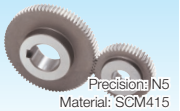
Spur Gears

MSGA/MSGB Ground Spur Gears

Precision: N5
Material: SCM415
Heat Treatment: Carburized
$m1 \sim 4$ Page 28

KSG Ground Spur Gears New

Precision: N6
Material: SCM440
Heat Treatment: Thermal refined / induction hardened
$m1 \sim 3$ Page 38

SSGS Ground Spur Pinion Shafts

Precision: N7
Material: S45C
Heat Treatment: Thermal refined / induction hardened
$m1.5 \sim 3$ Page 40

SSG Ground Spur Gears + Semi-Custom J Series

Precision: N7
Material: S45C
Heat Treatment: Gear teeth induction hardened
$m0.5 \sim 10$ Page 42

SSG Ground Spur Gears F Series

Precision: N7 equivalent
Material: S45C
Heat Treatment: Gear teeth induction hardened
$m2 \sim 3$ Page 58

SSG R Series Ground Spur Gears New R Series

Precision: N7 equivalent
Material: S45C
Heat Treatment: Gear teeth induction hardened
$m1.5 \sim 6$ Page 64

SSAG Ground Spur Gears New J Series

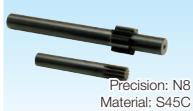
Precision: N7
Material: S45C
Heat Treatment: Gear teeth induction hardened
$m1 \sim 6$ Page 66

KS-H Hardened Spur Gears New Hardened Plus

Precision: N9 equivalent
Material: SCM440
Heat Treatment: Thermal refined / gear teeth induction hardened
$m1.5 \sim 5$ Page 70

KS Thermal Refined Spur Gears New

Precision: N8
Material: SCM440
Heat Treatment: Thermal refined
$m1.5 \sim 5$ Page 70

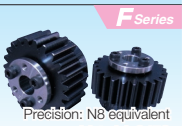
SSS Spur Pinion Shafts

Precision: N8
Material: S45C
Heat Treatment: Thermal refined
$m0.5 \sim 3$ Page 72

SS-H Hardened Spur Gears New Hardened Plus

Precision: N9 equivalent
Material: S45C
Heat Treatment: Gear teeth induction hardened
$m1 \sim 6$ Page 78

SS Spur Gears + Semi-Custom J Series

Precision: N8
Material: S45C
$m0.5 \sim 10$ Page 74

SS Spur Gears F Series

Precision: N8 equivalent
Material: S45C
$m1.5 \sim 3$ Page 100

SSA-H Hardened Spur Gears New Hardened Plus

Precision: N9 equivalent
Material: S45C
Heat Treatment: Gear teeth induction hardened
$m1 \sim 5$ Page 108

SSA Spur Gears + J Series

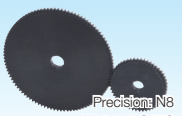
Precision: N8
Material: S45C
$m1 \sim 5$ Page 108

SSA Spur Gears F Series

Precision: N8 equivalent
Material: S45C
$m2 \sim 3$ Page 116

SSY Spur Gears

Precision: N8
Material: S45C
$m0.8, 1$ Page 120

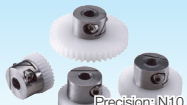
SSAY Spur Gears

Precision: N8
Material: S45C
$m1$ Page 124

SUS/SUSA Stainless Steel Spur Gears J Series

Precision: N8
Material: SUS303
$m1 \sim 4$ Page 126

SUSF F-Loc Gears

Precision: N8
Material: SUS303
$m0.5, 1$ Page 132

DSF F-Loc Gears

Precision: N10
Material: Polyacetal (SUS303)
$m0.5, 1$ Page 134

NSU Plastic Spur Gears with Steel Core J Series

Precision: N9
Material: MC602ST (S45C)
$m1 \sim 3$ Page 136

PU Plastic Spur Gears with Steel Core J Series

Precision: N9
Material: MC901 (SUS303)
$m1 \sim 2$ Page 140

PS/PSA Plastic Spur Gears J Series

Precision: N9
Material: MC901
$m1 \sim 3$ Page 142

SUKB Stainless Steel Hubs

PSA Dedicated
Material: SUS303
φ 30 ~ 100 Page 152

DS Injection Molded Spur Gears

Precision: N12 equivalent
Material: Duracon (M90-44)
$m0.5 \sim 1$ Page 154

BB Sintered Metal Bushings

Material: Oil-free copper alloy
φ 5 ~ 8 Page 156

BSS Spur Gears

Precision: N8
Material: Free cutting brass (C3604)
$m0.5 \sim 1$ Page 158

SSR Steel Ring Gears (Spur Gears)

