Driveshafts for Industrial Applications
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Dana: Driveshaft engineering experts  For more than 100 years, Dana’s expertise and worldwide network of manufacturing partnerships have sustained its ability to supply economically efficient, high-performance products to original equipment manufacturers (OEMs) in changing market environments.

Dana has been the industry leader for driveshafts and driveline technologies for more than 100 years. In a constantly changing market, Dana’s global manufacturing network continues to provide application specific, and high-performance product solutions for virtually every major original equipment manufacturer, and aftermarket customers worldwide.

With a focus on technical innovation, quality performance, reliability, and flexibility, Dana engineers continue to provide customers with the same quality and support they’ve come to expect.

Since 1946, Dana’s GWB™ driveshafts have been known for global innovation and quality performance. GWB heavy driveshafts were the first to be developed specifically for diesel locomotives. In the 1950s, GWB driveshafts were the largest available at that time, and were followed several decades later by the first maintenance-free driveshaft. Based on a long-standing commitment to continual innovation and customer satisfaction, GWB driveshafts have been recognized as a market leader throughout the world.
Today, there are basically two types of driveshafts that have evolved into a worldwide technology standard. Their main difference lies in the design of the bearing eye.

**Closed bearing eye:** This is a design used mainly in the commercial vehicles sector and for general mechanical engineering applications (series 687/688 and 587).

**Split bearing eye:** Developed for heavy and super-heavy duty applications, this design (series 390/392/393 and 492/498), provides compact dimensions in conjunction with a maximum torque transmission capability and greatly improved service life, apart from facilitating maintenance and assembly operations.

2.400 - 16.300.000 Nm
Survey of GWB™ driveshaft series

Series

687/688
Torque range $T_{cs}$ to 35 kNm
Flange diameter from 100 to 225 mm

587
Torque range $T_{cs}$ to 57 kNm
Flange diameter from 225 to 285 mm

390
Maximum bearing life
Torque range $T_{cs}$ to 255 kNm
Flange diameter from 285 to 435 mm

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## Survey of GWB™ Driveshaft Series

### Design Features

- Closed bearing eyes
- Compact design
- Low maintenance
- Plastic-coated splines
- Operating angle up to 25°, partly up to 44°

### Preferred Applications

- Railway vehicles
- Rolling mill plants
- Marine drives
- General machinery construction plants

Technical data (refer to data sheets)

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### Design Features

- Closed bearing eyes
- Compact design
- Low maintenance
- Splines coated with lubricating varnish (587.50 – plastic-coated)
- Operating angle up to 24°

### Preferred Applications

- Railway vehicles
- Rolling mill plants
- Marine drives
- General machinery construction plants

Technical data (refer to data sheets)

---

### Design Features

- Maximum bearing life in confined spaces
- Split bearing eyes with toothed bearing cap
- Compact design
- Optimized roller bearing
- Length compensation coated with lubricating varnish
- Operating angle up to 15°

### Preferred Applications

- Railway vehicles
- Marine drives
- Crane systems
- Paper machines
- General machinery construction plants

Technical data (refer to data sheets)
Survey of GWB™ driveshaft series

Series

392/393  High torque capacity/ optimized bearing life
Torque range $T_{CS}$ to 1.150 kNm
Flange diameter from 225 to 550 mm

492  Maximum torque capacity
Torque range $T_{CS}$ to 1.300 kNm
Flange diameter from 285 to 550 mm

498  Larger sizes available on request
Torque range $T_{CS}$ to 15.000 kNm
Flange diameter from 600 to 1.200 mm
Survey of GWB™ driveshaft series

**Design features**

- High torque capacity despite small connecting dimensions
- Split bearing eyes with toothed bearing cap
- Compact design
- Journal cross with low notch factor
- Length compensation coated with lubricating varnish
- Operating angle 10° up to 15°
- Series 393 with optimized bearing life

**Preferred applications**

- Rolling mill plants
- Calender drives
- Heavy-loaded plants of general machinery construction

Technical data (refer to data sheets)

---

**Increased torque capacity in comparison to 393**

- Split bearing eyes with toothed bearing cap
- Standard Hirth-serrated flange
- Journal cross with low notch factor
- Length compensation coated with lubricant varnish
- Operating angle 7° up to 15°

---

**Three operating angle versions for maximum torque or maximum bearing life capacity**

- Split bearing eyes with toothed bearing cap
- Standard Hirth-serrated flange
- Operating angle up to 15°

---

**Main rolling mill drive units**

- Heavy machinery construction plants

Technical data (refer to data sheets)
Special designs of GWB™ driveshafts and additional equipment

Series

587/190/390 Super short designs
Torque range TCS to 130 kNm
Flange diameter from 275 to 405 mm

392/393 Tunnel joint shafts
Torque range TCS to 1.053 kNm
Flange diameter from 225/315 to 550/710 mm

Intermediate shafts
Special designs of GWB™ driveshafts and additional equipment

### Design features

- Closed bearing eyes (series 587)
- Split bearing eyes (series 190/390)
- Joints and length compensation are regreaseable
- Operating angle up to 5°

### Preferred applications

- Railway vehicles
- Rolling mill plants
- Marine drives
- Calender drives
- Paper machines
- General machinery construction plants

Technical data (refer to data sheets)

---

### Additional features

- Shorter designs with large length compensation
- Length compensation through the joint
- High torque capacity with small connection dimensions
- Split bearing eyes with toothed bearing cap
- Bearings with labyrinth seals
- Operating angle up to 10°/7,5°

