

OILLESS BEARING



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SGO. CO., LTD.



Technical Value Creator

SGO

Fulfilling SGO's Commitment for Customer Satisfaction through Clean Environment and Management

Since its foundation in 2000, SGO has been specializing in broad ranges of its proprietary manufacturing and service technologies for maximizing the performances and efficiencies of oilless bearings used in industrial machines and molds.

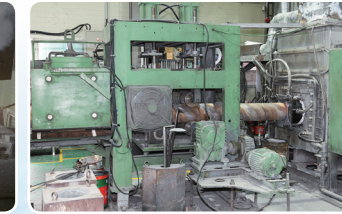
SGO's endless research and development efforts to meet customer's needs resulted in Develon, a far more improved multi-layer bearing than conventional products.

SGO's commitment for development of next-generation products and services does not stop with a number of patents granted in Korea, Germany and Italy.

SGO will continue to be a close partner to meet customer's needs and provide the best services.



Casting Foundry



Continuous Casting



2,750-ton Extruding Machine



Solid Lubricant Molding Machine



(Develon) Sintering



Machining



Inspection



Friction Test (Bushing & Plate)



MES

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What is Oilless bearing?

A bearing that can improve productivity and save cost/time by having the material properties which can withstand both high & low temperature, corrosive environment, foreign particles, and impact load. There are various kind of shapes and materials for oilless bearings such as metal, non-metal, plastic and ceramic.

Applications

- Place where lubrication cannot be applied or lubrication is dangerous.
- Place where product can be contaminated or failure is occurred due to lubrication.
- Low / High temperature, under-water, and place that is exposed to chemicals.
- Place that can prevent decrease in productivity due to machine stop while lubricating.
- Place where oiling is not effective due to harsh conditions such as frequent stop motion.
- Impact and vibration, high-load low-speed motion, rust occurrence, foreign substance penetration.
- Sliding motion, angular pitching motion.

Advantage & Disadvantage of each lubricating method

Lubrication Type

Dry Lubrication = Using solid lubricant

- Example) **SGO SDU Dry Bearing** → Teflon + Special additive
- SGO #500 Bearing** → Natural graphite + Teflon lubricant
- SGO DEVELON Bearing** → Natural graphite + Metal powder

Liquid lubrication (Using oil or water)

- Example) **SGO #300** → Oil impregnation in porous cast iron

What is solid lubricant?

Powder or solid type lubricant that is used in harsh conditions such as high temperature and corrosion environment and where oil or grease cannot be used. Generally it is mainly made with natural graphite, molybdenum disulfide, and P.T.F.E.

Advantage & Disadvantage of each lubricating method

Classification	Dry lubrication	Liquid lubrication
Advantage	<ul style="list-style-type: none"> • Can be used in high / low temperature. • Can be used in corrosive atmosphere. • Can be applied for high-load low-speed motion, reciprocating motion, impact load, angular pitching motion, and discontinuous frequent stop motion where oil lubrication is not effective. • Can be used without lubrication 	<ul style="list-style-type: none"> • Ideal for high speed in light and medium load. ※ Liquid lubrication prevent friction between metal to metal by forming oil film with continuously rotating by centrifugal force in the clearance of shaft and housing.
Disadvantage	<ul style="list-style-type: none"> • Can be used in low speed in principle without lubrication. ※ Using it in high speed condition may occur seizure or shorten life cycle of bearing, because solid lubricant has higher friction coefficient than liquid lubricant. 	<ul style="list-style-type: none"> • Oiling is required in regular basis. • Cannot be used in low / high temperature. • Cannot be used in corrosive atmosphere. • Not suitable for high-load & low-speed motion, reciprocating motion, impact load, angular pitching motion, and discontinuous frequent stop motion where oil film is difficult to be formed. • Not suitable for use in high load and high speed, which reduces lifetime due to excessive PV value.

Base metal and its use

CODE	SP	HP	BP	AI	B	F	SUS	S
Base metal	High Strength Brass Casing	Special High Strength Brass Casing	Brass Casting	Aluminum Bronze Casting	Bronze Casting	Cast iron	Stainless Steel	Steel
USE	General	Higher load and pressure than SP	General	General	General	High Temperature	Chemical Resistance	High Pressure
	High Pressure		Low load	Seawater	High speed	High temperature	Shock Resistance	
	Under water			Underwater				

Solid Lubricant type

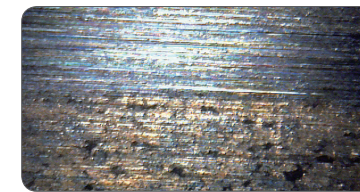
CODE	USE	CODE	USE
SL1	High Temperature	SL5	High Pressure, Sea water
SL2	General	SL7	Underwater, Eco-friendly
SL4	Underwater		

What is solid lubricant dispersed bearing, Develon?

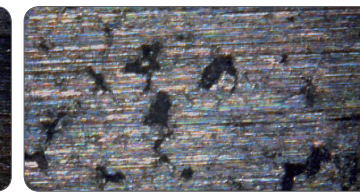
Solid lubricant dispersed bearing, Develon is made with steel in external layer and with special solid lubricant in internal layer. This bi-layer metal bearing can be used for medium and high load with excellent abrasion resistance.

Bearing structure

- Sintered bearing layer (1~1.2mm)
 - It is composed of solid lubricant such as Cu, Fe, Ni, Sn, MoS₂, graphite and pores filled with oil.
- Backing steel → KS SS400/ SM45C



Bi-layer structure



Distribution shape of solid lubricants



Characteristics

- Since solid lubricant is evenly distributed, it can be used for any motion direction.
- Since sintering and solid lubricant are applied, lubrication is multiplied, which can be used in high speed.
- Since it has lower heat expansion rate compared to general non-metal bearing, temperature change is low and it maintains high accuracy.
- Since heat processing is applied on external material, it is suitable for high load and it can be used without lubrication.
- Additional oil impregnation is needed to prevent oil washing after it has been stored for a long time or additional processing has been applied.
- Standards parts and custom-made parts available.

Characteristics

Code	Type	Lubrication	P Contact pressure	V velocity	PV value	T temperature	Specific gravity	Hardness	Elongation	Tensile strength
			kgf / cm ² N / mm ²	m / min m / s	kgf / cm ² · m / min N / mm ² · m / s	°C	g / cm ³	HRB	%	kgf / mm ² N / mm ²
200S	Fe-sintering	Dry	290 (760) 29 (76)	30 0.5	1,000 (3,000) 1.65 (4.90)	-40 ~ +120	6.3 ~ 7.1	0 ~ 20	17	41 400
		Periodic lubrication	500 (760) 50 (76)	60 1	1,500 (3,000) 2.45 (4.90)					
200SP	Cu-sintering	Dry	250 (700) 25 (70)	30 0.5	980 (2,800) 1.60 (4.58)	-40 ~ +120	6.0 ~ 6.8	-15 ~ 15	17	41 400
		Periodic lubrication	450 (700) 45 (70)	60 1	1,500 (3,000) 2.45(4.90)					
200H	Fe-sintering	Dry	450 (750) 45 (75)	30 0.5	1,000 (3,000) 1.63 (4.90)	-40 ~ +250	6.3 ~ 7.1	35 ~ 45	28	48 470
		Periodic lubrication	700 (1,200) 70 (120)	70 1.16	1,500 (3,000) 2.45 (4.90)					

※ () : Allowable static contact pressure (no sliding or sliding at extremely slow speed (0.1m / min or below))

※ Above data is based on backing steel KS SS400 / SM45C and its mechanical characteristics may be changed when backing steel is changed.

※ Value indicated above is general value and it can be changed without notification for improvement.

Operating Conditions

Code	Type	Allowable range				Mechanical properties				
		Lubrication	P Contact pressure	V velocity	PV value	T temperature	Specific gravity	Hardness	Elongation	Tensile strength
			kgf/cm ² N/mm ²	m/min m/s	kgf/cm ² ·m/min N/mm ² ·m/s	°C	g/cm ³	HB	%	kgf/mm ² N/mm ²
500SP	-	Dry	300 (1,500) 29 (150)	30 0.5	1,000 1.65	-40 ~ +150	7.8	210	12	77 755
		Periodic lubrication		60 1	2,000 3.25					
500HP	-	Dry	740 (1,800) 73 (180)	6 0.1	1,000 1.65	-40 ~ +150	7.8	245	12	77 755
		Periodic lubrication		15 0.25	2,000 3.25					
500SP9	-	Dry	920 (2,050) 90 (200)	15 0.25	1,000 1.65	-40 ~ +150	7.6	280	1	79 780
		Periodic lubrication		30 0.5	2,000 3.25					
500B	-	Dry	150 (500) 15 (49)	24 0.4	600 1.00	-40 ~ +150	8.7	-	15	20 195
		Periodic lubrication		51 0.85	1,000 1.65					
Develon 200S	Fe-sintering	Dry	290 (760) 29 (76)	30 0.5	1,000 (3,000) 1.65 (4.90)	-40 ~ +120	6.3 ~ 7.1	HRB 0 ~ 20	17	41 400
		Periodic lubrication		60 1	1,500 (3,000) 2.45 (4.90)					
Develon 200SP	Cu-sintering	Dry	250 (700) 25 (70)	30 0.5	980 (2,800) 1.60 (4.58)	-40 ~ +120	6.0 ~ 6.8	HRB -15 ~ 15	17	41 400
		Periodic lubrication		60 1	1,500 (3,000) 2.45 (4.90)					
Develon 200H	Cu-sintering for High load	Dry	450 (750) 45 (75)	30 0.5	1,000 (3,000) 1.63 (4.90)	-40 ~ +250	6.3 ~ 7.1	HRB 35~45	28	48 470
		Periodic lubrication		70 1.16	1,500 (3,000) 2.45 (4.90)					

※ () : Allowable static contact pressure (no sliding or sliding at extremely slow speed (0.1m/min or below))

※ Above data is based on backing steel KS SS400 / SM45C and its mechanical characteristics may be changed when backing steel is changed.

※ Value indicated above is general value and it can be changed without notification for improvement.

Non-ferrous metal Materials

Type	Code	Old code	Tensile strength	Elongation	Hardness	Foreign Standards	
			N/mm ²	%	HB	ASTM	DIN
Brass	CAC202	YBsc2	195 or above	20 or above	-	C85400	CuZn33Pb
	CAC203	YBsc3	245 or above	20 or above	-	C85700	CuZn37Pb
High Strength brass	CAC301	HBsc1	430 or above	20 or above	-	C86500	CuZn35Al1
	CAC302	HBsc2	490 or above	20 or above	-	C86400	CuZn34Al1
	CAC303	HBsc3	635 or above	18 or above	165 or above (10 / 3,000)	C86200	CuZn25Al5
	CAC304	HBsc4	755 or above	15 or above	200 or above (10 / 3,000)	C86300	CuZn25Al5
Bronze	CAC401	BC1	165 or above	15 or above	-	C84400	-
	CAC402	BC2	245 or above	20 or above	-	C90300	-
	CAC403	BC3	245 or above	15 or above	-	C90500	CuSn10Zn
	CAC406	BC6	195 or above	15 or above	-	C83600	CuSn5ZnPb
	CAC407	BC7	215 or above	18 or above	-	C92200	-
Phosphorous bronze	CAC502A	PBC2	195 or above	5 or above	60 or above (10 / 1,000)	-	CuSn10
	CAC502B	PBC2B	295 or above	5 or above	80 or above (10 / 1,000)	C90700	CuSn12
	CAC503B	PBC3B	265 or above	3 or above	90 or above (10 / 1,000)	C91000	CuSn12
Lead bronze	CAC602	LBC2	195 or above	10 or above	65 or above (10 / 500)	-	CuPb5Sn
	CAC603	LBC3	175 or above	7 or above	60 or above (10 / 500)	C93700	CuPb10Sn
	CAC604	LBC4	165 or above	5 or above	55 or above (10 / 500)	C93800	CuPb15Sn
	CAC605	LBC5	145 or above	5 or above	45 or above (10 / 500)	-	CuPb20Sn
	CAC607	C93200	207 or above	15 or above	-	C93200	-
Aluminum bronze	CAC701	AIBC1	440 or above	25 or above	80 or above (10 / 1,000)	C95200	CuAl10Fe
	CAC702	AIBC2	490 or above	20 or above	120 or above (10 / 1,000)	C95400	CuAl9Ni
	CAC703	AIBC3	590 or above	15 or above	150 or above (10 / 1,000)	C95800	CuAl10Ni
	CAC704	AIBC4	590 or above	15 or above	160 or above (10 / 1,000)	C95700	-
	CAC705	C95500	620 or above	6 or above	190 or above (10 / 3,000)	C95500	-
	CAC706	C95300	450 or above	20 or above	110 or above (10 / 3,000)	C95300	-
Silicon bronze	CAC801	SzBC1	345 or above	25 or above	-	C87400	-
	CAC802	SzBC2	440 or above	12 or above	-	C87500	CuZn15Si4
	CAC803	SzBC3	390 or above	20 or above	-	-	-

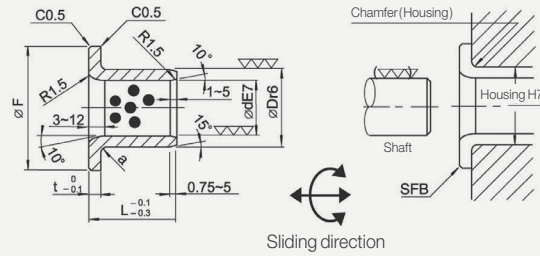
※ Refer to KS D 6024

Flange bushing SFB



Detail of a

d	10 ~ 16	55	60 ~
a	R 0.3	R 0.5	R 1



Material

● SOB : 500SP (CAC304 + Graphite)

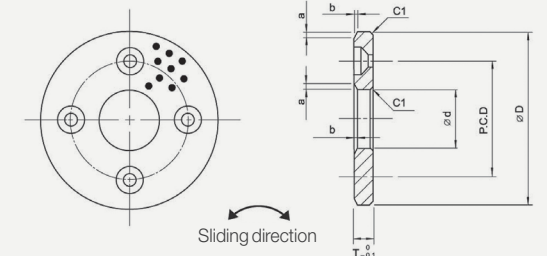
Tolerance

● Housing : H7
 ● Shaft : d8 - For high load, f7 - For high precision, e7 - For light load

