Components for parallel kinematics
Series GLK, GLAE

Joints and struts form the core components of machines with parallel kinematics (PKM). Irrespective of the control technology possibilities, good mechanical characteristics remain indispensable. These essentially determine the achievable rigidity and accuracy. INA PKM components were developed in order to fulfil the requirements of the various areas of application.

For the flexible linkage of the struts to the machine framework and the platform, INA offers cardanic joints with two or three degrees of freedom and ball joints whose design is matched to the area of application; for machine tools, these are high rigidity and documented accuracy, while for handling equipment large swivel angles and low mass are the primary requirements.

The telescopic struts are now available as catalogue items in two proven series with stroke length scales. Depending on the application, either ball screw drives or planetary roller screws with various pitch values can be used.

In short: the range offers improved cost-effectiveness for high precision movements through standardised sizes with numerous degrees of freedom. Naturally, individual customer solutions can also be designed as before.
Components for parallel kinematics

Ball joints
with three degrees of freedom

Cardanic joints
with two or three degrees of freedom

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**Features**

**Ball and cardanic joints**
Ball and cardanic joints for parallel kinematics:
- have, depending on their design, two or three degrees of freedom
- have very high rigidity and load carrying capacity
- are preloaded and thus clearance-free
- run smoothly and free from stick-slip
- have swivel angles appropriate to the design
- have a defined joint intersection point
- are sealed
- are greased using a special grease and can be relubricated.

**Ball joints**
- are complete units comprising:
  - a ball stud with an external thread, a ball socket with a centring device, a half-ball, a concave seal carrier and a locknut
  - a large number of small balls. As a result, the Hertzian pressure between the ball socket, half-ball, ball stud and rolling elements remains at a low level
  - a lubrication adapter for a polyamide tube to DIN 73 378
- have three degrees of freedom
- have a swivel angle of ±20°, optionally up to ±30°
- are coated with Corrotect®.

**Cardanic joints**
- are complete units comprising:
  - a joint yoke with a centring device, a crosspin and preloaded, sealed radial and axial needle roller bearings
- have either two or three degrees of freedom
  - the third degree is freedom is achieved by means of a radial/axial bearing combination in the head of the crosspin
- have maximum swivel angles
  - in axis I up to ±45°
  - in axis II up to ±90°
  - in axis III up to ±360°.
Telescopic struts

Features

Telescopic struts

Telescopic struts for parallel kinematics:

- are complete units comprising:
  - a sliding tube and fixed tube, a drive spindle with a nut,
  - a four-row axial angular contact ball bearing DKLFA and
    four linear ball bearing units KUVS
- can be fitted with INA ball and cardanic joints
  - the joint type depends on the application and
    can be freely selected by the customer
- are fitted, depending on the required rigidity,
  with a ball screw spindle or a planetary roller screw
  - the rigidity is defined in accordance with customer
    requirements
  - the four-row axial angular contact ball bearing DKLFA
    allows high spindle speeds with maximum rigidity
- can support tensile and compressive forces
- are suitable for high feed speeds
- run extremely accurately, smoothly and free from stick-slip
- are clearance-free in all directions due to the high torsional
  rigidity of the linear guidance systems and the raceways
  ground on the surface of the sliding tube
- have a low mass due to the dimensioning of the
  components
- can be supplied with a Corrotect® coating
- are produced with sliding tube diameters of 70 mm
  and 80 mm
  - other sizes may be available by agreement
- allow, in conjunction with the ball and cardanic joints,
  compact designs with a reduced number of components.
Basic load ratings for ball and cardanic joints

Maximum load carrying capacity
The maximum load carrying capacity $P_{\text{max}}$ of ball joints is shown in Figure 1.
It depends on:
- the size of the joint
- the direction of the load (tensile/compressive load).

Basic static load ratings for cardanic joints
The basic static load ratings $C_0$ are shown in Figure 2.
They depend on:
- the type of joint
- the swivel angle $\beta$.
The basic static load rating $C_0$ is only influenced by the swivel angle $\beta$. The swivel angles $\alpha$ and $\gamma$ have no influence on the basic static load rating.

Static load safety factor
⚠️ The static load safety factor $S_0$ must be $\geq 4$!
For other static load safety factors, INA must be consulted!

