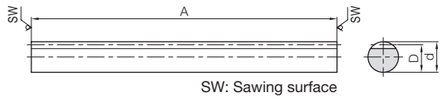
SROCP Circular pitch 2.5, 5, 10

CP Round Racks

Specifications	
Precision grade	KHK R 001 grade 4
Gear teeth	Standard full depth
Pressure angle	20°
Material	S45C
Heat treatment	—
Tooth hardness	(less than HB210)
Surface treatment	Black oxide coating



SW: Sawing surface

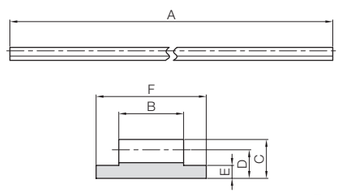
R2

Catalog Number	Pitch mm (Module)	Effective number of teeth	Shape	Total Length A	Outside dia. d_{h9}	Height to pitch line D	Allowable force (N) Bending strength	Allowable force (N) Surface durability	Allowable force (kgf) Bending strength	Allowable force (kgf) Surface durability	Backlash (mm)	Weight (kg)
SROCP2.5-500	**CP2.5**(0.7958)	200	R2	505	10	9.2	474	91.8	48.3	9.36	0.00~0.14	0.30
SROCP5-500	**CP5** (1.5915)	99		505	15	13.41	1650	324	169	33.1	0.09~0.25	0.65
SROCP10-1000	**CP10** (3.1831)	99		1010	30	26.82	6610	1300	674	132	0.14~0.35	5.16

FRCP Circular pitch 5

CP Metal Flexible Racks

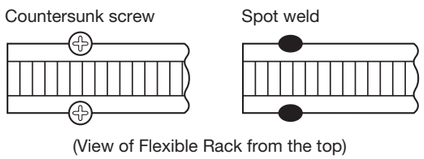
Specifications	
Precision grade	KHK R 001 grade 8
Gear teeth	Standard full depth
Pressure angle	20°
Material	SS400
Heat treatment	—
Tooth hardness	(less than 187HB)
Surface treatment	Black oxide coating



R3

Catalog Number	Pitch mm (Module)	Shape	Total Length A	Face width B	Height C	Height to pitch line D	Base thickness E	Base width F	Allowable force (N) Bending strength	Allowable force (kgf) Bending strength	Weight (kg)
FRCP5-2000	**CP5** (1.5915)	R3	2000	10	6	4.41	2	17	801	81.7	0.91
FRCP5-3000			3000								1.37
FRCP5-4000			4000								1.83

■ Installation Example of FRCP Metal Flex Rack



(View of Flexible Rack from the top)

Recommended Mating Pinions

SSCP

Please see Page 290 for more details.

Product Precautions → Page 270

Miter Gears

MMSGQ Ground Spiral Miter Gears	MMSG Ground Spiral Miter Gears	SMSG Ground Spiral Miter Gears	MMSA/MMSB Finished Bore Spiral Miter Gears	MMS Spiral Miter Gears	SMS Spiral Miter Gears	SMA/SMB/SMC Finished Bore Miter Gears
NEW J	J	J			NEW J	
						
Material: SCM415	Material: SCM415	Material: S45C	Material: SCM415	Material: SCM415	Material: S45C	Material: S45C
*m*2~4 Page 310	*m*2~4 Page 312	*m*1~5 Page 314	*m*1~10 Page 316	*m*2~5 Page 318	*m*1~8 Page 320	*m*1~8 Page 322

MM Miter Gears	LM Sintered Metal Miter Gears	SM Miter Gears	SAM Angular Miter Gears	SUM Stainless Steel Miter Gears	SUMA Finished Bore Stainless Steel Miter Gears	PM Plastic Miter Gears
NEW J		NEW J				
						
Material: SCM415	Material: SMF5040	Material: S45C	Material: S45C	Material: SUS303	Material: SUS303	Material: MC901
*m*2~5 Page 324	*m*0.8~1.5 Page 324	*m*1~8 Page 326	*m*1.5~3 Page 328	*m*1~4 Page 330	*m*1~4 Page 330	*m*1~4 Page 332