Code	Inner diameter d	Outer diameter D	Flange D F	Flange T t	Length (L-0.1 -0.3)															
					15	20	25	30	35	40	50	60	67.5	80	100					
SFB	10	+0.040 +0.025	14	+0.034 +0.023	22	2	1015	1020												
	12	+0.050 +0.032	18	+0.034 +0.023	25	3	1215	1220												
	13	+0.050 +0.032	19	+0.041 +0.028	26	3	1315	1320												
	14	+0.050 +0.032	20	+0.041 +0.028	27	3	1415	1420												
	15	+0.050 +0.032	21	+0.041 +0.028	28	3	1515	1520	1525											
	16	+0.050 +0.032	22	+0.041 +0.028	29	3	1615	1620	1625											
	20	+0.061 +0.040	30	+0.041 +0.028	40	5	2015	2020		2030		2040								
	25	+0.061 +0.040	35	+0.050 +0.034	45	5		2520	2525	2530		2540								
	30	+0.061 +0.040	40	+0.050 +0.034	50	5				3030		3040	3050							
	31.5	+0.075 +0.050	40	+0.050 +0.034	50	5				31.535										
	35	+0.075 +0.050	45	+0.050 +0.034	60	5				3530		3540	3550							
	40	+0.075 +0.050	50	+0.050 +0.034	65	5				4030		4040	4050							
	45	+0.075 +0.050	55	+0.060 +0.041	70	5				4530		4540		4560						
	50	+0.075 +0.050	60	+0.060 +0.041	75	5				5030		5040		5060						
	55	+0.090 +0.060	65	+0.060 +0.041	80	5						5540		5560						
	60	+0.090 +0.060	75	+0.062 +0.043	90	7.5						6040	6050					6080		
	63	+0.090 +0.060	75	+0.062 +0.043	85	7.5									6367.5					
	70	+0.090 +0.060	85	+0.073 +0.051	105	7.5								7050				7080		
	75	+0.090 +0.060	90	+0.073 +0.051	110	7.5										7560				
	80	+0.090 +0.060	100	+0.073 +0.051	120	10											8060	8080	80100	
90	+0.107 +0.072	110	+0.076 +0.054	130	10												9060	9080		
100	+0.107 +0.072	120	+0.076 +0.054	150	10													10080	100100	
120	+0.107 +0.072	140	+0.088 +0.063	170	10													12080	120100	

How to order → Code - dXL (Example) SFB - 20X20

Thrust washer SOW



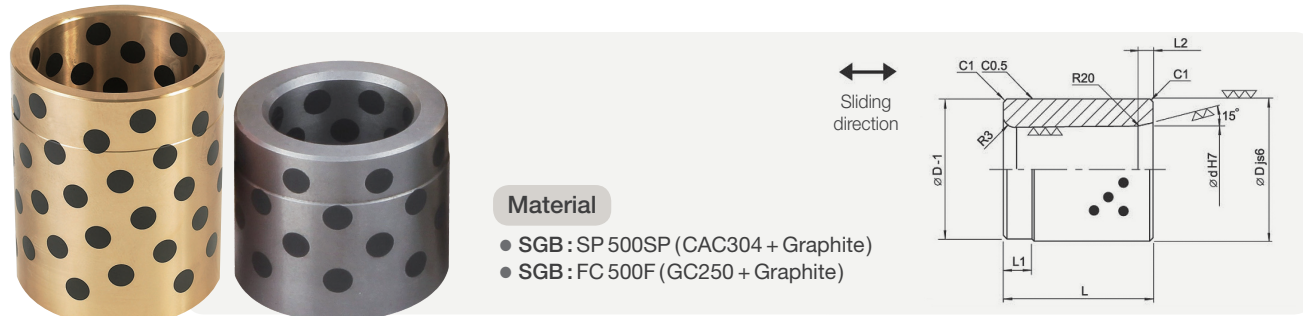
Material

● SOW : 500SP (CAC304 + Graphite)

Code	Nominal diameter	Inner diameter d	Outer diameter D	P.C.D	Set screws		Thickness T	a	b
					Dimension	Qt'y			
SOW	10	10.2	30	20	M3	2	3	1.5	0.3
	12	12.2	40	28	M3	2	3	2	0.4
	13	13.2	40	28	M3	2	3	2	0.4
	14	14.2	40	28	M3	2	3	2	0.4
	15	15.2	50	35	M3	2	3	2	0.4
	16	16.2	50	35	M3	2	3	2	0.4
	18	18.2	50	35	M3	2	3	2	0.4
	20	20.2	50	35	M5	2	5	2.5	0.4
	25	25.2	55	40	M5	2	5	2.5	0.4
	30	30.2	60	45	M5	2	5	2.5	0.4
	35	35.2	70	50	M5	2	5	2.5	0.4
	40	40.2	80	60	M6	2	7	3	0.5
	45	45.3	90	70	M6	2	7	3	0.5
	50	50.3	100	75	M6	4	8	4	0.7
	55	55.3	110	85	M6	4	8	4	0.7
	60	60.3	120	90	M8	4	8	5	0.9
	65	65.3	125	95	M8	4	8	5	0.9
	70	70.3	130	100	M8	4	10	5	0.9
	75	75.3	140	110	M8	4	10	5	0.9
	80	80.3	150	120	M8	4	10	5	0.9
90	90.5	170	140	M10	4	10	5	0.9	
100	100.5	190	160	M10	4	10	5	0.9	
120	120.5	200	175	M10	4	10	5	0.9	

How to order → Code - Nominal D (Example) SOW-10

Guide bushing SGB

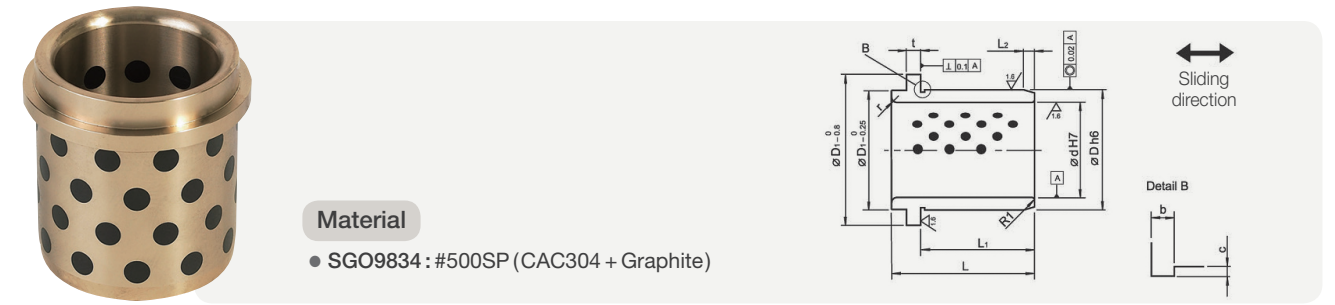


- Material**
- SGB : SP 500SP (CAC304 + Graphite)
 - SGB : FC 500F (GC250 + Graphite)

Code	Inner diameter d		Outer diameter D		Length			
	d	tolerance	D	tolerance	L	L1	L2	
SGB	25	+0.021 / 0	40	± 0.008	40	0 / -0.2	10	5
	30	+0.021 / 0	50	± 0.008	50	0 / -0.2	10	5
	35	+0.025 / 0	60	± 0.0095	55	0 / -0.2	15	5
	40	+0.025 / 0	60	± 0.0095	50, 60	0 / -0.2	10	5
	50	+0.025 / 0	70	± 0.0095	50, 75	0 / -0.2	15	10
	60	+0.030 / 0	80	± 0.011	60, 90	0 / -0.2	20	10
	80	+0.030 / 0	100	± 0.011	100, 120	0 / -0.2	25	10
	100	+0.035 / 0	120	± 0.011	150	0 / -0.2	25	10
	120	+0.035 / 0	140	± 0.0125	180	0 / -0.2	25	10

How to order → Code - dXL - Material (Example) SGB - 20 X 20 - FC

Guide bushing SGO9834 (DIN 9834)

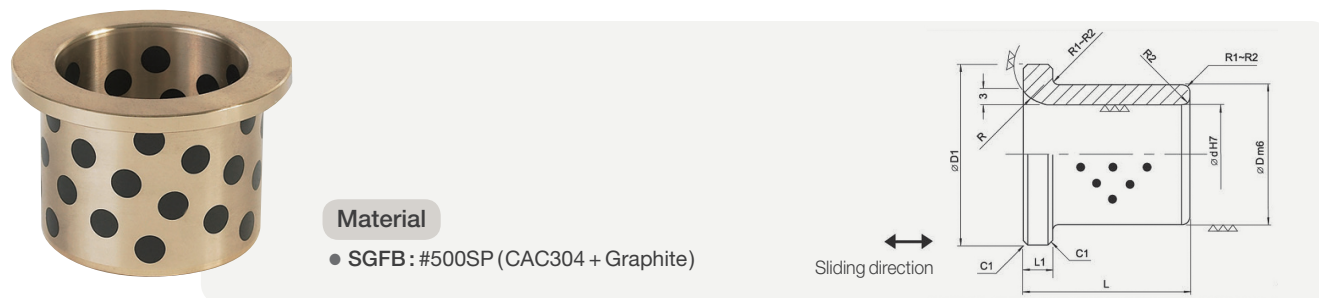


- Material**
- SGO9834 : #500SP (CAC304 + Graphite)

Code	d	H7	D	h6	L	D1	L1	L2	t	r	bxc
SGO9834-025	25	+0.021 / 0	32	0 / -0.016	40	40	30	3	6.3	3	0.6 X 0.3
SGO9834-032	32	+0.025 / 0	40	0 / -0.016	50	50	40	4	6.3	3	
SGO9834-040	40	+0.025 / 0	50	0 / -0.016	63	63	50	5	6.3	3	
SGO9834-050	50	+0.025 / 0	63	0 / -0.019	71	71	56	6.3	6.3	5	
SGO9834-063	63	+0.030 / 0	80	0 / -0.019	80	90	63	8	10	6	1.0 X 0.4
SGO9834-080	80	+0.030 / 0	100	0 / -0.022	100	112	80	10	10	8	
SGO9834-100	100	+0.035 / 0	125	0 / -0.025	125	140	106	12.5	10	10	
SGO9834-125	125	+0.040 / 0	160	0 / -0.025	160	180	132	16	10	12	
SGO9834-160	160	+0.040 / 0	200	0 / -0.029	200	220	170	16	10	18	

How to order → Code (Example) SGO9834-025 Make-to-order

Guide flange bushing SGFB

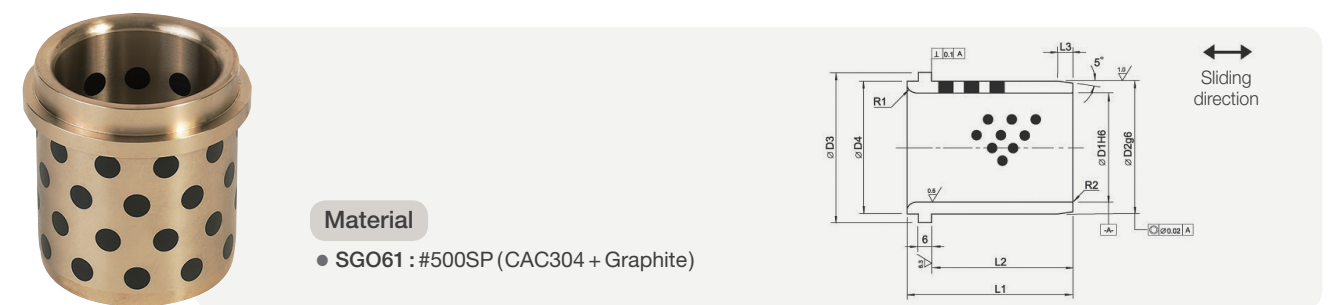


- Material**
- SGFB : #500SP (CAC304 + Graphite)

Code	Inner diameter d		Outer diameter D		Flange D1	Length		Flange T L1	R
	d	tolerance	D	tolerance		L	L1		
SGFB	25	+0.021 / 0	35	+0.025 / +0.009	45	40	0 / -0.3	7	10
	30	+0.021 / 0	40	+0.025 / +0.009	50	50	0 / -0.3	10	20
	40	+0.025 / 0	55	+0.030 / +0.011	65	70	0 / -0.3		
	50	+0.025 / 0	65	+0.030 / +0.011	75	80	0 / -0.3		
	60	+0.030 / 0	75	+0.030 / +0.011	85				
	65	+0.030 / 0	80	+0.030 / +0.011	90				
	80	+0.030 / 0	100	+0.035 / +0.013	110	120	0 / -0.3		
	100	+0.035 / 0	120	+0.035 / +0.013	130	100	0 / -0.3		
						140	0 / -0.3		

How to order → Code - dXL (Example) SGFB - 80 X 100

Guide bushing SGO61



- Material**
- SGO61 : #500SP (CAC304 + Graphite)

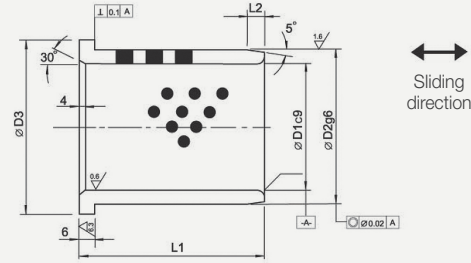
Code	D1	D2	D3	D4	L1	L2	L3	R1
SGO612540	25	32	40	32	40	30	4	3
SGO613250	32	40	50	40	50	40	4	3
SGO614063	40	50	63	50	63	50	5	3
SGO615071	50	63	71	63	71	56	6	5
SGO616380	63	80	90	80	80	63	8	6
SGO618010	80	100	112	100	100	80	10	8
SGO611012	100	125	140	125	125	106	12	10
SGO611114	115	140	155	140	140	120	12	10
SGO611216	125	160	180	160	160	132	12	12

How to order → Code (Example) SGO613250 Make-to-order

Guide bushing SGO71



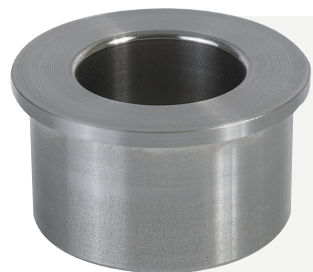
Material
 ● SGO71 : #500SP (CAC304 + Graphite)



