MMSG
Ground Spiral Miter Gears

*m*2 ~ 4 Page 424

SMSG
Ground Spiral Miter Gears

*m*2 ~ 5 Page 426

MMSA · MMSB
Finished Bore Spiral Miter Gears

*m*1 ~ 10 Page 428

MMS
Spiral Miter Gears

Newly added

*m*2 ~ 5 Page 430

SMS
Spiral Miter Gears

*m*1 ~ 8 Page 432

SMZG
Ground Zerol Miter Gears

New

*m*2 ~ 3 Page 434

SMA · SMB · SMC
Finished Bore Miter Gears

*m*1 ~ 8 Page 436

MM
Carburized & Hardened Miter Gears

Newly added

*m*2 ~ 5 Page 438

LM
Sintered Metal Miter Gears

*m*0.8 ~ 1.5 Page 438

SM
Steel Miter Gears

*m*1 ~ 8 Page 440

SAM
Angular Miter Gears

*m*1.5 ~ 3 Page 442

SUM
Stainless Steel Miter Gears

*m*1 ~ 4 Page 444

SUMA
Finished Bore Stainless Steel Miter Gears

*m*1 ~ 4 Page 444

PM
Plastic Miter Gears

*m*1 ~ 4 Page 446

DM
Injection Molded Miter Gears

*m*0.5 ~ 1.5 Page 446

BB
Sintered Metal Bushings

ϕ5 ~ 8 Page 447

Nissei KSP
Ground Spiral Miter Gears

*m*1.5 ~ 6 Page 486

Miter Gears

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) Miter Gears

M MS G 2 - 20 R

- R — Direction of Spiral (R)
- 20 — No. of teeth (20)
- 2 — Module (2)
- G — Others (Ground Gear)
- MS — Type (Spiral Miter Gear)
- M — Material (SCM415)

Material

S	S45C
M	SCM415
SU	SUS303
L	SMF5040
P	MC901
D	DURACON

Type

M	Straight Miter Gears
MS	Spiral Miter Gears
AM	Angular Miter Gears

Other Information

G	Ground Gears

Feature Icons

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

Miter Gears

Characteristics

Miter gears are a special class of bevel gears where the shafts intersect at 90° and the gear ratio is 1:1.
KHK stock miter gears are available in two types, spiral and straight tooth, with high precision grade for demanding torques and speeds, and commercial grade for economical applications. The following table lists the main features for easy selection.

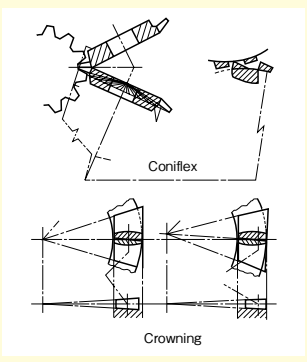
Type	Catalog No.	Module	No. of Teeth ( ) Shaft Angle	Material	Heat Treatment	Tooth Surface Finish	Precision JIS B 1704	Secondary Operations	Features
Spiral Miter Gears	**MMSG**	2 ~ 4	20、25、30	SCM415	Carburized Note 1	Ground	2	△	High strength, abrasion-resistant and compact for high speed & torque use.
	SMSG	2 ~ 5	20、25、30	S45C	Gear teeth induction hardened	Ground	2	△	Reasonably priced ground gear, yet remachinable except for the gear teeth.
	MMSA · MMSB	1 ~ 10	20	SCM415	Carburized	Cut	4	×	Ready to use without performing secondary operations. Strong and abrasion resistant.
	MMS	2 ~ 5	20、25、30	SCM415	Carburized Note 1	Cut	4	△	Only teeth are induction hardened, allowing user to perform secondary operations elsewhere.
	SMS	1 ~ 8	20、25、30	S45C	Gear teeth induction hardened	Cut	4	△	Large numbers of teeth and modules are offered in these affordable spiral miter gears.
Zerol miter gears	**SMZG**	2 ~ 3	20	S45C	Gear teeth induction hardened	Ground	2	△	A spiral miter gear with a helix angle less than 10 °. Receives forces from the same direction as straight miter gears receive and have excellent precision properties..
Straight Miter Gears	**SMA · SMB · SMC**	1 ~ 8	20、25、30	S45C	Gear teeth induction hardened	Cut	4	△	Usable without remachining, offered in 3 bore sizes.
	MM	2 ~ 5	20、25、30	SCM415	Carburized Note 1	Cut	4	△	Compared to SM miters, these are stronger and less abrasive, and allow secondary operations.
	LM	0.8 ~ 1.5	20	SMF5040 (Equiv. to S45C)	—	Sintered	5	○	Mass-produced, low cost sintered products. Small and light weight.
	SM	1 ~ 8	16、20、25、30	S45C	—	Cut	3	○	Popular straight miter for many uses.
	SAM	1.5 ~ 3	20 (45°、60°、120°)	S45C	—	Cut	3	○	3 types are available for shafts at 45°, 60° and 120°.
	SUM	1 ~ 4	20、25	SUS303	—	Cut	3	○	Suitable for food machinery due to SUS303's rust-resistant quality.
	SUMA	1 ~ 4	20、25	SUS303	—	Cut	3	△	Stainless steel products, usable without remachining.
	PM	1 ~ 4	20、25	MC901	—	Cut	4	○	MC nylon products are light and can be used without lubricant.
	DM	0.5 ~ 1.5	20	DURACON (M90-44)	—	Injection Molded	8	△	Injection molded, mass-produced products, suitable for office machines.

