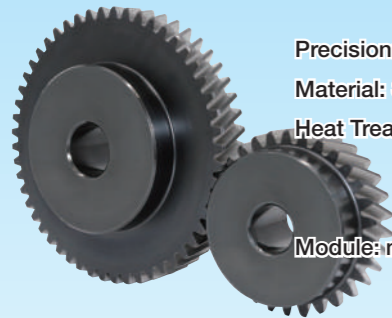


### KHG Ground Helical Gears

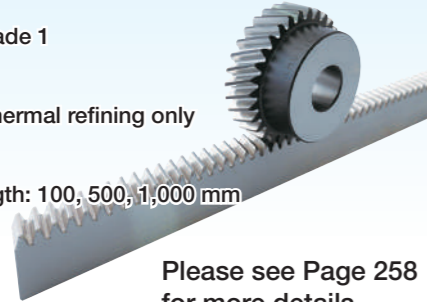


Precision: JIS Grade N6  
Material: SCM440  
Heat Treatment: Thermal refined / gear teeth induction hardened  
Module: m1 to 6

Please see Page 196 for more details.

### KRHG/KRHGF/KRHGFD Ground Helical Racks

Precision: KHK Grade 1  
Material: SCM440  
Heat Treatment: Thermal refining only  
Module: m1 to 3  
Nominal Total Length: 100, 500, 1,000 mm



Please see Page 258 for more details.

### SH Helical Gears

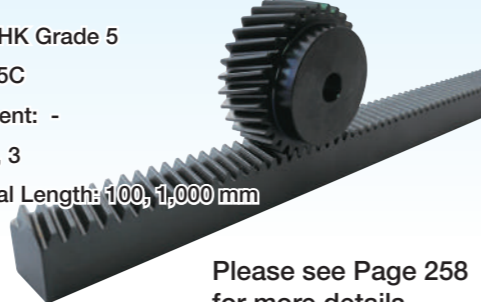


Precision: JIS Grade N8  
Material: S45C  
Heat Treatment: -  
Module: m2, 3

Please see Page 204 for more details.

### SRH·SRHF·SRHFD Helical Racks

Precision: KHK Grade 5  
Material: S45C  
Heat Treatment: -  
Module: m2, 3  
Nominal Total Length: 100, 1,000 mm



Please see Page 258 for more details.

### ZSTP Ground Helical Gears

**Dedicated for racks**



Precision: JIS Grade N6  
Material: SCM440  
Heat Treatment: Thermal refined / gear teeth induction hardened  
Module: m2 to 6

Please see Page 266 for more details.

### SHE Helical Gears

**Dedicated for racks**



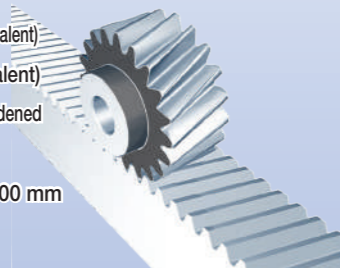
Precision: JIS Grade N8  
Material: S45C  
Heat Treatment: -  
Module: m1.5 to 6

Please see Page 264 for more details.

### ZST/ZSTD

### Hardened Ground Helical Racks

Precision: DIN Grade 6 (KHK Grade 2 equivalent)  
Material: DIN C45 (JIS S45C equivalent)  
Heat Treatment: Gear teeth induction hardened  
Module: m2 to 6  
Nominal Total Length: 1,000, 2,000 mm



Please see Page 266 for more details.

### SRHEF Helical Racks



Precision: KHK Grade 4  
Material: S45C  
Heat Treatment: -  
Module: m1.5 to 6  
Nominal Total Length: 1,000 mm

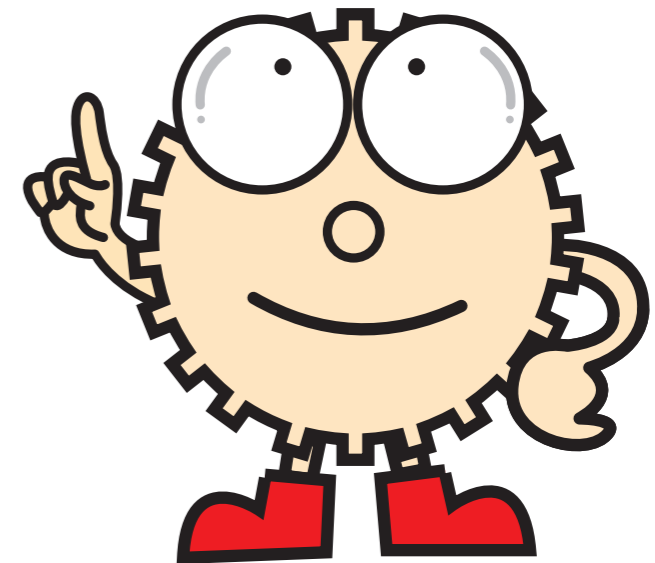


Please see Page 264 for more details.