DM Injection Molded Miter Gears	BB Sintered Metal Bushings	Nissei KSP Ground Spiral Miter
Material: Duracon (R) (M90-44)	Material: Oil-free copper alloy	Material: SCM415
*m*0.5~1.5 Page 332	*φ*5~8 Page 334	*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) Miter Gears

M MS G 2 - 20 R

- R — Direction of Helix (Right)
- 20 — No. of Teeth (20)
- 2 — Module (2)
- G — Other Products (Ground Gears)
- MS — Type (Spiral Miter)
- M — Material (SCM415)

Material

S	S45C
M	SCM415
SU	Stainless Steel
L	Sintered Metal Alloy
P	MC901
D	Polyacetal

Type

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

Other Information

G,GQ	Ground Gears

Features

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, straight miter and spiral miter, 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.

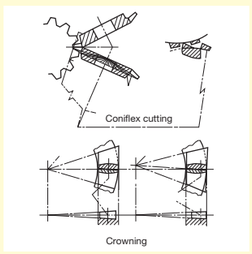
Type	Catalog Number	Module	No. of Teeth ( ) Shaft Angle	Material	Heat Treatment	Tooth Surface Finish	Precision JIS B 1704: 1978	Secondary Operations	Features
Spiral Miter Gears	**MMSGQ**	2~4	20, 30	SCM415	Carburized Note 1	Ground	0	△	Gears that have been hardened and ground that has grade-0 accuracy, strength, abrasion resistance and quietness. Secondary operations can be given except for the teeth.
	MMSG	2~4	20, 25, 30	SCM415	Carburized Note 1	Ground	1	△	Gears that have been hardened and ground that has excellent accuracy, strength and abrasion resistance. Secondary operations can be given except for the teeth.
	SMSG	1~5	20, 25, 30	S45C	Gear teeth induction hardened	Ground	2	△	Gears that have been hardened and ground that has excellent abrasion resistance. Secondary operations can be given except for the teeth.
	KSP	1.5~6	20~30	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.
	MMSA/MMSB	1~10	20	SCM415	Carburized	Cut	4	×	Gears that have been fully hardened that have excellent strength and wear resistance. Can be used in the finished shape.
	MMS	2~5	20, 25, 30	SCM415	Carburized Note 1	Cut	4	△	Gears that have been hardened that have excellent strength and wear resistance. Secondary operations are possible except for the teeth.
	SMS	1~5	20, 25, 30	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 Miter Gears	**SMA/SMB/ SMC**	1~8	20, 25, 30	S45C	Gear teeth induction hardened	Cut	4	△	Gears that have been hardened with excellent wear resistance. Can be used in the finished shape.
	MM	2~5	20, 25, 30	SCM415	Carburized Note 1	Cut	4	△	Gears that have been hardened that have excellent strength and wear resistance. Secondary operations are possible except for the teeth.
	LM	0.8~1.5	20	SMF5040 (S45C equivalent)	—	Sintered	5	○	Small gears made through sintering.
	SM	1~8	16, 20, 25, 30	S45C	—	Cut	3	○	Many lineups are available. The teeth can be additionally hardened.
	SAM	1.5~3	20 (45°, 60°, 120°)	S45C	—	Cut	3	○	3 types of angular miter are available for shafts at 45°, 60° and 120°.
	SUM	1~4	20, 25, 30	SUS303	—	Cut	3	○	Stainless steel gears with rust resistance.
	SUMA	1~4	20, 25	SUS303	—	Cut	3	△	Stainless steel gears with rust resistance. Keyways and tapping provided.
	PM	1~4	20, 25, 30	MC901	—	Cut	4	○	Nylon gears can be used with no lubrication.
	DM	0.5~1.5	20	Duracon (R) (M90-44) NOTE 2	—	Injection Molded	6	△	Low-priced gears made through injection molding. Suitable for light loads.