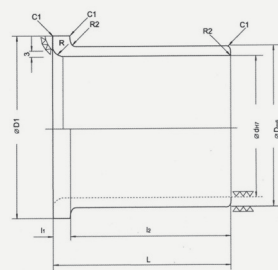
Code	D1	D2	D3	L1	L2
SGO712540	25	32	40	40	4
SGO713250	32	40	50	50	4
SGO714055	40	50	63	55	5
SGP715063	50	63	71	63	6
SGO716375	63	80	90	75	8
SGO718090	80	100	112	90	10
SGO711011	100	125	140	115	12
SGO711213	125	160	180	138	12

How to order → Code (Example) SGO718090 **Make-to-order**

Develon Guide flange bushing SBSF



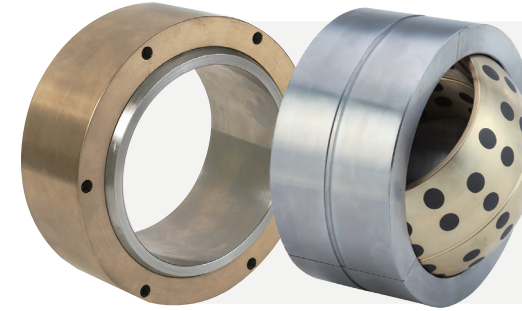
Material
 ● SBSF : Develon 200S (SS400 + Sintered layer)



Code	$\phi dH7$	$\phi Dm6$	$\phi D1$	L	L1
SBSF-25	25	35	45	40	7
SBSF-30	30	40	50	50	10
SBSF-40	40	55	64	70	10
SBSF-50	50	65	75	80	10
SBSF-60	60	75	85	80	10
SBSF-65S	65	80	90	80	10
SBSF-65L	65	80	90	120	10
SBSF-80S	80	100	110	100	10
SBSF-80L	80	100	110	140	10
SBSF-100S	100	120	130	100	10
SBSF-100L	100	120	130	140	10

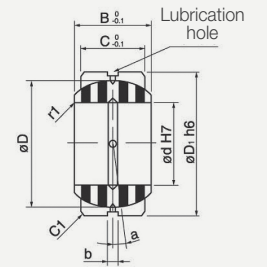
How to order → Code (Example) SBSF-65S **Make-to-order**

Spherical bearing SOSB



Tolerance

Tolerance	Shaft	Use
d8	N7	High load
e7	H7	Low load



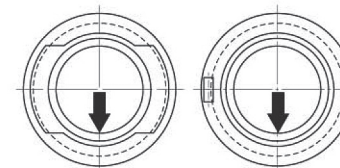
Material

● Inner Ring : #500SP (CAC304 + Graphite) ● Outer Ring : Bearing steel (SUJ2)

Code	d H7	D1 h6	B	C	D	b	Alignment angle a		
015	15	+0.018 / 0	26	0 / -0.013	12	9	22	4	8
020	20	+0.021 / 0	32	0 / -0.016	16	14	28	4	4
025	25	+0.021 / 0	42	0 / -0.016	21	18	36	4	5
030	30	+0.021 / 0	50	0 / -0.016	27	23	44	4	6
035	35	+0.025 / 0	55	0 / -0.019	30	26	49	4	5
040	40	+0.025 / 0	62	0 / -0.019	33	28	55	4	6
045	45	+0.025 / 0	72	0 / -0.019	36	31	62	4	5
050	50	+0.025 / 0	80	0 / -0.019	42	36	70	4	5
060	60	+0.030 / 0	100	0 / -0.022	53	45	90	4	6
070	70	+0.030 / 0	110	0 / -0.022	58	50	99	4	5
080	80	+0.030 / 0	130	0 / -0.022	70	60	115	4	6
090	90	+0.035 / 0	140	0 / -0.025	76	65	125	4	6
100	100	+0.035 / 0	160	0 / -0.025	88	75	145	6	6
110	110	+0.035 / 0	170	0 / -0.025	93	80	155	6	5
120	120	+0.035 / 0	190	0 / -0.029	105	90	170	6	6
130	130	+0.040 / 0	200	0 / -0.029	110	95	180	6	5
140	140	+0.040 / 0	210	0 / -0.029	90	70	180	6	7
150	150	+0.040 / 0	220	0 / -0.029	120	105	200	6	5
160	160	+0.040 / 0	230	0 / -0.029	105	80	200	6	8
180	180	+0.040 / 0	260	0 / -0.032	105	80	225	6	6
200	200	+0.046 / 0	290	0 / -0.032	130	100	250	6	7
220	220	+0.046 / 0	320	0 / -0.036	135	100	275	6	8
240	240	+0.046 / 0	340	0 / -0.036	140	100	300	9	8
260	260	+0.056 / 0	370	0 / -0.036	150	110	325	9	7
280	280	+0.056 / 0	400	0 / -0.036	155	120	350	9	6
300	300	+0.056 / 0	430	0 / -0.040	165	120	375	9	7

How to order → Code (Example) SOSB-015 **Make-to-order**

Fixing direction



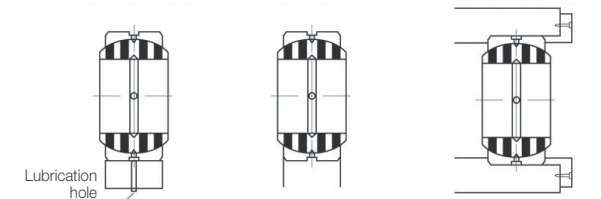
Slide insertion type

- ▶ ID (15 ~ 90)
- ▶ Loading direction perpendicular to the spherical insertion groove

Split bushing type

- ▶ Over ID 100
- ▶ Loading direction perpendicular to the split surface.

Fixing method

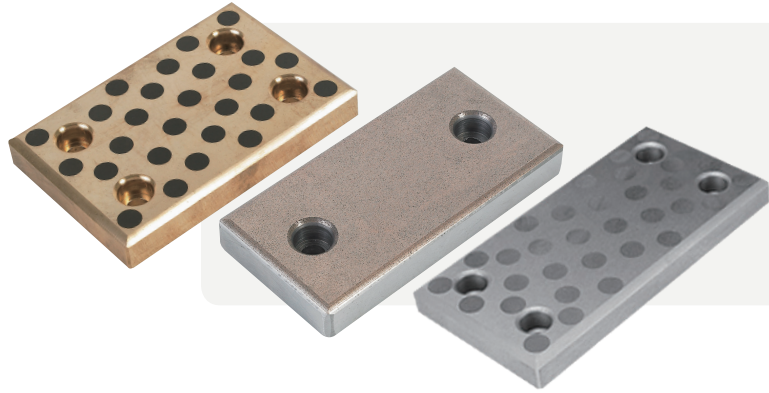


Press-fit / Cooling fit

Fixing bolt

Non-loosening plate

Wear plate SWP / SBP

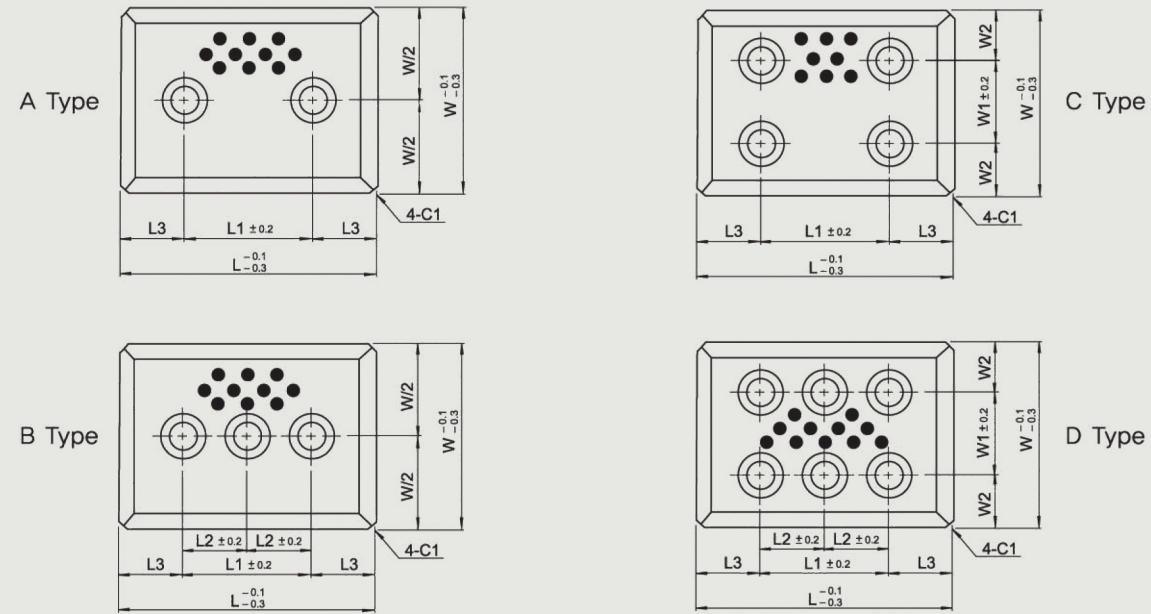


Material

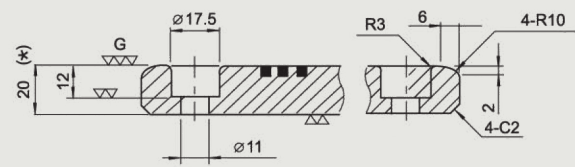
- SWP-SP : #500SP (CAC304 + Graphite)
- SWP-FC : 500F (GC250 + Graphite)
- SBP : 200S (SS400 + Sintered layer)

Tolerance

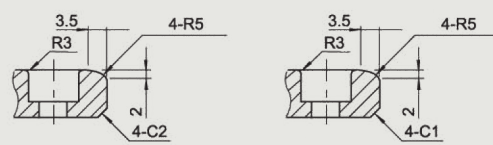
- Thickness tolerance : +/-0.01



Chamfer according to Width



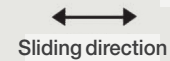
(W=75~200)



(W=48 & 58)

(W=28 & 38)

(1) W=28 & 38



(2) W=48 & 200

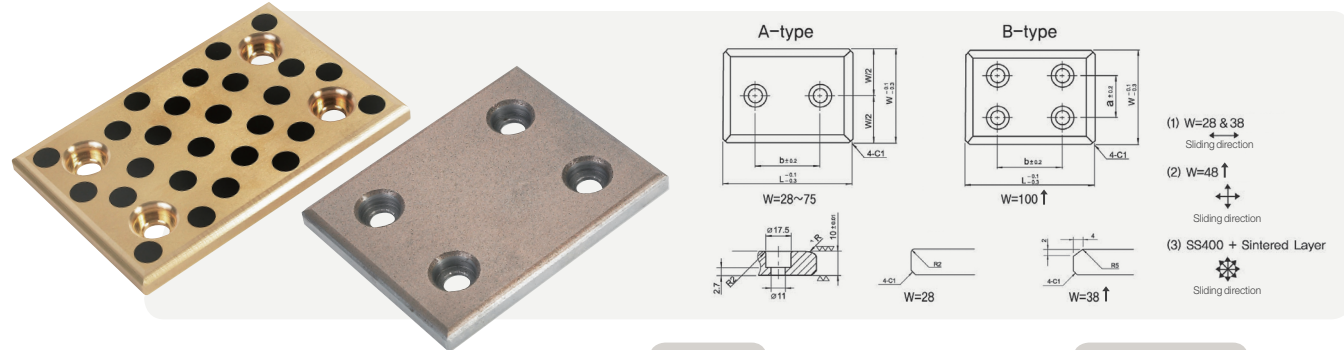


(3) SS400 + Sintered Layer



Code	W	L	Bolt hole					Type
			W1	W2	L1	L2	L3	
SWP SBP	28	75			45		15	A
		100			50			
		150			100	-		
		200			150		25	
		250			200			
		300			250	125		
	38	75			45		15	A
		100			50			
		125			75	-		
		150			100		25	
		200			150			
		250			200			
	48	75			45		15	A
		100			50			
		125			75	-		
		150			100		25	
		200			150			
		250			200			
	58	75			45		15	A
		100			50			
		150			100	-		
		200			150		25	
		250			200			
		300			250	125		
75	75			25		25	A	
	100			50				
	125			75	-			
	150			100		25		
	200			150				
	250			200				
100	100			50		50	C	
	125			75				
	150		25	100	-			
	200			150		25		
	250			200				
	300		50	200 (250)	-(125)	50 (25)		
125	125			75		25	C	
	150			100				
	200			150	-			
	250			200		25		
	300			200 (250)	-(125)	50 (25)		
	350			200		75		
150	150			100		25	C	
	200		100	150	-			
	250			200		25		
200	200			150		25	C (D)	
	250		150	200	-(125)			
	300			250		25		
200	200			150		25	C	
	250		150	200	-			
	300			250	-(125)			

Thin wear plate STWP / SBPT



Material

- STWP : #500SP (CAC304 + Graphite)
- SBPT : 200S (SS400 + Sintered layer)

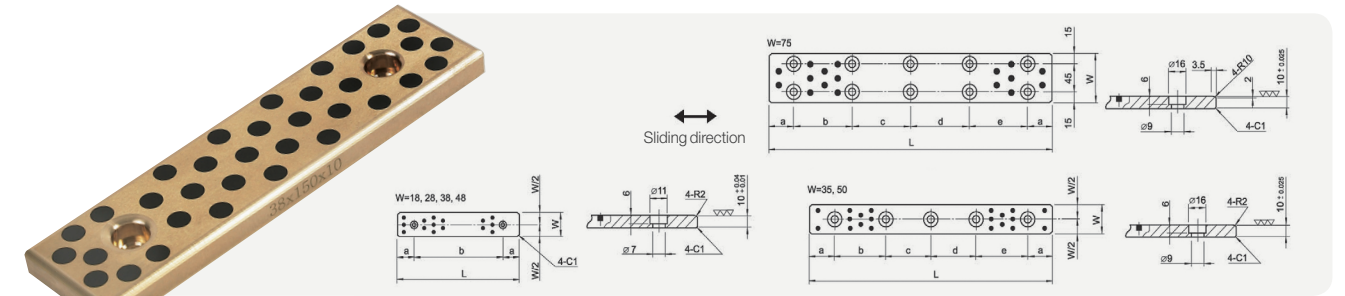
Mounting bolt

- Low head socket cap screw

Code	W	L	a	b	Type	Bolt Qt'y
STWP SBPT	28	75	-	45	A	2
		100		50		
		125		75		
		150		100		
	38	75		45		
		100		50		
		125		75		
		150		100		
	48	75		45		
		100		50		
		125		75		
		150		100		
	58	75		45		
		100		50		
		125		75		
		150		100		
	75	75		25		
		100		50		
		125		75		
		150		100		
	100	175		125		
		200		150		
		100		50		
		125		75		
125	150	100				
	200	150				
	250	200				
	100	50				
150	150	100				
	200	150				
	100	50				
	150	100				
	100	50	B	100	4	
		75		150		
		100		200		
		150		250		

