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) Racks

KRGF 2 - 500 H

Material
- M: SCM415
- K: SCM440
- S: S45C
- SU: Stainless Steel
- BS: Brass
- P: MC901
- D: Polyacetal

Other Information
- F: Racks with Machined Ends
- D: Racks with Bolt Holes
- K: Racks with Drill Holes
- G: Ground Gears
- H: Gear teeth induction hardened

Type
- R: Racks
- RH: Helical Racks
- RO: Round Racks
- S: Spur Gears

Other Products
- End Machined
- Ground Gears

Other Products
- Material
- Other Information

Series

MRGF/MRGF-D
- Hardened Ground Rack
- Heat Treatment: Tooth area carburized
- Total Length (500mm)
- Module (2)
- Other Products (End Machined)
- Other Products (Ground Gears)
- Type (Rack)
- Material (SCM440)

KRGF-H/KRGFD-H
- Hardened Ground Racks
- Heat Treatment: Thermal refined
- Total Length (500mm)
- Module (2)

SRG/SRGF/SRGFD/SRGFK
- Thermal Refined Ground Racks
- Heat Treatment: Thermal refined
- Total Length (500mm)
- Module (2)

KRF-H/KRFD-H
- Hardened Racks
- Heat Treatment: Thermal refined
- Total Length (500mm)
- Module (2)

SRF-H/SRFD-H
- Hardened Racks
- Heat Treatment: Thermal refined
- Total Length (500mm)
- Module (2)

SRG/SRGF/SRGFD/SRGFK
- Hardened Ground Racks
- Heat Treatment: Gear teeth induction hardened
- Total Length (500mm)
- Module (2)

SRF-H/SRFD-H
- Hardened Racks
- Heat Treatment: Gear teeth induction hardened
- Total Length (500mm)
- Module (2)

SRG/SRGF/SRGFD/SRGFK
- Hardened Ground Racks
- Heat Treatment: Thermal refined
- Total Length (500mm)
- Module (2)

SRF-H/SRFD-H
- Hardened Racks
- Heat Treatment: Thermal refined
- Total Length (500mm)
- Module (2)
**Racks**

KHK stock racks are made for high precision linear motion applications. We offer a large selection of racks ranging from module 0.5 to 10 and lengths from 100 to 2000 mm. The following table lists the main features.

### Racks

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Module</th>
<th>Total length</th>
<th>Pitch/number of teeth</th>
<th>Material</th>
<th>Heat Treatment</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRGB/MRGBFD</td>
<td>1.5 to 3</td>
<td>500</td>
<td>SCM415</td>
<td>Cut</td>
<td>1</td>
<td>A ground rack made of carburized chrome steel. Our highest-performance rack, with accumulated pitch error of 10µm or less. J Series products are also available.</td>
</tr>
<tr>
<td>KRGB-KRGBFD-H</td>
<td>1.5 to 3</td>
<td>500, 1000</td>
<td>SCM440</td>
<td>Ground</td>
<td>1</td>
<td>High strength and abrasion-resistant for precision linear motion. J Series products are also available.</td>
</tr>
<tr>
<td>SRF/SSRF/SSRFD/SSRFK</td>
<td>0.5 to 6</td>
<td>50, 100, 1500, 2000</td>
<td>545C</td>
<td>Cut 4</td>
<td>Coated with a unique shape patented by KHK. It is also effective for reducing noise.</td>
<td></td>
</tr>
<tr>
<td>KRF-KRFD-H</td>
<td>1.5 to 5</td>
<td>1000</td>
<td>SCM440</td>
<td>Cut 5</td>
<td>Stable hardened racks with high strength, long life span are reasonably priced. J Series products are also available.</td>
<td></td>
</tr>
<tr>
<td>SRF/SSRF/SSRFD/SRFD</td>
<td>1 to 4</td>
<td>1000</td>
<td>545C</td>
<td>Cut 4</td>
<td>J Series products are also available.</td>
<td></td>
</tr>
<tr>
<td>RU/SSRO/SSROF</td>
<td>1 to 4</td>
<td>500, 1000</td>
<td>SUS304</td>
<td>Cut 5</td>
<td>Suitable for food machinery due to SUS304's rust resistance qualities. J Series products are also available.</td>
<td></td>
</tr>
<tr>
<td>DPP/DFP/DFD</td>
<td>1 to 3</td>
<td>500, 1000</td>
<td>Polyurethane</td>
<td>Cut 5</td>
<td>Light-weight products made of MC Nylon can be used without lubrication.</td>
<td></td>
</tr>
<tr>
<td>BSR</td>
<td>0.5 to 1</td>
<td>300</td>
<td>M25-44</td>
<td>Cut 4</td>
<td>Small pitch racks made of free-cutting brass (C3604), excellent workability and high rust resistance.</td>
<td></td>
</tr>
<tr>
<td>SRO/SROS</td>
<td>1 to 6</td>
<td>500, 1000</td>
<td>545C</td>
<td>Cut 4</td>
<td>High strength and abrasion-resistant characteristics. J Series products are also available.</td>
<td></td>
</tr>
<tr>
<td>SRD/SSRFD/SSRFD</td>
<td>2 to 3</td>
<td>100, 500, 1000</td>
<td>545C</td>
<td>Cut 4</td>
<td>Effective in reducing noise and vibration due to large contact ratio of helical gears.</td>
<td></td>
</tr>
<tr>
<td>SRH/SSRF/SSF</td>
<td>1.5 to 6</td>
<td>1000</td>
<td>545C</td>
<td>Cut 4</td>
<td>General-purpose helical racks with product dimensions and helix angle (19° 31’ 41”) according to EU specifications.</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