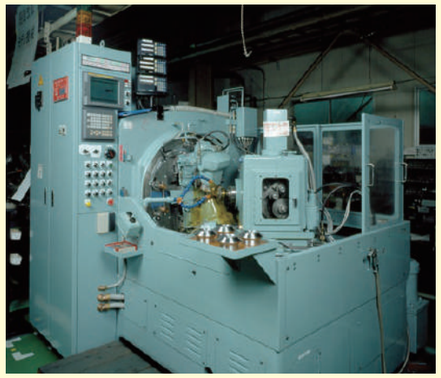
[NOTE 1] Although these are carburized products, secondary operations can be performed as the bore and the hub portions are masked during the carburization. However, note that high hardness (HRC40 at maximum) occurs in some cases.
[NOTE 2] "Duracon (R)" is a registered trademark of Polyplastics Co., Ltd. in Japan as well as other countries.

○ Possible △ Partly possible × Not possible

We use the Crowning method for gear cutting

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





Gleason Coniflex No.104

Application Examples

KHK stock bevel gears (miter gears) are adopted in driving devices for all kinds of intersecting axes, including transport devices.

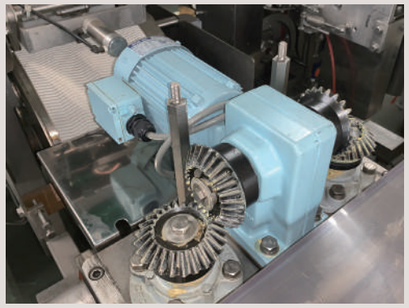
■ Masdac Dorayaki Machine

SM miter gears used for reversing fabrics

■ Carton former

SM and SMB miters used to drive X/Y axes and transmit mechanical power

■ Fish processing machine manufactured by TOYO SUISAN KIKAI CO.,LTD.



SMB miter used for filleting fish

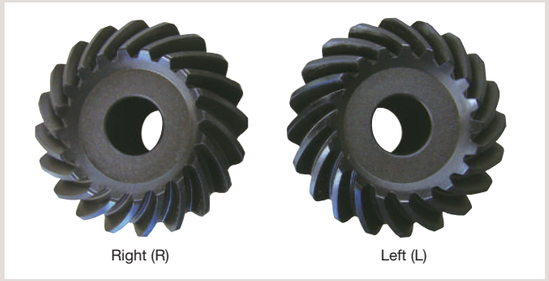
■ Angular Miter Gear Box

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 miters require additional consideration since the right-hand mates with the left-hand spiral as shown in the table below.



■ Straight Miter (○ Allowable × Not allowable)

Catalog Number	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 × Not allowable)

Catalog Number	Series	MMSGQ	MMSG	SMSG	MMSA MMSB	MMS	SMS
Series	Direction of spiral	R	R	R	R	R	R
MMSGQ	L	○	×	×	×	×	×
MMSG	L	×	○	×	×	×	×
SMSG	L	×	×	○	×	×	×
MMSA/MMSB	L	×	×	×	○	×	×
MMS	L	×	×	×	×	○	×
SMS	L	×	×	×	×	×	○

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	MMSGQ,MMSG MMSA,MMSB MMS,MM	SMSG/SMS SMA/SMB/ SMC	SM SAM	SUM SUMA LM NOTE 2	PM	DM
Formula NOTE 1	Formula of bevel gears on bending strength (JGMA403-01)				The Lewis formula	
No. of teeth of mating gears	Same no. of teeth				—	
Rotational Speed	100rpm (600rpm for MMSGQ, MMSG and SMSG)				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 *m* 1.5 1.8 NOTE 2 (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	10.5		
Safety factor K_R	1.2					

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

Item				
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	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] The values of the allowable bending stresses for DM *m*1.5 gears and the allowable root bending stress for LM gears are our own estimates.

Selecting the Gears

Step 1 Determine the calculated load torque applied to the gear and the gear type suitable for the purpose.

Step 2 Select provisionally from the allowable torque table in this catalog based on the load torque.