How to order → Code - W X L (Example) STWP - 75 X 100

Sliding plate SP



Material

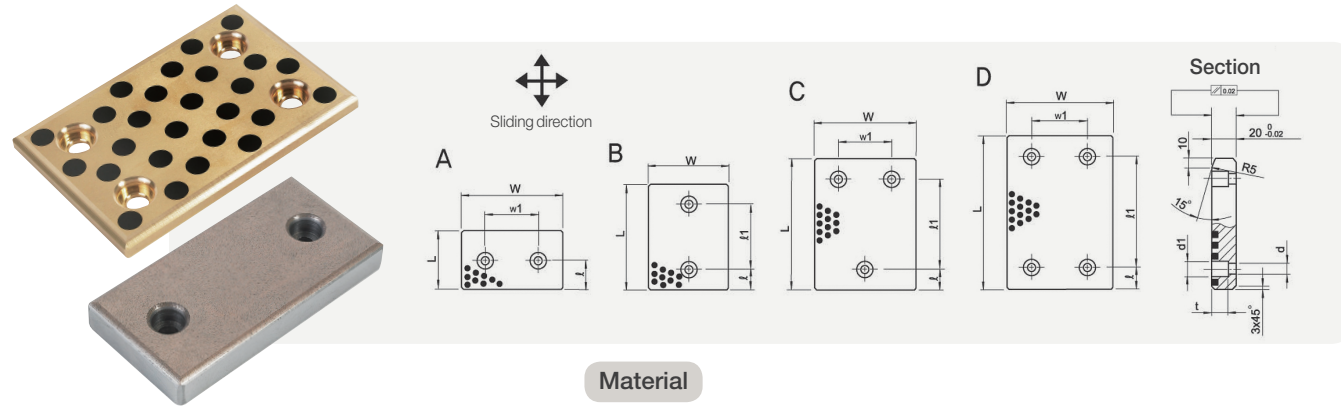
- SP : #500SP (CAC304 + Graphite)

Code	W	L		Bolt					Mounging bolt		
		Dimension	Tolerance	a	b	c	d	e	Size	Qt'y	
SP	18	75	0 / -0.2	15	45				M6	2	
		100		25	50						
		125		25	75						
		150		25	100						
	28	75		15	45						
		100		25	50						
		125		25	75						
		150		25	100						
	35	100		20	60					*M8	3
		150		20	55	55					4
		200		20	55	50	55				5
		250		20	70	70	70				
		300		20	65	65	65	65			
	38	350		20	80	75	75	80			
		75		15	45						
		100		25	50						
		125		25	75						
	48	150		25	100						
		75		15	45						
		100		25	50						
		125		25	75						
	50	150		25	100						
		100		20	60					*M8	3
		150		20	55	55					4
200		20	55	50	55			5			
250	20	70	70	70							
75	300	20	65	65	65	65					
	400	20	90	90	90	90					
	150	20	110						4		
	200	20	80	80					6		
	250	20	105	105					8		
500	300	20	85	90	85						
	400	20	120	120	120						
	500	20	115	115	115	115					

* Mark : Low head socket cap screw

How to order → Code - W X L (Example) SP - 38 X 100

Wear plate SWPV / SBPV

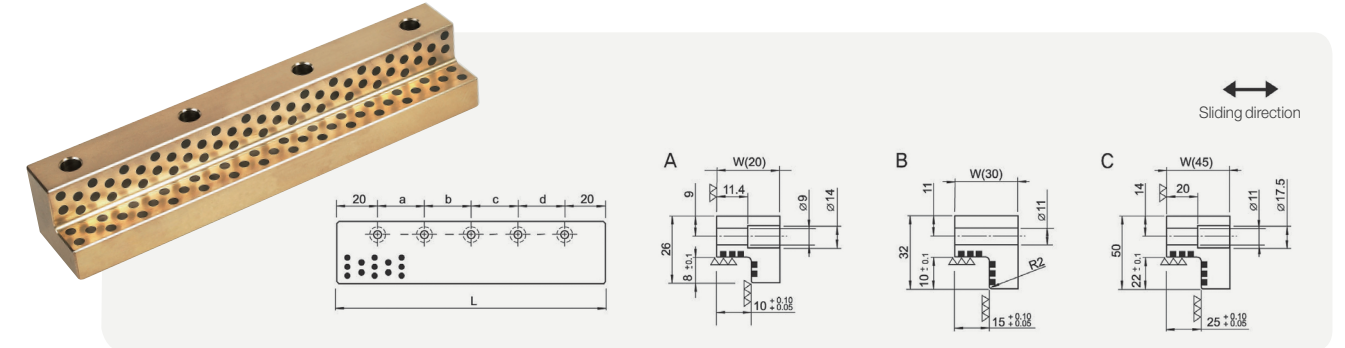


Material
 ● SWPV : #500SP (CAC304 + Graphite) ● SBPV : 200S (SS400 + Sintered layer)

Code	W	L	φ	φ 1	w1	d	d1	t	Type	Bolt Qt'y	
SWPV SBPV	50	80	25	30	-	9	15	9	B	2	
		100		50		13.5	20	13			
		125		75							
		160		110							
		200		150							
	80	50	40	-	-	13.5	20	13	A	2	
		80		30							
		100		50							
		125		75							
		160		110							
		200		150							
		250		170							
	315	235									
	100	50	25	-	50	-	13.5	20	13	A	2
		80		40							
		100		50							
		125		75							
		160		110							
		200		150							
		315		235							
	125	50	25	-	75	-	13.5	20	13	C	3
		80		40							
		100		50							
		125		75							
160		110									
200		150									
315		235									
160	50	25	-	110	-	13.5	20	13	A	2	
	80		40								
	100		50								
	125		75								
	160		110								
	200		150								
	315		235								

How to order → Code - W X L (Example) SWPV - 100 X 100 **Make-to-order**

Sliding liner SL

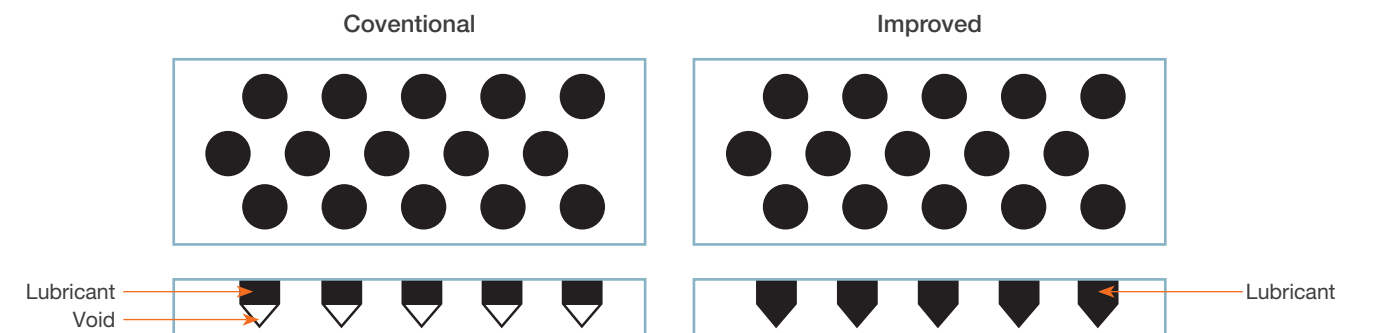


Material
 ● SL : #500SP (CAC304 + Graphite)

Code	W	L	Bolt hole				Mounting bolt		Type	
			a	b	c	d	Size	Qt'y		
SL	20	100	60	-	-	-	M8	2	A	
		150	55	55	-			3		
		200		50	55			4		
	30	100	60	-	-		M10	2	B	
		150	55	55	-			3		
		200		50	55			4		
		250	70	70	70					
		350	80	75	75					80
	45	200	55	50	55		M10	4	C	
		250	70	70	70					
		300	65	65	65					5
		350	80	75	75					

How to order → Code - W X L (Example) SL - 20 X 100

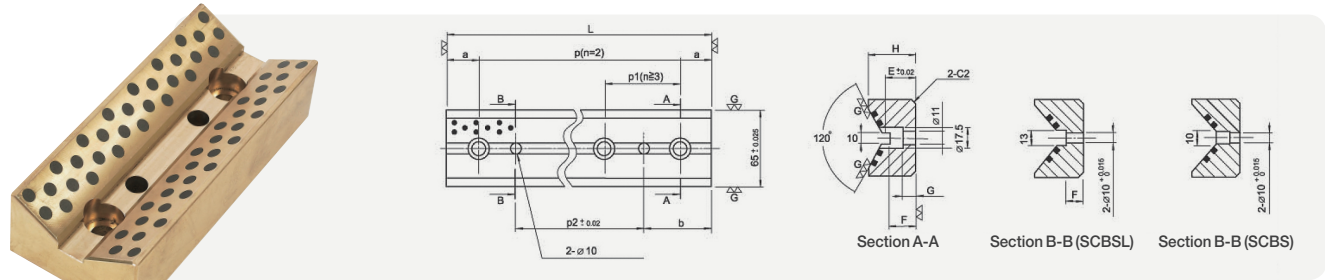
Conical plugs for sliding plates (Design registration)



► Void inside the sliding plate, causing sinking or swelling problems, is eliminated by forming the lubricant in a cone shape.

How to order → Code - W X L (Example) SWPV - 100 X 100 **Make-to-order**

Cam bottom plate SCBS / SCBSL

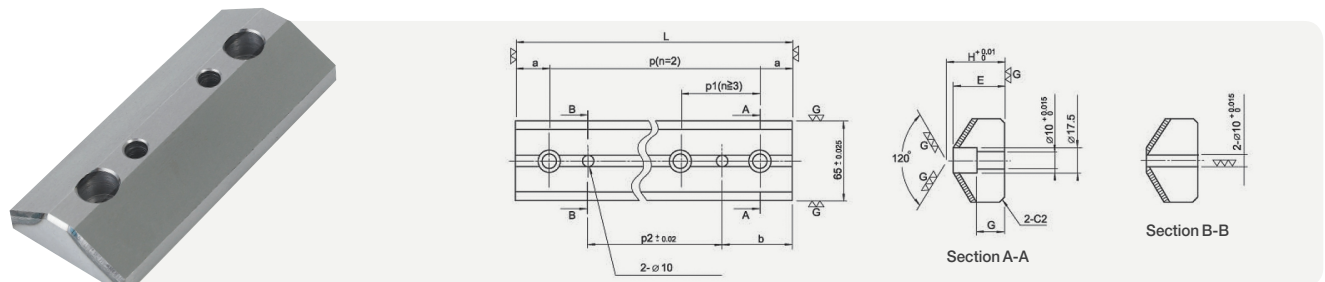


Material ● SCBS / SCBSL : #500SP (CAC304 + Graphite)

Code	L	H	E	F	G	a	p1	Bolt hole Q'ty	b	p2	p		
SCBS	100	35	18	15	8	20	-	2	40	20	60		
	125					25	50	50	25	-			
	150								3		25		
	200								4		50		
	250								5		100		
	300								6		150		
SCBL	100	37	20	20	10	20	-	2	40	20	60		
	125					25	75	50	25	-			
	150								100		50	75	
	200										125	100	100
	250											150	
	300										200		

How to order → Code - L (Example) SCBS - 150

Cam bottom steel plate SCBSP / SCBSPL



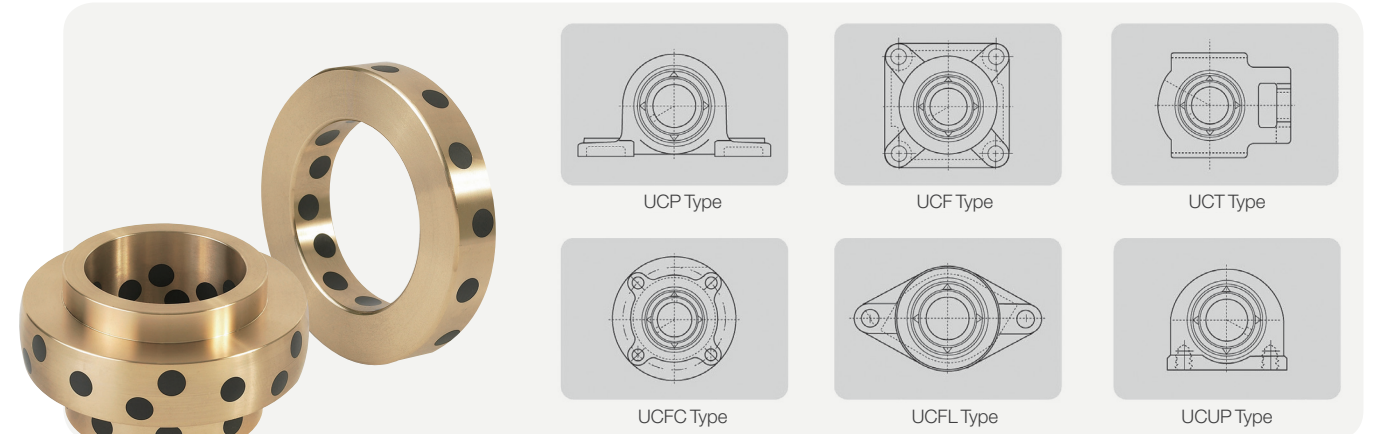
Material ● SCBSP / SCBSPL : SM45C + HRC 50
(High frequency quenching on hatched area)

Assembly	①	②	H
SCBS	SCBSP	65	
SCBSL	SCBSPL	50	

Code	L	H	E	G	a	p1	Bolt hole Q'ty	b	p2	p		
SCBSP	100	47	44	20	20	-	2	40	20	60		
	125				25	50	50	25	-			
	150							3		25		
	200							4		50		
	250							5		100		
	300							6		150		
SCBSPL	100	37	26	10	20	-	2	40	20	60		
	125				25	75	50	25	-			
	150							100		50	75	
	200									125	100	100
	250										150	
	300									200		

