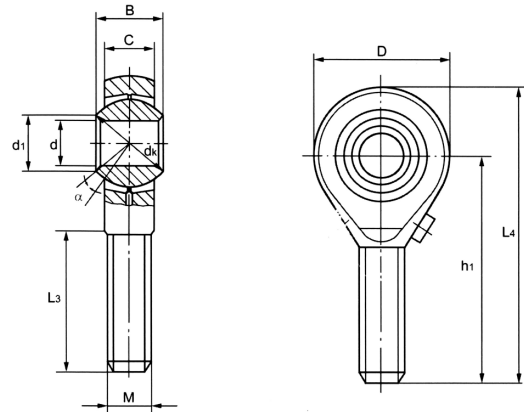
ISO12240-4, dimension series K

Sliding contact surface: steel/bronze

Series: POS...HD

SPOS...HD (stainless steel series)

(Specification is available)



Designation	Dimensions (mm)										Basic load rating (kN)		Degr -ee	Mass
	d	B	C	d ₁	D	H ₁	L ₄	L ₃	d _k	M 6g	Dyn. C _r	Stat. Co _r	α ⁰	≈kg
POS 5 HD	5	8	6	7.7	18	33	42	19	11.1	M5	3.3	4.3	13	0.013
POS 6 HD	6	9	6.75	8.9	20	36	46	21	12.7	M6	4.3	6.0	13	0.020
POS 8 HD	8	12	9	10.3	24	42	54	25	15.8	M8	7.1	11.0	14	0.038
POS 10 HD	10	14	10.5	12.9	28	48	62	28	19.0	M10	10.0	17.4	13	0.055
POS 12 HD	12	16	12	15.4	32	54	70	32	22.2	M12	13.3	23.5	13	0.085
POS 14 HD	14	19	13.5	16.8	36	60	78	36	25.4	M14	17.1	20.8	16	0.140
POS 16 HD	16	21	15	19.3	42	66	87	37	28.5	M16	21.4	32.0	15	0.210
POS 18 HD	18	23	16.5	21.8	46	72	95	41	31.7	M18×1.5	26.2	38.6	15	0.280
POS 20 HD	20	25	18	24.3	50	78	103	45	34.9	M20×1.5	31.4	43.8	14	0.380
POS 22 HD	22	28	20	25.8	54	84	111	48	38.1	M22×1.5	38.1	52.6	15	0.480
POS 25 HD	25	31	22	29.5	60	94	124	55	42.8	M24×2	47.1	62.7	15	0.640
POS 28 HD	28	35	24	32.29	66	103	136	62	47.6	M27×2	59.0	77.0	15	0.949
POS 30 HD	30	37	25	34.8	70	110	145	66	50.8	M30×2	63.5	81.6	17	1.100

Rod End

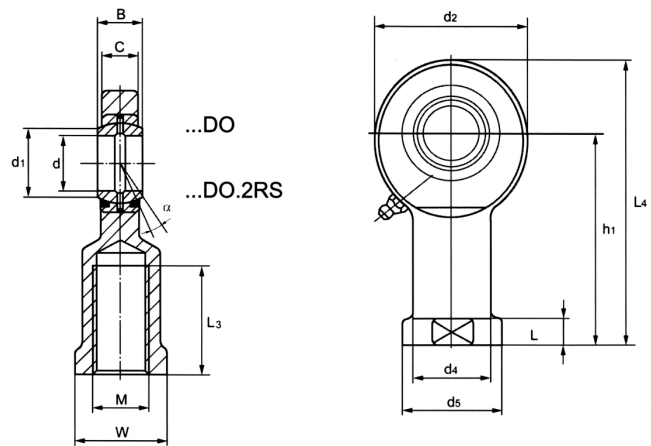
requiring maintenance

ISO 12 240-4, dimension series E

Sliding contact surface steel/steel

Series: GIR...DO

GIR...DO.2RS



Designation		Dimensions (mm)													Basic load rating (kN)		Degr ee	Mass
Without seals	With seals	d	B	C	d ₁	d ₂ max	h ₁	L ₄	L ₃ max	d ₅	d ₄	L	W	M 6H	Dyn. C _r	Stat. Co _r	α°	≈kg
GIR 6 DO		6	6	4.4	8.00	21	30	40.5	11	13	10.0	5.0	11	M6	3.40	8.15	13	0.021
GIR 8 DO		8	8	6.0	10.25	24	36	48.0	15	16	12.5	5.0	14	M8	12.9	12.9	15	0.039
GIR 10 DO		10	9	7.0	13.23	29	43	57.5	15	19	15.0	6.5	17	M10	8.15	17.6	12	0.061
GIR 12 DO		12	10	8.0	14.96	34	50	67.0	18	22	17.5	6.5	19	M12	10.8	24.5	10	0.096
GIR 15 DO		15	12	10.0	18.43	40	61	81.0	21	26	21.0	8.0	22	M14	17.0	36.0	8	0.180
GIR 17 DO		17	14	11.0	20.71	46	67	90.0	24	30	24.0	10.0	27	M16	21.2	45.0	10	0.220
GIR 20 DO	2RS	20	16	13.0	24.18	53	77	103.5	30	35	27.5	10.0	32	M20×1.5	30.0	60.0	9	0.350
GIR 25 DO	2RS	25	20	17.0	28.72	64	94	126.0	36	42	33.5	12.0	36	M24×2	48.0	83.0	7	0.640
GIR 30 DO	2RS	30	22	19.0	33.40	73	110	146.5	45	50	40.0	15.0	41	M30×2	62.0	110.0	6	0.930
GIR 35 DO	2RS	35	25	21.0	39.00	82	125	166.0	60	58	47.0	15.0	50	M36×3	80.0	146.0	6	1.300
GIR 40 DO	2RS	40	28	23.0	45.00	92	142	188.0	65	65	52.0	18.0	55	M39×3	100.0	180.0	7	2.000
GIR 45 DO	2RS	45	32	27.0	50.00	102	145	196.0	65	70	58.0	20.0	60	M42×3	127.0	240.0	7	2.500

Rod End

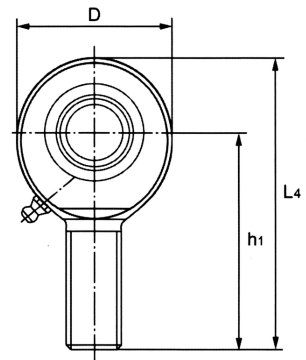
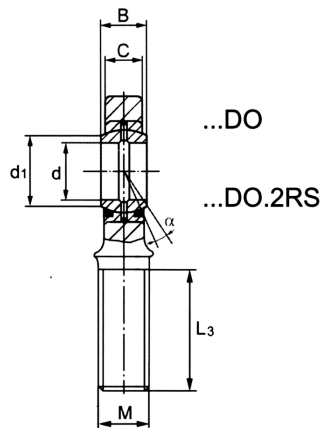
requiring maintenance

ISO 12 240-4, dimension series E

Sliding contact surface steel/steel

Series: GAR...DO

GAR...DO.2RS



Designation		Dimensions (mm)									Basic load rating (kN)		Degree	Mass
Without seals	With seals	d	B	C	d ₁	D	h ₁	L ₄	L ₃	M	Dyn. C _r	Stat. Co _r	α ⁰	≈kg
GAR 6 DO		6	6	4.4	8.00	21	30	40.5	16	M6	3.40	8.15	13	0.017
GAR 8 DO		8	8	6.0	10.25	24	36	48.0	21	M8	12.9	12.9	15	0.029
GAR 10 DO		10	9	7.0	13.23	29	43	57.5	26	M10	8.15	17.6	12	0.051
GAR 12 DO		12	10	8.0	14.96	34	50	67.0	28	M12	10.8	24.5	10	0.086
GAR 15 DO		14	12	10.0	18.43	40	61	81.0	34	M14	17.0	36.0	8	0.140
GAR 17 DO		17	14	11.0	20.71	46	67	90.0	36	M16	21.2	45.0	10	0.190
GAR 20 DO	2RS	20	16	13.0	24.18	53	77	103.5	43	M20×1.5	30.0	60.0	9	0.310
GAR 25 DO	2RS	25	20	17.0	28.72	64	94	126.0	53	M24×2	48.0	83.0	7	0.560
GAR 30 DO	2RS	30	22	19.0	33.40	73	110	146.0	65	M30×2	62.0	110.0	6	0.890
GAR 35 DO	2RS	35	25	21.0	39.00	82	140	181.0	82	M36×3	80.0	146.0	6	1.400
GAR 40 DO	2RS	40	28	23.0	45.00	92	150	196.0	86	M39×3	100.0	180.0	7	1.800
GAR 45 DO	2RS	45	32	27.0	50.00	102	163	214.0	92	M42×3	127.0	240.0	7	2.600

Rod End

Maintenance-free

ISO 12 240-4, dimension series K

Sliding contact surface: steel/ PTFE

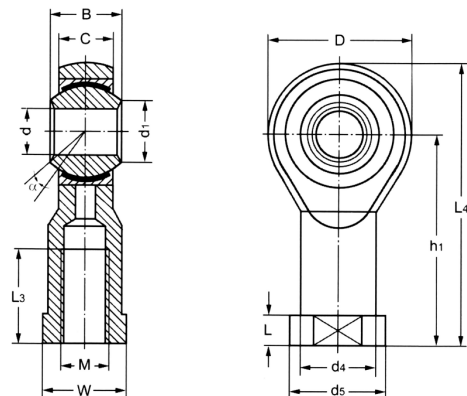
Series:

CHS

CHS...1

CHS (stainless steel series)

(Specification is available)



Designation	Dimensions (mm)													Basic load rating (kN)		Degr-ee	Mass	Fin thread	
	d	B	C	d ₁	D	h ₁	L ₄	L ₃	d ₃	d ₄	L	W	M	Dyn.	Stat.	α°	≈kg	Designa	M
			max		max				max				6H	C _r	Co _r	≈		tion	6H
CHS 5	5	8	6	7.7	18	27	36	8	11	9	4	9	M5	3.25	5.70	13	0.016	CHS5-1	M4
CHS 6	6	9	6.75	8.9	20	30	40	9	13	10	5	11	M6	4.25	7.2	13	0.022	CHS 6-1	M6
CHS 8	8	12	9	10.3	24	36	48	12	16	12.5	5	14	M8	7.1	11.6	14	0.047	CHS 8-1	M8
CHS 10	10	14	10.5	12.9	28	43	57	15	19	15	6.5	17	M10	9.80	14.5	13	0.077	CHS10-1	M10×1.25
CHS 12	12	16	12	15.4	32	50	66	18	22	17.5	6.5	19	M12	13.20	17.0	13	0.100	CHS 12-1	M12×1.25
CHS 14	14	19	13.5	16.8	36	57	75	21	26	20	8	22	M14	17.0	24.0	16	0.160	CHS 14-1	M14
CHS 16	16	21	15	19.3	42	64	85	24	28	22	8	22	M16	21.4	28.5	15	0.220	CHS 16-1	M16×1.5
CHS 18	18	23	16.5	21.8	46	71	94	27	31	25	10	27	M18×1.5	26.0	42.5	15	0.320	CHS 18-1	M18×1.5
CHS 20	20	25	18	24.3	50	77	102	30	35	27.5	10	30	M20×1.5	31.0	42.5	14	0.420	CHS 20-1	M20×1.5
CHS 22	22	28	20	25.8	54	84	111	33	38	30	12	32	M22×1.5	42.2	57.0	15	0.540	CHS 22-1	M22×1.5
CHS 25	25	31	22	29.5	60	94	124	36	42	33.5	12	36	M24×2	52.7	68.0	15	0.730	CHS 25-1	M24×2
CHS 28	28	35	24	32.29	66	103	136	41	46	37	14	41	M27×2	58.8	69.0	15	0.949	CHS 28-1	M27×2
CHS 30	30	37	25	34.8	70	110	145	45	50	40	15	41	M30×2	70.7	88	17	1.100	CHS 30-1	M27×2

