



Bevel Gears

MHP High-Ratio Hypoid Gears Gear Ratio 15 ~ 200  m1, 1.5 Page 288 RoHS   	MBSG Ground Spiral Bevel Gears Gear Ratio 2  m2 ~ 4 Page 290 RoHS   	SBSG Ground Spiral Bevel Gears Gear Ratio 1.5 ~ 3  m2 ~ 4 Page 292 RoHS    	MBSA · MBSB Finished Bore Spiral Bevel Gears Gear Ratio 1.5 ~ 3  m2 ~ 6 Page 294 RoHS  	SBS Spiral Bevel Gears Gear Ratio 1.5 ~ 4  m1 ~ 5 Page 298 RoHS   	SBZG Ground Zerol Bevel Gears Gear Ratio 1.5, 2  m2 ~ 3 Page 302 RoHS    	SB Steel Bevel Gears Gear Ratio 1.5 ~ 4  m1.5 ~ 6 Page 304 RoHS   
SBY Steel Bevel Gears Gear Ratio 2 ~ 4  m5 ~ 8 Page 304 RoHS  	SB Steel Bevel Gears & Pinion Shafts Gear Ratio 5  m1.5 ~ 3 Page 308 RoHS   	SUB Stainless Steel Bevel Gears Gear Ratio 1.5 ~ 3  m1.5 ~ 3 Page 310 RoHS  	PB Plastic Bevel Gears Gear Ratio 1.5 ~ 3  m1 ~ 3 Page 312 RoHS  	DB Injection Molded Bevel gears Gear Ratio 2  m0.5 ~ 1 Page 314 RoHS   	BB Sintered Metal Bushings  φ5 ~ 8 Page 314 RoHS  	Nissei KSP Ground Spiral Bevel Gears Gear Ratio 1.5 ~ 2  m2 ~ 5 Page 320 RoHS   

Spur Gears

Helical Gears

Internal Gears

Racks

CP Racks & Pinions

Miter Gears

Bevel Gears

Screw Gears

Worm Gear Pair

Bevel Gearboxes

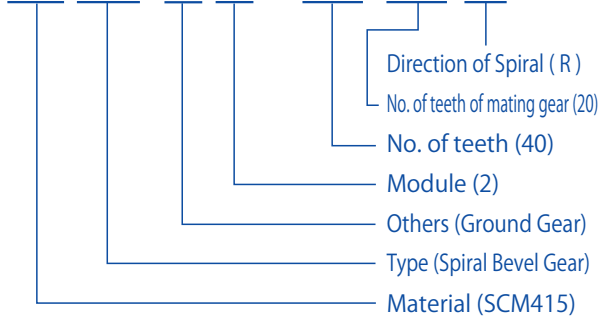
Other Products

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 B S G 2 - 40 20 R



Material

S	S45C
M	SCM415
SU	SUS303
P	MC901
D	DURACON











Type

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

Other Information

G	Ground Gears
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Feature Icons

 RoHS Compliant Product	 Finished Product	 Ground Gear	 Resin Product	 Injection Molded Product
 Re-machinable Product	 Heat Treated Product	 Stainless Product	 Copper Alloy Product	 Black Oxide coated Product



