Table of Contents

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 1 - 60

└ No. of teeth (60)

Module (1)

Type (Internal Gear)
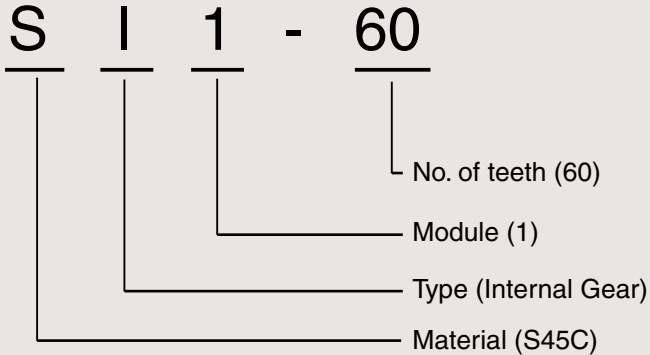
Material (S45C)

Material
S   S45C

Type
I   Internal Gears
IR   Ring Gears

3

Internal Gears

Internal Gears

For Convenient Use in Various Purposes Such as Planetary Gear Drives and Segment Gears.

Characteristics

KHK stock internal gears are offered in modules 1 to 3 in 50 to 200 teeth. They can be used in many applications including planetary gear drives.

■ SI Internal Gears

SI internal gears can be combined with SS and SSA spur gears to make planetary gear drives.

■ SIR ring gears

SIR ring gears can be cut to make segment gears and corner racks.

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. Use of catalog numbers when ordering will simplify and expedite the processing of your order.

1. Caution in Selecting the Mating Gears

Most KHK stock spur gears may be used as the mating gears except CP spur gears and gears with large numbers of teeth. When the difference in the numbers of teeth between an internal gear and its mating gear is small, involute interference, trochoid interference or trimming interference may occur.

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 on the right contains the assumptions established for these products in order to compute gear strengths.

■ Calculation of 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	100min^{-1}	
Durability	Over 10^7 cycles	
Impact from motor	Uniform load	
Impact from load	Uniform load	
Direction of load	Bidirectional	
Allowable beam stress at root σFlim NOTE 2	12.67kgf/mm^2	
Safety factor S$_F$	1.2	

■ Calculation of 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 σHlim	49kgf/mm^2
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 (min^{-1}) 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.

3. Other Points to Consider in Selection Process

①There are various footnotes to the product pages under the headings of "NOTES". Please consider them carefully when selecting these products.

②There may be slight differences in color or shape of products shown in the photograph from the actual products.

③KHK reserves the right to make changes in specifications and dimensions without notice.

④KHK is ready to produce and supply custom order products. When you require specific gears different from KHK Stock Gears please contact our distributor for quotation. Also, please refer to page 16 "KHK Custom Order Products".

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.

1. Point of Caution in Assembling

① KHK 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.

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

where
 a = center distance
 d_1 = pitch diameter of pinion
 d_2 = pitch diameter of internel 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
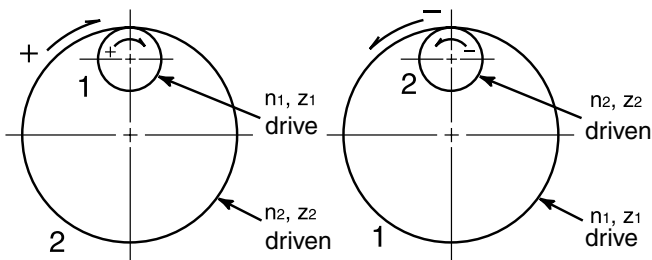
(a) Internal gear is driven   (b) Internal gear drives

Gear ratio $\quad i = \dfrac{z_1}{z_2} = \dfrac{n_2}{n_1}$ $\quad$ z = No. of teeth
n = Rotational speed

③ Various types of interference and their symptoms and causes are tabulated below

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.

④ To use as a planetary gear drive, the following conditions must be satisfied.