How to order → Code - L (Example) SCBSP - 150

SGO U/C bearing



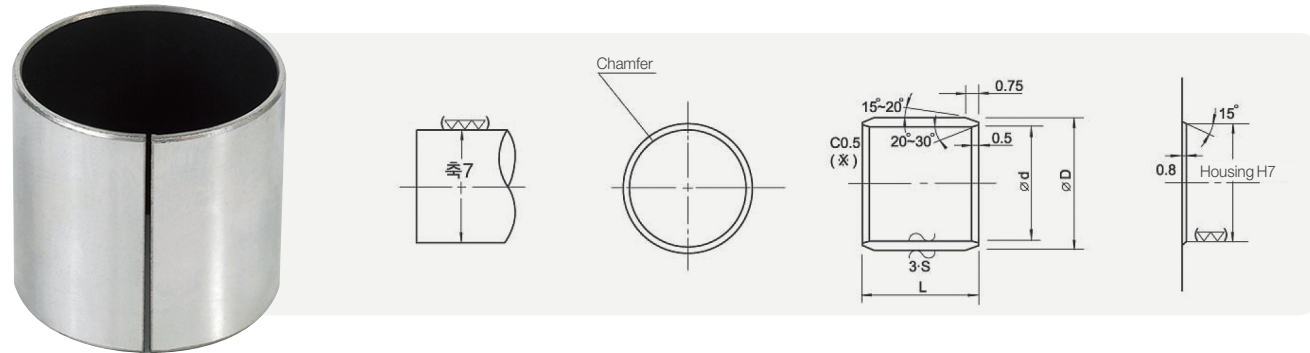
● Type : Case specification

Bearing No.	Shaft (mm)
UC 201	12
UC 202	15
UC 203	17
UC 204	20
UC 205	25
UC 206	30
UC 207	35
UC 208	40
UC 209	45
UC 210	50
UC 211	55
UC 212	60
UC 213	65
UC 214	70
UC 215	75
UC 216	80
UC 217	85
UC 218	90
UC 305	25
UC 306	30
UC 307	35

Bearing No.	Shaft (mm)
UC 308	40
UC 309	45
UC 310	50
UC 311	55
UC 312	60
UC 313	65
UC 314	70
UC 315	75
UC 316	80
UC 317	85
UC 318	90
UC 319	95
UC 320	100
UC 321	105
UC 322	110
UC 324	120
UC 326	130
UC 328	140

How to order → Bearing No. (Example) UC201
Make-to-order

Dry bearing SDU Pb-Free



Bushing		Shaft diameter		Housing diameter		Length							
ID Ød	OD ØD					3	4	5	6	7	8	10	12
3	5	3	-0.025 / -0.034	5 (H7)	+0.012 / 0	0303	0304	0305	0306				
4	6	4	-0.025 / -0.037	6 (H7)	+0.012 / 0		0404		0406		0408		
5	7	5	-0.025 / -0.037	7 (H7)	+0.015 / 0	0503	0504	0505	0506		0508		
6	8	6	-0.025 / -0.037	8 (H7)	+0.015 / 0			0605	0606	0607	0608	0610	
7	9	7	-0.025 / -0.040	9	+0.015 / 0			0705	0706	0707		0710	0712
8	10	8	-0.025 / -0.040	10 (H7)	+0.015 / 0			0805	0806	0807	0808	0810	0812
9	11	9	-0.025 / -0.040	11	+0.015 / 0							0910	
10	12	10	-0.025 / -0.040	12 (H7)	+0.018 / 0				1006	1007	1008	1010	1012
12	14	12	-0.025 / -0.043	14	+0.018 / 0				1206		1208	1210	1212
13	15	13	-0.025 / -0.043	15	+0.018 / 0						1308	1310	
14	16	14	-0.025 / -0.043	16	+0.018 / 0							1410	1412
15	17	15	-0.025 / -0.043	17	+0.018 / 0						1508	1510	1512
16	18	16	-0.025 / -0.043	18	+0.018 / 0							1610	1612
17	19	17	-0.025 / -0.043	19	+0.021 / 0							1710	
18	20	18	-0.025 / -0.043	20 (H7)	+0.021 / 0							1810	1812
19	22	19	-0.025 / -0.045	22	+0.021 / 0							1910	
20	23	20	-0.025 / -0.045	23	+0.021 / 0							2010	2012
22	25	22	-0.025 / -0.045	25	+0.021 / 0							2210	2212
24	27	24	-0.025 / -0.045	27	+0.021 / 0								
25	28	25	-0.025 / -0.045	28	+0.021 / 0							2510	2512
26	30	26	-0.025 / -0.045	30	+0.021 / 0								
28	32	28	-0.025 / -0.045	32 (H7)	+0.025 / 0								2812
30	34	30	-0.025 / -0.045	34	+0.025 / 0								3012
31	35	31	-0.025 / -0.050	35	+0.025 / 0								
32	36	32	-0.025 / -0.050	36	+0.025 / 0								
35	39	35	-0.025 / -0.050	39	+0.025 / 0								3512
38	42	38	-0.025 / -0.050	42	+0.025 / 0								4012
40	44	40	-0.025 / -0.050	44	+0.025 / 0								
45	50	45	-0.025 / -0.050	50	+0.025 / 0								
50	55	50	-0.025 / -0.050	55 (H7)	+0.030 / 0								
55	60	55	-0.025 / -0.055	60	+0.030 / 0								
60	65	60	-0.025 / -0.055	65	+0.030 / 0								
65	70	65	-0.035 / +0.005	70	+0.030 / 0								
70	75	70	-0.035 / +0.005	75	+0.030 / 0								
75	80	75	-0.035 / +0.005	80	+0.030 / 0								
80	85	80	-0.035 / +0.005	85 (H7)	+0.035 / 0								
85	90	85	+0.035 / 0	90	+0.035 / 0								
90	95	90	+0.035 / 0	95	+0.035 / 0								
100	105	100	+0.035 / 0	105	+0.035 / 0								
110	115	110	+0.035 / 0	115	+0.035 / 0								
120	125	120	+0.035 / 0	125 (H7)	+0.040 / 0								
130	135	130	+0.035 / 0	135	+0.040 / 0								
140	145	140	+0.035 / 0	145	+0.040 / 0								
150	155	150	+0.035 / 0	155	+0.040 / 0								
160	165	160	+0.035 / 0	165	+0.040 / 0								

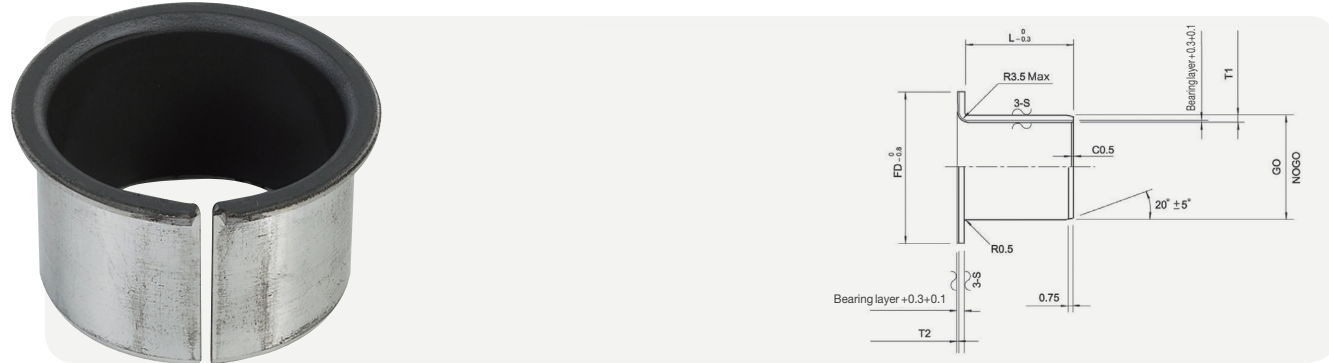
Operation condition

Contact pressure P	Velocity V	PV value	Temperature	Lubrication
kgf / cm ²	m / min	kgf / cm ² · m / min	°C	
250 (1400)	15 ~ 60	1050 (2100)	-200 ~ +250	Dry

※ () : indicates static allowable contact pressure with no sliding at extremely low velocity of under 6m/min

Length												
15	20	25	30	35	40	50	60	70	80	90	95	100
0815												
1015	1020											
1215	1220											
1315												
1415	1420											
1515	1520	1525										
1615	1620	1625										
1715												
1815	1820	1825										
1915												
2015	2020	2025	2030									
2215	2220	2225	2230									
2415	2420	2425	2430									
2515	2520	2525	2530	2535								
2615	2620	2625	2630									
2815	2820	2825	2830									
3015	3020	3025	3030	3035	3040							
3115		3125			3140							
	3220	3225	3230		3240							
	3520	3525	3530	3535	3540	3550						
	3820	3825	3830	3835	3840							
4015	4020	4025	4030	4035	4040	4050						
	4520	4525	4530	4535	4540	4550						
	5020	5025	5030	5035	5040	5050	5060					
		5525	5530	5535	5540	5550	5560					
			6030	6035	6040		6060					
			6530		6540	6550	6560					
			7030	7035	7040	7050	7060					
			7530	7535	7540	7550	7560		7080			
					8040	8050	8060		7580			
					8540	8550	8560		8080			
					9040		9060		8580	9090		
						10050		10070			10095	
						11050		11070			11095	
						12050		12070			12095	
						13050			13080			
						14050			14080			140100
						15050			15080			150100
						16050			16080			160100

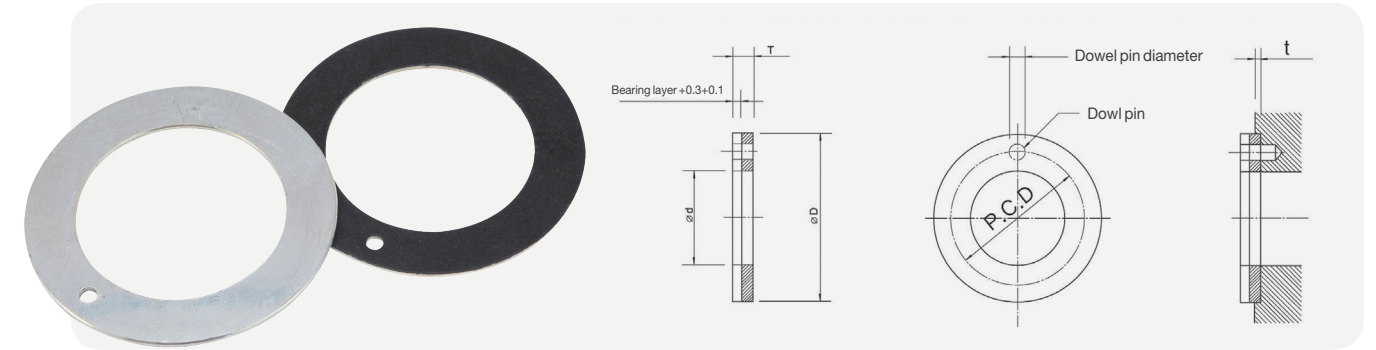
Dry bearing SDUF Pb-Free



Bushing		Recommended tolerance		Thickness		Length										
ID	Flange D ØFD	Housing tolerance H7	Shaft	T1	T2	6	8	10	12	15	20	25	30	40	50	60
3	7	4.6	+0.012 / 0	3	-0.025 / -0.035	0.8	0 / -0.035	0.8	0 / -0.15							
4	9	5.6	+0.012 / 0	4	-0.025 / -0.037											
5	10	7	+0.015 / 0	5	-0.025 / -0.037											
6	12	8	+0.015 / 0	6	-0.025 / -0.037											
7	13	9	+0.015 / 0	7	-0.025 / -0.040											
8	15	10	+0.015 / 0	8	-0.025 / -0.040											
10	18	12	+0.018 / 0	10	-0.025 / -0.040	1.0	0 / -0.025	1.0	0 / -0.15							
12	20	14	+0.018 / 0	12	-0.025 / -0.043											
14	22	16	+0.018 / 0	14	-0.025 / -0.043											
15	23	17	+0.018 / 0	15	-0.025 / -0.043											
16	24	18	+0.018 / 0	16	-0.025 / -0.043											
18	26	20	+0.021 / 0	18	-0.025 / -0.043											
20	31	23	+0.021 / 0	20	-0.025 / -0.046											
22	33	25	+0.021 / 0	22	-0.025 / -0.046	1.5	0 / -0.025	1.5	0 / -0.15							
24	35	27	+0.021 / 0	24	-0.025 / -0.046											
25	36	28	+0.021 / 0	25	-0.025 / -0.046											
26	38	30	+0.021 / 0	26	-0.025 / -0.046											
28	40	32	+0.025 / 0	28	-0.025 / -0.046											
30	42	34	+0.025 / 0	30	-0.025 / -0.046											
31	45	35	+0.025 / 0	31	-0.025 / -0.050	2.0	0 / -0.025	2.0	0 / -0.15							
32	46	36	+0.025 / 0	32	-0.025 / -0.050											
35	49	39	+0.025 / 0	35	-0.025 / -0.050											
38	52	42	+0.025 / 0	38	-0.025 / -0.050											
40	54	44	+0.025 / 0	40	-0.025 / -0.050											
45	60	50	+0.025 / 0	45	-0.025 / -0.050											
50	65	55	+0.030 / 0	50	-0.025 / -0.050	2.5	0 / -0.025	2.5	0 / -0.15							
55	70	60	+0.030 / 0	55	-0.025 / -0.055											
60	75	65	+0.030 / 0	60	-0.025 / -0.055											

How to order → Code - d X L - FD (Example) SDUF - 04 X 06 - 9

Dry bearing SWC Pb-Free



Code	Nominal	ID Ød	OD ØD	Thickness T	Dowel pin		Housing depth t				
					Dowel pin diameter	P.C.D					
SWC 06	6	8	16	1.5	-0.03 -0.08	1.100	+0.20 0	12	±0.12	1.0	+0.20 -0.05
SWC 08	8	10	18					14	±0.12		
SWC 10	10	12	24			1.625	18	±0.12			
SWC 12	12	14	26				20	±0.12			
SWC 14	14	16	30			2.125	23	±0.12			
SWC 16	16	18	32				25	±0.12			
SWC 18	18	20	36			3.125	28	±0.12			
SWC 20	20	22	38				30	±0.12			
SWC 22	22	24	42			4.125	33	±0.12			
SWC 24	24	26	44				35	±0.12			
SWC 25	25	28	48	2.0	38	±0.12					
SWC 30	30	32	54		43	±0.12					
SWC 35	35	38	62	50	±0.12						
SWC 40	40	42	66	54	±0.12						
SWC 45	45	48	74	61	±0.12						
SWC 50	50	52	78	65	±0.12						

How to order → Code - Nominal ID (Example) SWC 10

Extrusion Material



High Strength Brass

- Excellent strength, hardness, corrosion resistance, and toughness
- Superior abrasion resistance in high load.
- Used such as bearing, valve seat, lever, arm, gear, fittings for ship, sliding parts with low speed and high load, bearing for bridge, nut, slipper, and water pressure cylinder parts.