Precision: N9
Material: S45C
$m2 \sim 3$ Page 162

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) Spur Gears

S S G 1 - 15

- 15: No. of Teeth (15)
- 1: Module (1)
- G: Other Products (Ground Gears)
- S: Type (Spur Gear)
- S: Material (S45C)

Material

M	SCM415
K	SCM440
S	S45C
SU	Stainless Steel
P	MC901
N	MC602ST
D	Polyacetal
BS	Brass
L	Sintered Metal Alloy

Type

S	Spur Gears

Other Information

A	Hubless Gears
G	Ground Gears
F	F-loc Hub Gears
R	Ring Gears
S	Pinion Shafts
U	Plastic Gears with Steel Core
Y	Thin Face Gears

Features

To meet your requirements, KHK stock gears are made in a variety of types, materials, configurations, modules and numbers of teeth. We also offer products that allow for secondary operations to be performed on the bores, shafts, outside diameters, keyways and set screws. The following table lists the main features.

Catalog Number	Module	Material	Heat Treatment	Tooth Surface Finish	Precision JIS B 1702-1:1998	Secondary Operations	Features
MSGA/MSGB	1 to 4	SCM415	Carburized	Ground	N5	×	High strength, abrasion-resistant and compact.
KSG	1 to 3	SCM440	Thermal refined, gear teeth induction hardened	Ground	N6	△	High-strength and high-precision spur gear made of thermally refined and hardened chrome molybdenum steel. Allows secondary operations.
SSGS	1.5 to 3	S45C	Thermal refined, gear teeth induction hardened	Ground	N7	△	Ground shaft pinions that allow for modification of the shafts to fit your bearings.
SSG	0.5 to 6	S45C	Gear teeth induction hardened NOTE 1	Ground	N7	△	Although heat treatment is applied to the tooth area, secondary operation can be added. Finished J, F, and R Series products are also available.
SSAG	1 to 6	S45C	Gear teeth induction hardened	Ground	N7	△	Hubless gears for lighter and more compact applications. Finished J Series products are also available.
KS	1.5 to 5	SCM440	Thermal refined	Cut	N8	○	High-strength spur gear made of thermally refined chrome molybdenum steel. Use as mating pinions for KRF thermally refined racks.
SSS	0.5 to 3	S45C	Thermal refined NOTE 2	Cut	N8 NOTE 3	○	For the SS series, Shaft-Pinions with a small number of teeth (10 to 13 teeth) are available.
SS	0.5 to 10	S45C	—	Cut	N8 NOTE 3	○	Low cost, large selections of modules and number of teeth. Finished J and F series products are also available.
SSA	1 to 5	S45C	—	Cut	N8	○	Hubless gears for lighter and more compact applications. Finished J and F series products are also available.
SSY	0.8, 1	S45C	—	Cut	N8 NOTE 3	○	Narrower face gears for light-duty applications.
SSAY	1	S45C	—	Cut	N8	○	Hubless and narrow faces for even lighter and more compact gears.
SUS/SUSA	1 to 4	SUS303	—	Cut	N8	○	SUS303 gears for more rust-resistant gears. Finished J Series products are also available.
SUSF	0.5, 1	SUS303	—	Cut	N8 NOTE 3	△	Fine-pitch gears with rust resistance, enabled to clamp to shafts without any keys or set screws.
DSF	0.5, 1	Polyacetal (SUS303)	—	Cut	N10 NOTE 3	△	Fine-pitch gears can be used without lubrication, easily clamped to shafts without any keys or set screws.
NSU	1 to 3	MC602ST (S45C)	—	Cut	N9	○	Nylon teeth with S45C hubs that can have keyways and set screws added. Finished J Series products are also available.
PU	1 to 2	MC901 (SUS303)	—	Cut	N9	○	Nylon teeth with SUS303 hubs for rust-resistance. Finished J Series products are also available.
PS/PSA	1 to 3	MC901	—	Cut	N9	○	Made of MC nylon, possible to operate without lubrication. Suitable for food processing machines. Finished J Series products are also available.
DS	0.5 to 1	Duracon (M90-44)	—	Injection Molded	N12 equivalent	△	Low cost, mass-produced products suitable for light duty office machines.
BSS	0.5 to 1	Free cutting brass (C3604)	—	Cut	N8 NOTE 3	○	Fine-pitch gears with rust resistance. Suitable for mating with DS gears.
SSR	2 to 3	S45C	—	Cut	N9	○	Allows large gear ratios. Can also be used as segment gears and corner racks.