Rod End

maintenance-free

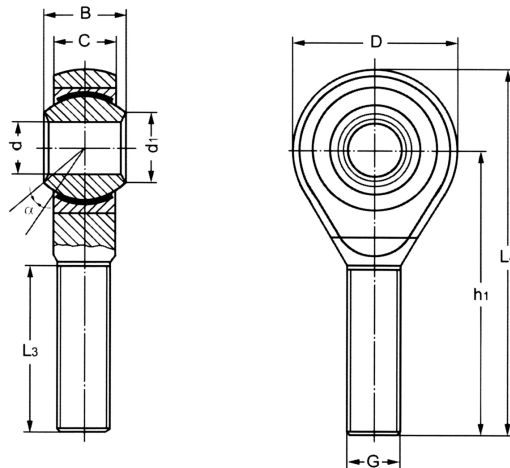
ISO 12 240-4, dimension series K

Sliding contact surface: steel/PTFE

Series: COS

SCOS (stainless steel series)

(Specification is available)



Designation	Dimensions (mm)									Basic load rating (kN)		Degree	Mass
	d	B	C	d ₁	D	h ₁	L ₄	L ₃	M 6g	Dyn. C _r	Stat. Co _r	α ⁰	≈kg
COS 5	5	8	6	7.7	18	33	42	19	M5	3.25	8.0	13	0.013
COS 6	6	9	6.75	8.9	20	36	46	21	M6	4.25	8.9	13	0.020
COS 8	8	12	9	10.3	24	42	54	25	M8	7.10	14.1	14	0.038
COS 10	10	14	10.5	12.9	28	48	62	28	M10	9.80	19.3	13	0.055
COS 12	12	16	12	15.4	32	54	70	32	M12	13.2	23.5	13	0.085
COS 14	14	19	13.5	16.8	36	60	78	36	M14	17.0	20.8	16	0.140
COS 16	16	21	15	19.3	42	66	87	37	M16	21.4	32.0	15	0.210
COS 18	18	23	16.5	21.8	46	72	95	41	M18×1.5	26.0	38.6	15	0.280
COS 20	20	25	18	24.3	50	78	103	45	M20×1.5	31.0	43.8	14	0.380
COS 22	22	28	20	25.8	54	84	111	48	M22×1.5	42.2	52.6	15	0.480
COS 25	25	31	22	29.5	60	94	124	55	M24×2	52.7	62.4	15	0.640
COS 28	28	35	24	32.29	66	103	136	62	M27×2	58.8	77.0	15	0.949
COS 30	30	37	25	34.8	70	110	145	66	M30×2	70.7	81.6	17	1.100

Rod End

maintenance-free

ISO 12 240-4, dimension series E

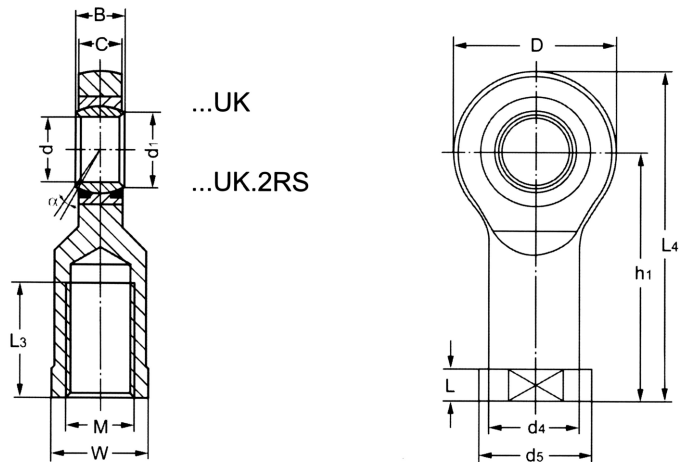
Series:

GIR...UK

Sliding contact surface: steel/PTFE

GIR...UK.2RS

Sliding contact surface: steel/PTFE fabric



Designation		Dimensions (mm)													Basic load rating (kN)		Deg ree α^0	Mass $\approx$ kg
Without Seals	With Seals	d	B	C	d ₁	D max	h ₁	L ₄	L ₃ max	d ₅	b ₄	L	W	M 6H	Dyn. C _r	Stat. C _{0r}		
GIR 6 UK		6	6	4.4	8.00	21	30	40.5	11	13	11	5.0	11	M6	3.60	8.15	13	0.021
GIR 8 UK		8	8	6.0	10.25	24	36	48.0	15	16	13	5.0	14	M8	5.85	12.9	15	0.039
GIR 10 UK		10	9	7.0	13.23	29	43	57.5	15	19	16	6.5	17	M10	8.65	17.6	12	0.061
GIR 12 UK		12	10	8.0	14.96	34	50	67.0	18	22	19	6.5	19	M12	11.4	24.5	10	0.096
GIR 15 UK		15	12	10.0	18.43	40	61	81.0	21	26	22	8.0	22	M14	17.6	36.0	8	0.180
GIR 17 UK		17	14	11.0	20.71	46	67	90.0	24	30	25	10.0	27	M16	22.4	45.0	10	0.220
GIR 20 UK	2RS	20	16	13.0	24.18	53	77	103.5	30	35	28	10.0	32	M20×1.5	31.5	60.0	9	0.350
GIR 25 UK	2RS	25	20	17.0	28.72	64	94	126.0	36	42	35	12.0	36	M24×2	51.0	83.0	7	0.640
GIR 30 UK	2RS	30	22	19.0	33.40	73	110	146.5	45	50	42	15.0	41	M30×2	66.5	110.0	6	0.930
GIR 30 UK	2RS	35	25	21.0	39.00	82	125	166.0	60	58	47	15.0	50	M36×3	112.0	146.0	6	1.500
GIR 40 UK	2RS	40	28	23.0	45.00	92	142	188.0	65	65	52	18.0	55	M39×3	140.0	180.0	7	2.100
GIR 45 UK	2RS	45	32	27.0	50.00	102	145	196.0	65	70	58	20.0	60	M42×3	180.0	240.0	7	2.700

Rod End

maintenance-free

ISO 12 240-4, dimension series E

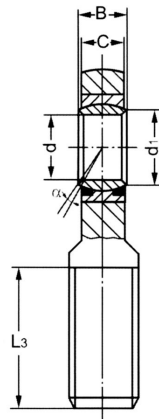
Series:

GAR...UK

Sliding contact surface: steel/PTFE

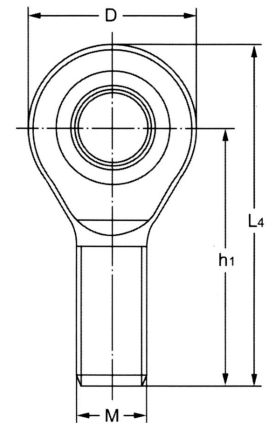
GAR...UK.2RS

Sliding contact surface: steel/PTFE fabric



...UK

...UK.2RS



Designation		Dimensions (mm)									Basic load rating (kN)		Degree	Mass
Without seals	With seals	d	B	C	d ₁	D	h ₁	L ₄	L ₃	M	Dyn. C _r	Stat. Co _r	α°	≈kg
GAR 6 UK		6	6	4.4	8.00	21	36	46.5	16	M6	3.60	8.15	13	0.017
GAR 8 UK		8	8	6.0	10.25	24	42	54.0	21	M8	5.85	12.9	15	0.029
GAR 10 UK		10	9	7.0	13.23	29	48	62.5	26	M10	8.65	17.6	12	0.051
GAR 12 UK		12	10	8.0	14.96	34	54	71.0	28	M12	11.4	24.5	10	0.086
GAR 15 UK		14	12	10.0	18.43	40	63	83.0	34	M14	17.6	36.0	8	0.140
GAR 17 UK		17	14	11.0	20.71	46	69	92.0	36	M16	22.4	45.0	10	0.190
GAR 20 UK	2RS	20	16	13.0	24.18	53	78	104.5	43	M20×1.5	31.5	60.0	9	0.310
GAR 25 UK	2RS	25	20	17.0	28.72	64	94	126.0	53	M24×2	51.0	83.0	7	0.560
GAR 30 UK	2RS	30	22	19.0	33.40	73	110	146.0	65	M30×2	66.5	110.0	6	0.890
GAR 35 UK	2RS	35	25	22.0	39.00	82	140	181.0	82	M36×3	112.0	146.0	6	1.400
GAR 40 UK	2RS	40	28	24.0	45.00	92	150	196.0	86	M39×3	140.0	180.0	7	1.800
GAR 45 UK	2RS	45	32	28.0	50.00	102	163	214.0	94	M42×3	180.0	240.0	7	2.500

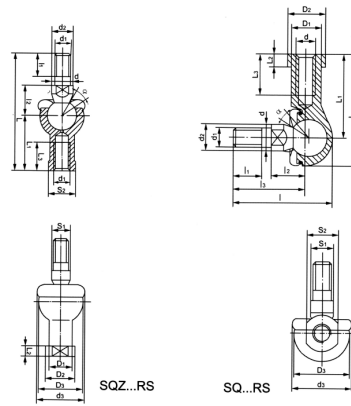
Ball Joints

Ball joint housing made of zinc base alloy

Shank with internal thread

Series:

