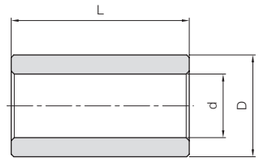
Sintered Metal Bushings

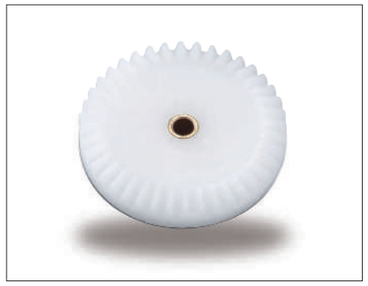
When using the injection molded bevel gear as an idler gear and a shaft diameter smaller than the inside diameter of the molded gear, please press fit one of the following standard bushings.



Catalog Number	Inner dia. $d^{+0.02}_{0}$	Outside dia. $D^{+0.02}_{-0.01}$	Length $L^{0}_{-0.3}$	Gear example
BB30507	3	5	7	DM0.8
BB30608	3	6	8	DM1
BB40609	4	6	9	DM1
BB50814	5	8	14	DM1.5

Material: Oil-free copper alloy

T8



Bevel Gears

MHP High-Ratio Hypoid Gears	MBSG Ground Spiral Bevel Gears	SBSG Ground Spiral Bevel Gears	MBSA/MBSB Finished Bore Spiral Bevel Gears	SBS Spiral Bevel Gears	SB Bevel Gears	SBY Bevel Gears
Gear Ratio 15~60	Gear Ratio 2	Gear Ratio 1.5~3	Gear Ratio 1.5~3	Gear Ratio 1.5~4	Gear Ratio 1.5~4	Gear Ratio 2~4
Material: SCM415	Material: SCM415	Material: S45C	Material: SCM415	Material: S45C	Material: S45C	Material: S45C
*m*1, 1.5 Page 342	*m*2~4 Page 346	*m*2~4 Page 348	*m*2~6 Page 350	*m*1~5 Page 354	*m*1~6 Page 358	*m*5~8 Page 358

SB Steel Bevel Gears & Pinion Shafts	SUB Stainless Steel Bevel Gears	PB Plastic Bevel Gears	DB Injection Molded Bevel Gears	BB Sintered Metal Bushings	Nissei KSP Ground Spiral Bevel Gears
Gear Ratio 5	Gear Ratio 1.5~3	Gear Ratio 1.5~3	Gear Ratio 2		Gear Ratio 1~2
Material: S45C	Material: SUS303	Material: MC901	Material: Duracon (R) (M90-44)	Material: Oil-free copper alloy	Material: SCM415
*m*1.5~3 Page 362	*m*1.5~3 Page 364	*m*1~3 Page 366	*m*0.5~1 Page 368	*φ*5~6 Page 368	*m*1.5~6 Page 370

Catalog Number of KHK Stock Gears

The Catalog Number for KHK stock gears is based on the simple formula listed below. Please order KHK gears by specifying the Catalog Numbers.

(Example) Bevel Gears

M BS G 2 - 40 20 R

- R: Direction of Helix (Right)
- 20: No. of teeth of mating gears (20)
- 40: No. of Teeth (40)
- 2: Module (2)
- G: Other Products (Ground Gears)
- BS: Type (Spiral Bevel Gears)
- M: Material (SCM415)

Material	
S	S45C
M	SCM415
SU	Stainless Steel
P	MC901
D	Polyacetal

Type	
B	Straight Bevel Gears
BS	Spiral Bevel Gears
HP	High-Ratio Hypoid Gears

Other Information	
G	Ground Gears

Product Precautions → Page 306

Features

KHK stock bevel gears are available in two types, spiral bevel gears and straight bevel gears, in gear ratios of 1.5 through 5, and are offered in a large variety of modules, numbers of teeth, materials and styles. The following table lists the main features for easy selection.