- [NOTE 1] The catalog numbers in the above tables with a suffix of F have both ends machined so that they can be butt welded against each other to make any desired length. The items with D and D have mounting screw holes for easier assembly.
- [NOTE 2] Products with module less than 0.6 are thermal refined, without their gear teeth being induction hardened.
- [NOTE 3] J Series products are also available.

### Pinion

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Module</th>
<th>Total length</th>
<th>Pitch/number of teeth</th>
<th>Material</th>
<th>Heat Treatment</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHE</td>
<td>1.5 to 6</td>
<td>(18 to 30)</td>
<td>545C</td>
<td>Cut</td>
<td>A product designed so that the helix angle is 19° 31’ 41” and the distance of the pinion traveled in one turn is an integer (mm).</td>
<td></td>
</tr>
</tbody>
</table>

**For safe handling and to prevent damage such as deformation, KHK stock racks have round chamfering at the corners of the top land of the gear tooth.**

This rounded chamfered shape is patented by KHK. It is also effective for reducing noise.

- Black products are KHK stock gears that have an applied black oxide coating for rust resistance; this “blackness” is a product characteristic of KHK stock gears.

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**Application Examples**

KHK stock racks & pinions are adopted in driving devices for all kinds of linear motion systems, including transport devices.

- **Automatic packaging machine manufactured by Toyota Machinery Co., Ltd.**
  - SRH stainless steel rack used for film winding tension part
  - PR plastic rack used for feeding Long Strip Cutter
  - PR rack used for label feeding

- **Lathe Auto Loader**
  - SRGFD-HL ground gear rack used as a workpiece conveying device
  - SRO Round Rack used as a workpiece storage device (lifting/lowering table)
  - SRGFD-HL ground gear rack used as a workpiece conveying device

- **Packaging Machine**
  - SR Rack used for label feeding
  - SRO Round Rack used for positioning
  - SR Rack used for label feeding

- **Extruder (design example)**
  - SRGFD-HL ground gear rack used as a workpiece conveying device

- **Film Sealer**
  - SR Rack used for label feeding
  - SR Rack used for label feeding

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**KHK Technical Information**
KHK Technical Information

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. With the exception of helical racks, KHK stock racks can mate with any spur gears of the same module. Products with different tooth width can also be mated as a pinion.
2. There are limited choices of mating gears for KRHG/ KRGF, SRHF, and SRH Ground Helical Racks and Helical Racks. Be sure to check the helix direction (right or left) when selecting.

2. Caution in Selecting Gears Based on Gear Strength

Allowable bending strength and surface durability values shown in product tables were computed by assuming a certain application environment. 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

| Gear Type | Catalog Number | Module | Effective Tooth Number | Racks/LH | RH | LH | DRF/SDF | PRF/PRF
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MRG Series</td>
<td>MRG-H</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-F</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-G</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-H</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-F</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-G</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-H</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-F</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-G</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
</tbody>
</table>

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

| Gear Type | Formula | Bending stress | Allowable bending stress (kgf/mm²) | Materials | Surface Durability | Notes
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MRG Series</td>
<td>MRG-H</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-F</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-G</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-H</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-F</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-G</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-H</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-F</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
<tr>
<td>MRG Series</td>
<td>MRG-G</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
<td>2.5</td>
<td>100</td>
</tr>
</tbody>
</table>

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, 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

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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.