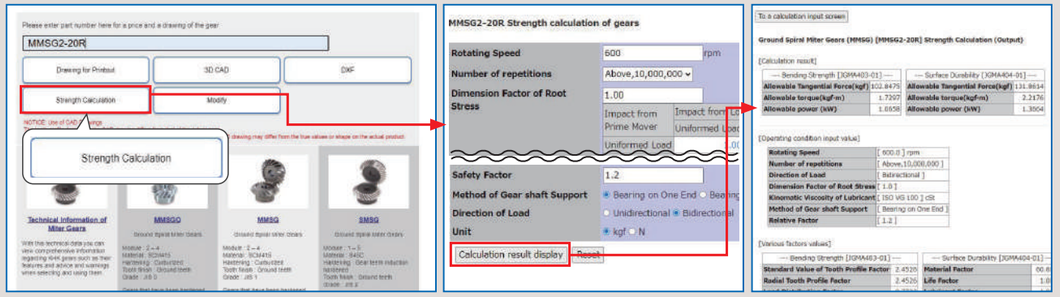
■ For provisional selection from this catalog

Catalog Number	Gear Ratio	No. of teeth	Shape	Bore A/O	B	C	D	E	F	G	H	I	J	K	Allowable torque (N·m) Bending strength	Surface durability	Allowable torque (kgf·m) Bending strength	Surface durability	Backlash (mm)
MMSG2-20R MMSG2-20L	1	20	B3	12	35	40	42.7	35	21.98	16.35	12.5	20	9	24.54	17.0	23.5	1.73	2.40	0.04~0
MMSG2.5-20R MMSG2.5-20L				14	42	50	53.2	45	28.63	21.6	16	26	11	30.89	32.7	46.1	3.33	4.70	0.05~0
MMSG3-20R MMSG3-20L				16	52	60	63.99	50	30.78	21.99	16	27	14	34.4	58.5	83.7	5.97	8.54	0.06~0
MMSG3.5-20R MMSG3.5-20L			B4	20	50	70	74.53	55	32.45	22.26	14	29	16	42.75	91.8	133	9.36	13.6	0.07~0
MMSG4-20R MMSG4-20L				20	55	80	84.99	65	39.13	27.5	17	35	18	49.08	136	199	13.8	20.3	0.09~0
MMSG2-25R MMSG2-25L	1	25	B4	12	38	50	52.5	40	23.43	16.25	11	21	11	30.89	27.5	47.0	2.80	4.79	0.04~0
MMSG2.5-25R MMSG2.5-25L				16	45	62.5	65.54	50	29.57	20.27	14	26	14	37.4	54.3	94.5	5.54	9.64	0.05~0
MMSG3-25R MMSG3-25L				20	55	75	78.78	60	35.6	24.39	17	31	17	43.92	94.5	167	9.64	17.0	0.06~0
MMSG3.5-25R MMSG3.5-25L				25	65	87.5	91.81	70	41.65	28.41	19	37	20	52.43	151	270	15.4	27.5	0.07~0
MMSG4-25R MMSG4-25L				28	75	100	104.7	80	47.8	32.35	22	42	23	58.95	216	392	22.1	40.0	0.09~0

Step 3 Calculate the strength under the actual usage conditions.

Calculate the strength formally using the various gear strength formulas. Please see our separate technical reference book for more details. We recommend using the Website that allows the strength to be easily calculated.

■ Use the strength calculation function on our website.



■ Bending strength

Calculated values of the strength at which the gear teeth do not break due to fatigue.

■ Surface durability;

Calculated values of the strength at which the gear teeth do not wear due to surface fatigue damage.

When selecting KHK standard gears, glance over the Cautions on Product Characteristics and Cautions on Performing Secondary Operations on Page 306.

① Products not listed in this catalog or materials, modules, number of teeth and the like not listed in the dimensional tables can be manufactured as custom items. Please see Page 26 for more details about custom-made orders.

② The color and shape of the product images listed on the dimension table page of each product may differ from the actual product. Be sure to confirm the shape in the dimension table before selection.

③ The details (specifications, dimensions, etc.) listed in the catalog may be changed without prior notice. Changes are announced on the KHK website.