Type	Catalog Number	Module	Gear Ratio	Material	Heat Treatment	Tooth Surface Finish	Precision JIS B 1704: 1978	Secondary Operations	Features
Hypoid Gear	**MHP**	1, 1.5	15~60	SCM415	Carburized Note 1	Cut	3	△	Hypoid gears that have been tempered and hardened that are capable of rapid deceleration.
Spiral Bevel Gears	**MBSG**	2~4	2	SCM415	Carburized Note 1	Ground	1	△	Gears that have been hardened and ground that has excellent accuracy, strength and abrasion resistance. Secondary operations are possible except for the teeth.
	SBSG	2~4	1.5~3	S45C	Gear teeth induction hardened	Ground	2	△	Gears that has been hardened and ground with a good balance of accuracy, wear resistance and cost. Secondary operations are possible except for the teeth.
	KSP	1.5~6	1~2	SCM415	Carburized Note 1	Ground	0	△	Gears that have been hardened and ground that has grade-0 accuracy, strength, abrasion resistance and quietness. Secondary operations can be given except for the teeth.
	MBSA/MBSB	2~6	1.5~3	SCM415	Carburized	Cut	4	×	Gears that have been fully hardened that have excellent strength and wear resistance. Can be used in the finished shape.
	SBS	1~5	1.5~4	S45C	Gear teeth induction hardened	Cut	4	△	Gears that have been hardened with excellent wear resistance. Secondary operations are possible except for the teeth.
Straight Bevel Gears	**SB/SBY**	1~8	1.5~5	S45C	—	Cut	3	○	Many lineups are available at a low price. The teeth can be additionally hardened.
	SUB	1.5~3	1.5~3	SUS303	—	Cut	3	○	Stainless steel gears with rust resistance.
	PB	1~3	1.5~3	MC901	—	Cut	4	○	Nylon gears can be used with no lubrication.
	DB	0.5~1	2	Duracon (R) (M90-44) NOTE 2	—	Injection Molded	6	△	Low-priced gears made through injection molding. Suitable for light loads.

○ Possible △ Partly possible × Not possible

[NOTE 1] Although these are carburized products, secondary operations can be performed as the bore and the hub portions are masked during the carburization.
However, note that high hardness (HRC40 at maximum) occurs in some cases.

[NOTE 2] "Duracon (R)" is a registered trademark of Polyplastics Co., Ltd. in Japan as well as other countries.

Application Examples

KHK stock bevel gears are used as gears for power transmission of intersecting axes in various devices.

■ Differential Gear Mechanism Example

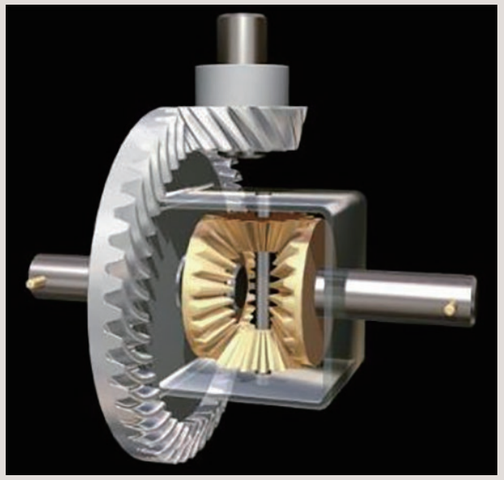


Image provided by: PK Design

■ SHESCO 2WD Bike

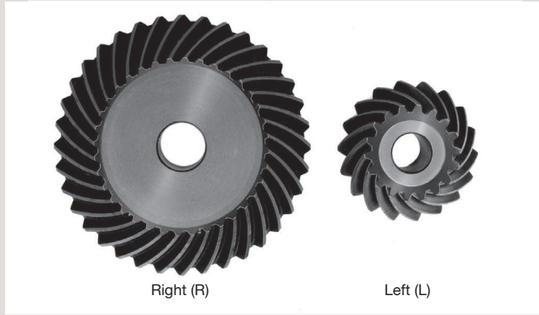
SB Bevel Gears are used in the driving components in both the front and rear wheels

Selection Hints

Please select the most suitable products by carefully considering the characteristics of items and contents of the product tables. It is also important to read all applicable "CAUTION" notes shown below before the final selection.

1. Caution in Selecting the Mating Gears

Basically, KHK stock bevel gears should be selected as shown in the catalog in pairs (e.g. MBSG2-4020R should mate with MBSG2-2040L). But, for straight tooth bevel gears, there is some interchangeability with different series. For plastic bevel gears, we recommend metal mating gears for good heat conductivity.



■ Selection Chart for Straight Bevel Gears (○ Allowable × Not allowable)

Pinion \ Gears	SB SBY	SUB	PB	DB
SB·SBY	○	○	○	×
SUB	○	○	○	×
PB	○	○	○	×
DB	×	×	×	○

■ Selection Chart for Spiral Bevel Gears (○ Allowable × Not allowable)

Pinion \ Gears	MBSG	SBSG	MBSA MBSB	SBS
MBSG	○	×	×	×
SBSG	×	○	×	×
MBSA/MBSB	×	×	○	×
SBS	×	×	×	○

2. Caution in Selecting Gears Based on Gear Strength

The gear strength values shown in the product pages were computed by assuming the application environment in the table below. Therefore, they should be used as reference only. We recommend that each user computes their own values by applying the actual usage conditions.