#### 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.

### 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

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

### 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.

Strength confirmation is simple when using the website.
### 3. Cautions on Selecting Racks By Precision

The precision standards of KHK stock racks are established by us. The table below indicates the tolerance ranges of our racks.

#### 1. Pitch Errors of Racks (KHK R 001)

Our precision grades for pitch errors are established by referring to JIS Standards. The precision grades are set from 1 to 8, in accordance with the tolerance of a single pitch error (S.P.E.), adjacent tooth-to-tooth error (T.T.E.), and the total composite error (T.C.E.) for each module and length.

#### Precision Grades of Racks (KHK R 001)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Unit: µm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over m1.4 to 1</td>
</tr>
<tr>
<td></td>
<td>CPS</td>
</tr>
<tr>
<td>T.C.E.</td>
<td></td>
</tr>
<tr>
<td>S.P.E.</td>
<td></td>
</tr>
<tr>
<td>T.T.E.</td>
<td></td>
</tr>
</tbody>
</table>

#### Dimensional Tolerance of Hardened Products

Independent of the precision grade, the dimensional tolerances are a maximum of 0.15 mm for module (m) and 0.1 mm for the Rack Length (nominal).

#### Pitch and inspection

A sample report using the Karl Zeiss UMC-550 Coordinate Measuring Machine is shown.

#### 2. Precision of Rack Blanks

<table>
<thead>
<tr>
<th>Face width</th>
<th>Tolerance for 1</th>
<th>Grades 2 to 5</th>
<th>Grades 6 or 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 0.05</td>
<td>-0.10</td>
<td>-0.11</td>
<td>-0.12</td>
</tr>
<tr>
<td>0.1 to 0.15</td>
<td>0.10</td>
<td>0.11</td>
<td>0.12</td>
</tr>
</tbody>
</table>

#### 3. Backlash of Rack Teeth (Amount of Tooth Thinning)

<table>
<thead>
<tr>
<th>Module (m)</th>
<th>Grade 1 &amp; 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
<th>Grade 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tooth Thinning (m)</td>
<td>Tooth Thinning (m)</td>
<td>Hardened Product</td>
<td>Stainless Steel/Rolled Racks</td>
</tr>
<tr>
<td>m0.5</td>
<td>0 to 0.07</td>
<td>0 to 0.08</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>m0.6, CP2.5</td>
<td>0 to 0.06</td>
<td>0 to 0.08</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>m1</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.04 to 0.13</td>
<td>0.04 to 0.15</td>
</tr>
<tr>
<td>m1.5, CP5</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.04 to 0.15</td>
<td>0.02 to 0.17</td>
</tr>
<tr>
<td>m2</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.05 to 0.16</td>
<td>0.03 to 0.18</td>
</tr>
<tr>
<td>m3</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.06 to 0.16</td>
<td>0.04 to 0.20</td>
</tr>
<tr>
<td>m4</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.07 to 0.18</td>
<td>0.05 to 0.22</td>
</tr>
<tr>
<td>m5, CP15</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.08 to 0.22</td>
<td>0.06 to 0.26</td>
</tr>
<tr>
<td>m6</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.09 to 0.24</td>
<td>0.08 to 0.26</td>
</tr>
<tr>
<td>m7</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.10 to 0.28</td>
<td>0.09 to 0.26</td>
</tr>
<tr>
<td>m8</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.13 to 0.32</td>
<td>0.10 to 0.26</td>
</tr>
<tr>
<td>m9</td>
<td>0 to 0.06</td>
<td>0 to 0.10</td>
<td>0.15 to 0.34</td>
<td>0.11 to 0.26</td>
</tr>
</tbody>
</table>

#### Backlash of Rack & Pinion

The backlash of assembled rack and pinion is given by:

\[
\text{Backlash (rack + pinion)} = \text{Amount of tooth thinning of the rack} + \text{Amount of tooth thinning of the pinion}
\]
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. Long racks and resin-identiforms are very delicate; please handle with care.