Available type and dimension

Type	Dimension	Remarks
Solid bar	ø28 ~ø194	-
Hollow bar	ø23 ~ø194	At least 7T or above

Standards		Chemical composition									Mechanical properties		
KS	Old code UNS NO.	Cu	Zn	Fe	Al	Mn	Sn	Pb	Ni	Si	Tensile strength N/mm ²	Elongation %	Hardness HB
CAC301	HBsC1	55.0 ~ 60.0	33.0 ~ 42.0	0.5 ~ 1.5	0.5 ~ 1.5	0.1 ~ 1.5	1.0	0.4	1.0	0.1	430 or above	20 or above	90 or above (10/1000)
CAC302	HBsC2	55.0 ~ 60.0	30.0 ~ 42.0	0.5 ~ 2.0	0.5 ~ 2.0	0.1 ~ 3.5	1.0	0.4	1.0	0.1	490 or above	18 or above	100 or above (10/1000)
CAC303	HBsC3	60.0 ~ 65.0	22.0 ~ 28.0	2.0 ~ 4.0	3.0 ~ 5.0	2.5 ~ 5.0	0.5	0.2	0.5	0.1	635 or above	15 or above	165 or above (10/3000)
CAC304	HBsC4	60.0 ~ 65.0	22.0 ~ 28.0	2.0 ~ 4.0	5.0 ~ 7.5	2.5 ~ 5.0	0.2	0.2	0.5	0.1	755 or above	12 or above	200 or above (10/3000)

Aluminum bronze

- High strength and toughness are high.
- Excellent resistance to bending, corrosion, heat, and abrasion in low temperature.
- Used in parts such as bearing, bush, gear, belt seat, plunger, paper-making roller, propeller for ship, nut, and safety tools.

Available type and dimension

Type	Dimension
Solid bar	ø40 ~ø194
Hollow bar	Inquire for available dimension

Standards		Chemical composition								Mechanical properties		
KS/JIS	Old code UNS NO.	Cu	Fe	Ni	Al	Mn	Sn	Pb	Zn	Tensile strength N/mm ²	Elongation %	Hardness HB
CAC701	AIBC1	85.0 ~ 90.0	1.0 ~ 3.0	0.1 ~ 1.0	8.0 ~ 10.0	0.1 ~ 1.0	0.1	0.1	0.5	440 or above	25 or above	80 (10/1000)
CAC702	AIBC2	80.0 ~ 88.0	2.5 ~ 5.0	1.0 ~ 3.0	8.0 ~ 10.5	0.1 ~ 1.5	0.1	0.1	0.5	490 or above	20 or above	120 (10/1000)
CAC703	AIBC3	78.0 ~ 85.0	3.0 ~ 6.0	3.0 ~ 6.0	8.5 ~ 10.5	0.1 ~ 1.5	0.1	0.1	0.5	590 or above	15 or above	120 (10/1000)

Brass

- Excellent hot forging and machinability.
- Used in parts such as bolt, nut, small screw, spindle, gear, valve, and mechanical parts.

Available type and dimension

Type	Dimension
Solid bar	ø28 ~ø194
Hollow bar	Min. ID 23, 7T or above

Standards		Chemical composition					Mechanical properties	
KS/JIS		Cu	Pb	Fe	Fe + Sn	Zn	Tensile strength N/mm ²	Elongation %
C3604		57.0 ~ 61.0	1.8 ~ 3.7	0.5	1.0	Rem	335	27
C3771		57.0 ~ 61.0	1.0 ~ 2.5	0.5	0.5	Rem	315	15



Technical Data

Bearing life and wear amount

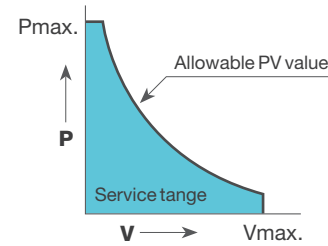
Allowance of abrasion for oil-less bearing depends on its dimension and accuracy, which directly leads to its lifetime. Since abrasion amount can be changed due to other conditions such as speed, load, inflow of foreign substance, temperature, axis processing status, and tolerance, it is difficult to accurately anticipate the abrasion amount and life time without using it. Also, oil-less bearing is mostly used in complex and special conditions compared to ball and roller bearing, so it is difficult to anticipate the life time using calculation formula. However, the wear amount is estimated by the following formula.

$$W = K \cdot P \cdot V \cdot T$$

W: Wear amount (mm) / **V:** Velocity (m/min) / **P:** Contact pressure (kgf/cm²)
T: Running time (hr) / **K:** Specific wear amount (mm/kgf/cm² · m/min·hr)

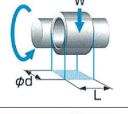
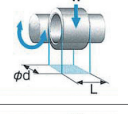
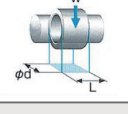
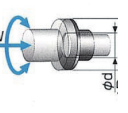
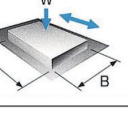
Specific wear amount K

Lubrication	mm/kgf/cm ² ·m/min·hr
Dry	1 X 10 ^{-3 ~ -5}
Boundary lubrication under low speed	1 X 10 ^{-5 ~ -7}
Periodic lubrication	1 X 10 ^{-6 ~ -8}
Continuous lubrication under water application	1 X 10 ^{-8 ~ -10}



PV Value

PV value is a value that has multiplied surface pressure per unit area P (kgf/cm², unit area for bearing is internal diameter x length) and speed per unit time V (m/min), which is used as important criteria for selecting bearing. Therefore, PV value should be calculated and selected as indicated below so that it does not exceed allowable PV value for each bearing. Calculation formula is indicated as below.

Bushing	P (Kgf/cm ²)	V (m/min)	PV (Kgf/cm ² · m/min)
 Radial journal rotation	$\frac{10^2 W}{\phi d \times L}$	$\frac{\pi \phi d n}{10^3}$	$\frac{\pi W n}{10 \times L}$
 Oscillation	$\frac{10^2 W}{\phi d \times L}$	$\frac{\pi \phi d c \theta}{180 \times 10^3}$	$\frac{\pi W c \theta}{18 \times 10^2 \times L}$
 Reciprocation	$\frac{10^2 W}{\phi d \times L}$	$\frac{2 c S}{10^3}$	$\frac{W c S}{5 \times \phi d \times L}$
Washer	P (Kgf/cm ²)	V (m/min)	PV (Kgf/cm ² · m/min)
 Thrust motion	Rotation $\frac{400 W}{\pi \times (\phi D^2 - \phi d^2)}$	Rotation $\frac{\pi \phi D n}{10^3}$	Rotation $\frac{4 W \phi D n}{10^3 \times (\phi D^2 - \phi d^2)}$
	Rotation $\frac{400 W}{\pi \times (\phi D^2 - \phi d^2)}$	Rotation $\frac{\pi \phi D \theta}{180 \times 10^3}$	Rotation $\frac{4 W \phi D c \theta}{180 \times 10^3 \times (\phi D^2 - \phi d^2)}$
Plate	P (Kgf/cm ²)	V (m/min)	PV (Kgf/cm ² · m/min)
 Reciprocation	$\frac{10^2 W}{B \times L}$	$\frac{2 c S}{10^3}$	$\frac{W c S}{5 \times B \times L}$

Inner diameter : ϕd mm / Outer diameter : ϕD mm / Length : L mm / Width : B mm / Rotating speed : n rpm
 Oscillating cycle : c cpm / Stroke distance : S mm / Oscillating angle : θ° / Load : W kgf

Effect of peridic greasing

Additional lubrication with grease or oil can reduce friction heat and abrasion compared to dry lubrication status. Also, it can discharge worn particles abrasion and prevent foreign substance from flowing in (seal effect), and rust from occurring, which can improve bearing performance and life cycle. Also, if initial lubricant is applied on internal diameter where it requires no lubrication, it can reduce rapid initial wear amount that is occurred in starting and achieve soft operation effect.

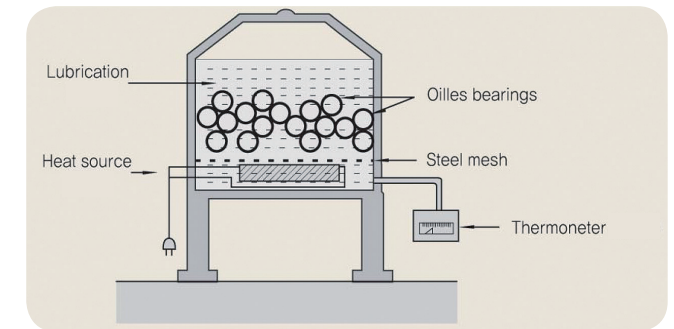
▼ Lubricant can be used effectively as below depending on the using condition.

Using condition	Lubricant
Low-load, High-speed	Spindle oil having low viscosity of < 8~17cst (30°C)
Medium-load, Medium-speed	Motor oil and turbine oil having viscosity of < 7~15cst (98.9°C)
High-load, Low-speed	Gear oil and cylinder oil having high viscosity of 100~1,000 cst (37°C) (Oil containing MoS ² is effective)

※ For using on high-load and resistance to abrasion and heat, grease containing molybdenum disulfide (MoS²) is most effective, which is recommended for improving performance and life cycle.

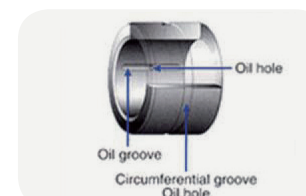
Oil impregnation method

When using solid lubricant dispersed bearing, Develon by purchasing the material and machining or grinding, be sure to apply oil impregnation. There are heating type and vacuum type in impregnation method. Heating method contains processed product in the container with lubricant (motor oil) and gradually heats to 100 ~ 110°C and keep the temperature 1 to 2 hours until bubble does not occur. Cut the heat source and let it cool down to the room temperature and takes products out of the bath. If oil impregnation by heating is not available, leave the products in the oil bath for 24 hours or more. Also, vacuum impregnation can be available on request.

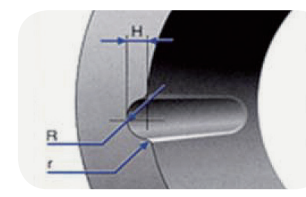


Design for oil groove and oil hole

- **Oil groove:** Design can be applied evenly on the internal diameter surface based on the maximum load point. Length of oil groove should be 80 % more or less of bearing length. All edges should be chamfered. In case of injecting oil from outside of the housing, it is very effective to make the rotation groove on the housing internal diameter or bearing external diameter surface in order to avoid inadequate lubrication from clogged oil hole caused by shifting of the oil hole from the housing oil groove.
- **Oil hole:** Normally, 1 oil hole is made to the direction where load is not applied. In case of rotational motion, 2 oil holes are made to both direction based on the maximum load point. Also, when bearing length is long, 2 oil holes are made to length direction.



Oil hold and oil groove



Cross sectional configuraton of oil groove

ID Item	R	r	H	Qt'y
30 or below	1.5	1.5	1.2	1 ~ 2
30 ~ 50	2	2	1.8	3
50 ~ 80	3	3	2.5	3
80 ~ 120	3.5	3.5	3.5	4
120 ~ 180	4	4	5	4
180 ~ 250	5	5	6	5
250 ~ 315	6	6	7	6
315 ~ 400	7	7	8	8
400 ~ 500	8	8	8	8

Technical Data

Bearing mounting

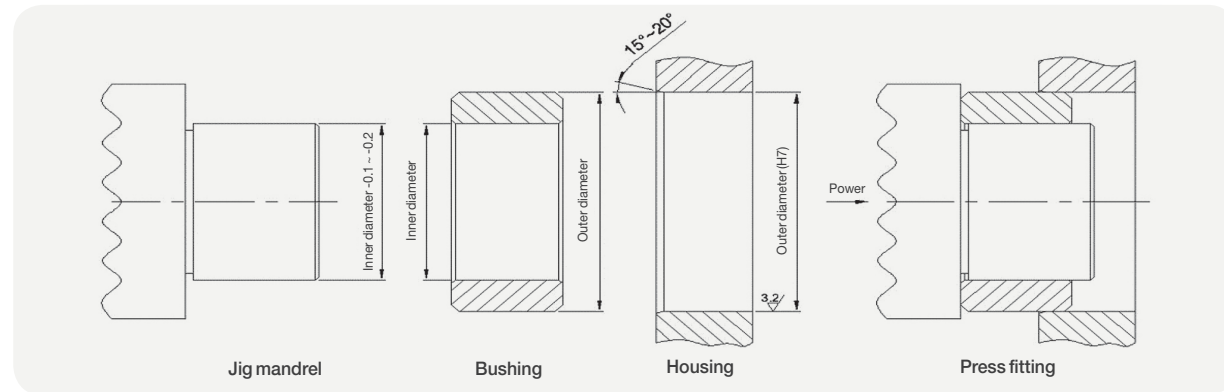
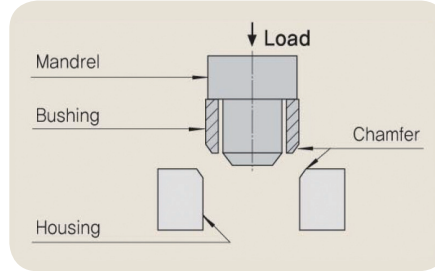
There are pressing fit and cooling fit for inserting the bearing into the housing.

Cooling fit

- Nitrogen and dry ice are used for cooling fit.
- Compared to pressing fit, it can achieve more accurate installation.
- Shrinkage fit can deteriorate the bearing function.

Pressing fit

- In general, mandrel and press machine are used for pressing the oil-less bearing into the housing.
- As indicated on the figure, oil-less bearing is pressed into the housing with jig (fixing device) by a small press.
- In case of pressing large product, chamfering should be made on the bearing external diameter and housing internal diameter first before using the oil.