■ Calculation of Bending Strength of Gears

Item \ Catalog Number	MBSG MBSA MBSB	SBSG/SBS	SB NOTE 2 SBY	SUB	PB	DB
Formula NOTE 1	Formula of bevel gears on bending strength (JGMA403-01)				The Lewis formula	
No. of teeth of mating gears	No. of teeth of the mating gear of the set				—	
Rotational Speed of Pinion	100rpm (600rpm for MBSG and SBSG)				100rpm	
Design Life (Durability)	Over 10^7 cycles				—	
Impact from motor	Uniform load				Allowable bending stress (kgf/mm²)	
Impact from load	Uniform load				1.15 (40°C with No Lubrication)	*m* 0.5 4.0 *m* 0.8 4.0 *m* 1.0 3.5 (40°C with Grease Lubrication)
Direction of load	Bidirectional load (calculated with allowable bending stress of 2/3)					
Allowable bending stress at root σ_{Flim} (kgf/mm²)	47	21	19 (24.5)	10.5		
Safety factor K_R	1.2					

■ Calculation of Surface Durability (Except where it is common with bending strength)

Formula NOTE 1	Formula of bevel gears on surface durability (JGMA404-01)
Kinematic viscosity of lubricant	100cSt (50°C)
Gear support	Shafts & gear box have normal stiffness, and gears are supported on one end
Allowable Hertz stress σ_{Hlim} (kgf/mm²)	166 / 90 / 49 (62.5) / 41.3
Safety factor C_R	1.15

[NOTE 1] The gear strength formula is based on JGMA (Japanese Gear Manufacturers Association) specifications, "MC Nylon Technical Data" by Mitsubishi Chemical Advanced Materials and "Duracon (R) Gear" by Polyplastics Co. The units for the rotational speed (rpm) and the stress (kgf/mm²) are adjusted to the units needed in the formula.

[NOTE 2] Since SB Bevel Pinion Shafts are thermally refined, the allowable tooth-root bending stress and allowable hertz stress are the value shown in parentheses.

Product Precautions

Common Notes

[Caution on Product Characteristics]

(1) The allowable torque shown in the table are calculated values according to the assumed usage conditions. Please see Page 337 for more details.
(2) Dimensions of the outside diameter, the total length and crown to back length are all theoretical values, and some differences will occur due to the corner chamfering of the gear tips.
(3) These bevel gears produce axial thrust forces. Please see Page 340 for more details.
(4) Variations in temperature or humidity can cause dimensional changes in plastic gears, including tooth diameter, bore, and backlash. The accuracy and tolerances shown in the catalog are values obtained when machining is performed.
(5) Keyways are made according to JIS B1301 standards, Js9 tolerance. Also note that keyway tooth position alignment is not performed.
(6) For products having a tapped hole, a set screw is included. (excludes B7)

[Caution on Secondary Operations]

(1) Please read "Cautions on Performing Secondary Operations" (Page 340) when performing modifications and/or secondary operations for safety concerns.
(2) Due to the gear teeth being induction hardened, no secondary operations can be performed on tooth areas including the bottom land (approx. 2 to 3 mm).
(3) In the illustration, the area surrounded with ---- line is masked during the carburization process (max. HRC40 or so) and can be modified.

MHP High Ratio Hypoid Gears

[Caution on Product Characteristics]

(1) Radial and thrust load coefficients are the factors used for calculation of those loads.
As shown in the figure B8, CW and CCW stand for clockwise and counterclockwise rotation. A plus sign means that the two gears in a set move away each other when load is applied. A minus sign means that two gears in a set approach each other when load is applied.
Use gear calculation software GCSW.

MBS(A,B) Finished Bore Spiral Bevel Gears

[Caution on Product Characteristics]

(1) The keyway tolerance is the value before hardening.

[Caution on Secondary Operations]

(1) No secondary operations can be performed on these finished gears due to the applied carburizing process.

SBS Spiral Bevel Gears

[Caution on Product Characteristics]

(1) The bore may slightly vary due to the effect of heat treatment. When using with the indicated hole diameter, provide machining with a reamer or the like before use.

SB Bevel Gears

[Caution on Product Characteristics]

(1) For the handling conveniences, the BT series has the tapped holes on the holding surface. Please see Page 340 for L and tap sizes.