SQZ...RS



SQZ...RS

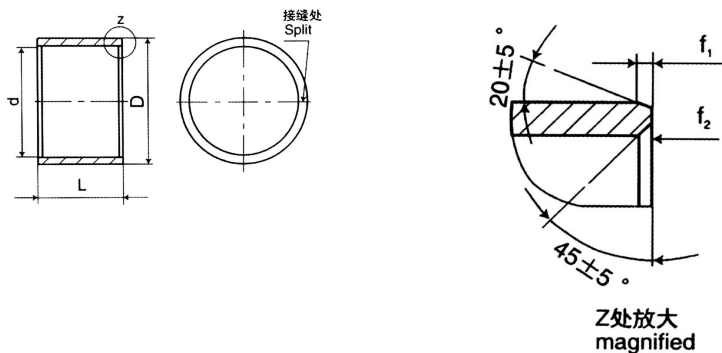
SQ...RS

Designation	Dimensions (mm)																Basic load rating (kN)	Degree	Mass
	D	d ₁	d ₂	d ₃	l ₁	l ₂	S ₁	L	L ₁	L ₂	L ₃	D ₁	D ₂	D ₃	S ₂	CO _r	α ⁰	≈kg	
			min	max	min			max		max	min	max	max	max					
SQZ 5-RS	5	M5	9	20	8	11.0	7	46.0	24	4.0	12	9.0	11	17	9	2.8	15.0	0.025	
SQZ 6-RS	6	M6	10	20	11	12.2	8	55.2	38	5.0	15	10.0	13	20	11	3.7	15.0	0.041	
SQZ 8-RS	8	M8	12	24	12	16.0	10	65.0	32	5.0	16	12.5	16	24	14	5.8	15.0	0.075	
SQZ 10-RS	10	M10×1.25	14	30	15	19.5	11	74.5	35	6.5	18	15.0	19	28	17	8.4	15.0	0.120	
SQZ 12-RS	12	M12×1.25	17	32	17	21.0	15	84.0	40	6.5	20	17.5	22	32	19	11.0	15.0	0.180	
SQZ14-RS	14	M14×1.5	19	38	22	23.5	17	103.0	45	8.0	25	20.0	25	36	22	15.0	11.0	0.270	
SQZ 16-RS	16	M16×1.5	22	44	23	25.5	19	112.0	50	8.0	27	22.0	27	40	22	15.0	11.0	0.360	
SQZ 18-RS	18	M18×1.5	23	45	25	31.0	20	130.5	58	10.0	32	25.0	31	45	27	19.0	11.0	0.540	
SQZ 20-RS	20	M20×1.5	27	50	25	29.0	24	133.0	63	10.0	38	27.5	34	45	30	19.0	7.5	0.570	
SQZ 22-RS	22	M22×1.5	27	52	26	33.0	24	145.0	70	12.0	43	30.0	37	50	32	23.0	7.5	0.760	

Series: SQ...RS

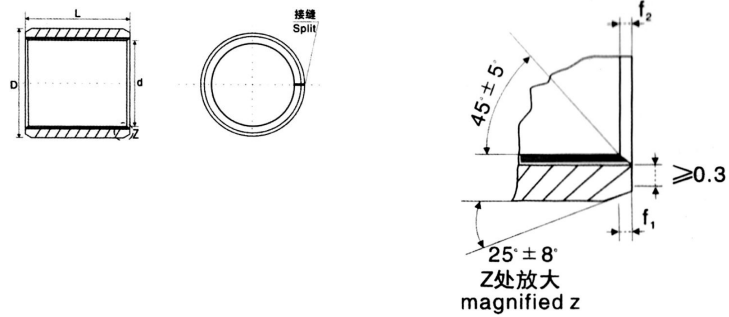
Design ation	Dimensions (mm)																	Basic load rating	Degree	Mass
	d	d ₁	d ₂	d ₃	l	l ₁	l ₂	l ₃	S ₁	L	L ₁	L ₂	L ₃	D ₁	D ₂	D ₃	S ₂	CO _r		
			min	max	max	min				max		max	min	max	max	max		KN	α ⁰	≈kg
SQ 5-RS	5	M5	9	19	29.0	8	10.0	21	7	35	27	4.0	14	9.0	11	16	9	2.2	25	0.026
SQ 6-RS	6	M6	10	20	35.5	11	11.0	26	8	40	30	5.0	14	10.0	13	19	11	3.5	25	0.039
SQ 8-RS	8	M8	12	24	42.5	12	14.0	31	10	48	36	5.0	17	12.5	16	23	14	6.6	25	0.068
SQ 10-RS	10	M10×1.25	14	30	50.5	15	17.0	37	11	57	43	6.5	21	15.0	19	27	17	10.0	25	0.112
SQ 12-RS	12	M12×1.25	17	32	57.5	17	19.0	42	15	66	50	6.5	25	17.5	22	31	19	16.0	25	0.164
SQ14-RS	14	M14×1.5	19	38	73.5	22	21.5	56	17	75	57	8.0	26	20.0	25	35	22	19.0	25	0.254
SQ 16-RS	16	M16×1.5	22	44	79.5	23	23.5	60	19	84	64	8.0	32	22.0	27	39	22	26.0	20	0.336
SQ 18-RS	18	M18×1.5	23	45	90.0	25	26.5	68	20	93	71	10.0	34	25.0	31	44	27	33.0	20	0.464
SQ 20-RS	20	M20×1.5	27	50	90.0	25	27.5	68	24	99	77	10.0	35	27.5	34	44	30	45.0	20	0.538
SQ 22-RS	22	M22×1.5	27	52	95.0	26	28.5	70	24	109	84	12.0	41	30.0	37	50	32	48.0	16	0.713

Series: BK-1



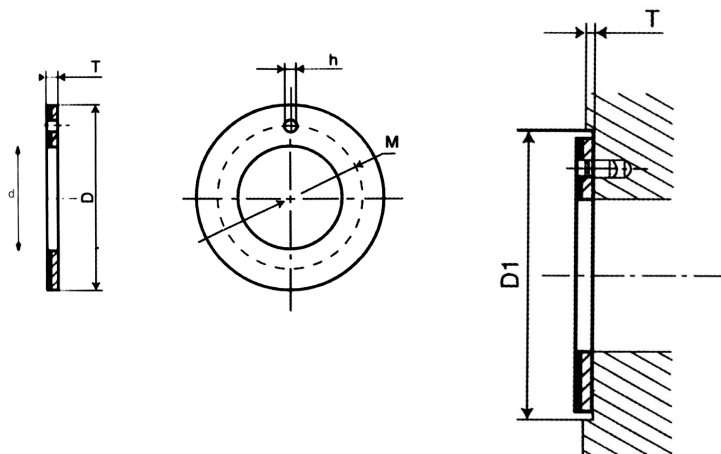
d	D	Shaft diameter	Housing hole H7	Wall thickness		f1	f2	$L_{-0.40}^0 (\Phi 28L-0.3 \text{ } \Phi 30L-0.4)$									
				Min.	Max.			6	8	10	12	15	20	25	30	40	50
6	8	6 ^{-0.013} _{-0.028}	8 ^{+0.015}	0.980	1.005	0.5	0.3	0606	0608	0610							
8	10	8 ^{-0.013} _{-0.028}	10 ^{+0.015}					0806	0808	0810	0812	0815					
10	12	10 ^{-0.016} _{-0.034}	12 ^{+0.018}					1006	1008	1010	1012	1015	1020				
12	14	12 ^{-0.016} _{-0.034}	14 ^{+0.018}					1206	1208	1210	1212	1215	1220	1225			
13	15	13 ^{-0.016} _{-0.034}	15 ^{+0.018}							1310			1320				
14	16	14 ^{-0.016} _{-0.034}	16 ^{+0.018}							1410	1412	1415	1420	1425			
15	17	15 ^{-0.016} _{-0.034}	17 ^{+0.018}							1510	1512	1515	1520	1525			
16	18	16 ^{-0.016} _{-0.034}	18 ^{+0.018}							1610	1612	1615	1620	1625			
17	19	17 ^{-0.016} _{-0.034}	19 ^{+0.021}							1710	1712		1720				
18	20	18 ^{-0.016} _{-0.034}	20 ^{+0.021}							1810	1812	1815	1820	1825			
20	23	20 ^{-0.020} _{-0.041}	23 ^{+0.021}	1.475	1.505	0.8	0.4			2010	2012	2015	2020	2025	2030		
22	25	22 ^{-0.020} _{-0.041}	25 ^{+0.021}							2210	2212	2215	2220	2225	2230		
24	27	24 ^{-0.020} _{-0.041}	27 ^{+0.021}									2415	2420	2425	2430		
25	28	25 ^{-0.020} _{-0.041}	28 ^{+0.021}								2512	2515	2520	2525	2530	2540	2550
28	32	28 ^{-0.020} _{-0.041}	32 ^{+0.025}									2815	2820	2825	2830	2840	
30	34	30 ^{-0.020} _{-0.041}	34 ^{+0.025}								3012	3015	3020	3025	3030	3040	
32	36	32 ^{-0.025} _{-0.050}	36 ^{+0.025}										3220		3230	3240	
35	39	35 ^{-0.025} _{-0.050}	39 ^{+0.025}								3512	3515	3520	3525	3530	3540	3550
38	42	38 ^{-0.025} _{-0.050}	42 ^{+0.025}									3815			3830	3840	
40	44	40 ^{-0.025} _{-0.050}	44 ^{+0.025}								4012		4020	4025	4030	4040	4050

Series: BK-1



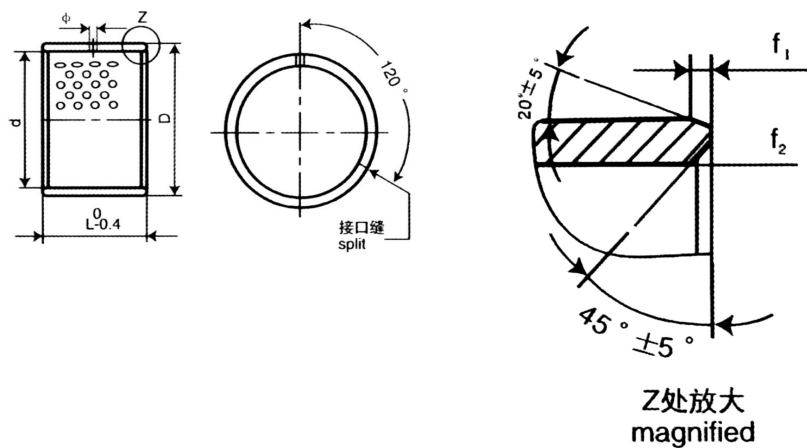
d	D	Shaft diameter	Housing hole H7	Wall thickness		f1	f2	$L_{-0.40}^0$								
				Min.	Max.			20	25	30	40	50	60	70	80	100
45	50	45 ^{-0.025} _{-0.050}	50 ^{+0.025}	2.460	2.505	1.2	0.6	4520	4525	4530	4540	4550				
50	55	50 ^{-0.030} _{-0.060}	55 ^{+0.030}					5020		5030	5040	5050	5060			
55	60	55 ^{-0.030} _{-0.060}	60 ^{+0.030}							5530	5540	5550	5560			
60	65	60 ^{-0.030} _{-0.060}	65 ^{+0.030}							6030	6040	6050	6060	6070		
65	70	65 ^{-0.030} _{-0.060}	70 ^{+0.030}							6530	6540	6550	6560	6570		
70	75	70 ^{-0.030} _{-0.060}	75 ^{+0.030}								7040	7050	7060	7070	7080	
75	80	75 ^{-0.035}	80 ^{+0.030}							7530	7540	7550	7560	7570	7580	
80	85	80 ^{-0.035}	85 ^{+0.035}								8040	8050	8060	8070	8080	80100
85	90	85 ^{-0.035}	90 ^{+0.035}							8540		8560			8580	85100
90	95	90 ^{-0.035}	95 ^{+0.035}							9040		9050	9060		9070	90100
95	100	95 ^{-0.035}	100 ^{+0.035}	2.440	2.490	1.4	0.7	9520				9550	9560		9580	95100
100	105	100 ^{-0.035}	105 ^{+0.035}									10050	10060		10080	
105	110	105 ^{-0.035}	110 ^{+0.035}										10560		10580	
110	115	110 ^{-0.035}	115 ^{+0.035}										11060		11080	
120	125	120 ^{-0.04}	125 ^{+0.035}										12060		12080	120100
125	130	125 ^{-0.04}	130 ^{+0.040}										12560			125100
130	135	130 ^{-0.04}	135 ^{+0.040}										13060		13080	130100
140	145	140 ^{-0.04}	145 ^{+0.040}										14060		14080	140100
150	155	150 ^{-0.04}	155 ^{+0.040}									15050	15060		15080	150100
160	165	160 ^{-0.04}	165 ^{+0.040}										16060		16080	160100
180	185	180 ^{-0.046}	185 ^{+0.046}	2.415	2.465	1.6	0.8								18080	180100
190	195	190 ^{-0.046}	195 ^{+0.046}												19080	190100
200	205	200 ^{-0.046}	205 ^{+0.046}										20060		20080	200100
220	225	220 ^{-0.046}	225 ^{+0.046}												22080	220100
250	255	250 ^{-0.052}	255 ^{+0.052}												25080	250100
260	265	260 ^{-0.052}	265 ^{+0.052}												26080	260100
280	285	280 ^{-0.052}	285 ^{+0.052}												28080	280100
300	305	300 ^{-0.052}	305 ^{+0.052}												30080	300100