Condition on number of teeth in planetary mechanism

Condition1... $z_c = z_a + 2z_b$

Condition 2... $\dfrac{z_a + z_c}{N}$ = Integer

Condition 3... $z_b + 2 < (z_a + z_b)\, \mathrm{Sin}\, \dfrac{180°}{N}$

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
50	3	16	17	1/4.125	1/1.32	-1/3.125
80	3	16	32	1/6	1/1.2	-1/5
80	3	40	20	1/3	1/1.5	-1/2
100	3	20	40	1/6	1/1.2	-1/5
100	3	50	25	1/3	1/1.5	-1/2

Types of Planetary gear reduction mechanism
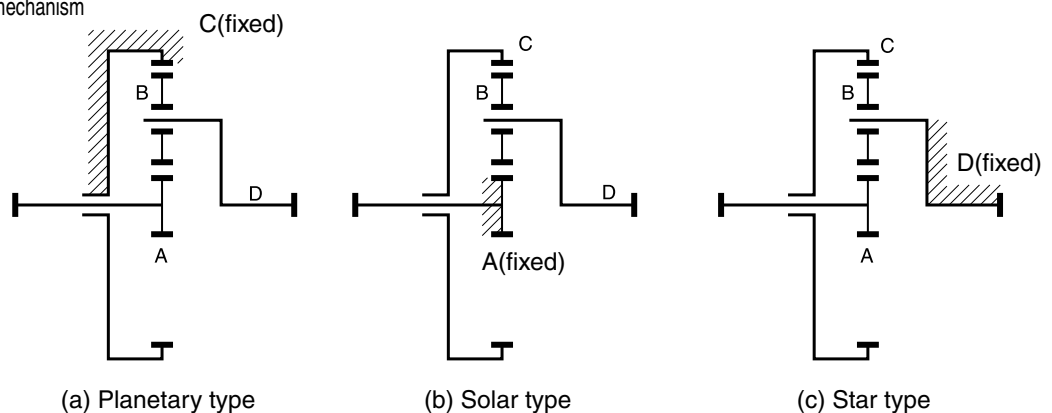
(a) Planetary type   (b) Solar type   (c) Star type

Internal Gears

S I
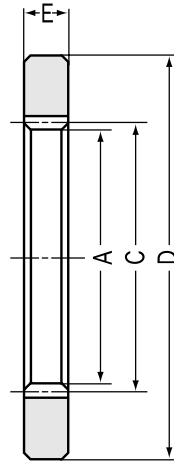
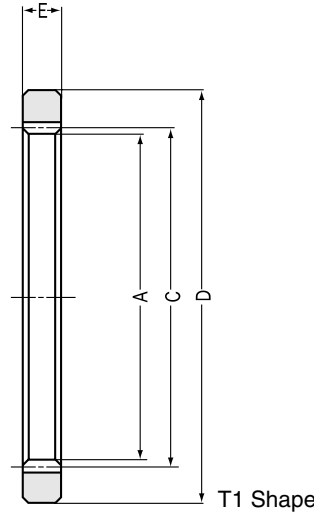|	
Precision	JIS N8 grade (JIS1 B1702-1: 1998) OLD JIS 4 grade (JIS B1702: 1976)
Gear teeth	**Standard full depth**
Pressure angle	**20°**
Material	**S45C**
Heat treatment	—
Tooth hardness	**Less than 194HB**
Surface treatment	**Black oxide**
Tooth surface finishing	**Cut**
Datum reference surface for gear cutting	**Outside diameter**
Secondary Operations	**Possible**