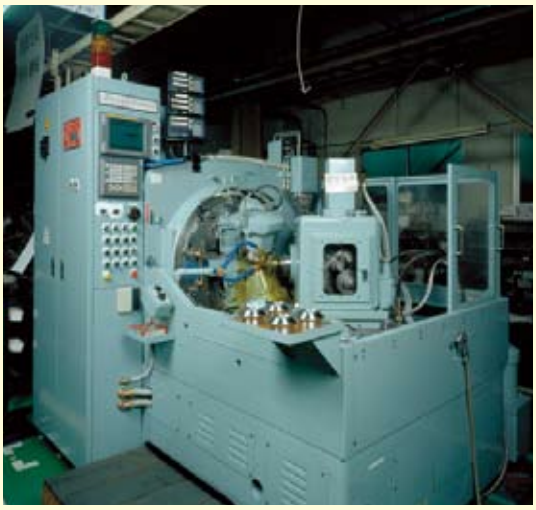
(NOTE 1) Although these are carburized products, secondary operations can be performed as the bore and the hub portions are masked during the carburization. However, as a precaution, high hardness (HRC40 at maximum) occurs in some cases.

○ Possible △ Partly Possible × Not possible

We use Crowning method for gear cutting

KHK utilizes Gleason Coniflex No.104, 102 and 114 bevel gear generating machinery, also equipped for mass production of straight miter gears. You can count on a stable supply of economically priced straight miter gears from KHK





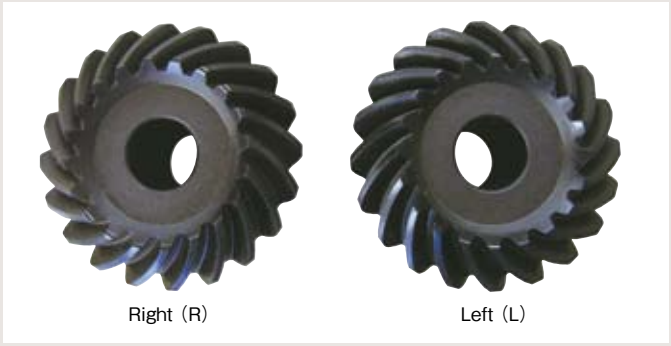
Gleason Coniflex No.104

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

Among KHK stock miter gears, there are products which are not interchangeable even when the module and the number of teeth are the same. Also, spiral miter gears require additional consideration since the right-hand mates with the left-hand spiral as shown in the table below.



Right (R) Left (L)

■ Straight Miter (○ Allowable × Not allowable)

Catalog No.	SMA SMB SMC	MM	SM	SUM	SUMA	PM	DM	LM	SAM
SMA·SMB·SMC	○	○	○	○	○	○	×	×	×
MM	○	○	○	○	○	○	×	×	×
SM	○	○	○	○	○	○	×	×	×
SUM	○	○	○	○	○	○	×	×	×
SUMA	○	○	○	○	○	○	×	×	×
PM	○	○	○	○	○	○	×	×	×
DM	×	×	×	×	×	×	○	×	×
LM	×	×	×	×	×	×	×	○	×
SAM	×	×	×	×	×	×	×	×	○

■ Spiral Miter (○ Allowable △ Allowable in certain cases × Not allowable)

Catalog No.	Series	MMSG	SMSG	MMSA MMSB	MMS	SMS
Series	Spiral hand	R	R	R	R	R
MMSG	L	○	×	×	×	×
SMSG	L	×	○	×	×	×
MMSA·MMSB	L	×	×	○	△	×
MMS	L	×	×	△	○	×
SMS	L	×	×	×	△	○

〔CAUTION〕 For selecting items in the " △ " category, please reconfirm with your nearest KHK dealer that the pair can work.

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 the strength calculations, please refer to the technical information contained in the "Bending Strength of Bevel Gears" section on page 679, and the "Surface Durability of Bevel Gears" section on page 685.