Series: BK...SF



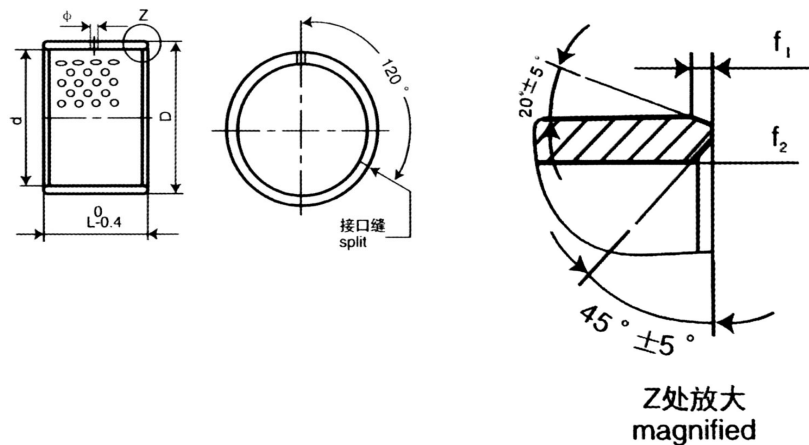
Designation	Mating shaft	Washer dimensions				Installing dimensions		
		$d^{+0.25}$	$D_{-0.25}$	$T_{-0.05}$	$M^{+0.12}_{-0.12}$	$D^{+0.4}_{+0.1}$	$T^{+0.2}_{-0.2}$	$M^{+0.12}$
BK 10 SF	8	10	20	1.5	15	1.5	1	20
BK 12 SF	10	12	24	1.5	18	1.5	1	24
BK 14 SF	12	14	26	1.5	20	2	1	26
BK 16 SF	14	16	30	1.5	23	2	1	30
BK 18 SF	16	18	32	1.5	25	2	1	32
BK 20 SF	18	20	36	1.5	28	3	1	36
BK 22 SF	20	22	38	1.5	30	3	1	38
BK 24 SF	22	24	42	1.5	33	3	1	42
BK 26 SF	24	26	44	1.5	35	3	1	44
BK 28 SF	25	28	48	1.5	38	4	1	48
BK 32 SF	30	32	54	1.5	43	4	1	54
BK 38 SF	35	38	62	1.5	50	4	1	62
BK 42 SF	40	42	66	1.5	54	4	1	66
BK 48 SF	45	48	74	1.5	61	4	1.5	74
BK 52 SF	50	52	78	2	65	4	1.5	78
BK 62 SF	60	62	90	2	76	4	1.5	90

Series: BK-2



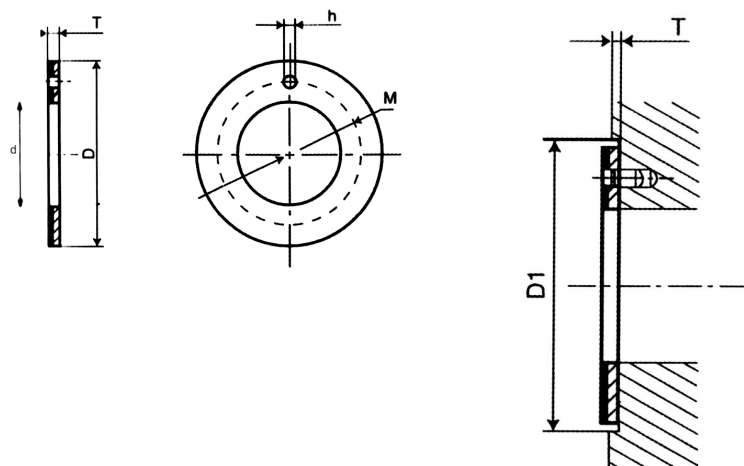
d	D	Shaft diameter	Housing hole H7	Wall thickness		Oil hole	f1	f2	$L^0_{-0.40}$									
				Min.	Max.				10	12	15	20	25	30	35	40	45	50
10	12	10 ^{-0.022}	12 ^{+0.018}	0.955	0.980	4	0.5	0.3	1010	1210	1015	1020	1525	2030	3030	3040	4050	
12	14	12 ^{-0.0278}	14 ^{+0.018}			4					1215	1220						
14	16	14 ^{-0.027}	16 ^{+0.018}			4					1415	1420						
15	17	15 ^{-0.027}	17 ^{+0.018}			4					1515	1520						
16	18	16 ^{-0.027}	18 ^{+0.018}			4					1615	1620	1625					
18	20	18 ^{-0.027}	20 ^{+0.021}	1.445	1.475	4	0.8	0.4			1815	1820	1825	2030	3030	3040	4050	
20	23	20 ^{-0.033}	23 ^{+0.021}			4				2015	2020	2025						
22	25	22 ^{-0.033}	25 ^{+0.021}			6				2215	2225	2530						
25	28	25 ^{-0.033}	28 ^{+0.021}			6					2520		2525					
28	32	28 ^{-0.033}	32 ^{+0.025}			6					2820		2830					
30	34	30 ^{-0.033}	34 ^{+0.025}	1.935	1.970	6	1.0	0.5			3020	3025	3030	3535	3540	4545	4050	
35	39	35 ^{-0.039}	39 ^{+0.025}			6					3520		3530					
40	44	40 ^{-0.039}	44 ^{+0.025}			6					4020		4030					
45	50	45 ^{-0.039}	50 ^{+0.025}			8					4520		4530					
50	55	50 ^{-0.046}	55 ^{+0.030}			8							5030					
55	60	55 ^{-0.046}	60 ^{+0.030}	2.415	2.460	8	1.2	0.6					5530	6030	5540	5550	6050	
60	65	60 ^{-0.046}	65 ^{+0.030}			8							6030					

Series: BK-2



d	D	Shaft diameter	Housing hole H7	Wall thickness		Oil hole	f1	f2									
				Min.	Max.				40	45	50	60	65	80	90	95	100
65	70	65 ^{-0.046}	70 ^{+0.030}	2.415	2.460	8	1.2	0.6	6540			6560					
70	75	70 ^{-0.046}	75 ^{+0.030}			8			7040		7050		7065	7080			
75	80	75 ^{-0.046}	80 ^{+0.030}			9.5			7540			7560		7580			
80	85	80 ^{-0.046}	85 ^{+0.035}			9.5			8040			8060		8080			
85	90	85 ^{-0.054}	90 ^{+0.035}			9.5			8540			8560		8580			
90	95	90 ^{-0.054}	95 ^{+0.035}			9.5			9040			9060		9080	9090		
100	105	100 ^{-0.054}	105 ^{+0.035}			9.5	1.4	0.7			10050			10080		10095	
105	110	105 ^{-0.054}	110 ^{+0.035}			9.5						10560		10580		10595	105100
110	115	110 ^{-0.054}	115 ^{+0.035}			9.5						11060		11080		11095	110100
120	125	120 ^{-0.054}	125 ^{+0.035}			9.5						12060		12080			120100
125	130	125 ^{-0.054}	130 ^{+0.040}			9.5						12560		12580			125100
130	135	130 ^{-0.063}	135 ^{+0.040}			9.5						13060		13080			130100
140	145	140 ^{-0.063}	145 ^{+0.040}			9.5						14060		14080			140100
150	155	150 ^{-0.063}	155 ^{+0.040}			9.5						15060		15080			150100
160	165	160 ^{-0.063}	165 ^{+0.040}	2.385	2.450	11						16060		16080			160100
170	175	170 ^{-0.063}	175 ^{+0.040}			11						17060		17080			170100
180	185	180 ^{-0.04}	185 ^{+0.040}			11						18060		18080			180100
190	195	190 ^{-0.072}	195 ^{+0.046}			11	1.6	0.8				19060		19080			190100
200	205	200 ^{-0.072}	205 ^{+0.046}			11						20060		20080			200100
220	225	220 ^{-0.072}	225 ^{+0.046}			12						22060		22080			220100
240	245	240 ^{-0.072}	245 ^{+0.046}			12						24060		24080			240100
250	255	250 ^{-0.081}	255 ^{+0.046}			12						25060		25080			250100
260	265	260 ^{-0.081}	265 ^{+0.052}			12						26060		26080			260100
280	285	280 ^{-0.081}	285 ^{+0.052}			12						28060		28080			280100
300	305	300 ^{-0.081}	305 ^{+0.052}			12						30060		30080			300100