Bevel Gears

Characteristics



KHK stock bevel gears are available in two types, spiral and straight tooth, 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 No.	Module	Gear Ratio	Material	Heat Treatment	Tooth Surface Finish	Precision JIS B 1704 : 1978	Secondary Operations	Features
Hypoid Gear	MHP	1 ~ 1.5	15 ~ 200	SCM415	Carburized Note 1	Cut	3	△	High speed reduction ratio, high efficiency, high rigidity and compact gear assembly.
Spiral bevel gears	MBSG	2 ~ 4	2	SCM415	Carburized Note 1	Ground	1	△	High strength, abrasion-resistant and compact for high-speed & torque use.
	SBSG	2 ~ 4	1.5 ~ 3	S45C	Gear teeth induction hardened	Ground	2	△	Reasonably priced ground gear, yet remachinable except for the gear teeth.
	KSP F type	1.5 ~ 5	20 ~ 30	SCM415	Carburized	Ground	0	×	Superior performance with regard to high speed, low noise, and low vibration.
	KSP U type				Carburized Note 1			△	
	MBSA · MBSB	2 ~ 6	1.5 ~ 3	SCM415	Carburized	Cut	4	×	Ready to use without performing secondary operations. Strong and abrasion resistant.
SBS	1 ~ 5	1.5 ~ 4	S45C	Gear teeth induction hardened	Cut	4	△	Large nos. of teeth and modules are offered in these affordable spiral bevel gears.	
Zero Lead Bevel Gears	SBZG	2 ~ 3	1.5 ~ 2	S45C	Gear teeth induction hardened	Ground	2	△	A spiral bevel gears with a helix angle less than 10°. Receives forces from the same directions straight bevel gears receive and have excellent precision.
Straight bevel gears	SB · SBY	1 ~ 8	1.5 ~ 5	S45C	—	Cut	3	○	Popular series of straight bevel gears for many uses.
	SUB	1.5 ~ 3	1.5 ~ 3	SUS303	—	Cut	3	○	Suitable for food machinery due to SUS303's rust-resistant quality.
	PB	1 ~ 3	1.5 ~ 3	MC901	—	Cut	4	○	MC nylon products are light and can be used without lubricant.
	DB	0.5 ~ 1	2	Duracon (M90-44)	—	Injection Molded	6	△	Injection molded, mass-produced productions, suitable for office machines.

(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, as a precaution, high hardness (HRC40 at maximum) occurs in some cases.

○ Possible △ Partly possible
× Not possible

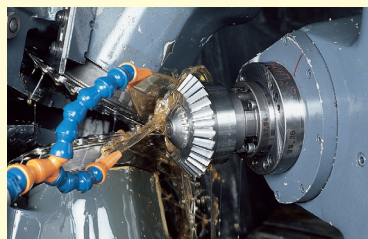
- For safe handling and to prevent damage such as deformation, KHK stock bevel gears have round chamfering at the corners, on the top surface plane of a gear tooth.

The chamfering of the corner gear tips for bevel gear

Module	Outside edge R	Inside edge R
0.5 up to 1	0.5	All burrs removed
1 up to 2.5	1	0.5
2.5 up to 5	2	1
Over 5	3	1.5

Integrated combination of cutting-edge technologies and know-how.

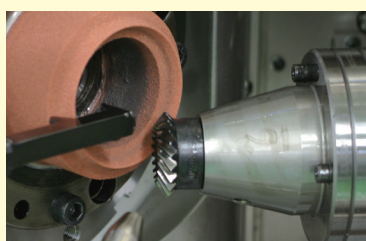
The popularity in our large selection of product lineups is established by a production system integrated with advanced manufacturing technology and know-how, achieving quality products.



Gear cutting of Straight Bevel Gears



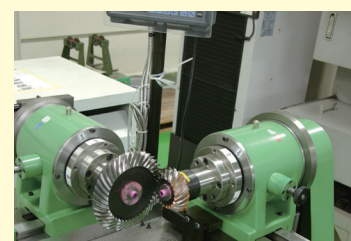
Bevel Gear Grinding Machine (Gleason PH-275HG)



Gear cutting of Spiral Bevel Gears



Bevel Gear Cutting Machine Equipments



Inspection Equipment

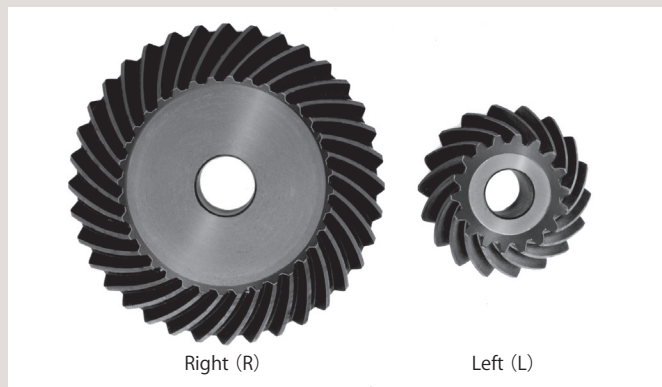
Selection Hints



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 \ Gear	SB	SUB	PB	DB
SB	○	○	○	×
SUB	○	○	○	×
PB	○	○	○	×
DB	×	×	×	○

■ Zerol Bevel Gears

SBZG products are not interchangeable with products in other series.