T1 Shape

■ Module 1, 1.5, 2, 2.5, 3

Catalog No.	Module	No. of teeth	Shape	Internal dia. A	Pitch dia. C	Outside dia. D	Face width E	Allowable torque (N·m) NOTE 1 Bending strength	Allowable torque (N·m) NOTE 1 Surface durability	Allowable torque (kgf·m) Bending strength	Allowable torque (kgf·m) Surface durability	Backlash (mm) NOTE 2	Weight (kg)
SI1-60	*m*1	60	T1	58	60	90	10	30.0	5.95	3.06	0.61	0.11~0.24	0.28
SI1-80		80	T1	78	80	110	10	38.8	6.59	3.96	0.67	0.11~0.24	0.35
SI1-100		100	T1	98	100	130	10	47.8	7.64	4.87	0.78	0.13~0.27	0.42
SI1.5-50	*m*1.5	50	T1	72	75	115	15	87.1	20.9	8.88	2.13	0.13~0.29	0.71
SI1.5-60		60	T1	87	90	130	15	101	20.6	10.3	2.10	0.13~0.29	0.81
SI1.5-80		80	T1	117	120	160	15	131	23.3	13.4	2.38	0.13~0.29	1.00
SI1.5-100		100	T1	147	150	190	15	161	27.0	16.5	2.75	0.15~0.32	1.30
SI2-50	*m*2	50	T1	96	100	150	20	206	50.3	21.0	5.13	0.16~0.33	1.50
SI2-60		60	T1	116	120	170	20	240	50.5	24.5	5.15	0.16~0.33	1.80
SI2-80		80	T1	156	160	210	20	311	57.0	31.7	5.81	0.16~0.33	2.30
SI2-100		100	T1	196	200	250	20	382	65.7	39.0	6.70	0.17~0.37	2.80
SI2.5-50	*m*2.5	50	T1	120	125	185	25	403	101	41.1	10.3	0.17~0.37	2.70
SI2.5-60		60	T1	145	150	210	25	469	101	47.8	10.3	0.17~0.37	3.30
SI2.5-80		80	T1	195	200	260	25	607	114	61.9	11.6	0.17~0.37	4.10
SI3-50	*m*3	50	T1	144	150	220	30	697	178	71.0	18.1	0.19~0.41	4.80
SI3-60		60	T1	174	180	250	30	811	178	82.7	18.2	0.19~0.41	5.60

CAUTION: Please check for the involute interference, trochoid interference and trimming interference prior to using internal gears.
NOTE 1: The allowable torques shown in the table are the calculated values according to the assumed usage conditions. Please see page 148 for more details.
NOTE 2: The backlash values shown in the table are the theoretical values of a 30 tooth SS spur gear in mesh with the internal gear.

⊚ SIR Ring Gears Modules 2~3 — *Ring Gears*

Specifications

Precision	JIS N9 grade (JIS1 B1702-1: 1998) OLD JIS 5 grade (JIS B1702: 1976)
Gear teeth	**Standard full depth**
Pressure angle	**20°**
Material	**S45C**
Heat treatment	—
Tooth hardness	**Less than 194HB**
Surface treatment	**Black oxide**
Tooth surface finishing	**Cut**
Datum reference surface for gear cutting	**Outside diameter**
Secondary Operations	**Possible**

T1 Shape

Internal Gears

S I R

■ Module 2, 2.5, 3

Catalog No.	Module	No. of teeth	Sharpe	Internal dia. A	Pitch dia. C	Outside dia. D	Face width E	Allowable torque (N·m) NOTE 1		Allowable torque (kgf·m)		Backlash (mm) NOTE 2	Weight (kg)
								Bending strength	Surface durability	Bending strength	Surface durability		
SIR2-120	**m2**	120	T1	236	240	286	20	413	68.8	42.1	7.02	0.17~0.37	3.00
SIR2-200		200	T1	396	400	446	20	677	110	69.0	11.2	0.20~0.41	4.80
SIR2.5-120	**m2.5**	120	T1	295	300	355	25	807	138	82.3	14.0	0.19~0.41	5.50
SIR2.5-200		200	T1	495	500	555	25	1320	220	135	22.5	0.22~0.46	8.90
SIR3-120	**m3**	120	T1	354	360	424	30	1390	244	142	24.9	0.22~0.45	10.0
SIR3-160		160	T1	474	480	544	30	1840	315	188	32.1	0.22~0.45	12.1

CAUTION: Ring gears are susceptible to deformation, so careful handling is required.
NOTE 1: The allowable torques shown in the table are the calculated values according to the assumed usage conditions. Please see page 148 for more details.
NOTE 2: The backlash values shown in the table are the theoretical values of a 30 tooth SS spur gear in mesh with the internal gear.