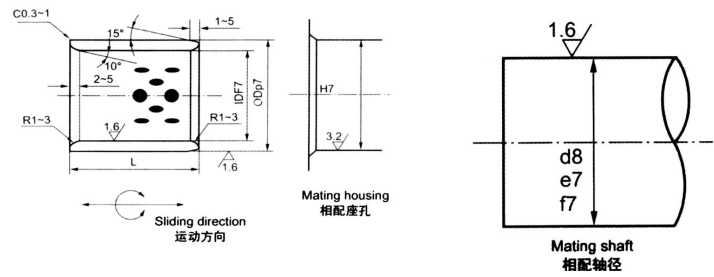
Series: BK-2...SF



Designation	Mating shaft	$d^{+0.25}$	Washer dimensions			Installing dimensions		
			$D_{-0.25}$	$T_{-0.05}$	$M_{0.12}^{+0.12}$	$D_{+0.1}^{+0.4}$	$T_{-0.2}^{+0.2}$	$M^{+0.12}$
BK-2 10 SF	8	10	20	1.5	15	1.5	1	20
BK-2 12 SF	10	12	24	1.5	18	1.5	1	24
BK-2 14 SF	12	14	26	1.5	20	2	1	26
BK-2 16 SF	14	16	30	1.5	23	2	1	30
BK-2 18 SF	16	18	32	1.5	25	2	1	32
BK-2 20 SF	18	20	36	1.5	28	3	1	36
BK-2 22 SF	20	22	38	1.5	30	3	1	38
BK-2 24 SF	22	24	42	1.5	33	3	1	42
BK-2 26 SF	24	26	44	1.5	35	3	1	44
BK-2 28 SF	25	28	48	1.5	38	4	1	48
BK-2 32 SF	30	32	54	1.5	43	4	1	54
BK-2 38 SF	35	38	62	1.5	50	4	1	62
BK-2 42 SF	40	42	66	1.5	54	4	1	66
BK-2 48 SF	45	48	74	1.5	61	4	1.5	74
BK-2 52 SF	50	52	78	2	65	4	1.5	78
BK-2 62 SF	60	62	90	2	76	4	1.5	90

Series: KDB

Mating size for stander bearings

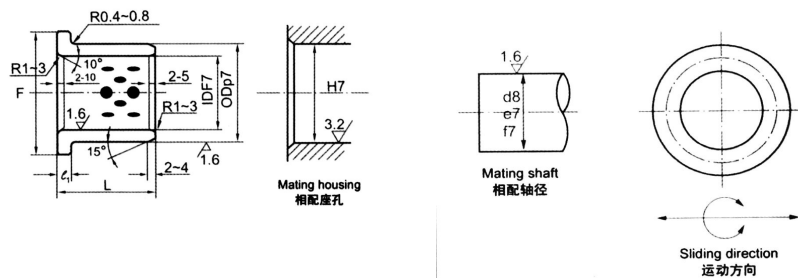


d	D	IDF7	ODp7	$L_{-0.30}^{-0.10}$													
				8	10	12	15	16	20	25	30	35	40	50	60	70	80
8	12	8 ^{+0.028}	12	•	•	•	•										
10	14	1 ^{+0.013}	14 ^{+0.036} +0.018	•	•	•	•		•								
12	18	12	18		•	•	•	•	•	•	•						
13	19	13	19		•	•	•	•									
14	20	14 ^{+0.034}	20 ^{+0.043}		•	•	•		•	•	•						
15	21	15 ^{+0.016}	21 ^{+0.022}		•	•	•	•	•	•	•						
16	22	16	22		•	•	•	•	•	•	•	•	•				
18	24	18	24			•	•	•	•	•	•	•	•				
20	28	20	28		•	•	•	•	•	•	•	•	•	•			
22	32	22 ^{+0.041}	32			•	•	•	•	•				•			
25	33	25 ^{+0.020}	33			•	•	•	•	•			•	•	•		
30	38	30	38 ^{+0.051}			•	•		•	•	•	•	•	•	•		
35	45	35	45 ^{+0.026}						•	•	•	•	•	•	•		
40	50	40 ^{+0.050}	50							•	•	•	•	•	•	•	•
45	55	45 ^{+0.025}	55 ^{+0.062}								•	•	•	•	•	•	
50	60	50	60 ^{+0.032}								•	•	•	•	•	•	•

d	D	IDF7	ODp7	$L_{-0.30}^{-0.10}$											
				30	35	40	50	60	70	80	100	120	130	140	150
50	62	50 ^{+0.050}	62	•	•	•	•	•	•	•					
50	65	50 ^{+0.025}	65	•		•	•	•	•	•	•				
55	70	55	70			•	•	•	•	•					
60	74	60	74 ^{+0.062} +0.032	•	•	•	•	•	•	•					
60	75	60	75	•	•	•	•	•	•	•	•				
63	75	63	75				•	•	•	•					
65	80	65	80				•	•	•	•					
70	85	70 ^{+0.060}	85		•	•	•	•	•	•	•				
70	90	70 ^{+0.030}	90				•	•	•	•					
75	90	75	90					•	•	•	•				
75	95	75	95 ^{+0.072}					•	•	•	•				
80	96	80	96 ^{+0.037}				•	•	•	•	•	•			
80	100	80	100			•	•	•	•	•	•	•		•	
90	110	90	110	•			•	•	•	•	•	•			
100	120	100 ^{+0.071}	120					•	•	•	•	•		•	
110	130	110 ^{+0.036}	130						•	•	•	•			
120	140	120	140							•	•	•		•	
125	145	125	145								•	•			
130	150	130	150 ^{+0.083} +0.043								•	•	•		
140	160	140 ^{+0.083} +0.043	160								•	•		•	
150	170	150	170								•	•			•
160	180	160	180								•	•			•

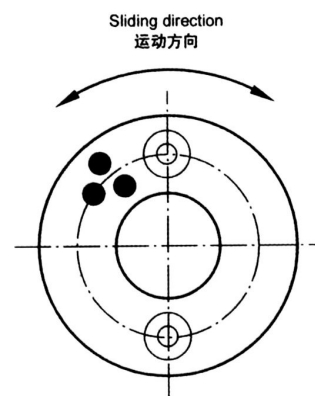
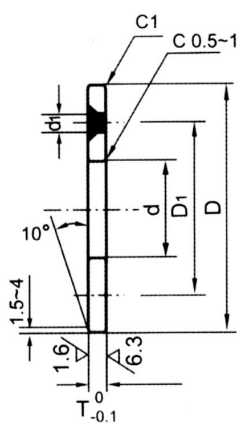
Series: KFB

Mating size for stander bearings



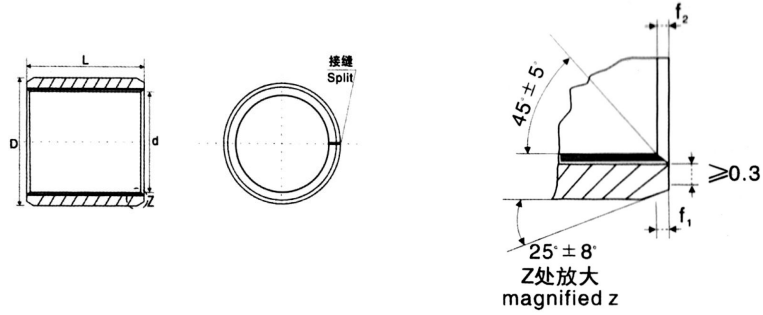
d	D	IDF7	ODp7	F	e ₁ -0.10	$L_{-0.30}^{-0.10}$									
						15	20	25	30	35	40	50	60	80	100
10	14	10 ^{+0.028}	14 ^{+0.036}	22	2	•	•								
12	18	12 ^{+0.013}	18 ^{+0.018}	25		•	•								
13	19	13	19	26		•	•								
14	20	14 ^{+0.034}	20	27	3	•	•								
15	21	15 ^{+0.016}	21 ^{+0.043} ^{+0.022}	28		•	•	•	•						
16	22	16	22	29		•	•	•	•						
20	30	20	30	40		•	•	•	•		•				
25	35	25 ^{+0.041}	35	45		•	•	•	•		•				
30	40	30 ^{+0.02}	40				•	•	•	•	•	•			
31.5	40	31.5	40 ^{+0.051} ^{+0.026}	50			•			•					
35	45	35	45	60			•				•	•			
40	50	40 ^{+0.05}	50	65	5		•		•		•	•			
45	55	45 ^{+0.025}	55	70					•		•	•	•		
50	60	50	60	75					•		•	•	•	•	
55	65	55	65 ^{+0.062} ^{+0.032}	80							•	•	•		
60	75	60	75	90							•	•		•	
63	75	63	75	85										•	
70	85	70 ^{+0.06} ^{+0.03}	85	105	7.5							•		•	
75	90	75	90	110									•		
80	100	80	100 ^{+0.072} ^{+0.037}	120									•	•	•
90	110	90	110	130									•	•	
100	120	100 ^{+0.071}	120	150	10									•	•
120	140	120 ^{+0.036}	140 ^{+0.083} ^{+0.043}	170										•	•

Series: KTW Thrust Washer



Designation	D	D	$T_{-0.1}^0$	D1	Q'ty	bolt size	d1
KTW 10	10.2 ^{+0.2} _{+0.1}	30		---	---	---	---
KTW 12	12.2 ^{+0.2} _{+0.1}						
KTW 13	13.2 ^{+0.2} _{+0.1}	40		28			
KTW 14	14.2 ^{+0.2} _{+0.1}				2	M3	3.5
KTW 15	15.2 ^{+0.2} _{+0.1}		3				
KTW 16	16.2 ^{+0.2} _{+0.1}			35			
KTW 16N				---	---	---	---
KTW 18	18.2 ^{+0.2} _{+0.1}	50				M3	3.5
KTW 20				35	2	M5	6
KTW 20N	20.2 ^{+0.2} _{+0.1}			---	---	---	---
KTW 25				40	2	M5	6
KTW 25N	25.2 ^{+0.2} _{+0.1}	55	5	---	---	---	---
KTW 30	30.2 ^{+0.2} _{+0.1}	60		45			
KTW 35	35.2 ^{+0.2} _{+0.1}	70		50		M5	6
KTW 40	40.2 ^{+0.2} _{+0.1}	80		60	2		
KTW 45	45.2 ^{+0.2} _{+0.1}	90	7	70			
KTW 50	50.3 ^{+0.3} _{+0.1}	100		75		M6	7
KTW 55	55.3 ^{+0.3} _{+0.1}	110		85			
KTW 60	60.3 ^{+0.3} _{+0.1}	120	8	90			
KTW 65	65.3 ^{+0.3} _{+0.1}	125		95			
KTW 70	70.3 ^{+0.3} _{+0.1}	130		100		M8	9
KTW 75	75.3 ^{+0.3} _{+0.1}	140		110	4		
KTW 80	80.3 ^{+0.3} _{+0.1}	150		120			
KTW 90	90.5 ^{+0.3} _{+0.1}	170	10	140			
KTW 100	100.5 ^{+0.3} _{+0.1}	190		160		M10	11
KTW 120	120.5 ^{+0.3} _{+0.1}	200		175			