2. Cautions on Performing Secondary Operations

① Secondary operations can be performed on all KHK stock racks except for the racks with their gear teeth induction hardened. To avoid problems of gear precision, do not reduce the face width. The precision of ground racks and racks with mounting holes may drop if you do not exercise extreme caution during installation or while modifying.

② Pitch lines of racks are controlled by using the bottom surface as the reference datum and over-pin measurements on tooth thickness. If you machine the bottom surfaces, the precision of the racks may be affected.

③ When connecting two racks, the machining of the mating end requires careful consideration in terms of the pitch (p) accuracy. The meshing will be poor if the pitch straddling the connection has a positive tolerance. We recommend a minus tolerance on pitch of at the connection.

The below is an indication of pitch tolerance for each module.

<table>
<thead>
<tr>
<th>Module</th>
<th>Pitch p</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>m0.5</td>
<td>1.37</td>
<td>±0.15</td>
</tr>
<tr>
<td>m0.8</td>
<td>2.71</td>
<td>±0.25</td>
</tr>
<tr>
<td>m1</td>
<td>5.14</td>
<td>±0.31</td>
</tr>
<tr>
<td>m1.5</td>
<td>7.57</td>
<td>±0.31</td>
</tr>
<tr>
<td>m2</td>
<td>9.99</td>
<td>±0.31</td>
</tr>
<tr>
<td>m2.5</td>
<td>12.42</td>
<td>±0.31</td>
</tr>
<tr>
<td>m3</td>
<td>14.85</td>
<td>±0.31</td>
</tr>
<tr>
<td>m4</td>
<td>19.77</td>
<td>±0.4</td>
</tr>
<tr>
<td>m5</td>
<td>25.19</td>
<td>±0.4</td>
</tr>
<tr>
<td>m6</td>
<td>31.61</td>
<td>±0.4</td>
</tr>
<tr>
<td>m10</td>
<td>52.33</td>
<td>±0.4</td>
</tr>
</tbody>
</table>

④ To use dowel pins to secure racks, attach the racks to the base and drill both simultaneously.

⑤ KHK stock racks made of S45C and SCM440 (except for ground racks) can be induction hardened. However, the precision of pitch is decreased.

⑥ To be able to handle parts safely, all burrs and sharp corners should be removed after the secondary operations are done.

⑦ If you are going to modify the gear by gripping the teeth, please exercise caution not to crush the teeth by applying too much pressure. Any scarring will cause noise during operation.

⑧ If the racks are not secured properly to the base, they could shift during operation and cause unexpected problems. It is very important to inscribe mounting by the use of dowel pins or similar devices.

⑨ KHK type of KHK stock ground racks have four surfaces ground parallel with high precision. To maintain true angle, they should be mounted on high precision bases hardened. To avoid problems of gear precision, do not deform particularly easily, so please handle with care.

⑩ Secondary operations can be performed on all KHK stock racks except for the racks with their gear teeth induction hardened. To avoid problems of gear precision, do not reduce the face width. The precision of ground racks and racks with mounting holes may drop if you do not exercise extreme caution during installation or while modifying.

⑪ When connecting two racks, the machining of the mating end requires careful consideration in terms of the pitch (p) accuracy. The meshing will be poor if the pitch straddling the connection has a positive tolerance. We recommend a minus tolerance on pitch of at the connection.

3. Points of Caution during Assembly

① KHK stock racks are designed to give the proper normal direction backlash when assembled using the mounting distance given by the formula below (mounting distance tolerance of H7 to H8 required). The backlash values are given in the table on Page 193. Make sure that the mounting distance stays constant for the length of the rack.

\[ d = \frac{m}{t} \times n \]

\[ d = \text{Height of pitch line of rack + Pitch radius of pinion} \]

[NOTE] Pins are assumed to be standard stock spur gears (X=6).

② KHK type of KHK stock ground racks have four surfaces ground parallel with high precision. To maintain true angle, they should be mounted on high precision bases hardened. To avoid problems of gear precision, do not deform particularly easily, so please handle with care.

How to mount racks on a mounting base (For SRFD2-1000)

1. Pitch alignment

Place SRFD2-1000 on the mounting base, align SR2-100 and temporarily tighten the bolt.

2. Securing to the mounting base

Drill and secure dowel pins or similar devices.

3. Run the pinion and check the following

Is the backlash appropriate?
Is there abnormal noise or vibration?