# Internal Gears

SI Steel Internal Gears	SIR Internal Ring Gears
	
Material: S45C m0.5-2.5 Page 210	Material: S45C m2-3 Page 212



### 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) Internal Gears

**S I R 2 - 120**



## Features

KHK stock internal gears are offered in modules 0.5 to 3 in 60 to 200 teeth. They can be used in many applications including planetary gear drives.

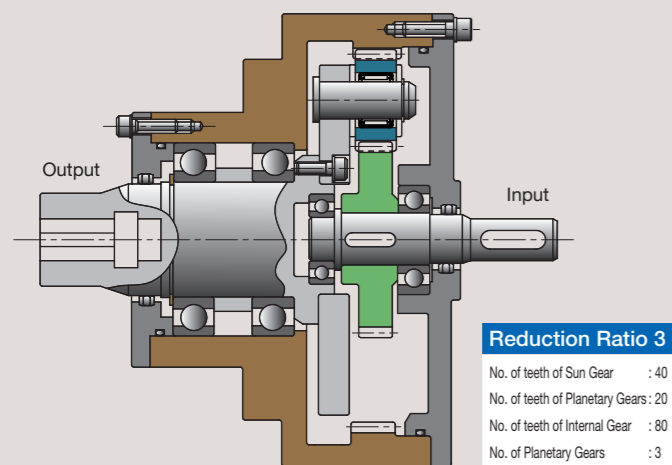
Catalog Number	SI	SIR
Module	0.5~2.5	2~3
Material	S45C	S45C
Heat Treatment	—	—
Tooth Surface Finish	Cut	Cut
Precision JIS B 1702-1:1998	N8 NOTE 1	N9
Secondary Operations	Possible	Possible
Features	A popular type of internal gear; Allows secondary operations.	They have a ring shape with a large number of teeth. Allows secondary operations.

[Note 1] The product accuracy class having a module less than 0.8 corresponds to 'equivalent' as shown in the table.

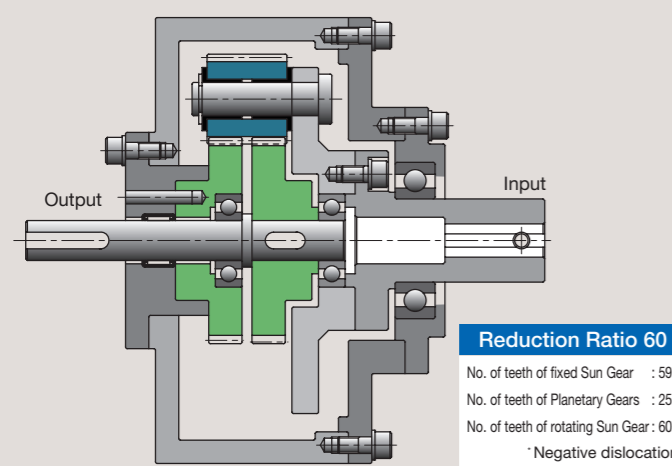
## Application Examples

KHK stock internal gears are used to reduce the size of various equipment, such as reduction gears.

■ Design example of reduction gear (not a design for machinery or a device in actual use)



Planetary Gear Mechanism used in a reduction gear

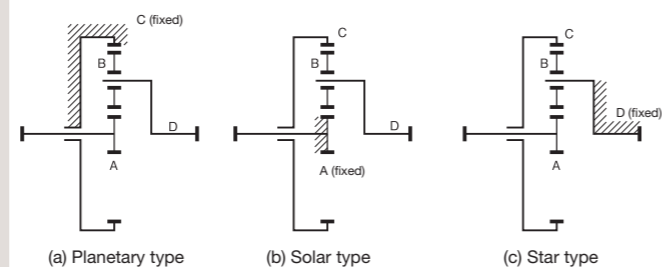


Mechanical Paradox Gear Mechanism used in a large reduction gear

## Example of combinations

No. of teeth of Internal Gear	No. of Planetary Gears	No. of teeth of sun gear	No. of teeth of Planetary Gears	Reduction ratio of planetary type	Reduction ratio of solar type	Reduction ratio of star type
60	3	18	21	4.333	1.3	-3.333
80	3	16	32	6	1.2	-5
80	3	40	20	3	1.5	-2
100	3	20	40	6	1.2	-5
100	3	50	25	3	1.5	-2

## Types of Planetary Gear Mechanism



## Selection Hints

Please select the most suitable products by carefully considering the characteristics of items and contents of the product tables.

### 1. Caution in Selecting the Mating Gears

KHK stock internal gears can mate with any spur gears of the same module, however, there are cases of interference depending on the number of teeth of the mating gear. The table below contains the assumptions established for these products in order to compute gear strengths.