[NOTE 1] Products with module less than 0.8 are thermal refined, without their gear teeth being hardened.
[NOTE 2] SA-shaped products with module less than 1 have no material thermal refinement treatment.
[NOTE 3] The product accuracy class having a module less than 0.8 corresponds to 'equivalent' as shown in the table.

○ Possible △ Partly possible × Not possible

● **By chamfering the corners of the top land, gear noise is reduced, and the chances of damage due to handling and transportation are decreased. All KHK gears larger than *m*1.5 have their teeth chamfered.**
● **Black products are KHK stock gears that have an applied black oxide coating for rust resistance; this is a product characteristic of KHK stock gears.**

Application Examples

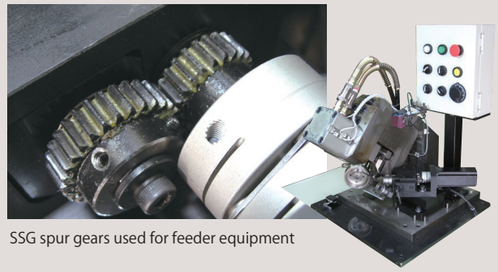
KHK stock spur gears are widely used in various industrial machines including food machinery.

■ **Food machinery by Jey Machine Co.**

SSA/SS spur gears used in stirrers

PS/PSA spur gears used in fully-automatic food forming machines

■ **Cutting machine with stainless steel belt**

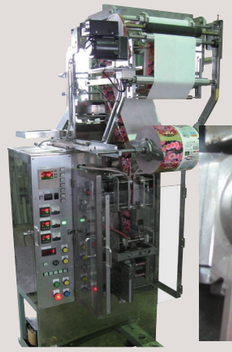


SSG spur gears used for feeder equipment

■ **High-speed automatic wire straightening/cutting machine manufactured by Takashima Sangyo Co.**

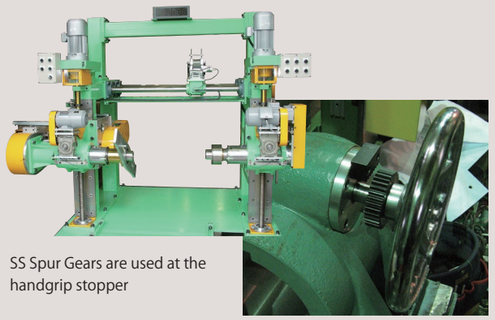
SS spur gears used for wire feeder

■ **Packing machine by New Max**



SS Spur Gears, segment shaped by secondary operation

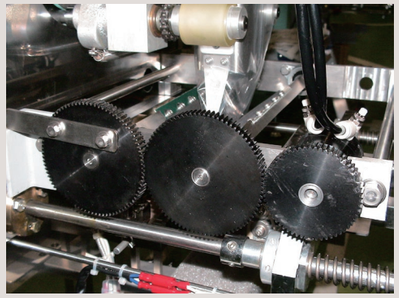
■ **Electric wire winder by Sakuma Tekko KK.**



SS Spur Gears are used at the handgrip stopper

■ **Automatic packing machine**

SSA spur gears used for driving



SSAY spur gears used for film cutting

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

① Basically, all spur gears, internal gears and racks can be paired as long as the module and pressure angle match. Products with different materials, tooth widths, or methods of cutting the teeth can be mated.

② When using a pinion with an internal gear with a small difference in the numbers of teeth, there are possibilities of involute interference, trochoid interference and trimming interference. See the internal gear interference portion of the technical section to avoid problems in assembling these items. (Page 182)

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 their own values by applying the actual usage conditions. Also, SUSF F-loc hub spur gears, DSF F-loc hub spur gears and various F series that use the friction coupling method to fasten the gear shaft need additional consideration for starting torque.
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	MSGA MSGB	SSGS	SSG SSAG	SSS,SS SSA,SSY SSAY,SSR	SUS SUSA SUSF	BSS	KSG	KS	NSU	PU PS PSA	DSF DS
Formula NOTE 1	Formula of spur and helical gears on bending strength (JGMA401-01)								The Lewis formula		
No. of teeth of mating gears	Same number of teeth (30 for SSGS, SSS, SSR)						Racks		—		
Rotational speed	600rpm			100rpm					100 rpm		
Design life (durability)	Over 10^7cycles								—		
Impact from motor	Uniform load								Allowable bending stress (kgf/mm²)		
Impact from load	Uniform load								1.38 (40℃ with No Lubrication)	1.15 (40℃ with No Lubrication)	*m* 0.5 4.0 *m* 0.8 4.0 *m* 1.0 3.5 (40℃ with Grease Lubrication)
Direction of load	Bidirectional										
Allowable bending stress at root σ_{Flim} (kgf/mm²) NOTE 2	47	24.5	19 (24.5) Note 3	19 (24.5) Note 4	10.5	4	30	32			
Safety factor S_F	1.2										