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?
- If gears are exposed, be sure to attach a safety cover to ensure safety. Also, be careful not to touch rotating gears.
- Gear 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.

② For more technical information, please see the section “Gear Lubrication” (Page 112) of our technical reference book.

③ If there is any abnormality such as noise or vibration during startup, check the gears and assembly condition.

④ 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 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.
3. Turn off the power switch.
4. Do not touch or come under the product.
5. 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.
Since racks are a simple mechanism, the material, hardening, strength and precision can be designed according to the environment. They are also inexpensive, with parts that can be purchased separately for replacement. In the designing process, please refer to Features of Racks & Pinions and Ball Screws in the table below.

### Features of Racks & Pinions

#### Advantages
- Few component parts
- Supports heavy loads
- Compact products can be manufactured
- High transmission efficiency
- High feed speed
- No length limit
- Flexible production is available
- High-precision products can be manufactured
- Can be used for food-related machinery
- No backlash

#### Details
- Since it does not have parts such as balls and retainers, there is less risk of accidentally falling apart during assembly and disassembly.
- Gear grinding can be provided to minimize pitch error.
- It does not have parts such as balls and retainers, reducing the risk of parts falling apart during assembly and disassembly.
- Gear grinding can be provided to minimize pitch error.
- No backlash may become a problem in forward/reverse rotation positioning.
- Lubrication is required
- Metal racks require lubrication. Plastic racks do not require lubrication at light loads, but their precision is lower.

#### Disadvantages
- Backlash is present
- Backlash is required for smooth rotation. Backlash may become a problem in forward/reverse rotation positioning.
- Lubrication is required
- Metal racks require lubrication. Plastic racks do not require lubrication at light loads, but their precision is lower.

### Features of Ball Screws

#### Advantages
- High transmission efficiency
- High feed speed
- No backlash
- High-precision products can be manufactured
- Can be used for food-related machinery
- No length limit
- High feed speed
- High transmission efficiency

#### Details
- High transmission efficiency is more than 95%. (excluding lubrication oil stirring resistance and bearing resistance)
- High-precision ball screws can be manufactured by grinding.
- The use of pressure eliminates backlash.

#### Disadvantages
- Length is limited
- Hard to manufacture special products

#### Details
- The screw deflection, about 2 meters is the practical limit.
- Since it is hard to manufacture special products, machines must be adjusted to the shape of the ball screw.

### Comparison of Racks & Pinions and Ball Screws

Since racks are a simple mechanism, the material, hardening, strength and precision can be designed according to the environment. They are also inexpensive, with parts that can be purchased separately for replacement. In the designing process, please refer to Features of Racks & Pinions and Ball Screws in the table below.

### Features of Ball Screws

#### Advantages
- High transmission efficiency
- High feed speed
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### Comparison table of permissible transmission force of hardened racks

<table>
<thead>
<tr>
<th>Catalog Numbers (Comparison Example)</th>
<th>Material</th>
<th>Heat Treatment</th>
<th>Allowable force (kgf)</th>
<th>Bending strength</th>
<th>Surface durability</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRF3-1000</td>
<td>SCM440</td>
<td>Laser hardened</td>
<td>600</td>
<td>1000</td>
<td>1500</td>
</tr>
<tr>
<td>SRF3-1000H</td>
<td>SCM440</td>
<td>Laser hardened</td>
<td>600</td>
<td>1000</td>
<td>1500</td>
</tr>
<tr>
<td>SRF3-1000L</td>
<td>SCM440</td>
<td>Thermal refined</td>
<td>600</td>
<td>1000</td>
<td>1500</td>
</tr>
<tr>
<td>MRGF 3-500 (2 units)</td>
<td>SCM410</td>
<td>Carburetion</td>
<td>600</td>
<td>1000</td>
<td>1500</td>
</tr>
</tbody>
</table>

### Rack downsizing

The H Series, KHK stock racks with induction hardened gear teeth, and the HL Series, with laser hardening, are available. The graph below simulates the downsizing of KHK stock racks. It is possible to reduce the module (size) with equivalent transmission power, or to reduce the price likewise. Please select a product that fits your needs.

### Example of rack downsizing

The surface durability can be increased by hardening the gear teeth. By increasing the strength thus, the angular dimensions of modules and racks can be reduced. This helps reduce the cost.