SBY Bevel Gears

[Caution on Product Characteristics]

(1) For the handling conveniences, the BT series has the tapped holes on the holding surface. Please see Page 340 for L and tap sizes.

PB Plastic Bevel Gears

[Caution on Product Characteristics]

(1) To reduce heat generation, it is recommended to mate them with steel gears.

DB Injection Molded Bevel Gears

[Caution on Product Characteristics]

(1) The bore tolerance is -0.05 to -0.30, but it may be slightly higher at the center of the hole.
(2) For the dimensional accuracy of each part, see the dimensional tolerance of molded items on Page 369.

[Caution on Secondary Operations]

(1) As it is a molded item, bubbles may form inside the material. Avoid performing secondary operations.

KSP_U Nissei Ground Spiral Bevel Gears

[Caution on Product Characteristics]

(1) The allowable torque is the value at RPM 600. For other data, see the Transmission Capacity Table.

Application Hints

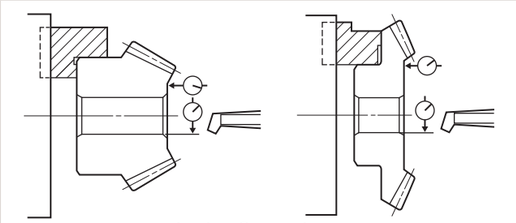
In order to use KHK stock bevel gears safely, carefully read the Application Hints before proceeding.
If there are questions or you require clarifications, please contact our technical department or your nearest distributor.
E-mail: info@khkgears.net

1. Cautions on Handling

① KHK products are packaged one by one to prevent scratches and dents, but if you find issues such as rust, scratches, or dents when the product is removed from the box after purchase, please contact the supplier.
② Depending on the handling method, the product may become deformed or damaged. Plastic gears and ring gears deform particularly easily, so please handle with care.

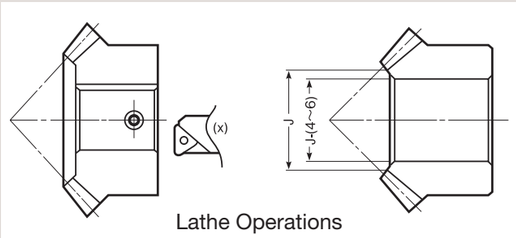
2. Caution on Performing Secondary Operations

① If reboring, it is important to pay special attention to locating the center in order to avoid runout.
② The reference datum for gear machining is the bore. Therefore, use the bore for locating the center. If it is too difficult to do for small bores, the alternative is to use one spot on the bore and the runout of the side surface.
③ If reworking using scroll chucks, we recommend the use of new or rebored jaws for improved precision. Please exercise caution not to crush the teeth.



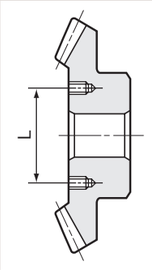
Lathe Operations

④ For items with induction hardened teeth, the hardness is high near the tooth root. When machining the front face, the machined area should be 4 to 6mm smaller than the holding surface diameter dimensions.



Lathe Operations

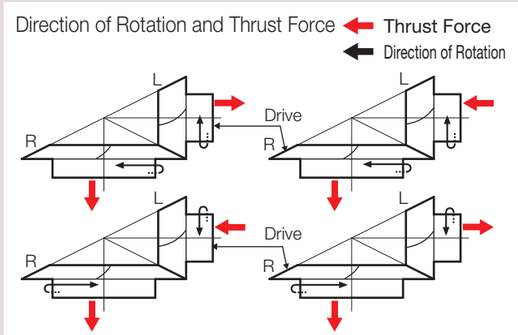
⑤ For tapping and keyway operations, see the examples given in "Caution on Performing Secondary Operations" in KHK Stock Spur Gear section. When cutting keyways, to avoid stress concentration, always round the corners.
⑥ PB plastic bevel gears are susceptible to changes due to temperature and humidity. Dimensions may change between, during, and after re-machining operations.
⑦ When induction-hardening S45C products, thermal stress cracks may appear. Also, note that the precision grade of the product declines by 1 or 2 grades, as deformation on material may occur. If you require tolerance for bore or other parts, machining is necessary after heat treatment.
⑧ For the handling conveniences, the SB and SBY series listed below have the tapped holes (180° apart, 2 places) on the holding surface. We appreciate your understanding.
Please pay attention to the machining position.