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

Pinion \ Gear	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 a certain application environment. Therefore, they should be used as reference only. We recommend that each user computes their own values by applying the actual usage conditions. To learn more about strength calculation, please refer to the technical information contained in the "Bending Strength of Bevel Gears" section on Page 87, and the "Surface Durability of Bevel Gears" section on Page 93.

■ Calculation assumptions for Bending Strength of Gears

Item \ Catalog No.	MBSG MBSA MBSB	SBSG SBZG SBS	SB ^{NOTE 3} SBY	SUB	PB	DB
Formula ^{NOTE 1}	Formula of bevel gears on bending strength(JGMA403-01)				The Lewis formula	
No. of teeth of mating gear	No. of teeth of the mating gear of the set				—	
Rotation	100rpm (600rpm for MBSG, SBSG and SBZG)				100rpm	
Durability	Over 10 ⁷ cycles				—	
Impact from motor	Uniform load				Allowable bending stress (kgf/mm ²)	
Impact from load	Uniform load					
Direction of load	Bidirectional					
Allowable bending stress at root σ_{flim} (kgf/mm ²) ^{NOTE 2}	47	21	19 (24.5)	10.5	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)
Safety factor K_R	1.2					

■ Calculation assumptions for Surface Durability (Except those in 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/mm ²)	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 Nippon Polyplenco Limited and "Duracon Gear Data" by Polyplastic Co. Also, the units (rpm) of number of rotations and unit (kgf/mm²) of stress are adjusted to the units needed in the formula.

(NOTE 2) The allowable bending stress at the root σ_{flim} is calculated from JGMA403-01, and set to 2/3 of the value in the consideration of the use of planetary-, idler-, or other gear systems, loaded in both directions.

(NOTE 3) Since SB Bevel Pinion Shafts are thermally refined, the allowable tooth-root bending stress and allowable hertz stress are referred to the value shown in parentheses.



Bevel Gears

Application Hints

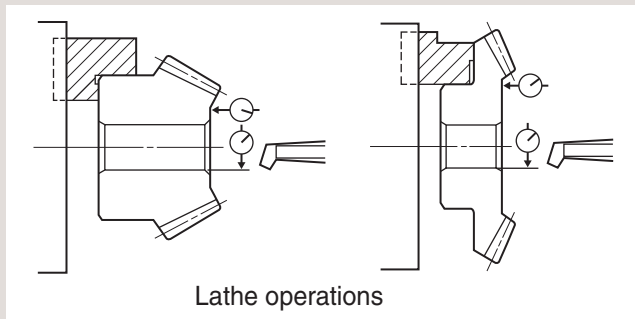


In order to use KHK stock gears safely, carefully read the Application Hints before proceeding. If there are questions or you require clarifications, please contact our technical department or your nearest distributor.

KHK USA Inc.
PHONE: 516-248-3850 FAX: 516-248-4385
E-mail info@khkgears.us

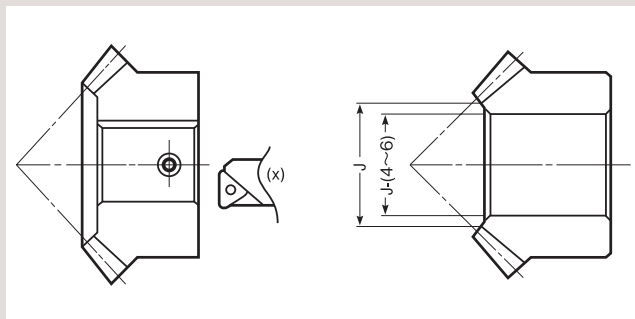
1. Caution on Performing Secondary Operations

- ① If you are re boring, it is important to pay special attention to locating the center in order to avoid runout.
- ② The reference datum for gear cutting is the bore. Therefore, it is best to 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 re bored jaws for improved precision. Please exercise caution not to crush the teeth by applying too much pressure. Any scarring will cause noise during operation.



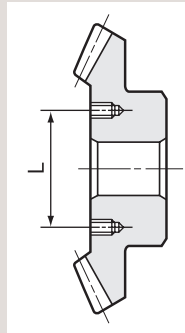
Lathe operations

- ④ For items with induction hardened teeth, such as SBSG and SBS series, the hardness is high near the tooth root. When machining the front end, the machined area should be 4 to 6mm smaller than the dimension, J.