■ Calculation assumptions for Bending Strength of Gears

Item \ Catalog No.	MMSG MMSA·MMSB MMS·MM	SMSG·SMZG SMS SMA·SMB·SMC	SM SAM	SUM SUMA LM NOTE 3	PM	DM
Formula NOTE 1	Formula of bevel gears on bending strength (JGMA403-01)				The Lewis formula	
No. of teeth of mating gear	Same number of teeth				——	
Rotation	100rpm (600rpm for MMSG, SMSG and SMZG)				100rpm	
Durability	Over 10^7cycles				——	
Impact from motor	Uniform load				Allowable bending stress (kgf/mm^2)	
Impact from load	Uniform load				1.15 (40℃ with No Lubrication)	*m* 0.5 4.0 *m* 0.8 4.0 *m* 1.0 3.5 *m* 1.5 1.8 NOTE 3 (40℃ with Grease Lubrication)
Direction of load	Bidirectional					
Allowable bending stresss at root σ_{Flim}(kgf/mm^2) NOTE 2	47	21	19	10.5		
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 bending strength (JGMA404-01)			
Kinematic viscosity of lubricant	100cSt (50℃)			
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	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 Polypenco Limited and "Duracon Gear Data" by Polyplastic Co. The units for the number of rotations (rpm) and the the stress (kgf/mm^2) are adjusted to the units needed in the formula.

〔NOTE 2〕 Since the load is bidirectional, the allowable bending stress at root σ_{Flim}, used in JGMA 403-01 formula is set to 2/3 of the value.

〔NOTE 3〕 The values of the allowable bending stresses for DM m1.5 and the allowable root bending stress for LM gears are our own estimates.

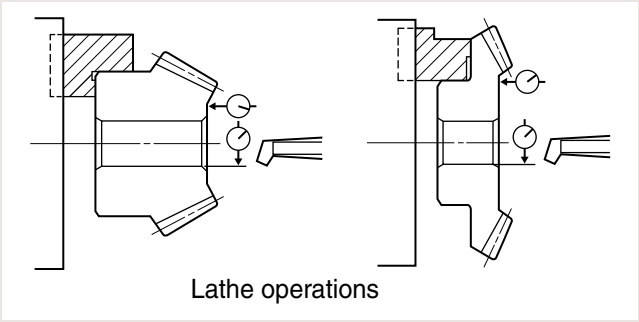
Application Hints

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 Co., Ltd.
TEL.048-254-1744 FAX.048-254-1765
E-mail export@khkgears.co.jp

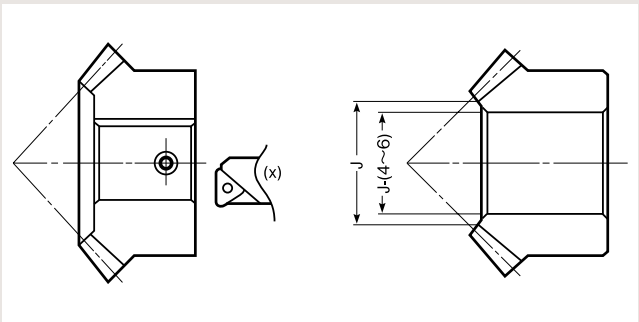
1. Caution on Performing Secondary Operations

① If you are reboring, 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 rebored 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

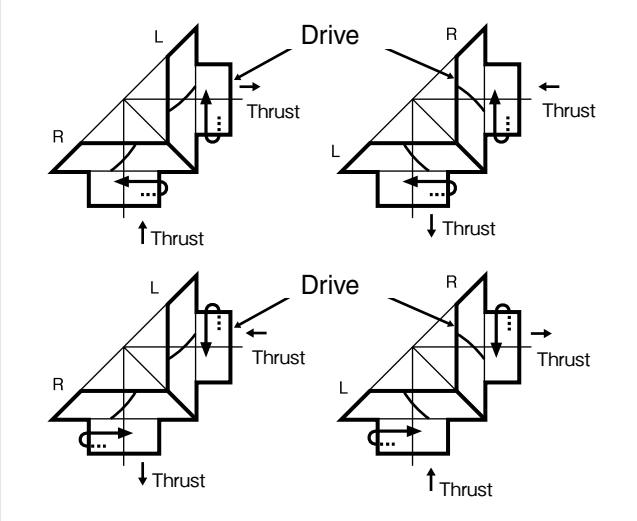
④ For items with induction hardened teeth, such as SMSG and SMS series, the hardness is high near the tooth root. When machining the front face, the machined area should be 4 to 6mm smaller than the dimension, J.