Website URL: https://khkgears.net/new/

Overseas Sales Department: Phone: +81-48-254-1744 Fax: +81-48-254-1765 E-mail: info@khkgears.net

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 304 for more details.
(2) The backlash values shown in the table are the theoretical values for the backlash in the normal direction of a pair of identical gears in mesh.
(3) A set of spiral miter gears must be identical in module and number of teeth, but opposite in spiral hands.
(4) 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.
(5) These bevel gears produce axial thrust forces. Please see Page 308 for more details.
(6) 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.
(7) Keyways are made according to JIS B1301 standards, Js9 tolerance. Also note that keyway tooth position alignment is not performed.
(8) 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" on Page 308 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.

[J Series]

(1) Cancellation is not possible for made-to-order products. For lead time details, see Page 38.
(2) Certain products which would otherwise have a very long tapped hole are counterbored. For details, please see the KHK website.
(3) Black oxide is not re-applied to parts undergoing secondary operations.
(4) For bores over ϕ 50, the bore tolerance is H8.

MMS(A,B) Finished Bore Spiral Miter 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.

SMS Spiral Miter 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.

SM(A,B,C) Finished Bore Miter Gears

[Caution on Product Characteristics]

(1) The dimensions of the keyway marked with * are different from the JIS Standards.

LM Sintered Metal Miter Gears

[Caution on Product Characteristics]

(1) Steam treatment (where the surface is rusted using steam) is provided.
(2) The product is not impregnated with lubricating oil.

SAM Angular Miter Gears

[Caution on Product Characteristics]

(1) The axis angle is where the same products are set together. The axis angle cannot be changed by using it with a different product.

PM Plastic Miter Gears

[Caution on Product Characteristics]

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

DM Plastic Miter 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 333.

[Caution on Secondary Operations]

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

Application Hints

In order to use KHK stock miters 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.

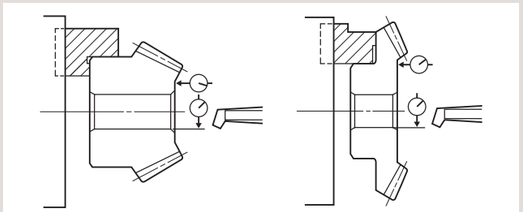
② Depending on the handling method, the product may become deformed or damaged. Resin gears and ring gears deform particularly easily, so please handle with care.

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.

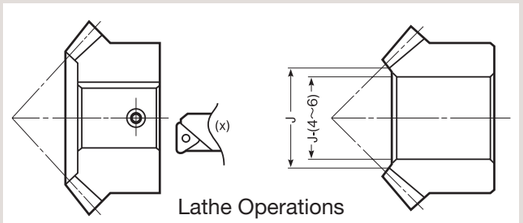
② The reference datum for gear machining is the bore. Therefore, use the bore for locating the center. If it is too difficult to do for small bores, the alternative is to use one spot on the bore and the runout of the side surface.

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.



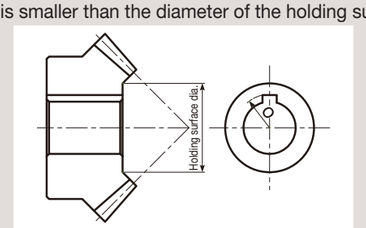
Lathe Operations

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 providing keyway operations, to avoid stress concentration, always round the corners. Make sure that the diameter (O) of the keyway angle is smaller than the diameter of the holding surface.

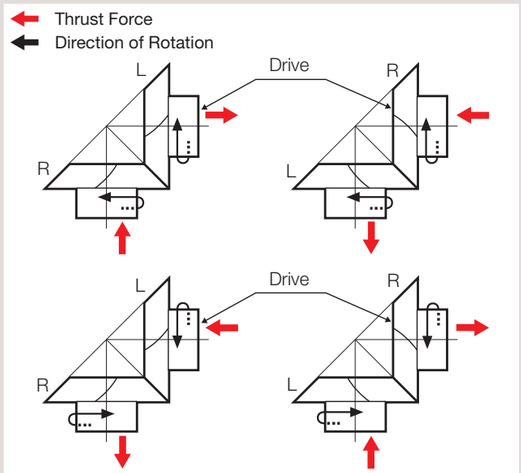


⑥ PM plastic miter gears are susceptible to changes due to temperature and humidity. Dimensions may change between, during, and after re-machining operations.