- ⑤ For tapping and keyway operations, see the examples given in "1. Caution on Performing Secondary Operations" in KHK Stock Spur Gear section. When cutting keyways, to avoid stress concentration, always leave radii on corners.
- ⑥ PB plastic bevel gears are susceptible to changes due to temperature and humidity. Dimensions may change between during and after remachining operations.
- ⑦ When heat treating S45C products, it is possible to get thermal stress cracks. It is best to subject them to penetrant inspection afterwards. While the teeth strength may increase four fold, the precision of the gear will drop approximately one grade.

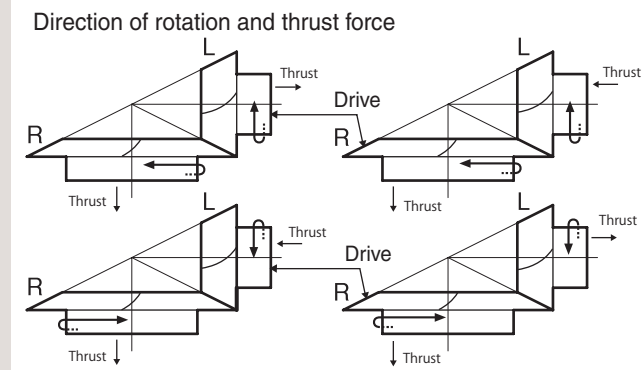
- ⑧ For the handling conveniences, the SB and SBY series listed below has the tapped holes (180° apart, 2 places) on the holding surface.



Catalog No.	L (mm)	Tap Size
SB6-4515	130	M10 deep 15
SBY8-4020	160	M10 deep 15
SBY8-4515	210	M10 deep 15
SBY5-6015	160	M10 deep 15
SBY6-6015	220	M10 deep 15

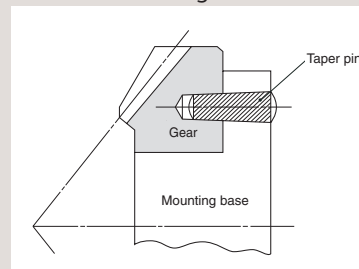
2. Points of Caution in Assembling

- ① Since bevel gears are cone shaped, they produce axial thrust forces. Especially for spiral bevel gears, the directions of thrust changes with the hand of spiral 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, please refer to separate technical reference book, section of "Gear Forces" (Page 108).



[NOTE] Bevel gears with the gear ratio 1.57 or less, produce a thrust force which has the same direction as miter gears. For details, see page 254.

- ② If a bevel gear is mounted on a shaft far from the bearings, the shaft may bend. We recommend mounting bevel gears as close to the bearings as possible. This is especially important since most bevel gears are supported on one end. The bending of shafts will cause abnormal noise and wear, and may even cause fatigue failure of the shafts. Both shafts and bearings must be designed with sufficient strength.
- ③ Due to the thrust load of bevel gears, the gears, shafts and bearings have the tendency to loosen up during operation. Bevel gears should be fastened to the shaft with keys and set screws, taper pins, step shafts, etc.
- ④ When installing MBSA or MBSB spiral bevel gears in B7 style (ring type), always secure the gears onto the mounting base with taper pins to absorb the rotational loads. It is dangerous to secure with bolts only.

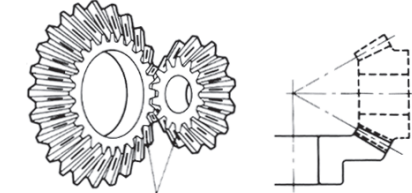


style (ring type), always secure the gears onto the mounting base with taper pins to absorb the rotational loads. It is dangerous to secure with bolts only.

⑤ KHK stock bevel gears are designed such that, when assembled according to the specified mounting distance with a tolerance of H7 - H8, the backlash shown in the table is obtained. Mounting distance error, offset error and shaft angle error must be minimized to avoid excessive noise and wear. For various conditions of teeth contact, please see the following illustrations, "Correct Tooth Contact" and "Incorrect Tooth Contact".