Series: DF-800



		Wall thick- ness	OD tolerance	ID tolerance	Mating housing	Shaft diameter			L-0.40												
d	D				H ₇	F ₇	f ₁	F ₂	10	15	20	25	30	40	50	60	80	90	100		
12	14	1-0.025	12 ^{+0.065 +0.030}	10 ^{+0.022 +0.000}	12 ^{+0.018}	10 ^{+0.013 +0.028}	0.5	0.3	1010	1015	1020										
14	16		14 ^{+0.065 +0.030}	12 ^{+0.027 +0.000}	14 ^{+0.018}	12 ^{+0.016 +0.034}			1210	1215	1220										
15	17		16 ^{+0.065 +0.030}	14 ^{+0.027 +0.000}	16 ^{+0.018}	14 ^{+0.016 +0.034}			1410	1415	1420										
16	18		17 ^{+0.065 +0.030}	15 ^{+0.027 +0.000}	17 ^{+0.018}	15 ^{+0.016 +0.034}			1510	1515	1520										
18	20		18 ^{+0.075 +0.035}	16 ^{+0.027 +0.000}	18 ^{+0.018}	16 ^{+0.016 +0.034}			1610	1615	1620										
20	23	1.5-0.030	20 ^{+0.075 +0.035}	18 ^{+0.033 +0.000}	20 ^{+0.021}	18 ^{+0.016 +0.034}	0.87	0.4	1810	1815	1820	1825									
22	25		23 ^{+0.035 +0.075}	20 ^{+0.033 +0.000}	23 ^{+0.021}	20 ^{+0.041 +0.020}			2010	2015	2020	2025									
24	27		25 ^{+0.035 +0.075}	22 ^{+0.033 +0.000}	25 ^{+0.021}	22 ^{+0.041 +0.020}			2210	2215	2220	2225									
25	28		27 ^{+0.035 +0.075}	24 ^{+0.033 +0.000}	27 ^{+0.021}	24 ^{+0.041 +0.020}			2410	2415	2420	2425	2430								
26	30		28 ^{+0.035 +0.085}	25 ^{+0.033 +0.000}	28 ^{+0.021}	25 ^{+0.041 +0.020}			2515	2520	2525	2530									
28	32	2-0.035	30 ^{+0.075 +0.035}	26 ^{+0.033 +0.000}	30 ^{+0.021}	26 ^{+0.020 +0.041}	1.0	0.5		2615	2620	2625	2630								
30	34		32 ^{+0.085 +0.045}	28 ^{+0.033 +0.000}	32 ^{+0.025}	28 ^{+0.020 +0.041}			2815	2820	2825	2830	2840								
32	36		34 ^{+0.085 +0.045}	30 ^{+0.039 +0.000}	34 ^{+0.025}	30 ^{+0.020 +0.041}			3015	3020	3025	3030	3040								
35	39		36 ^{+0.085 +0.045}	32 ^{+0.039 +0.000}	36 ^{+0.025}	32 ^{+0.025 +0.050}			3215	3220	3225	3230	3240								
38	42		39 ^{+0.085 +0.045}	35 ^{+0.039 +0.000}	39 ^{+0.025}	35 ^{+0.025 +0.050}				3520	3525	3530	3540	3550							
40	44	2.5-0.040	42 ^{+0.085 +0.045}	38 ^{+0.039 +0.000}	42 ^{+0.025}	38 ^{+0.025 +0.050}	1.2	0.6				3820	3825	3830	3840	3850					
45	50		44 ^{+0.085 +0.045}	40 ^{+0.039 +0.000}	44 ^{+0.025}	40 ^{+0.025 +0.050}			4020	4025	4030	4040	4050								
50	55		50 ^{+0.085 +0.045}	45 ^{+0.039 +0.000}	50 ^{+0.025}	45 ^{+0.025 +0.050}				4520	4525	4530	4540	4550							
55	60		55 ^{+0.100 +0.055}	50 ^{+0.046 +0.000}	55 ^{+0.030}	50 ^{+0.030 +0.060}						5030	5040	5050	5060						
60	65		60 ^{+0.100 +0.055}	55 ^{+0.046 +0.000}	60 ^{+0.030}	55 ^{+0.030 +0.060}						5530	5540	5550	5560						
65	70	3-0.045	65 ^{+0.100 +0.055}	60 ^{+0.046 +0.000}	65 ^{+0.030}	60 ^{+0.030 +0.060}	1.5	1.0					6030	6040	6050	6060					
70	75		70 ^{+0.100 +0.055}	65 ^{+0.046 +0.000}	70 ^{+0.030}	65 ^{+0.030 +0.060}			6530	6540	6550	6560									
75	80		75 ^{+0.100 +0.055}	70 ^{+0.046 +0.000}	75 ^{+0.030}	70 ^{+0.030 +0.060}			7030	7040	7050	7060	7080								
80	85		80 ^{+0.120 +0.070}	75 ^{+0.054 +0.000}	80 ^{+0.035}	75 ^{+0.030 +0.060}			7530	7540	7550	7560									
84	90		85 ^{+0.120 +0.070}	80 ^{+0.054 +0.000}	85 ^{+0.035}	80 ^{+0.030 +0.060}							8040	8050	8060	8080		=			
89	95	3.0-0.045	90 ^{+0.120 +0.070}	84 ^{+0.054 +0.000}	90 ^{+0.035}	84 ^{+0.036 +0.071}	1.8	1.2						8440	8450	8460	8480				
94	100		95 ^{+0.120 +0.070}	89 ^{+0.054 +0.000}	95 ^{+0.035}	89 ^{+0.036 +0.071}							8940	8950	8960	8980					
99	105		100 ^{+0.120 +0.070}	94 ^{+0.054 +0.000}	100 ^{+0.035}	94 ^{+0.036 +0.071}								9450	9460	9480	9480				
104	110		105 ^{+0.120 +0.070}	99 ^{+0.054 +0.000}	105 ^{+0.035}	99 ^{+0.036 +0.071}								9950	9960	9980	9990				
109	115		110 ^{+0.120 +0.070}	104 ^{+0.054 +0.000}	110 ^{+0.035}	104 ^{+0.036 +0.071}								10450	10460	10480					
114	120	3.5-0.050	115 ^{+0.120 +0.070}	109 ^{+0.054 +0.000}	115 ^{+0.035}	109 ^{+0.036 +0.071}	1.8	1.2							10950	10960	10980				
119	125		120 ^{+0.120 +0.070}	114 ^{+0.054 +0.000}	120 ^{+0.040}	114 ^{+0.036 +0.071}								11450	11460	11480					
123	130		125 ^{+0.170 +0.100}	119 ^{+0.054 +0.000}	125 ^{+0.040}	119 ^{+0.036 +0.071}								11950	11960	11980					
128	135		130 ^{+0.170 +0.100}	123 ^{+0.054 +0.000}	130 ^{+0.040}	123 ^{+0.043 +0.083}			2	1.5							12350	12360	12380		123100
133	140		135 ^{+0.170 +0.100}	128 ^{+0.063 +0.000}	135 ^{+0.040}	128 ^{+0.043 +0.083}			2	1.5							12850	12860	12880		128100
138	145	3.5-0.050	140 ^{+0.170 +0.100}	133 ^{+0.063 +0.000}	140 ^{+0.040}	133 ^{+0.043 +0.083}	2	1.5							13350	13360	13380		133100		
143	150		145 ^{+0.170 +0.100}	138 ^{+0.063 +0.000}	145 ^{+0.040}	138 ^{+0.043 +0.083}										13860	13880		138100		
148	155		150 ^{+0.170 +0.100}	143 ^{+0.063 +0.000}	150 ^{+0.040}	143 ^{+0.043 +0.083}											14360	14380		143100	
153	160		155 ^{+0.170 +0.100}	148 ^{+0.063 +0.000}	155 ^{+0.040}	148 ^{+0.043 +0.083}											14860	14880	14890		
158	165		160 ^{+0.170 +0.100}	153 ^{+0.063 +0.000}	160 ^{+0.040}	153 ^{+0.043 +0.083}											15360	15380	15390		
163	170	3.5-0.050	165 ^{+0.170 +0.100}	158 ^{+0.063 +0.000}	165 ^{+0.040}	158 ^{+0.043 +0.083}	2	1.5								15860	15880		158100		
168	175		170 ^{+0.170 +0.100}	163 ^{+0.063 +0.000}	170 ^{+0.040}	163 ^{+0.043 +0.083}											16360	16380		163100	
173	180		175 ^{+0.170 +0.100}	168 ^{+0.063 +0.000}	175 ^{+0.046}	168 ^{+0.043 +0.083}											16860	16880		168100	
178	185		180 ^{+0.170 +0.100}	173 ^{+0.063 +0.000}	180 ^{+0.046}	173 ^{+0.043 +0.083}											17360	17380		173100	
183	190		185 ^{+0.170 +0.100}	178 ^{+0.063 +0.000}	185 ^{+0.046}	178 ^{+0.043 +0.083}															

Appendix table 1: Comparison of SI, CGS and gravity units-1

Unit system Quantity	Length L	Mass M	Time T	Acceleration	Force	Stress	Pressure	Energy
SI	m	kg	s	m/ s2	N	Pa	Pa	J
CGS system	cm	g	s	Gal	dyn	dyn/cm2	dyn/cm2	erg
Gravitation system	m	kgf·s2/m	s	m/ s2	kgf	kgf/ m2	kgf/ m2	kgf·m

Appendix table 2: SI-customary unit conversion table-1

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Angle	Degree	°	$\pi/180$	Radian	rad
	Minute	'	$\pi/10\ 800$		
	Second	"(sec)	$\pi/648\ 000$		
Length	Meter	m	1	Meter	m
	Micron	μ	10-6		
	Angstrom	Å	10-10		
Area	Square meter	m2	1	Square meter	m2
	Are	a	102		
	Hectare	ha	104		
Volume	Cubic meter	m3	1	Cubic meter	m3
	Liter	R.L	10-3		
Mass	Kilogram	kg	1	Kilogram	kg
	Ton	t	103		
	Kilogram force / square second per meter	kgf·s2/m	9.806 65		
Time	Second	s	1	Second	s
	Minute	min	60		
	Hour	h	3 600		
	Day	d	86 400		
Speed	Meters per second	m/s	1	Meters per second	m/s
	Knot	kn	1 852/3 600		
Frequency and vibration	Cycle	s-1(pps)	1	Hertz	Hz
Revolutions (rotational speed)	Revolutions per minute (rpm)	rpm(r/min)	1/60	Per second	s-1
Angular speed	Radians per second	rad/s	1	Radians per second	rad/s
Acceleration	Meters per square second	m/ s2	1	Meters per square second	m/s2
	G	G	9.806 65		
Force	Kilogram force	kgf	9.806 65	Newton	N
	Ton force	tf	9 806.65		
	Dyne	dyn	10-5		
Force moment	Kilogram force / mete	kgf·m	9.806 65	Newton meter	N·m
Inertia moment	Kilogram force / meter / square second	kgf·m·s2	9.806 65	Kilogram / square meter	kg·m2
Stress	Kilogram force per square meter	Kgf/m2	9.806 65	Pascal or Newton per square meter	Pa or N/ m2
Pressure	Kilogram force per square meter	Kgf/m2	9.806 65	Pascal	Pa
	Meter water column	mH2O	9 806.65		
	Meter of mercury	mHg	101 325/0.76		
	Torr	Torr	101 325/760		
	Atmosphere	atm	101 325		
	Bar	bar	105		
Energy	Erg	erg	10-7	Joule	J
	IT calorie	calIT	4.186 8		
	Kilogram force / meter	kgf·m	9.806 65		
	Kilowatt hour	kW·h	3.600×106		
	Metric horsepower per hour	PS·h	2.647 79×106		
	Kilowatt hour				
Power rate and power	Watt	W	1	Watt	W
	Metric horsepower	PS	735.5		
	Kilogram force / meter per second	kgf·m/s	9.806 65		