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

Item								
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 Note 5						Supported on one end	
Allowable Hertz stress σ_{Hlim} (kgf/mm²)	166	99	90 (62.5) Note 3	49 (62.5) Note 4	41.3	—	112	79
Safety factor S_H	1.15							

[NOTE 1] The gear strength formula is based on JGMA (Japanese Gear Manufacturers Association) specifications, "MC Nylon Technical Data" by Nippon Polypenco Limited and "Duracon Gear Data" by Polyplastic 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 allowable bending stress at the root σ_{Flim} is calculated from JGMA401-01, and set to 2/3 of the value in the consideration of the use of planetary-, idler-, or other gear systems, loaded in both directions.

[NOTE 3] For SSG Ground Spur Gears, with module 0.8 or less, thermal refining is applied. Allowable bending stress and allowable hertz stress values are shown in parentheses.

[NOTE 4] For SSS Spur Pinion Shafts, with module over 1.5, tooth induction hardening is not applied. Allowable bending stress and allowable hertz stress values are shown in parentheses.

[NOTE 5] SSS Spur Pinion Shafts with module 1 or less (SA configuration) are set to cantilever support as they are single shaft types.

When selecting KHK standard gears, glance over the Cautions on Product Characteristics and Cautions on Performing Secondary Operations in the respective dimension tables.

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 16 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, prices, etc.) listed in the catalog may be changed without prior notice. Changes are announced on the KHK website.

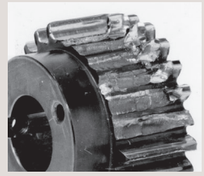
Website URL: https://khkgears.net/
Overseas Sales Department: TEL: 81-48-254-1744 FAX: 81-48-254-1765
E-mail: info@khkgears.net

The most important factor in selecting gears is the gear strength.

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

■ Definition of Bending Strength of Gears

The allowable bending strength of a gear is defined as the allowable tangential force at the pitch circle based on the mutually allowable root stress of two meshing gears under load.



Example of failure due to insufficient bending strength

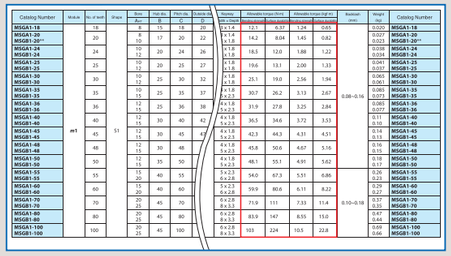
■ Definition of Surface Durability

The surface durability of a gear is defined as the allowable tangential force at the pitch circle, which permits the force to be transmitted safely without incurring surface failure. The allowable gear tooth load of a gear is defined as the allowable tangential force at the pitch circle based on the mutual gear tooth strength of two meshing gears under load.

Example of wear due to insufficient surface durability

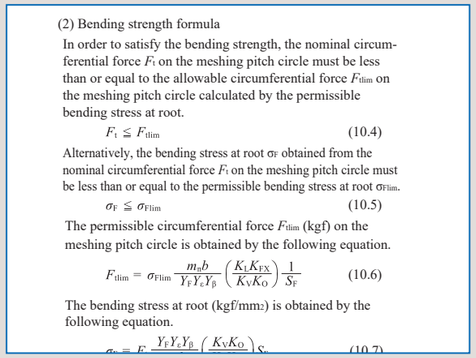
Step 2 **Select provisionally from the allowable torque table of the Master Catalog based on the load torque.**

■ For provisional selection from the Master Catalog



Step 3 **We recommend that each user computes their own values by applying the actual usage conditions to determine the suitability of the gear strength.**

Calculate the strength formally using the various gear strength formulas.
Please see Page 71 of our technical reference book for more details.