Caution

- Shaft should be ground (Ra0.8) in principle.
- Be sure to comply with the tolerance indicated on the dimension table of the catalog for the housing and shaft.
- Be sure to maintain bearing shaft horizontally so that it is not tilted to one side.
- Recommended to use the sealing to prevent foreign substance from flowing in.
- Hardening does not have to be applied on the shaft, but life cycle can be extended if it's chrome plated.

Calculation formula for shrinkage amount by cooling

Allowance of abrasion for oil-less bearing depends on its dimension and accuracy, which directly leads to its lifetime. Since abrasion amount can be changed due to other conditions such as speed, load, inflow of foreign substance, temperature, axis processing status, and tolerance, it is difficult to accurately anticipate the abrasion amount and life time without using it. Also, oil-less bearing is mostly used in complex and special conditions compared to ball and roller bearing, so it is difficult to anticipate the life time using calculation formula. However, the wear amount is estimated by the following formula.

$$\Delta D \approx D \times a \times (T_0 - T_1)$$

D: Outer diameter of the bearing / **a**: Heat expansion coefficient of the bearing
T₀: Room temperature / **T₁**: Cooling temperature

Heat expansion coefficient

- #500SP : a = 2.2 × 10⁻⁵°C
- #500B : a = 1.8 × 10⁻⁵°C
- #500F : a = 1.2 × 10⁻⁵°C

Ex) #500SP I.D 100 x O.D 130 x 100L
 Room temperature 20°C, Cooling temperature -70°C

$$\rightarrow \Delta D \approx 130 \times 2.2 \times 0.00001 \times (20 - (-70)) = 0.2574$$

※ Refer to it for below diameter 500 mm

Frictional heat

Frictional heat Q generated per unit time and unit area is indicated as below.

$$Q = \mu \cdot P \cdot V / J \text{ (kcal/min)}$$

J: Frictional heat per unit motion (≈ 427kgf-m/kcal) / **μ**: Frictional coefficient
P: Contact pressure (kgf/cm²) / **V**: Velocity (m/min)

Frictional heat is mainly affected by speed rather than contact pressure. Therefore, for similar PV values, additional lubrication should be considered for a higher velocity application to prevent seizure to the bearing or the mating shaft.

Mating shaft

Item	Shaft Material	Hardness	Shaft roughness
General purpose	General structural steel with SM35C or above	Higher strength material is recommended, when foreign substance flows in	3~12μ
High temperature	Stainless steel or chrome plating		
Corrosive environment	Rockwell "C" 35 or above		

- Reduce the shaft dimension to account for the heat expansion amount of the material when it is used on high temperature 100°C or above.

$$\text{Heat expansion amount} = \text{shaft heat expansion coefficient } (\alpha) \times \text{shaft diameter } (d) \times (\text{ambient temperature} - \text{room temperature})$$

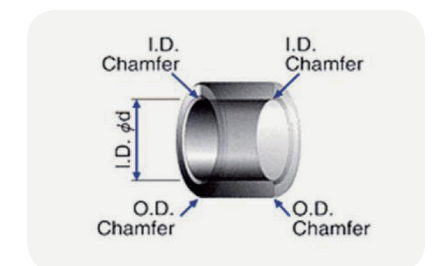
Ex) #500SP α : 2.2 × 10⁻⁵ / °C

- 2 ~ 3 chrome plating is ideal for seawater and liquid medicine.
- Nitric acid on shaft is effective in high pressure and low speed application.

Chamfering

It is ideal to chamfer the both ends of the oil-less bearing in order to prevent stress concentration.

ID Item	Chamfer
80 or below	0.5C
80 ~ 200	1.0C
200 ~ 300	1.5C
300 or below	2.0C



Calculation formula for appropriate thickness of the bearing

Thickness of standard bearing is calculated using the formula below.

$$T = (0.05 \sim 0.07) d + (2 \sim 5\text{mm})$$

Tolerances of Regularly Used Hole Fits

Size(mm)		D			E			F			G		H					
Over	below	D8	D9	D10	E7	E8	E9	F6	F7	F8	G6	G7	H5	H6	H7	H8	H9	H10
0	3	34.0	45.0	60.0	24.0	28.0	29.0	12.0	16.0	20.0	8.0	12.0	4.0	6.0	10.0	14.0	25.0	40.0
		20.0	20.0	20.0	14.0	14.0	14.0	6.0	6.0	6.0	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
3	6	48.0	60.0	78.0	32.0	38.0	50.0	18.0	22.0	28.0	12.0	16.0	5.0	8.0	12.0	18.0	30.0	48.0
		30.0	30.0	30.0	20.0	20.0	20.0	10.0	10.0	10.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
6	10	62.0	76.0	98.0	40.0	47.0	61.0	22.0	28.0	35.0	14.0	20.0	6.0	9.0	15.0	22.0	36.0	58.0
		40.0	40.0	40.0	25.0	25.0	25.0	13.0	13.0	13.0	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
10	14	77.0	93.0	120.0	50.0	59.0	75.0	27.0	34.0	43.0	17.0	24.0	8.0	11.0	18.0	27.0	43.0	70.0
		50.0	50.0	50.0	32.0	32.0	32.0	16.0	16.0	16.0	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
14	18	77.0	93.0	120.0	50.0	59.0	75.0	27.0	34.0	43.0	17.0	24.0	8.0	11.0	18.0	27.0	43.0	70.0
		50.0	50.0	50.0	32.0	32.0	32.0	16.0	16.0	16.0	6.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
18	24	98.0	117.0	149.0	61.0	73.0	92.0	33.0	41.0	53.0	20.0	28.0	9.0	13.0	21.0	33.0	52.0	84.0
		65.0	65.0	65.0	40.0	40.0	40.0	20.0	20.0	20.0	7.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0
24	30	98.0	117.0	149.0	61.0	73.0	92.0	33.0	41.0	53.0	20.0	28.0	9.0	13.0	21.0	33.0	52.0	84.0
		65.0	65.0	65.0	40.0	40.0	40.0	20.0	20.0	20.0	7.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0
30	40	119.0	142.0	180.0	75.0	89.0	112.0	41.0	50.0	64.0	25.0	34.0	11.0	16.0	25.0	39.0	62.0	100.0
		80.0	80.0	80.0	50.0	50.0	50.0	25.0	25.0	25.0	9.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0
40	50	119.0	142.0	180.0	75.0	89.0	112.0	41.0	50.0	64.0	25.0	34.0	11.0	16.0	25.0	39.0	62.0	100.0
		80.0	80.0	80.0	50.0	50.0	50.0	25.0	25.0	25.0	9.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0
50	65	146.0	174.0	220.0	90.0	106.0	134.0	49.0	60.0	76.0	29.0	40.0	13.0	19.0	30.0	46.0	74.0	120.0
		100.0	100.0	100.0	60.0	60.0	60.0	30.0	30.0	30.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0
65	80	146.0	174.0	220.0	90.0	106.0	134.0	49.0	60.0	76.0	29.0	40.0	13.0	19.0	30.0	46.0	74.0	120.0
		100.0	100.0	100.0	60.0	60.0	60.0	30.0	30.0	30.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0
80	100	174.0	207.0	260.0	107.0	126.0	156.0	58.0	71.0	90.0	34.0	47.0	15.0	22.0	35.0	54.0	87.0	140.0
		120.0	120.0	120.0	72.0	72.0	72.0	36.0	36.0	36.0	12.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0
100	120	174.0	207.0	260.0	107.0	126.0	156.0	58.0	71.0	90.0	34.0	47.0	15.0	22.0	35.0	54.0	87.0	140.0
		120.0	120.0	120.0	72.0	72.0	72.0	36.0	36.0	36.0	12.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0
120	140	208.0	245.0	305.0	125.0	148.0	185.0	68.0	83.0	106.0	39.0	54.0	18.0	25.0	40.0	63.0	100.0	160.0
		145.0	145.0	145.0	85.0	85.0	85.0	43.0	43.0	43.0	14.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0
140	160	208.0	245.0	305.0	125.0	148.0	185.0	68.0	83.0	106.0	39.0	54.0	18.0	25.0	40.0	63.0	100.0	160.0
		145.0	145.0	145.0	85.0	85.0	85.0	43.0	43.0	43.0	14.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0
160	180	208.0	245.0	305.0	125.0	148.0	185.0	68.0	83.0	106.0	39.0	54.0	18.0	25.0	40.0	63.0	100.0	160.0
		145.0	145.0	145.0	85.0	85.0	85.0	43.0	43.0	43.0	14.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0
180	200	242.0	285.0	355.0	146.0	172.0	215.0	79.0	96.0	122.0	44.0	61.0	20.0	29.0	46.0	72.0	115.0	185.0
		170.0	170.0	170.0	100.0	100.0	100.0	50.0	50.0	50.0	15.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0
200	225	242.0	285.0	355.0	146.0	172.0	215.0	79.0	96.0	122.0	44.0	61.0	20.0	29.0	46.0	72.0	115.0	185.0
		170.0	170.0	170.0	100.0	100.0	100.0	50.0	50.0	50.0	15.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0
225	250	242.0	285.0	355.0	146.0	172.0	215.0	79.0	96.0	122.0	44.0	61.0	20.0	29.0	46.0	72.0	115.0	185.0
		170.0	170.0	170.0	100.0	100.0	100.0	50.0	50.0	50.0	15.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0
250	280	271.0	320.0	400.0	162.0	191.0	240.0	88.0	108.0	137.0	49.0	69.0	23.0	32.0	52.0	81.0	130.0	210.0
		190.0	190.0	190.0	110.0	110.0	110.0	56.0	56.0	56.0	17.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0
280	315	271.0	320.0	400.0	162.0	191.0	240.0	88.0	108.0	137.0	49.0	69.0	23.0	32.0	52.0	81.0	130.0	210.0
		190.0	190.0	190.0	110.0	110.0	110.0	56.0	56.0	56.0	17.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0
315	355	299.0	350.0	440.0	182.0	214.0	265.0	98.0	119.0	151.0	54.0	79.0	25.0	36.0	57.0	89.0	140.0	230.0
		210.0	210.0	210.0	125.0	125.0	125.0	62.0	62.0	62.0	18.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0
355	400	299.0	350.0	440.0	182.0	214.0	265.0	98.0	119.0	151.0	54.0	79.0	25.0	36.0	57.0	89.0	140.0	230.0
		210.0	210.0	210.0	125.0	125.0	125.0	62.0	62.0	62.0	18.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0
400	450	327.0	385.0	480.0	198.0	232.0	290.0	108.0	131.0	165.0	60.0	83.0	27.0	40.0	63.0	97.0	155.0	250.0
		230.0	230.0	230.0	135.0	135.0	135.0	68.0	68.0	68.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0
450	500	327.0	385.0	480.0	198.0	232.0	290.0	108.0	131.0	165.0	60.0	83.0	27.0	40.0	63.0	97.0	155.0	250.0
		230.0	230.0	230.0	135.0	135.0	135.0	68.0	68.0	68.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0

Size(mm)		Js			K			M			N		P		R	S	T	U	X
Over	below	Js5	Js6	Js7	K5	K6	K7	M5	M6	M7	N6	N7	P6	P7	R7	S7	T7	U7	X7
0	3	2.0	3.0	5.0	0.0	0.0	0.0	-2.0	-2.0	-2.0	-4.0	-4.0	-6.0	-6.0	-10.0	-14.0	•	-18.0	-20.0
		-2.0	-3.0	-5.0	-4.0	-6.0	-10.0	-6.0	-8.0	-12.0	-10.0	-14.0	-12.0	-16.0	-20.0	-24.0	•	-28.0	-30.0
3	6	2.5	4.0	6.0	0.0	2.0	3.0	-3.0	-1.0	0.0	-5.0	-4.0	-9.0	-8.0	-11.0	-15.0	•	-19.0	-24.0
		-2.5	-4.0	-6.0	-5.0	-6.0	-9.0	-8.0	-9.0	-12.0	-13.0	-16.0	-17.0	-20.0	-23.0	-27.0	•	-31.0	-36.0
6	10	3.0	4.5	7.5	1.0	2.0	5.0	-4.0	-3.0	0.0	-7.0	-4.0	-12.0	-9.0	-13.0	-17.0	•	-22.0	-28.0
		-3.0	-4.5	-7.5	-5.0	-7.0	-10.0	-10.0	-12.0	-15.0	-16.0	-19.0	-21.0	-24.0	-28.0	-32.0	•	-37.0	-43.0
10	14	4.0	5.5	9.0	2.0	2.0	6.0	6.0	-4.0	0.0	-9.0	15.0	-15.0	-11.0	-16.0	-21.0	•	-26.0	-33.0
		-4.0	-5.5	-9.0	-6.0	-9.0	-12.0	-15.0	-18.0	-20.0	-23.0	-26.0	-29.0	-34.0	-39.0	•	-44.0	-51.0	
14	18	4.0	5.5	9.0	2.0	2.0	6.0	6.0	-4.0	0.0	-9.0	15.0	-15.0	-11.0	-16.0	-21.0	•	-26.0	-38.0
		-4.0	-5.5	-9.0	-6.0	-9.0	-12.0	-15.0	-18.0	-20.0	-23.0	-26.0	-29.0	-34.0	-39.0	•	-44.0	-56.0	
18	24	4.5	6.5	10.5	1.0	2.0	6.0	-5.0	-4.0	0.0	-11.0	-7.0	-18.0	-14.0	-20.0	-27.0	•	-33.0	-46.0
		-4.5	-6.5	-10.5	-8.0	-11.0	-15.0	-14.0	-17.0	-21.0	-24.0	-28.0	-31.0	-35.0	-41.0	-48.0	•	-54.0	-67.0
24	30	4.5	6.5	10.5	1.0	2.0	6.0	-5.0	-4.0	0.0	-11.0	-7.0	-18.0	-14.0	-20.0	-27.0	-33.0	-40.0	-56.0
		-4.5	-6.5	-10.5	-8.0	-11.0	-15.0	-14.0	-17.0	-21.0	-24.0	-28.0	-31.0	-35.0	-41.0	-48.0	-54.0	-61.0	-77.0
30	40	5.5	8.0	12.5	2.0	3.0	7.0	-5.0	-4.0	0.0	-12.0	-8.0	-21.0	-17.0	-25.0	-34.0	-39.0	-51.0	•
		-5.5	-8.0	-12.5	-9.0	-13.0	-18.0	-16.0	-20.0	-25.0	-28.0	-33.0	-37.0	-42.0	-50.0	-59.0	-64.0	-76.0	•
40	50	5.5	8.0	12.5	2.0	3.0	7.0	-5.0	-4.0	0.0	-12.0	-8.0	-21.0	-17.0	-25.0	-3			