Appendix table 1: S1, CGS and gravity units-2

Quantity Unit system	Power rate	Temperature	Viscosity	Dynamic viscosity	Magnetic flux	Flux density	Magnetic field strength
SI	W	K	Pa·s	m ² /s	Wb	T	A/m
CGS system	erg/s	°C	P	St	Mx	Gs	Oe
Gravitation system	kgf·m/s	°C	kgf·s/m ²	m ² /s	—	—	—

Appendix table 2: SI-customary unit conversion table-2

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Viscosity	Poise	P	10 ⁻¹	Pascal second	Pa·s
	Centipoise	cP	10 ⁻³		
	Kilogram force / square second per meter	kgf·s/m ²	9.806 65		
Dynamic viscosity	Stoke	St	10 ⁻⁴	Square meter per second	m ² /s
	Centistoke	cSt	10 ⁻⁶		
Temperature	Degree	°C	+273.5	Kelvin	K
Radioactive	Curie	Ci	3.7×10 ¹⁰	Becquerel	Bq
Dosage	Roentgen	R	2.58×10 ⁻⁴	Coulombs per kilogram	C/kg
Absorption dosage	Rad	rad	10 ⁻²	Gray	Gy
Dosage equivalent	Rem	rem	10 ⁻²	Sievert	Sv
Magnetic flux	Maxwell	Mx	10 ⁻⁸	Weber	Wb
Flux density	Gamma	Y	10 ⁻⁹	Tesla	T
	Gauss	Gs	10 ⁻⁴		
Magnetic field strength	Oersted	Oe	103/4π	Amperes per meter	A/m
Quantity of electricity	Coulomb	C	1	Coulomb	C
Potential difference	Volt	V	1	Volt	V
Electric resistance	Ohm	Ω	1	Ohm	Ω
Current	Ampere	A	1	Ampere	A

Appendix table 3: Tenth power multiples of SI unit

Multiples of unit	Prefix		Multiples of unit	Prefix	
	Name	Symbol		Name	Symbol
10 ¹⁸	Exa	E	10 ⁻¹	Deci	d
10 ¹⁵	Peta	P	10 ⁻²	Centi	c
10 ¹²	Tera	T	10 ⁻³	Mili	m
10 ⁹	Giga	G	10 ⁻⁶	Micro	μ
10 ⁶	Mega	M	10 ⁻⁹	Nano	n
10 ³	Kilo	k	10 ⁻¹²	Pico	p
10 ²	Hecto	h	10 ⁻¹⁵	Femto	f
10	Deca	da	10 ⁻¹⁸	Ato	a

Appendix table 4: Dimensional tolerance for shafts

Diameter division (mm) Over incl	a13		c12		d6		e6		e13		f5		f6		g5		g6	
	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low
3 6	-270	-450	-70	-190	-30	-38	-20	-28	-20	-200	-10	-15	-10	-18	-4	-9	-4	-12
6 10	-280	-500	-80	-230	-40	-49	-25	-34	-25	-245	-13	-19	-13	-22	-5	-11	-5	-14
10 18	-290	-560	-95	-275	-50	-61	-32	-43	-32	-302	-16	-24	-16	-27	-6	-14	-6	-17
18 30	-300	-630	-110	-320	-65	-78	-40	-53	-40	-370	-20	-29	-20	-33	-7	-16	-7	-20
30 40	-310	-700	-120	-370	-80	-96	-50	-66	-50	-440	-25	-36	-25	-41	-9	-20	-9	-25
40 50	-320	-710	-130	-380														
50 65	-340	-800	-140	-440	-100	-119	-60	-79	-60	-520	-30	-43	-30	-49	-10	-23	-10	-29
65 80	-360	-820	-150	-450														
80 100	-380	-920	-170	-520	-120	-142	-72	-94	-72	-612	-36	-51	-36	-58	-12	-27	-12	-34
100 120	-410	-950	-180	-530														
120 140	-460	-1090	-220	-600	-145	-170	-85	-110	-85	-715	-43	-61	-43	-68	-14	-32	-14	-39
140 160	-520	-1150	-210	-610														
160 180	-580	-1210	-230	-630														
180 200	-660	-1380	-240	-700	-170	-199	-100	-129	-100	-820	-50	-70	-50	-79	-15	-35	-15	-44
200 225	-740	-1460	-260	-720														
225 250	-820	-1540	-280	-740														
250 280	-920	-1730	-300	-820	-190	-222	-110	-142	-110	-920	-56	-79	-56	-88	-17	-40	-17	-49
280 315	-1050	-1860	-330	-850														
315 355	-1200	-2090	-360	-930	-210	-246	-125	-161	-125	-1015	-62	-87	-62	-98	-18	-43	-18	-54
355 400	-1350	-2240	-400	-970														
400 450	-1500	-2470	-440	-1070	-230	-270	-135	-175	-135	-1105	-68	-95	-68	-108	-20	-47	-20	-60
450 500	-1650	-2620	-480	-1110														
500 560	—	—	—	—	-260	-304	-145	-189	—	—	—	—	-76	-120	—	—	-22	-66
560 630																		
630 710	—	—	—	—	-290	-340	-160	-210	—	—	—	—	-80	-130	—	—	-24	-74
710 800																		
800 900	—	—	—	—	-320	-376	-170	-226	—	—	—	—	-86	-142	—	—	-26	-82
900 1000																		
1000 1120	—	—	—	—	-350	-416	-195	-261	—	—	—	—	-98	-164	—	—	-28	-94
1120 1250																		
1250 1400	—	—	—	—	-390	-468	-220	-298	—	—	—	—	-110	-188	—	—	-30	-108
1400 1600																		

Diameter division (mm) Over incl	j5		js5		j6		js6		j7		K4		K5		K6		M5	
	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low
3 6	+3	-2	+2.5	-2.5	+6	-2	+4	-4	+8	-4	+5	+1	+6	+1	+9	+1	+9	+4
6 10	+4	-2	+3	-3	+7	-2	+4.5	-4.5	+10	-5	+5	+1	+7	+1	+10	+1	+12	+6
10 18	+5	-3	+4	-4	+8	-3	+5.5	-5.5	+12	-6	+6	+1	+9	+1	+12	+1	+15	+7
18 30	+5	-4	+4.5	-4.5	+9	-4	+6.5	-6.5	+13	-8	+8	+2	+11	+2	+15	+2	+17	+8
30 40																		
40 50	+6	-5	+5.5	-5.5	+11	-5	+8	-8	+15	-10	+9	+2	+13	+2	+18	+2	+20	+9
50 65																		
65 80	+6	-7	+6.5	-6.5	+12	-7	+9.5	-9.5	+18	-12	+10	+2	+15	+2	+21	+2	+24	+11
80 100																		
100 120	+6	-9	+7.5	-7.5	+13	-9	+11	-11	+20	-15	+13	+3	+18	+3	+25	+3	+28	+13
120 140																		
140 160	+7	-11	+9	-9	+14	-11	+12.5	-12.5	+22	-18	+15	+3	+21	+3	+28	+3	+33	+15
160 180																		
180 200																		
200 225	+7	-13	+10	-10	+16	-13	+14.5	-14.5	+25	-21	+18	+4	+24	+4	+33	+4	+37	+17
225 250																		
250 280	+7	-16	+11.5	-11.5	+16	-16	+16	-16	+26	-26	+20	+4	+27	+4	+36	+4	+43	+20
280 315																		
315 355	+7	-18	+12.5	-12.5	+18	-18	+18	-18	+29	-28	+22	+4	+29	+4	+40	+4	+46	+21
355 400																		
400 450	+7	-20	+13.5	-13.5	+20	-20	+20	-20	+31	-32	+25	+5	+32	+5	+45	+5	+50	+23
450 500																		
500 560	—	—	—	—	—	—	+22	-22	—	—	—	—	—	—	+44	0	—	—
560 630																		
630 710	—	—	—	—	—	—	+25	-25	—	—	—	—	—	—	+50	0	—	—
710 800																		
800 900	—	—	—	—	—	—	+28	-28	—	—	—	—	—	—	+56	0	—	—
900 1000																		
1000 1120	—	—	—	—	—	—	+33	-33	—	—	—	—	—	—	+66	0	—	—
1120 1250																		

Appendix Table

oBee

Unit: μm

h4	h5	h6	h7	h8	h9	h10	h11	h13	js4	Diameter division (mm) Over incl.
high low	high low	high low	high low	high low	high low	high low	high low	high low	high low	
0 -4	0 -5	0 -8	0 -12	0 -18	0 -30	0 -48	0 -75	0 -180	+2 -2	3 6
0 -4	0 -6	0 -9	0 -15	0 -22	0 -36	0 -58	0 -90	0 -220	+2 -2	6 10
0 -5	0 -8	0 -11	0 -18	0 -27	0 -43	0 -70	0 -110	0 -270	+2.5 -2.5	10 18
0 -6	0 -9	0 -13	0 -21	0 -33	0 -52	0 -84	0 -130	0 -330	+3 -3	18 30
0 -7	0 -11	0 -16	0 -25	0 -39	0 -62	0 -100	0 -160	0 -390	+3.5 -3.5	30 40
										40 50
0 -8	0 -13	0 -19	0 -30	0 -46	0 -74	0 -120	0 -190	0 -460	+4 -4	50 65
										65 80
0 -10	0 -15	0 -22	0 -35	0 -54	0 -87	0 -140	0 -220	0 -540	+5 -5	80 100
										100 120
0 -12	0 -18	0 -25	0 -40	0 -63	0 -100	0 -160	0 -250	0 -630	+6 -6	120 140
										140 160
										160 180
0 -14	0 -20	0 -29	0 -46	0 -72	0 -115	0 -185	0 -290	0 -720	+7 -7	180 200
										200 225
										225 250
0 -16	0 -23	0 -32	0 -52	0 -81	0 -130	0 -210	0 -320	0 -810	+8 -8	250 280
										280 315
0 -18	0 -25	0 -36	0 -57	0 -89	0 -140	0 -230	0 -360	0 -890	+9 -9	315 355
										355 400
0 -20	0 -27	0 -40	0 -63	0 -97	0 -155	0 -250	0 -400	0 -970	+10 -10	400 450
										450 500
— —	— —	0 -44	0 -70	0 -110	0 -175	0 -280	0 -440	0 —	— —	500 560
										560 630
— —	— —	0 -50	0 -80	0 -125	0 -200	0 -320	0 -500	0 —	— —	630 710
										710 800
— —	— —	0 -56	0 -90	0 -140	0 -230	0 -360	0 -560	0 —	— —	800 900
										900 1000
— —	— —	0 -66	0 -105	0 -165	0 -260	0 -420	0 -660	0 —	— —	1000 1120
										1120 1250
— —	— —	0 -78	0 -125	0 -195	0 -310	0 -500	0 -780	0 —	— —	1250 1400
										1400 1600