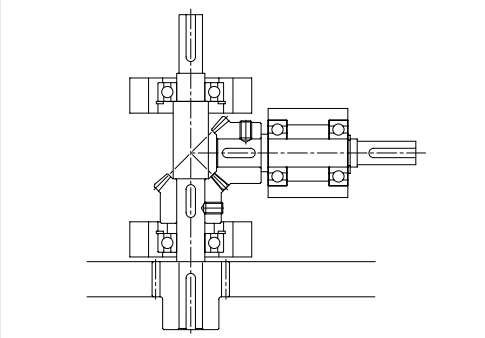
⑤ For tapping and keyway operations, see the examples given in "1. Caution on Performing Secondary Operations" in KHK Stock Spur Gear section. When cutting keyways, to avoid stress concentration, always leave radii on corners.
⑥ PM plastic miter gears are susceptible to changes due to temperature and 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. If tooth strength is not sufficient, it can be increased approximately four times by heat-treating. On the other hand, the precision of the gear will drop about one grade.

2. Points of Caution in Assembling

① Since miter gears are cone shaped, they produce axial thrust forces. Specifically with regard to spiral miter gears, the directions of thrust change 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 more technical information see the section "Gear Forces" (Page 699).

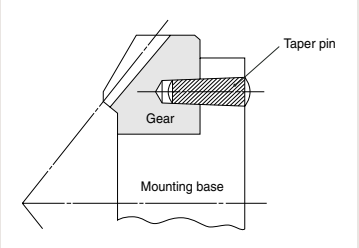


② If a miter gear is mounted on a shaft far from the bearings, the shaft may bend. We recommend mounting bevel gears as close to the bearings as possible. This is especially important since most miter gears are supported on one end. The bending of shafts will cause abnormal noise and wear, and may even cause fatigue failure of the shafts. Both shafts and bearings must be designed with sufficient strength.



Example of Assembling

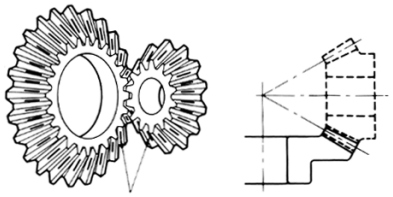
③ Due to the thrust load of miter gears, the gears, shafts and bearings have the tendency to loosen up during operation. Miter gears should be fastened to the shaft with keys and set screws, taper pins, step shafts, etc.
④ When installing MMSA or MMSB finished bore spiral miter gears in B7 style (ring 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.



⑤ KHK stock miter gears are designed such that, when assembled according to the specified mounting distance with a tolerance of H7 to H8, the backlash shown in the table are obtained. 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 teeth contact are shown below.

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.

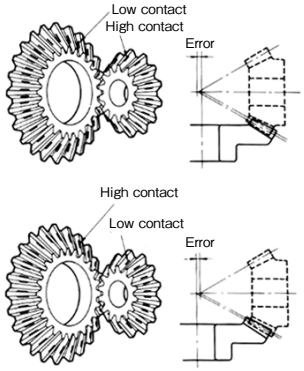


Center contact closer to toes

Incorrect Tooth Contact

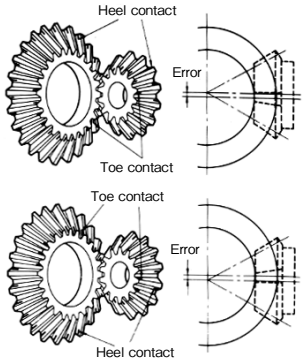
■ Mounting Distance Error

● 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.



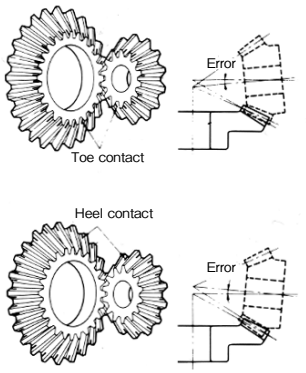
■ Offset Error

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



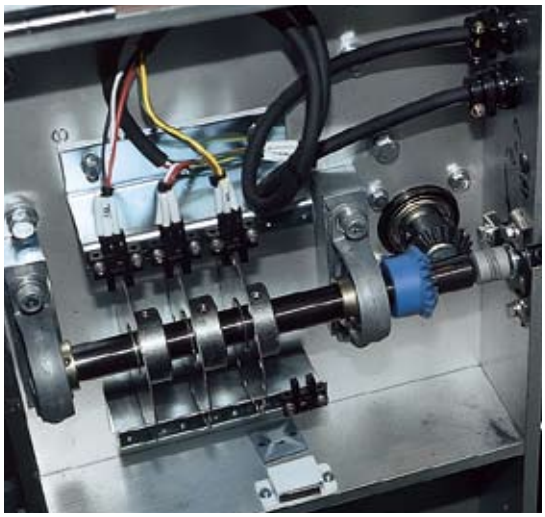
■ Shaft Angle Error

● 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

Automatic packaging machine (Miter gears - inset)



Electric components assembly line (Miter gears <SM and PM>)