Catalog Number	L(mm)	Tap Size
SB6-4515	130	M10 deep 20
SBY8-4020	160	M10 deep 20
SBY8-4515	210	M10 deep 20
SBY5-6015	160	M10 deep 20
SBY6-6015	220	M10 deep 20

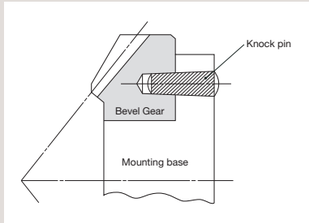
3. Points of Caution during Assembly

① Since bevel gears are cone shaped, they produce axial thrust forces. Especially for spiral bevel gears, the directions of thrust change with the hand of helix and the direction of rotation. This is illustrated below. The bearings must be selected properly to be able to handle these thrust forces. For details, use gear calculation software GCSW.



[NOTE] Bevel gears with the gear ratio 1.57 or less, produce a thrust force which is the same as miter gears. For details, please see Page 308.

② If a gear is mounted on a shaft far from the bearings, the shaft may bend. We recommend designing bevel gears to be as close to the bearings as possible. Design the gear box, shaft and bearing with high rigidity.
③ Be sure to fasten the bevel gear to prevent the gears from moving, as thrust acts on it while rotating.
④ When installing MBSA or MBSB spiral bevel gears produced in B7 style (ring gear), always secure the gears onto the mounting base with taper pins to absorb the rotational loads. It is dangerous to secure with bolts only.



⑤ The recommended assemble distance tolerance of KHK stock bevel gears is H7 for ground gears and H8 for cut gears. Mounting distance error, offset error and shaft angle error must be minimized to avoid excessive noise and wear. Inaccurate assembly will lead to irregular noises and uneven wear. Various conditions of tooth contact are shown below.
Also, when changing the normal direction backlash, adjust the mounting distance according to the amount of axial movement shown in the table below so as not to change the tooth contact.

Gear Ratio (Reduction Ratio)	Normal direction backlash	Travel in axial direction	
		Pinion	Gears
1.5	j_n	$0.81\times j_n$	$1.22\times j_n$
2		$0.65\times j_n$	$1.31\times j_n$
2.5		$0.54\times j_n$	$1.36\times j_n$
3		$0.46\times j_n$	$1.39\times j_n$
4		$0.35\times j_n$	$1.42\times j_n$
5		$0.29\times j_n$	$1.43\times j_n$
15 or more		$1.4\times j_n \div$ Gear Ratio	$1.4\times j_n$

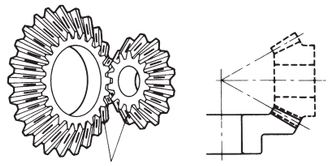
4. Cautions on Starting

① Check the following items before starting.
- Are the gears fastened securely?
- Is there uneven tooth contact?
- Is there adequate backlash?
  (Be sure to avoid zero-backlash.)
- Has proper lubrication been supplied?

② If gears are exposed, be sure to attach a safety cover to ensure safety. Also, be careful not to touch rotating gears.
③ If there is any abnormality such as noise or vibration during startup, stop the operation immediately and check the assembly condition such as tooth contact, eccentricity and looseness.

Correct Tooth Contact

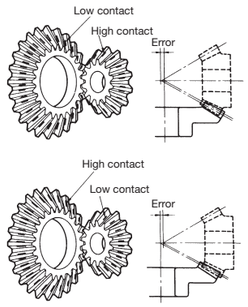
● When assembled correctly, the contact will occur on both gears in the middle of the flank and center of face width but somewhat closer to the toe.



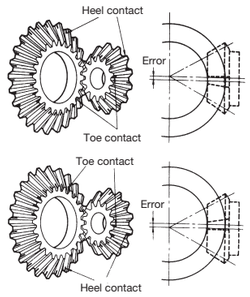
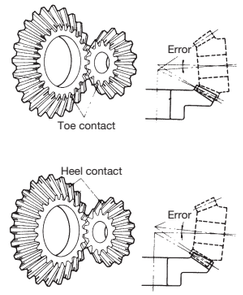
Center contact closer to toes

Incorrect Tooth Contact

■ Mounting Distance Error
● When the mounting distance of the pinion is incorrect, the contact will occur too high on the flank on one gear and too low on the other.



■ Offset Error
● When the pinion shaft is offset, the contact surface is near the toe of one gear and near the heel of the other.



■ Shaft Angle Error
● When there is an angular error of shafts, the gears will contact at the toes or heels depending on whether the angle is greater or less than 90°.