m6	n5	n6	p5	p6	r6	r7	Basic tolerance				Diameter division (mm) over incl.
high low	high low	high low	high low	high low	high low	high low	IT2	IT3	IT5	IT7	
+12 +4	+13 +8	+16 +8	+17 +12	+20 +12	+23 +15	+27 +15	1.5	2.5	5	12	3 6
+15 +6	+16 +10	+19 +10	+21 +15	+24 +15	+28 +19	+34 +19	1.5	2.5	6	15	6 10
+18 +7	+20 +12	+23 +12	+26 +18	+29 +18	+34 +23	+41 +23	2	3	8	18	10 18
+21 +8	+24 +15	+28 +15	+31 +22	+35 +22	+41 +28	+49 +28	2.5	4	9	21	18 30
+25 +9	+28 +17	+33 +17	+37 +26	+42 +26	+50 +34	+59 +34	2.5	4	11	25	30 40
											40 50
+30 +11	+33 +20	+39 +20	+45 +32	+51 +32	+60 +41	+71 +41	3	5	13	30	50 65
					+62 +43	+73 +43					65 80
+35 +13	+38 +23	+45 +23	+52 +37	+59 +37	+73 +51	+86 +51	4	6	15	35	80 100
					+76 +54	+89 +54					100 120
+40 +15	+45 +27	+52 +27	+61 +43	+68 +43	+88 +63	+103 +63	5	8	18	40	120 140
					+90 +65	+105 +65					140 160
					+93 +68	+108 +68					160 180
+46 +17	+51 +31	+60 +31	+70 +50	+79 +50	+106 +77	+123 +77	7	10	20	46	180 200
					+109 +80	+126 +80					200 225
					+113 +84	+130 +84					225 250
+52 +20	+57 +34	+66 +34	+79 +56	+88 +56	+126 +94	+146 +94	8	12	23	52	250 280
					+130 +98	+150 +98					280 315
+57 +21	+62 +37	+73 +37	+87 +62	+98 +62	+144 +108	+165 +108	9	13	25	57	315 355
					+150 +114	+171 +114					355 400
+63 +23	+67 +40	+80 +40	+95 +68	+108 +68	+166 +126	+189 +126	10	15	27	63	400 450
					+172 +132	+195 +132					450 500
+70 +26	— —	+88 +44	— —	+122 +78	+194 +150	+220 +150	—	—	—	70	500 560
					+199 +155	+225 +155					560 630
+80 +30	— —	+100 +50	— —	+138 +88	+225 +175	+255 +175	—	—	—	80	630 710
					+235 +185	+265 +185					710 800
+90 +34	— —	+112 +56	— —	+156 +100	+266 +210	+300 +210	—	—	—	90	800 900
					+276 +220	+310 +220					900 1000
+106 +40	— —	+132 +66	— —	+186 +120	+316 +250	+355 +250	—	—	—	105	1000 1120
					+326 +260	+365 +260					1120 1250

Unit: μm

Appendix table 5: Kgf to N conversion table

kgf		N	kgf		N	kgf		N
0.1020	1	9.8066	3.4670	34	333.43	6.8321	67	657.04
0.2039	2	19.613	3.5690	35	343.23	6.9341	68	666.85
0.3059	3	29.420	3.6710	36	353.04	7.0361	69	676.66
0.4079	4	39.227	3.7730	37	362.85	7.1380	70	686.46
0.5099	5	49.033	3.8749	38	372.65	7.2400	71	696.27
0.6118	6	58.840	3.9769	39	382.46	7.3420	72	706.08
0.7138	7	68.646	4.0789	40	392.27	7.4440	73	715.88
0.8158	8	78.453	4.1808	41	402.07	7.5459	74	725.69
0.9177	9	88.260	4.2828	42	411.88	7.6479	75	735.50
1.0197	10	98.066	4.3848	43	421.68	7.7499	76	745.30
1.1217	11	107.87	4.4868	44	431.49	7.8518	77	755.11
1.2237	12	117.68	4.5887	45	441.30	7.9538	78	764.92
1.3256	13	127.49	4.6907	46	451.10	8.0558	79	774.72
1.4276	14	137.29	4.7927	47	460.91	8.1578	80	784.53
1.5296	15	147.10	4.8946	48	470.72	8.2597	81	794.34
1.6316	16	156.91	4.9966	49	480.52	8.3617	82	804.14
1.7335	17	166.71	5.0986	50	490.33	8.4637	83	813.95
1.8355	18	176.52	5.2006	51	500.14	8.5656	84	823.76
1.9375	19	186.33	5.3025	52	509.94	8.6676	85	833.56
2.0394	20	196.13	5.4045	53	519.75	8.7696	86	843.37
2.1414	21	205.94	5.5065	54	529.56	8.8716	87	853.18
2.2434	22	215.75	5.6085	55	539.36	8.9735	88	862.98
2.3454	23	225.55	5.7104	56	549.17	9.0755	89	872.79
2.4473	24	235.36	5.8124	57	558.98	9.1775	90	882.60
2.5493	25	245.17	5.9144	58	568.78	9.2764	91	892.40
2.6513	26	254.97	6.0163	59	578.59	9.3814	92	902.21
2.7532	27	264.78	6.1183	60	588.40	9.4834	93	912.02
2.8552	28	274.59	6.2203	61	598.20	9.5854	94	921.82
2.9572	29	284.39	6.3223	62	608.01	9.6873	95	931.63
3.0592	30	294.20	6.4242	63	617.82	9.7893	96	941.44
3.1611	31	304.01	6.5262	64	627.62	9.8913	97	951.24
3.2631	32	313.81	6.6282	65	637.43	9.9932	98	961.05
3.3651	33	323.62	6.7302	66	647.24	10.0952	99	970.86

1kgf=9.80665N

1N=0.101972kgf

(How to read the table)

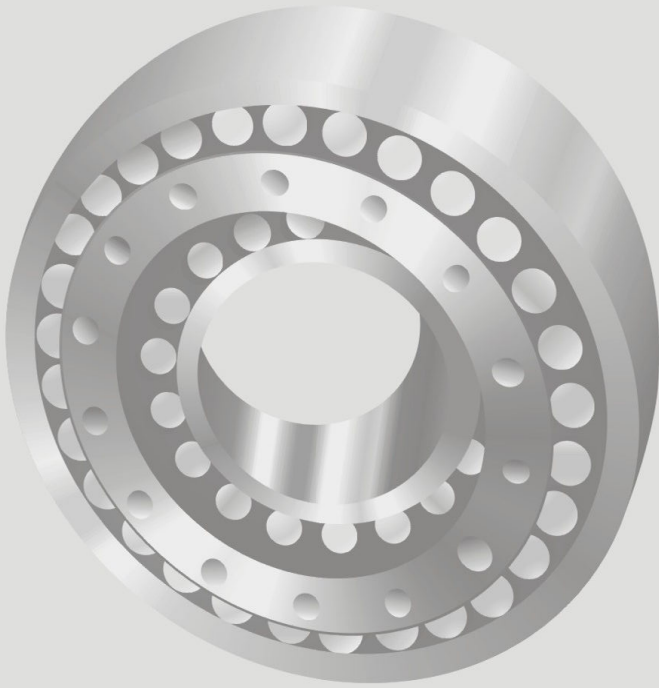
If for example you want to convert 10 kgf to N, find "10" in the middle column of the first set of columns on the right. Look in the N column directly to the right of "10," and you will see that 10 kgf equals 98.066 N. Oppositely, to convert 10 N to kgf, look in the kgf column to the right of "10" and you will see that 10 N equals 1.0197 kgf.

Appendix table 6: Hardness conversion table (reference)

Rockwell hardness	Picker's hardness	Brinell hardness		Rockwell hardness		Shore hardness
C Scale 1471.0N (150kgf)		Standard steel balls	Tungsten carbide steel balls	A Scale 588.4N (60kgf)	B Scale 980.7N (100kgf)	
68	940			85.6		97
67	900			85.0		95
66	865			84.5		92
65	832		739	83.9		91
64	800		722	83.4		88
63	772		705	82.8		87
62	746		688	82.3		85
61	720		670	81.8		83
60	697		654	81.2		81
59	674		634	80.7		80
58	653		615	80.1		78
57	633		595	79.6		76
56	613		577	79.0		75
55	595	—	560	78.5		74
54	577	—	543	78.0		72
53	560	—	525	77.4		71
52	544	500	512	76.8		69
51	528	487	496	76.3		68
50	513	475	481	75.9		67
49	498	464	469	75.2		66
48	484	451	455	74.7		64
47	471	442	443	74.1		63
46	458	432	432	73.6		62
45	446	421	421	73.1		60
44	434	409	409	72.5		58
43	423	400	400	72.0		57
42	412	390	390	71.5		56
41	402	381	381	70.9		55
40	392	371	371	70.4	—	54
39	382	362	362	69.9	—	52
38	372	353	353	69.4	—	51
37	363	344	344	68.9	—	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35
20	238	226	226		97.8	34
(18)	230	219	219	60.5	96.7	33
(16)	222	212	212	—	95.5	32
(14)	213	203	203	—	93.9	31
(12)	204	194	194	—	92.3	29
(10)	196	187	187		90.7	28
(8)	188	179	179		89.5	27
(6)	180	171	171		97.1	26
(4)	173	165	165		85.5	25
(2)	166	158	158		83.5	24
(0)	160	152	152		81.7	24

Appendix table 7: Greek alphabet list

Upright	Italic		Reading
Upper case	Upper case	Lower case	
A	<i>A</i>	<i>α</i>	Alpha
B	<i>B</i>	<i>β</i>	Beta
Γ	<i>Γ</i>	<i>γ</i>	Gamma
Δ	<i>Δ</i>	<i>δ</i>	Delta
E	<i>E</i>	<i>ε</i>	Epsilon
Z	<i>Z</i>	<i>ζ</i>	Zeta
H	<i>H</i>	<i>η</i>	Eta
Θ	<i>Θ</i>	<i>θ</i>	Theta
I	<i>I</i>	<i>ι</i>	Iota
K	<i>K</i>	<i>κ</i>	Kappa
Λ	<i>Λ</i>	<i>λ</i>	Lambda
M	<i>M</i>	<i>μ</i>	Mu
N	<i>N</i>	<i>ν</i>	Nu
Ξ	<i>Ξ</i>	<i>ξ</i>	Xi
O	<i>O</i>	<i>ο</i>	Omicron
Π	<i>Π</i>	<i>π</i>	Pi
P	<i>P</i>	<i>ρ</i>	Rho
Σ	<i>Σ</i>	<i>σ</i>	Sigma
T	<i>T</i>	<i>τ</i>	Tau
Υ	<i>Υ</i>	<i>υ</i>	Upsilon
Φ	<i>Φ</i>	<i>φ</i>	Phi
X	<i>X</i>	<i>χ</i>	Khi
Ψ	<i>Ψ</i>	<i>ψ</i>	Psi
Ω	<i>Ω</i>	<i>ω</i>	Omega



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