(2) Bending strength formula

In order to satisfy the bending strength, the nominal circumferential force F_t on the meshing pitch circle must be less than or equal to the allowable circumferential force F_{tlim} on the meshing pitch circle calculated by the permissible bending stress at root.

$$F_t \leqq F_{tlim} \qquad (10.4)$$

Alternatively, the bending stress at root σ_F obtained from the nominal circumferential force F_t on the meshing pitch circle must be less than or equal to the permissible bending stress at root σ_{Flim}.

$$\sigma_F \leqq \sigma_{Flim} \qquad (10.5)$$

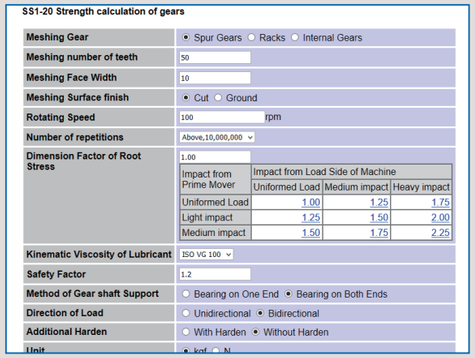
The permissible circumferential force F_{tlim} (kgf) on the meshing pitch circle is obtained by the following equation.

$$F_{tlim} = \sigma_{Flim} \frac{m_n b}{Y_F Y_\varepsilon Y_\beta} \left(\frac{K_t K_{FX}}{K_V K_O} \right) \frac{1}{S_F} \qquad (10.6)$$

The bending stress at root (kgf/mm²) is obtained by the following equation.

$$\sigma_F = F_t \frac{Y_F Y_\varepsilon Y_\beta}{} \left(\frac{K_V K_O}{} \right) S_F \qquad (10.7)$$

Strength confirmation is simple when using the website.



SS1-20 Strength calculation of gears

Meshing Gear	◉ Spur Gears ○ Racks ○ Internal Gears
Meshing number of teeth	50
Meshing Face Width	10
Meshing Surface finish	◉ Cut ○ Ground
Rotating Speed	100 rpm
Number of repetitions	Above,10,000,000
Dimension Factor of Root Stress	1.00

Impact from Prime Mover	Impact from Load Side of Machine		
	Uniformed Load	Medium impact	Heavy impact
Uniformed Load	1.00	1.25	1.75
Light impact	1.25	1.50	2.00
Medium impact	1.50	1.75	2.25

Kinematic Viscosity of Lubricant	ISO VG 100
Safety Factor	1.2
Method of Gear shaft Support	○ Bearing on One End ◉ Bearing on Both Ends
Direction of Load	○ Unidirectional ◉ Bidirectional
Additional Harden	○ With Harden ◉ Without Harden
Unit	◉ kgf ○ N

Application Hints

In order to use KHK stock gears 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.

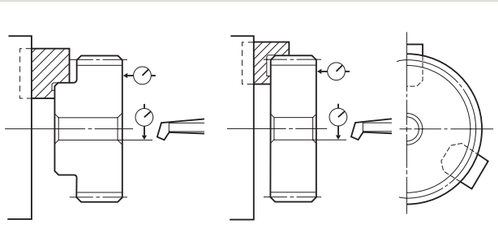
TEL: 81-48-254-1744 FAX: 81-48-254-1765 E-mail: info@khkgears.net

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. Cautions on Performing Secondary Operations

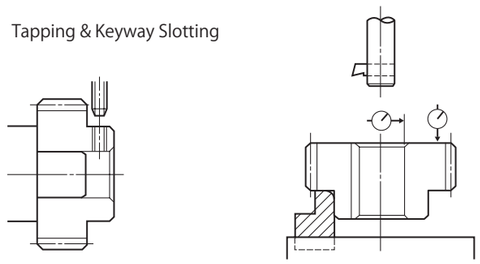
① If reboring, it is important to pay special attention to locating the center in order to avoid runout.
② The reference datum for gear cutting is the bore. Therefore, use the bore for locating the center. If it is too difficult to do for small bores, the alternative is to use one spot on the bore and 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 by applying too much pressure. Any scarring will cause noise during operation.



Lathe Operations

④ The maximum bore size is dictated by the requirement that the strength of the hub is to be higher than that of the gear teeth. The maximum bore size should be 60% to 70% of the hub diameter (or tooth root diameter), and 50% to 60% for keyway applied modifications.
⑤ In order to avoid stress concentration, round the keyway corners.

Tapping & Keyway Slotting



⑥ To avoid problems of reduced gear precision and other manufacturing difficulties, do not attempt to machine the gears to reduce face widths.
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.