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.

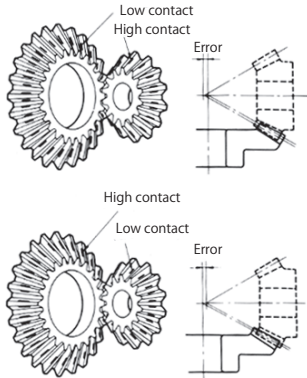


Center contact closer to toes

Incorrect Tooth Contact

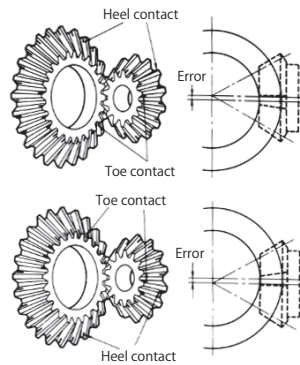
■ Mounting Distance Error

- 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.



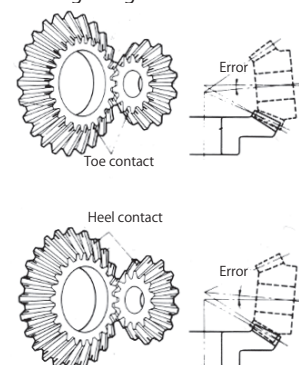
■ Offset Error

- When the pinion shaft is offset, the contact surface is near the toe of one gear and near the heel of the other.

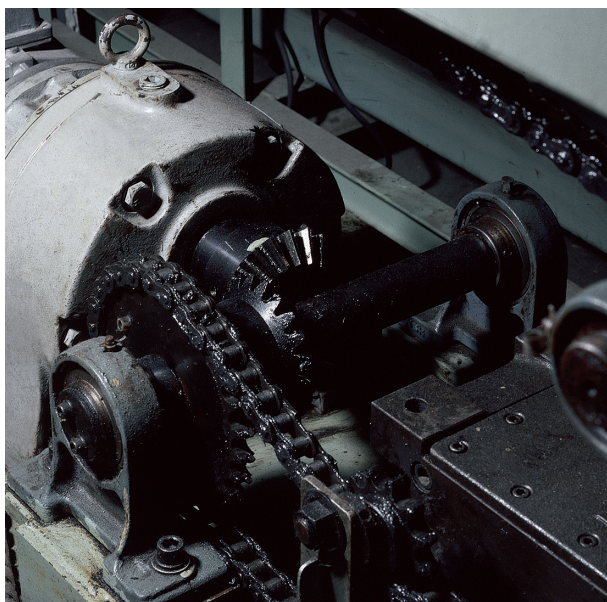


■ Shaft Angle Error

- 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°.



Application Examples



SB Bevel Gears are used in the automatic line-feeding of a machine part processing machine.



2WD Bicycle by SHESCO
SB Bevel Gears are used in the driving components in both the front and rear wheels.



Features of MHP High Ratio Hypoid Gears

A pair of MHP high-ratio hypoid gears are able to produce an amazing reduction of speed of 200:1 in one stage.

1. Total-cost reduction

The MHP provides a compact gearing body replacing several stages of reduction gears. This reduces the cost sharply.

2. High efficiency

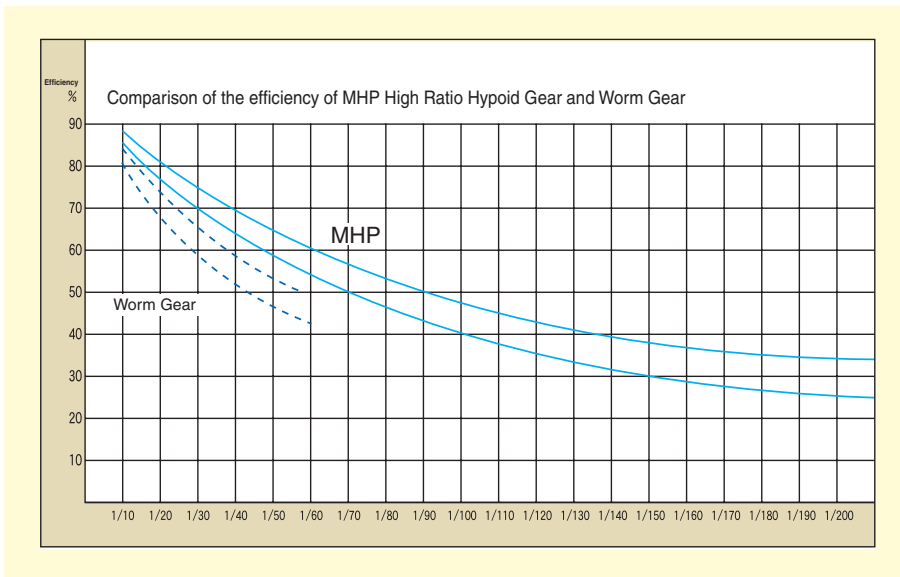
Compared to worm gear drives, the MHP has less sliding contact. The resulting higher efficiency allows the use of smaller motors (See the graph on the right).

