SI
Steel Internal Gears

Newly added

*m*0.5 ~ 3 Page 368

SIR
Steel Ring Gears

*m*2 ~ 3 Page 369

Internal 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) Internal Geas

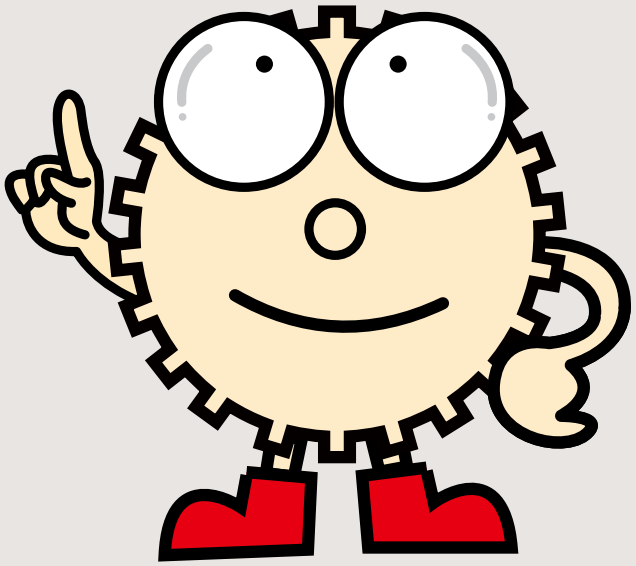
S I R 1 - 60

- 60: No. of teeth (60)
- 1: Module (1)
- R: Others (Ring Gear)
- I: Type (Internal Gear)
- S: Material (S45C)

Material
S S45C

Type
I Internal Gears

Other Information
R Ring 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

Internal Gears

Characteristics

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 No.	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; low cost and suitable for many applications.	Ring gear large in size / number of tooth. It can be cut to make segment gears and corner racks.

〔Note 1〕 The Product accuracy class having a module less than 0.8 corresponds to 'equivalent' as shown in the table.

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 notes before the final selection.

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 involute, trochoid and trimming interference occurrences, depending on the number of teeth of the mating gear. Various types of interference and their symptoms and causes are tabulated below, also shown, the number of teeth of allowable mating pinions.

■ 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 by Involute interference	Upper limit No. of teeth by Trochoid interference	Upper limit No. of teeth by 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

Established equipment and technology. Custom Gears are also available.

Diameter ϕ700mm maximum, Module 6.5 maximum, Cutting Stroke 170 mm

Gear cutting by CNC Gear Shaper

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 his own values by applying the actual usage conditions. The table below contains the assumptions established for these products in order to compute gear strengths.

■ Calculation assumptions for Bending Strength of Gears

Item \ Catalog No.	SI	SIR
Formula NOTE 1	Formula of spur and helical gears on bending strength (JGMA401-01)	
No. of teeth of mating gears	30	
Rotation	100rpm	
Durability	Over 10^7cycles	
Impact from motor	Uniform load	
Impact from load	Uniform load	
Direction of load	Bidirectional	
Allowable beam stress at root σ_{Flim} (kgf/mm^2) Note 2	19	
Safety factor S_F	1.2	

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

Formula NOTE 1	Formula of spur and helical gears on surface durability (JGMA402-01)
Kinematic viscosity of lubricant	100cSt (50℃)
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) The units for the rotational speed (rpm) and 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} calculated is set to 2/3 of the value.

Application Hints

In order to use KHK stock internal gears safely, read the Application Hints carefully before proceeding. Also "1. Caution on Performing Secondary Operations", "3. Notes on Starting Operations" and "4. Other Points to Consider in Applications" in the spur gear section should be consulted (Page 36).

1. Point of Caution in Assembling

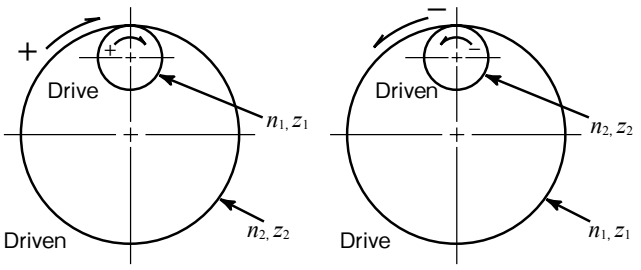
①KHK stock internal gears are designed to give the proper backlash when assembled using the center distance given by the formula below. The amount of backlash is given in the product table for each gear.