Figure 1 · Maximum load carrying capacity $P_{\text{max}}$

Figure 2 · Basic static load ratings $C_0$ as a function of the swivel angle $\beta$
# Bearings for cardanic support

## Dimension table - Dimensions in mm

<table>
<thead>
<tr>
<th>F-number</th>
<th>Mass (kg)</th>
<th>Dimensions</th>
<th>Basic load ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>d</td>
<td>D</td>
</tr>
<tr>
<td>F-231091</td>
<td>0.35</td>
<td>25</td>
<td>57</td>
</tr>
<tr>
<td>F-233697</td>
<td>0.39</td>
<td>30</td>
<td>62</td>
</tr>
<tr>
<td>F-232183</td>
<td>0.4</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

### F-231091, F-233697
- Axial angular contact ball bearings
- Coupling and swiveling bearing arrangement

### F-232183
- Axial angular contact ball bearings
- Coupling and swiveling bearing arrangement

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**Supply with inspection certificate**

Axial angular contact ball bearings F-231091, F-233697, coupling and swiveling bearing arrangement F-232183
## Telescopic struts

Series GLAE

<table>
<thead>
<tr>
<th>Designation</th>
<th>Diameter of sliding tube</th>
<th>Dimensions</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>d3</th>
<th>Mₘ</th>
<th>Lₘₘ</th>
<th>L₁</th>
<th>L₂</th>
<th>L₃</th>
<th>Stroke length</th>
<th>Spindle diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLAE F-232220</td>
<td>70</td>
<td></td>
<td>70</td>
<td>130</td>
<td>90</td>
<td>120</td>
<td>30₁)</td>
<td>94₁)</td>
<td>114₁)</td>
<td>50₁)</td>
<td>85₁)</td>
<td>–</td>
<td>600</td>
<td>800</td>
</tr>
<tr>
<td>GLAE F-236437</td>
<td>80</td>
<td></td>
<td>80</td>
<td>170</td>
<td>130</td>
<td>130</td>
<td>45₁)</td>
<td>138₀</td>
<td>124₁)</td>
<td>95₀</td>
<td>56₃</td>
<td>900</td>
<td>50₀</td>
<td>950</td>
</tr>
</tbody>
</table>

₁) Dependent on the adjacent construction. To be defined by the customer.

₂) Dependent on the joint type.

₃) Other sizes may be available by agreement.
Hole pattern for GLAE F-232220

Hole pattern for GLAE F-236437
Swivelling rotary/cardanic joints

with two degrees of freedom
Series GLK 2

with three degrees of freedom
Series GLK 3

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**Dimension table - Dimensions in mm**

<table>
<thead>
<tr>
<th>Designation</th>
<th>F-number</th>
<th>Mass (kg)</th>
<th>Degrees of freedom</th>
<th>Swivel angle (°)</th>
<th>Fixing screws</th>
<th>Lubrication nipple</th>
<th>Basic load ratings</th>
<th>Rigidity (Cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLK 3</td>
<td>F-237169</td>
<td>1</td>
<td>3</td>
<td>360 × 90 × 360°</td>
<td>M1, M2</td>
<td>NIP DIN 3 405</td>
<td>4,2</td>
<td>50</td>
</tr>
<tr>
<td>GLK 2</td>
<td>F-237169.1</td>
<td>0,95</td>
<td>2</td>
<td>90 × 360°</td>
<td></td>
<td></td>
<td>4,2</td>
<td>50</td>
</tr>
<tr>
<td>GLK 3</td>
<td>F-232919.1</td>
<td>7</td>
<td>3</td>
<td>90 × 45 × 360°</td>
<td>M8 × 30, M8 × 60</td>
<td>AM 8 × 1</td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>GLK 2</td>
<td>F-232920.1</td>
<td>7</td>
<td>2</td>
<td>90 × 45</td>
<td>M8 × 30, M8 × 60</td>
<td>AM 8 × 1</td>
<td>450</td>
<td></td>
</tr>
</tbody>
</table>

1) Measured and documented.
2) Basic load ratings: see diagram, page 4.
3) Ensure prior orientation.
Swivel angles $\alpha$ and $\beta$.

F-232920.1 with two degrees of freedom.

F-232919.1 with three degrees of freedom.

1) Flatness of adjacent surface

* documented
Ball joint
with three degrees of freedom
Series GLK

<table>
<thead>
<tr>
<th>Designation</th>
<th>F-number</th>
<th>Mass</th>
<th>Degrees of freedom</th>
<th>Swivel angle °</th>
<th>Dimensions</th>
<th>Basic load ratings</th>
<th>Rigidity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>m=kg</td>
<td></td>
<td>α</td>
<td>β</td>
<td>γ</td>
<td>H</td>
</tr>
<tr>
<td>GLK</td>
<td>F-232956</td>
<td>2.3</td>
<td>3</td>
<td>20 × 20 × 360</td>
<td>144 35 35 35 20 19 10</td>
<td>70 40 32</td>
<td>6</td>
</tr>
<tr>
<td>GLK</td>
<td>F-232386.1</td>
<td>4.5</td>
<td>3</td>
<td>20 × 20 × 360</td>
<td>185 40 50 44 30 21</td>
<td>10 90 55</td>
<td>45</td>
</tr>
</tbody>
</table>

1) Rapid-fit cartridge for polyamide tube to DIN 73 378/4 x 0.75 with threaded connector M10 x 1, min. 6 mm deep.
2) Measured and documented.
3) At 2 points on circumference.
4) At 6 points on circumference.
5) Basic load ratings: see diagram, page 4.
Application example

PKM machining centre