### Interferences and the symptoms

Type	SYMPTOMS	CAUSES
Involute interference	The tip of the internal gear digs into the root of the pinion.	Too few teeth on the pinion.
Trochoid interference	The exiting pinion tooth contacts the internal gear tooth.	Too little difference in number of teeth of the two gears.
Trimming interference	Pinion can slide in or out axially but cannot move radially.	Too little difference in number of teeth of the two gears.

### Allowable Mating Pinions and Number of Teeth

No. of teeth of Internal Gear	No. of teeth of Allowable Mating Pinions		
	Lower limit No. of teeth due to involute interference	Upper limit No. of teeth due to trochoid interference	Upper limit No. of teeth due to trimming interference
60	21	51	43
80	20	72	64
100	19	92	84
120	19	112	104
160	19	152	144
200	18	192	184

## 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. The table below contains the assumptions established for various products in order to compute gear strengths.

### Calculation of Bending Strength of Gears

Item	SI	SIR
Formula NOTE 1	Formula of spur and helical gears on bending strength (JGMA401-01)	
No. of teeth of mating gears	30	
Rotational Speed	100rpm	
Design Life (Durability)	Over 10 <sup>7</sup> cycles	
Impact from motor	Uniform load	
Impact from load	Uniform load	
Direction of load	Bidirectional load (calculated with allowable bending stress of 2/3)	
Allowable bending stress at root $\sigma_{Hlim}$ (kgf/mm <sup>2</sup> )	19	
Safety factor $S_F$	1.2	

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

Item	SI	SIR
Formula NOTE 1	Formula of spur and helical gears on surface durability (JGMA402-01)	
Kinematic viscosity of lubricant	100cSt (50°C)	
Gear support	Symmetric support by bearings	
Allowable Hertz stress $\sigma_{Hlim}$ (kgf/mm <sup>2</sup> )	49	
Safety factor $S_H$	1.15	

[NOTE 1] The gear strength formula is based on JGMA (Japanese Gear Manufacturers Association) specifications. The units for the rotational speed (rpm) and the stress (kgf/mm<sup>2</sup>) are adjusted to the units needed in the formula.

## Application Hints

In order to use KHK stock internal gears safely, read the Application Hints carefully before proceeding. Please refer to Page 52 for "Cautions on Handling" and Page 53 for "Cautions on Starting". Please read "Cautions on Performing Secondary Operations" below when performing modifications and/or secondary operations for safety concerns. Avoid performing secondary operations that narrow the tooth width, as it affects precision and strength.

### 1. Caution on Performing Secondary Operations

- ① If performing outer diameter machining, it is important to pay special attention to locating the center in order to avoid runout.
- ② Please exercise caution not to cause deformation when chucking the outer diameter. Gear precision may deteriorate and cause trouble.

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 ISO9001 quality management system; if you notice any malfunctions upon purchasing a product, please contact the supplier.

## 2. Points of Caution during Assembly

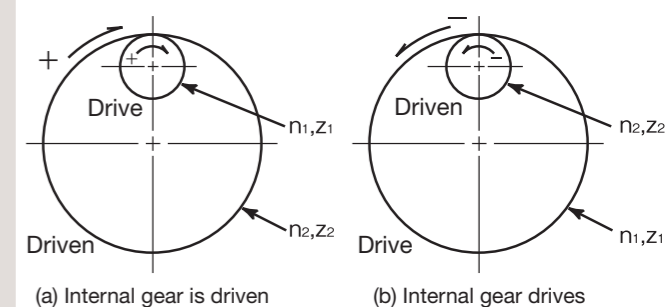
- ① KHK stock internal gears are designed to give the proper normal direction backlash when assembled using the center distance given by the formula below. The amount of backlash is given in the dimension table for each gear.

$$a = \frac{d_2 - d_1}{2}$$

Where  
 $a$  : Center distance  
 $d_1$  : Pitch diameter of pinion  
 $d_2$  : Pitch diameter of internal gear

- ② Refer to the figure below for the direction of rotation of internal gears.

### Gear Ratio and Direction of Rotation



$$\text{Gear Ratio } i = \frac{z_2}{z_1} = \frac{n_1}{n_2} \quad \begin{matrix} z : \text{No. of teeth} \\ n : \text{Rotational speed} \end{matrix}$$

- ③ To use as a planetary gear drive, the following conditions must be satisfied.

### Gear tooth conditions for planetary gear mechanisms

- Condition 1:  $z_c = z_a + 2z_b$
- Condition 2:  $\frac{z_a + z_c}{N} = \text{Integer}$
- Condition 3:  $z_b + 2 < (z_a + z_b) \sin \frac{180^\circ}{N}$

$z_a$  : No. of teeth of Sun Gear  
 $z_b$  : No. of teeth of Planetary Gears  
 $z_c$  : No. of teeth of Internal Gear  
 $N$  : No. of Planetary Gears