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

Where
a : Center distance
d_1 : Pitch diameter of Pinion
d_2 : Pitch diameter of Internal Gear

② Note that the direction of rotation of the internal gear is different from that of two spur gears in mesh.

Gear Ratio and Direction of Rotation



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.

Condition on number of teeth in planetary mechanism

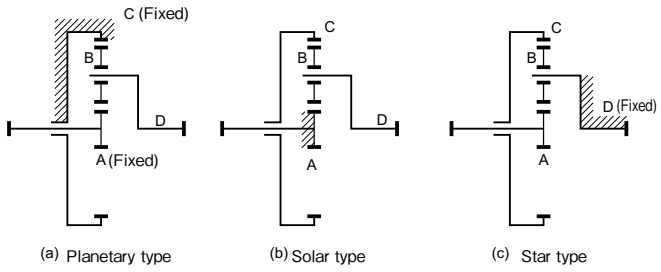
- Condition 1 $\cdots z_c = z_a + 2z_b$
- Condition 2 $\cdots \frac{z_a + z_c}{N}$ = Integer
- Condition 3 $\cdots z_b + 2 < (z_a + z_b) \sin\frac{180°}{N}$

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

■ Example of combinations

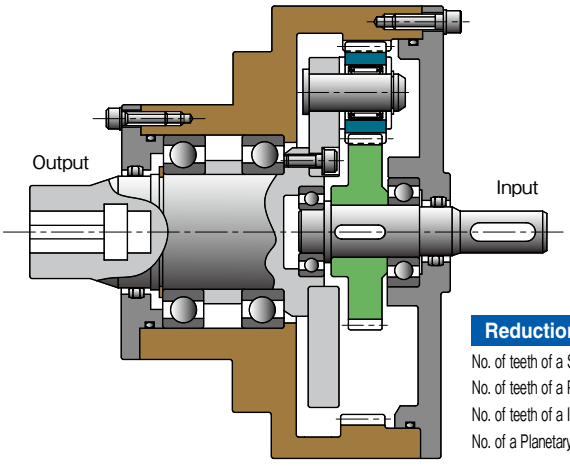
No. of teeth of internal gear	No. of planet gears	No. of teeth of sun gear	No. of teeth of planet gears	Reduction ratio of planetary type	Reduction ratio of solar type	Reduction ratio of star type
60	3	18	21	4.333	1.3	− 3.333
80	3	16	32	6	1.2	− 5
80	3	40	20	3	1.5	− 2
100	3	20	40	6	1.2	− 5
100	3	50	25	3	1.5	− 2

Types of planetary gear reduction mechanism



Application Examples

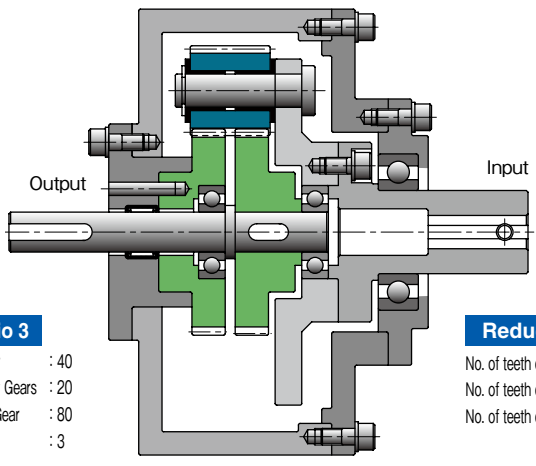
* The illustration is a design example, not a design for machinery or a device in actual use.



Reduction Ratio 3

No. of teeth of a Sun Gear : 40
No. of teeth of a Planetary Gears : 20
No. of teeth of a Internal Gear : 80
No. of a Planetary Gears : 3

Planetary Gear Mechanism used in a reduction gear *



Reduction Ratio 60

No. of teeth of a fixed Sun Gear : 60
No. of teeth of a Planetary Gears : 25
No. of teeth of a rotating Sun Gear : 61*
*Negative dislocation

Mechanical Paradox Gear Mechanism used in a large reduction gear