Tolerances of Regularly Used Shaft Fits

Size(mm)		b		c		d		e			f			g			h			
Over	below	b9	c9	d8	d9	e7	e8	e9	f6	f7	f8	g4	g5	g6	h4	h5	h6	h7		
0	3	-140.0	-60.0	-20.0	-20.0	-14.0	-14.0	-14.0	-6.0	-6.0	-6.0	-2.0	-2.0	-2.0	0.0	0.0	0.0	0.0		
		-165.0	-85.0	-34.0	-45.0	-24.0	-28.0	-29.0	-12.0	-16.0	-20.0	-5.0	-6.0	-8.0	-3.0	-4.0	-6.0	-10.0		
3	6	-140.0	-70.0	-30.0	-30.0	-20.0	-20.0	-20.0	-10.0	-10.0	-10.0	-4.0	-4.0	-4.0	0.0	0.0	0.0	0.0		
		-170.0	-100.0	-48.0	-60.0	-32.0	-38.0	-50.0	-18.0	-22.0	-28.0	-8.0	-9.0	-12.0	-4.0	-5.0	-8.0	-12.0		
6	10	-150.0	-80.0	-40.0	-40.0	-25.0	-25.0	-25.0	-13.0	-13.0	-13.0	-5.0	-5.0	-5.0	0.0	0.0	0.0	0.0		
		-186.0	-116.0	-62.0	-76.0	-40.0	-47.0	-61.0	-22.0	-28.0	-35.0	-9.0	-11.0	-14.0	-4.0	-6.0	-9.0	-15.0		
10	14	-150.0	-95.0	-50.0	-50.0	-32.0	-32.0	-32.0	-16.0	-16.0	-16.0	-6.0	-6.0	-6.0	0.0	0.0	0.0	0.0		
		-193.0	-138.0	-77.0	-93.0	-50.0	-59.0	-75.0	-27.0	-34.0	-43.0	-11.0	-14.0	-17.0	-5.0	-8.0	-11.0	-18.0		
14	18	-150.0	-95.0	-50.0	-50.0	-32.0	-32.0	-32.0	-16.0	-16.0	-16.0	-6.0	-6.0	-6.0	0.0	0.0	0.0	0.0		
		-193.0	-138.0	-77.0	-93.0	-50.0	-59.0	-75.0	-27.0	-34.0	-43.0	-11.0	-14.0	-17.0	-5.0	-8.0	-11.0	-18.0		
18	24	-160.0	-110.0	-65.0	-65.0	-40.0	-40.0	-40.0	-20.0	-20.0	-20.0	-7.0	-7.0	-7.0	0.0	0.0	0.0	0.0		
		-212.0	-162.0	-98.0	-117.0	-61.0	-73.0	-93.0	-33.0	-41.0	-53.0	-13.0	-16.0	-20.0	-6.0	-9.0	-13.0	-21.0		
24	30	-160.0	-110.0	-65.0	-65.0	-40.0	-40.0	-40.0	-20.0	-20.0	-20.0	-7.0	-7.0	-7.0	0.0	0.0	0.0	0.0		
		-212.0	-162.0	-98.0	-117.0	-61.0	-73.0	-93.0	-33.0	-41.0	-53.0	-13.0	-16.0	-20.0	-6.0	-9.0	-13.0	-21.0		
30	40	-170.0	-120.0	-80.0	-80.0	-50.0	-50.0	-50.0	-25.0	-25.0	-25.0	-9.0	-9.0	-9.0	0.0	0.0	0.0	0.0		
		-232.0	-182.0	-119.0	-142.0	-75.0	-89.0	-112.0	-41.0	-50.0	-64.0	-16.0	-20.0	-25.0	-7.0	-11.0	-16.0	-25.0		
40	50	-180.0	-130.0	-80.0	-80.0	-50.0	-50.0	-50.0	-25.0	-25.0	-25.0	-9.0	-9.0	-9.0	0.0	0.0	0.0	0.0		
		-242.0	-192.0	-119.0	-142.0	-75.0	-89.0	-112.0	-41.0	-50.0	-64.0	-16.0	-20.0	-25.0	-7.0	-11.0	-16.0	-25.0		
50	65	-190.0	-140.0	-100.0	-100.0	-60.0	-60.0	-60.0	-30.0	-30.0	-30.0	-10.0	-10.0	-10.0	0.0	0.0	0.0	0.0		
		-264.0	-214.0	-146.0	-174.0	-90.0	-106.0	-134.0	-49.0	-60.0	-76.0	-18.0	-23.0	-29.0	-8.0	-13.0	-19.0	-30.0		
65	80	-200.0	-150.0	-100.0	-100.0	-60.0	-60.0	-60.0	-30.0	-30.0	-30.0	-10.0	-10.0	-10.0	0.0	0.0	0.0	0.0		
		-274.0	-224.0	-146.0	-174.0	-90.0	-106.0	-134.0	-49.0	-60.0	-76.0	-18.0	-23.0	-29.0	-8.0	-13.0	-19.0	-30.0		
80	100	-220.0	-170.0	-120.0	-120.0	-72.0	-72.0	-72.0	-36.0	-36.0	-36.0	-12.0	-12.0	-12.0	0.0	0.0	0.0	0.0		
		-307.0	-257.0	-174.0	-207.0	-107.0	-126.0	-159.0	-58.0	-71.0	-90.0	-22.0	-27.0	-34.0	-10.0	-15.0	-22.0	-35.0		
100	120	-240.0	-180.0	-120.0	-120.0	-72.0	-72.0	-72.0	-36.0	-36.0	-36.0	-12.0	-12.0	-12.0	0.0	0.0	0.0	0.0		
		-327.0	-267.0	-174.0	-207.0	-107.0	-126.0	-159.0	-58.0	-71.0	-90.0	-22.0	-27.0	-34.0	-10.0	-15.0	-22.0	-35.0		
120	140	-260.0	-200.0	-145.0	-145.0	-85.0	-85.0	-85.0	-43.0	-43.0	-43.0	-14.0	-14.0	-14.0	0.0	0.0	0.0	0.0		
		-360.0	-300.0	-208.0	-245.0	-125.0	-148.0	-185.0	-68.0	-83.0	-106.0	-26.0	-32.0	-39.0	-12.0	-18.0	-25.0	-40.0		
140	160	-280.0	-210.0	-145.0	-145.0	-85.0	-85.0	-85.0	-43.0	-43.0	-43.0	-14.0	-14.0	-14.0	0.0	0.0	0.0	0.0		
		-380.0	-310.0	-208.0	-245.0	-125.0	-148.0	-185.0	-68.0	-83.0	-106.0	-26.0	-32.0	-39.0	-12.0	-18.0	-25.0	-40.0		
160	180	-310.0	-230.0	-145.0	-145.0	-85.0	-85.0	-85.0	-43.0	-43.0	-43.0	-14.0	-14.0	-14.0	0.0	0.0	0.0	0.0		
		-410.0	-330.0	-208.0	-245.0	-125.0	-148.0	-185.0	-68.0	-83.0	-106.0	-26.0	-32.0	-39.0	-12.0	-18.0	-25.0	-40.0		
180	200	-340.0	-240.0	-170.0	-170.0	-100.0	-100.0	-100.0	-50.0	-50.0	-50.0	-15.0	-15.0	-15.0	0.0	0.0	0.0	0.0		
		-455.0	-355.0	-242.0	-285.0	-146.0	-172.0	-215.0	-79.0	-96.0	-122.0	-29.0	-35.0	-44.0	-14.0	-20.0	-29.0	-46.0		
200	225	-380.0	-260.0	-170.0	-170.0	-100.0	-100.0	-100.0	-50.0	-50.0	-50.0	-15.0	-15.0	-15.0	0.0	0.0	0.0	0.0		
		-495.0	-375.0	-242.0	-285.0	-146.0	-172.0	-215.0	-79.0	-96.0	-122.0	-29.0	-35.0	-44.0	-14.0	-20.0	-29.0	-46.0		
225	250	-440.0	-280.0	-170.0	-170.0	-100.0	-100.0	-100.0	-50.0	-50.0	-50.0	-15.0	-15.0	-15.0	0.0	0.0	0.0	0.0		
		-535.0	-395.0	-242.0	-285.0	-146.0	-172.0	-215.0	-79.0	-96.0	-122.0	-29.0	-35.0	-44.0	-14.0	-20.0	-29.0	-46.0		
250	280	-480.0	-300.0	-190.0	-190.0	-110.0	-110.0	-110.0	-56.0	-56.0	-56.0	-17.0	-17.0	-17.0	0.0	0.0	0.0	0.0		
		-610.0	-430.0	-271.0	-320.0	-162.0	-191.0	-240.0	-88.0	-108.0	-132.0	-33.0	-40.0	-49.0	-16.0	-23.0	-32.0	-52.0		
280	315	-540.0	-330.0	-190.0	-190.0	-110.0	-110.0	-110.0	-56.0	-56.0	-56.0	-17.0	-17.0	-17.0	0.0	0.0	0.0	0.0		
		-670.0	-460.0	-271.0	-320.0	-162.0	-191.0	-240.0	-88.0	-108.0	-132.0	-33.0	-40.0	-49.0	-16.0	-23.0	-32.0	-52.0		
315	355	-600.0	-360.0	-210.0	-210.0	-125.0	-125.0	-125.0	-62.0	-62.0	-62.0	-18.0	-18.0	-18.0	0.0	0.0	0.0	0.0		
		-740.0	-500.0	-299.0	-350.0	-182.0	-214.0	-265.0	-98.0	-119.0	-151.0	-36.0	-43.0	-54.0	-18.0	-25.0	-36.0	-57.0		
355	400	-680.0	-400.0	-210.0	-210.0	-125.0	-125.0	-125.0	-62.0	-62.0	-62.0	-18.0	-18.0	-18.0	0.0	0.0	0.0	0.0		
		-820.0	-540.0	-299.0	-350.0	-182.0	-214.0	-265.0	-98.0	-119.0	-151.0	-36.0	-43.0	-54.0	-18.0	-25.0	-36.0	-57.0		
400	450	-760.0	-440.0	-230.0	-230.0	-135.0	-135.0	-135.0	-68.0	-68.0	-68.0	-20.0	-20.0	-20.0	0.0	0.0	0.0	0.0		
		-915.0	-595.0	-327.0	-385.0	-198.0	-232.0	-290.0	-108.0	-131.0	-165.0	-40.0	-47.0	-60.0	-20.0	-27.0	-40.0	-63.0		
450	500	-840.0	-480.0	-230.0	-230.0	-135.0	-135.0	-135.0	-68.0	-68.0	-68.0	-20.0	-20.0	-20.0	0.0	0.0	0.0	0.0		
		-995.0	-635.0	-327.0	-385.0	-198.0	-232.0	-290.0	-108.0	-131.0	-165.0	-40.0	-47.0	-60.0	-20.0	-27.0	-40.0	-63.0		

Size(mm)		h		js				k			m			n	p	r	s	t	u	x	
Over	below	h8	h9	js4	js5	js6	js7	k4	k5	k6	m4	m5	m6	n6	p6	r6	s6	t6	u6	x6	
0	3	0.0	0.0	1.5	2.0	3.0	5.0	3.0	4.0	6.0	5.0	6.0	8.0	10.0	12.0	16.0	20.0	•	24.0	26.0	
		-14.0	-25.0	-1.5	-2.0	-3.0	-5.0	0.0	0.0	0.0	2.0	2.0	2.0	4.0	6.0	10.0	14.0	14.0	•	18.0	20.0
3	6	0.0	0.0	2.0	2.5	4.0	6.0	5.0	6.0	9.0	8.0	9.0	12.0	16.0	20.0	23.0	27.0	•	31.0	36.0	
		-18.0	-30.0	-2.0	-2.5	-4.0	-6.0	1.0	1.0	1.0	4.0	4.0	4.0	8.0	12.0	15.0	19.0	19.0	•	23.0	28.0
6	10	0.0	0.0	2.0	3.0	4.5	7.5	6.0	7.0	10.0	10.0	12.0	15.0	19.0	24.0	28.0	32.0	•	37.0	43.0	
		-22.0	-36.0	-2.0	-3.0	-4.5	-7.5	1.0	1.0	1.0	6.0	6.0	6.0	10.0	15.0	19.0	23.0	23.0	•	28.0	34.0
10	14	0.0	0.0	2.5	4.0	5.5	9.0	6.0	9.0	12.0	12.0	15.0	18.0	23.0	29.0	34.0	39.0	•	44.0	51.0	
		-27.0	-43.0	-2.5	-4.0	-5.5	-9.0	1.0	1.0	1.0	7.0	7.0	7.0	12.0	18.0	23.0	28.0	28.0	•	33.0	40.0
14	18	0.0	0.0	2.5	4.0	5.5	9.0	6.0	9.0	12.0	12.0	15.0	18.0	23.0	29.0	34.0	39.0	•	44.0	56.0	
		-27.0	-43.0	-2.5	-4.0	-5.5	-9.0	1.0	1.0	1.0	7.0	7.0	7.0	12.0	18.0	23.0	28.0	28.0	•	33.0	45.0
18	24	0.0	0.0	3.0	4.5	6.5	10.5	8.0	11.0	15.0	14.0	17.0	21.0	28.0	35.0	41.0	48.0	•	54.0	67.0	
		-33.0	-52.0	-3.0	-4.5	-6.5	-10.5	2.0	2.0	2.0	8.0	8.0	8.0	15.0	22.0	28.0	35.0	35.0	•	41.0	54.0
24	30	0.0	0.0	3.0	4.5	6.5	10.5	8.0	11.0	15.0	14.0	17.0	21.0	28.0	35.0	41.0	48.0	54.0	•	61.0	77.0
		-33.0	-52.0	-3.0	-4.5	-6.5	-10.5	2.0	2.0	2.0	8.0	8.0	8.0	15.0	22.0	28.0	35.0	41.0	48.0	48.0	64.0
30	40	0.0	0.0	3.5	5.5	8.0	12.5	9.0	13.0	18.0	16.0	20.0	25.0	33.0	42.0	50.0	59.0	64.0	75.0	•	
		-39.0	-																		

Application

Plastic Injection Molding Machines



Power Plants



Press Dies and Molds



Construction Machinery



Hydraulic Press Machines



Steel Production Facilities

