Avoid performing secondary operations that narrow the tooth width, as it affects precision and strength.

When used as speed reducers, the input is the sun gear and the output is the carrier.

Selection of the number of teeth also enables you to create various planetary gears with different transmission ratios.

The velocity ratio is calculated using the following formula:

\[ \text{Velocity ratio} = \frac{z_1}{z_2} \]

where:
- \( z_1 \) is the number of teeth of the sun gear,
- \( z_2 \) is the number of teeth of the planetary gear (also known as the number of teeth of the planet carrier).

Note 1: In planetary gear systems, multiple teeth on the planetary gear are meshed with the sun gear, leading to decentralized load distribution. This allows planetary gears to have higher efficiency compared to spur gears.

Note 2: In planetary gear systems, the sun gear is the input and the planet carrier is the output. Planetary gears are used in many applications due to their ability to achieve high reduction ratios with a compact design.
**Internal Gears**

### Features

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**

- KSI
- KSR

**Module**

- 0.5 to 3
- 3 to 7

**Material**

- 54Cr
- 54Cr

**Heat Treatment**

- Cut
- Cut

**Tooth Surface Finish**

- Cut
- Cut

**Precision**

- ANSI
- 8
- 9

**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 teeth. It can be cut to make segment gears and corner sags.

**Application Examples**

Internal gears are used to reduce the size of various equipment, such as reduction gears.

#### Example of combinations

<table>
<thead>
<tr>
<th>No. of teeth of Internal Gear</th>
<th>No. of teeth of Pinion Gear</th>
<th>Reduction ratio</th>
<th>Reduction ratio of module type</th>
<th>Reduction ratio of module type</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>3</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>80</td>
<td>3</td>
<td>16</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>100</td>
<td>20</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

#### Types of planetary gear reduction mechanism

- **(a) Planetary type**
  - Diameter of pinion: Dp
  - Diameter of pinion: Dp

- **(b) Sun type**
  - Diameter of pinion: Dp
  - Diameter of pinion: Dp

- **(c) Star type**
  - Diameter of pinion: Dp
  - Diameter of pinion: Dp

**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

Internal gears can mate with any spur gears of the same module; however, there are cases of involute, trochoidal, and trimming interference occurrences, depending on the number of teeth of the mating gear. The table below contains the assumptions established for these product-sets in order to compute gear strengths.

#### Interferences and the symptoms

<table>
<thead>
<tr>
<th>Type</th>
<th>SYMPTOMS</th>
<th>CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involute Interference</td>
<td>The tip of the internal gear digs into the root of the pinion.</td>
<td>Too few teeth on the pinion.</td>
</tr>
<tr>
<td>Trochoidal Interference</td>
<td>The exiting pinion tooth contacts the internal gear tooth.</td>
<td>Too little difference in number of teeth of the two gear types.</td>
</tr>
<tr>
<td>Trimming Interference</td>
<td>Pinion can slide in or out axially but cannot move radially.</td>
<td>Too little difference in number of teeth of the two gear types.</td>
</tr>
</tbody>
</table>

#### Allowable Mating Pinions and Number of Teeth

<table>
<thead>
<tr>
<th>No. of teeth of Internal Gear</th>
<th>No. of teeth of Allowable Mating Pinions</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>22</td>
</tr>
<tr>
<td>60</td>
<td>21</td>
</tr>
<tr>
<td>70</td>
<td>20</td>
</tr>
<tr>
<td>80</td>
<td>19</td>
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<td>90</td>
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<td>150</td>
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<td>160</td>
<td>11</td>
</tr>
<tr>
<td>170</td>
<td>10</td>
</tr>
<tr>
<td>180</td>
<td>9</td>
</tr>
<tr>
<td>190</td>
<td>8</td>
</tr>
<tr>
<td>200</td>
<td>7</td>
</tr>
</tbody>
</table>

### Calculation of Bending Strength of Gears

#### Formula

\[
S = \frac{1.15H}{n_{a}}
\]

- **S**: Allowable bending stress at root
- **H**: Kinematic viscosity of lubricant (100cSt (50° C))
- **n_a**: Speed factor

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

- **Formula**

#### Gear Ratio and Direction of Rotation

- **Gear Ratio**
- **Direction of Rotation**

### Application Hints

In order to use KHK stock internal gears safely, read the Application Hints carefully before proceeding. Please refer to Page 26 for “Caution on Handling” and Page 27 for “Caution on Starting”.

**Condition 1**: 

\[
\frac{z_1}{z_2} < 1
\]

**Condition 2**: 

\[
\frac{z_1}{z_2} = n
\]

**Condition 3**: 

\[
\frac{z_1}{z_2} > 2\left(1 + \frac{n}{2}\right) \leq 180
\]

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.
   - Turn off the power switch.
   - Do not reach inside 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 ISO9001 quality management system. If you notice any malfunctions upon purchasing a product, please contact the supplier.