3. High rigidity

The carburized hypoid gears lead to smaller size than comparable worms gears.

4. Compact gear assembly

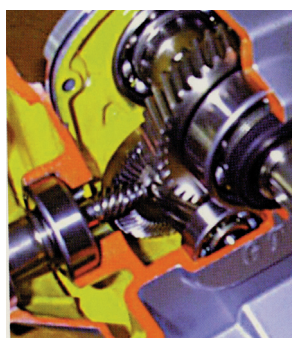
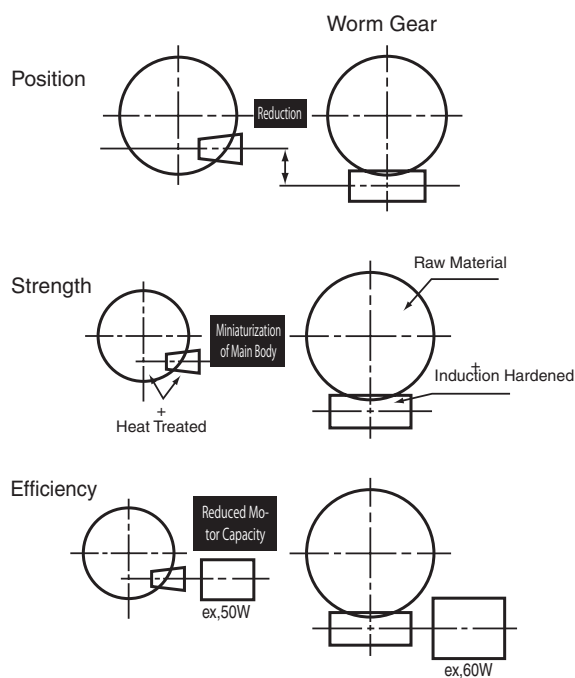
The size of the gear housing is nearly the same as outer diameter of the large gear. (See the diagrams below)



How to determine the radial and thrust loads

Before using the MHP high-ratio hypoid gears, be sure to confirm the direction of radial and thrust loads. Following equations are used to compute these loads. The radial and thrust load coefficients are given on the product pages.

Comparison of MHP and Worm Gear



Radial load calculation

W_{RP} : Radial load on the pinion or L(N)

$$W_{RP} = W_{KP} \times T_G \times \frac{n}{z}$$

W_{KP} : Radial load coefficient of pinion or L (given on the product pages)

T_G : Torque of gear or R(N·m)

n : Number of teeth of pinion or L

z : Number of teeth of gear or R

W_{RG} : Radial load on the gear or R(N)

$$W_{RG} = W_{KG} \times T_G$$

W_{KG} : Radial load coefficient of gear or R (given on the product pages)

T_G : Torque of gear or R(N·m)

Thrust load calculation

W_{XP} : Thrust load on the pinion or L(N)

$$W_{XP} = W_{NP} \times T_G \times \frac{n}{z}$$

W_{NP} : Thrust load coefficient of pinion or L (given on the product page)

T_G : Torque of gear or R(N·m)

n : Number of teeth of pinion or L

z : Number of teeth of gear or R

W_{XG} : Thrust load of gear or R(N)

