



**APEX PRECISION
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Features



KHK stock internal gears are offered in modules 0.5 to 3 in 50 to 200 teeth. They can be used in many applications including planetary gear drives.

Catalog Number	SI	SIR
Module	0.5~3	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.

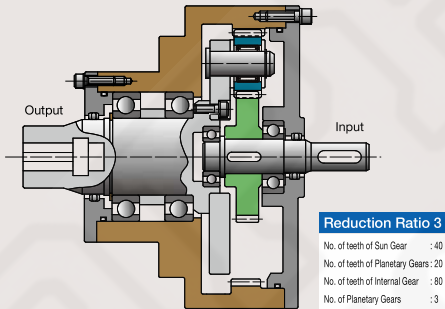
[Note 1] The product accuracy class having a module less than 0.8 corresponds to 'equivalent' as shown in the table.

Application Examples

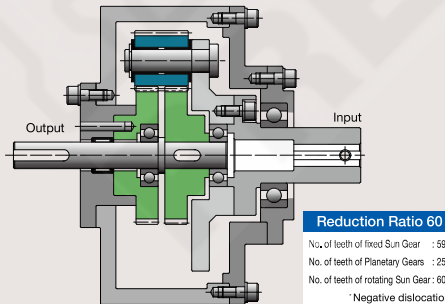


KHK stock internal gears are used to reduce the size of various equipment, such as reduction gears.

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



Planetary Gear Mechanism used in a reduction gear

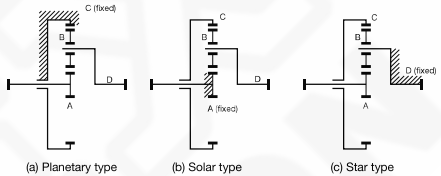


Mechanical Paradox Gear Mechanism used in a large reduction gear

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
50	22	41	33
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	Catalog Number	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 ⁷ 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 σ_{Flim} (kgf/mm ²)		19	
Safety factor S_F		1.2	

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

Item	Catalog Number	SI	SIR
Formula	NOTE 1	Formula of spur and helical gears on surface durability (JGMA402-01)	
Kinematic viscosity of lubricant		100cSt (60°C)	
Gear support		Symmetric support by bearings	
Allowable Hertz stress σ_{Hlim} (kgf/mm ²)		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/mm²) 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 40 for "Cautions on Handling" and Page 41 for "Cautions on Starting".

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.
- ③ To avoid problems of reduced gear precision and other manufacturing difficulties, do not attempt to machine the gears to reduce face widths.

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.

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.

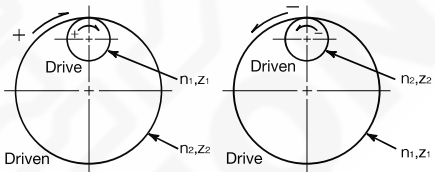
$$a = \frac{d_2 - d_1}{2}$$

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



(a) Internal gear is driven

(b) Internal gear drives

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

- 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