Induction Hardening

If you apply induction hardening to the gear teeth of S45C products, you need to designate the hardness and where to apply the heat treatment. Below is an example of common specifications and KHK's specifications for hardening:

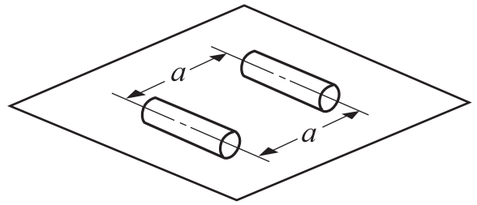
● Common Specifications for Heat Treatment
Hardening location: Gear tooth surface or tooth surface and tooth root
Hardness: Within the range of 45 to 60 HRC and 10 HRC width
(Example: 48 to 58 HRC)

● KHK's Specifications for Heat Treatment
Hardened location: Tooth surface, or Tooth surface and Tooth root
Hardness: 50 to 60 HRC

＊Hardness and Depth of Gear-teeth Induction Hardening
The hardening method and the state of the hardened teeth area vary depending on the size of gears.
Since different hardening treatment is applied in accordance with the module and number of teeth, the hardness level you designate is referred to as the hardness of the reference diameter. For some of our products, the hardness at tooth tip / root may not be equal to the hardness you designated.
As to the effective case depth for S45C, it is specified by JIS, as "The distance from the surface of the case to the area with hardness HV450." The case depth differs from area to area of a tooth.

3. Points of Caution during Assembly

① KHK stock spur gears are designed to give the proper backlash when assembled using the center distance given by the formula below (center distance tolerance of H7 – H8). For the backlash of each product, please refer to the dimension table.
Backlash may be adjusted by changing the center distance of mating gears. For more information, please consult the technical section on gear backlash (page 56) in our separate technical reference book.



$a=m(Z_1+Z_2)/2$

Where
a : Center distance
m : Module
Z_1 : No. of teeth of pinion
Z_2 : No. of teeth of gear

② The table below indicates the tolerance on the total length of KHK stock spur gears. Please refer to this data when designing gear boxes or other components.

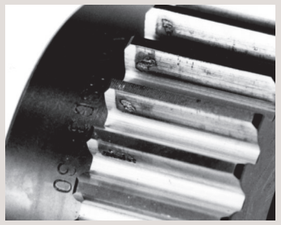
■ Total Length Tolerance for Spur and Helical Gears

Total Length (mm)	Tolerance
30 or less	0 −0.10
31 to 100	0 −0.15
Over 100	0 −0.20

[Note] The following products are excluded from this table: Spur pinion shafts, Injection molded spur gears, F-loc hub spur gears, and MC nylon products.

③ Spur gears produce no thrust forces; however, be sure to fasten them firmly with stepped shafts, or collars, to prevent shifting toward the shaft.
Keyways are generally used in fastening gears to a shaft, and they should be secured by applying drilled holes for set screws, or applying flats to the shaft, in case of fastening only with set screws.
There are also methods of secure settings using a Mecha-Lock, a POSI-LOCK, or a Spannring, which are parts for engaging the hole and the axis.
④ Verify that the two shafts are parallel. Incorrect assembly will lead to uneven teeth contact which will cause noise and wear. (Check the assembly by painting a thin layer of red lead primer or the like on the gear teeth, meshing them together and rotating them.)

■ Test example: Abrasion occurred on SSG3-30 due to poor edge contact (only 30% with proper contact).



Poor tooth contact and pitting

Gear oil (equivalent to JIS gear oil category 2 No. 3)
The design conditions were load torque at 278 rpm, 42.5 kg/m (12 kW), 1.5 times the allowable bending strength, and 3 times the allowable surface durability torque.
The pitting occurred on the poor tooth contact area after 60 hours of continuous operation.

4. Cautions on Starting

① Check the following items before starting.
• Are the gears installed 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 Gears can be lubricated with the "grease lubrication method", "splash lubrication method (oil bath method)", or "forced lubrication method (circulation lubrication method)".
For initial operation, the lubricant may deteriorate markedly, so check the condition of the lubricant after starting.
For more technical information, please see the section "Gear Lubrication" (Page 112) of our technical reference book.
④ If there is any abnormality such as noise or vibration during startup, check the gears and assembly condition.
"High gear accuracy", "smooth gear teeth surface" and "correct tooth contact" are some of the measures against gear noise. For more technical information, please see the section "Gear Noise and Countermeasures" (Page 119) of our technical reference book.

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.