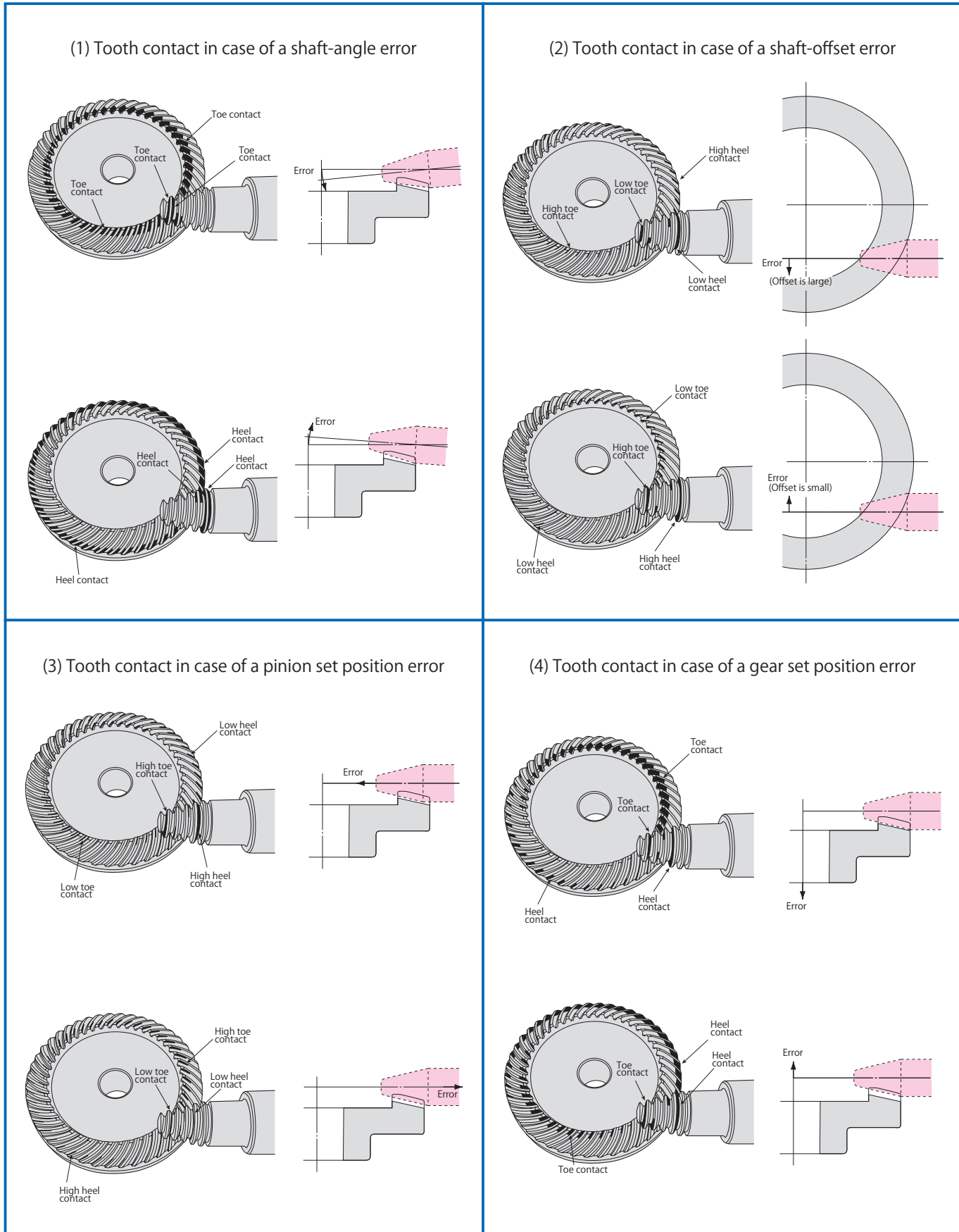
$$W_{XG} = W_{NG} \times T_G$$

W_{NG} : Thrust load coefficient of gear or R (given on the product pages)

T_G : Torque of gear or R(N·m)

Variations in tooth contact due to poor alignment of gears

If the gear engagement position is out of the normal position, variations in tooth contact, as illustrated below, may appear.



- Spur Gears
- Helical Gears
- Internal Gears
- Racks
- CP Racks & Pinions
- Miter Gears
- Bevel Gears
- Screw Gears
- Worm Gear Pair
- Bevel Gearboxes
- Other Products