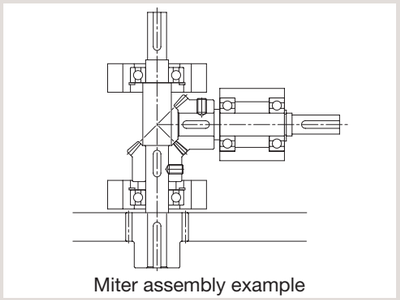
⑦ When induction-hardening S45C products, thermal stress cracks may appear. Also, note that the precision grade of the product declines by 1 or 2 grades, as deformation on material may occur. If you require tolerance for bore or other parts, machining is necessary after heat treatment.

3. Points of Caution during Assembly

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 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.



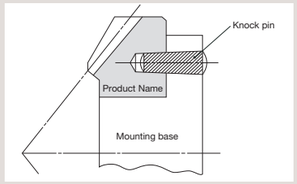
② If a gear is mounted on a shaft far from the bearings, the shaft may bend. We recommend designing bevel gears to be as close to the bearings as possible. Design the gear box, shaft and bearing with high rigidity.



Miter assembly example

③ Be sure to fasten the miter to prevent the gears from moving, as thrust acts on it while rotating.

④ When installing MMSA or MMSB finished bore spiral miter gears produced as 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. (See the top of the right page for reference figure)

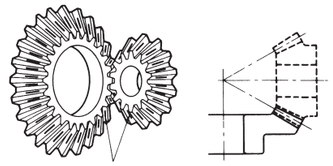


⑤ The recommended assemble distance tolerance of KHK stock miters is H7 for ground gears and H8 for cut gears. Mounting distance error, offset error and shaft angle error must be minimized to avoid excessive noise and wear. Inaccurate assembly will lead to irregular noises and uneven wear. Various conditions 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 on the right so as not to change the tooth contact.

Shaft angle (°)	Normal direction Backlash	Travel in axial direction	
		Drive gear	Driven gear
90	j_n	$1.03 \times j_n$	$1.03 \times j_n$
60		$1.46 \times j_n$	$1.46 \times j_n$
120		$0.84 \times j_n$	$0.84 \times j_n$

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.

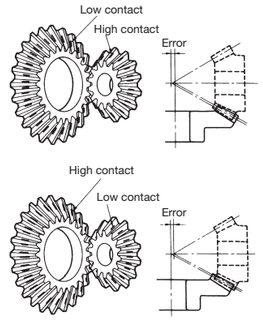


Center contact closer to toes

Incorrect Tooth Contact

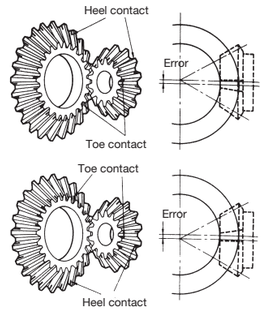
■ Mounting Distance Error

● 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.



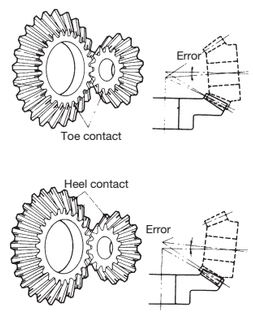
■ Offset Error

● 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°.



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.

KHK considers safety a priority in the use of our products.
When handling, adding secondary operations, assembling, and operating KHK products, please be aware of the following issues in order to prevent accidents.

Warning: Precautions for preventing physical and property damage

1. When using KHK products, follow relevant safety regulations (Occupational Safety and Health Regulations, etc.).
2. Pay attention to the following items when installing, removing, or performing maintenance and inspection of the product.
   ① Turn off the power switch.
   ② Do not reach or crawl under the product.
   ③ Wear appropriate clothing and protective equipment for the work.

Caution: Cautions in Preventing Accidents

1. Before using a KHK product, read the precautions in the catalog carefully in order to use it correctly.
2. Avoid use in environments that may adversely affect the product.
3. Our products are manufactured under a superior quality control system based on the ISO9000 quality management system; if you notice any malfunctions upon purchasing a product, please contact the supplier.