### Other applications

- Rolling mill plants
- With or without length compensation
- Integrated bearing location

### Other machinery

- Pump drives
- Closed bearing eyes (series 587)
- Split bearing eyes (series 190/390)
- Joints and length compensation are regreaseable
- Operating angle up to 5°
Notations for reviewing data sheets

**Standard designs**

- Driveshaft with length compensation, tubular design
- Driveshaft without length compensation, tubular design
- Driveshaft with length compensation, short design
- Driveshaft without length compensation, double flange shaft design

**Special designs**

- Driveshaft with large length compensation, tubular design
- Driveshaft with length compensation, super short design
Intermediate shafts*

(available with intermediate bearing on request)

Intermediate shaft with length compensation

Intermediate shaft without length compensation

Midship shaft

* Data sheet and/or drawing available on request.
Data sheet series 687/688

0.02  with length compensation, tubular design
0.03  without length compensation, tubular design
9.01  with length compensation, short design
9.04  without length compensation, double flange shaft design

Design

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>687/688.15</th>
<th>687/688.20</th>
<th>687/688.25</th>
<th>687/688.30</th>
<th>687/688.35</th>
<th>687/688.40</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T_{CS}</strong> kNm</td>
<td>2.4</td>
<td>3.5</td>
<td>5</td>
<td>6.5</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td><strong>T_{DW}</strong> kNm</td>
<td>0.7</td>
<td>1.0</td>
<td>1.6</td>
<td>1.9</td>
<td>2.9</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>L_{c}</strong> mm</td>
<td>1.79 \times 10^{-4}</td>
<td>5.39 \times 10^{-4}</td>
<td>1.79 \times 10^{-3}</td>
<td>2.59 \times 10^{-3}</td>
<td>0.0128</td>
<td>0.0422</td>
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<table>
<thead>
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<th>b (°)</th>
<th>25</th>
<th>25</th>
<th>25</th>
<th>25</th>
<th>25</th>
<th>44</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (mm)</td>
<td>100</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>150</td>
<td>180</td>
</tr>
<tr>
<td>K (mm)</td>
<td>90</td>
<td>98</td>
<td>113</td>
<td>127</td>
<td>127</td>
<td>144</td>
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<tr>
<td>B (± 0.1 mm)</td>
<td>84</td>
<td>101.5</td>
<td>101.5</td>
<td>101.5</td>
<td>130</td>
<td>155.5</td>
</tr>
<tr>
<td>C (H)</td>
<td>57</td>
<td>75</td>
<td>75</td>
<td>90</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>F ^2 (mm)</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>G (mm)</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>H (± 0.2 mm)</td>
<td>8.25</td>
<td>10.25</td>
<td>10.25</td>
<td>10.25</td>
<td>12.25</td>
<td>14.1</td>
</tr>
<tr>
<td>P ^2 (°)</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>M (mm)</td>
<td>48</td>
<td>54</td>
<td>70</td>
<td>72</td>
<td>78</td>
<td>90</td>
</tr>
<tr>
<td>S (mm)</td>
<td>63.5 x 2.4</td>
<td>76.2 x 2.4</td>
<td>89 x 2.4</td>
<td>90 x 3</td>
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<td>120 x 3</td>
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<tr>
<td>W (DIN 5480)</td>
<td>36 x 1.5</td>
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<td>45 x 1.5</td>
<td>48 x 1.5</td>
<td>48 x 1.5</td>
<td>62 x 1.75</td>
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</table>

**T_{CS}** = Functional limit torque*  
*If the permissible functional limit torque T_{CS} is to be fully utilized, the flange connection must be reinforced.

**T_{DW}** = Reversing fatigue torque*  
*See specifications of driveshafts.

**L_{c}** = Bearing capacity factor*  

**b** = Maximum deflection angle per joint

Tubular shafts with welded-on balancing plates have lower fatigue torques T_{DW}:

1) Effective spigot depth
2) Number of flange holes
L_z min = Shortest possible compressed length

L_a = Length compensation

L_{f min} = Shortest fixed length

L_z + L_a = Maximum operating length

G = Weight of shaft

G_{R} = Weight per 1.000 mm tube

J_m = Moment of inertia

J_{mR} = Moment of inertia per 1.000 mm tube

\( C = \text{Torsional stiffness of shaft without tube} \)

\( C_{R} = \text{Torsional stiffness per 1.000 mm tube} \)

### Data sheet series 687/688

#### Design

<table>
<thead>
<tr>
<th>Design</th>
<th>Shaft size</th>
<th>687/688.15</th>
<th>687/688.20</th>
<th>687/688.25</th>
<th>687/688.30</th>
<th>687/688.35</th>
<th>687/688.40</th>
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<tr>
<td>0.02</td>
<td>L_{z min}</td>
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<td>mm</td>
<td>mm</td>
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<tr>
<td></td>
<td>L_z</td>
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<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
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<tr>
<td></td>
<td>G</td>
<td>kg</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>J_m</td>
<td>kgm^2</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
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<tr>
<td></td>
<td>J_{mR}</td>
<td>kgm^2</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td>C</td>
<td>Nm/rd.</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td>C_{R}</td>
<td>Nm/rd.</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
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<tr>
<td></td>
<td>L_z</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>kg</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>J_m</td>
<td>kgm^2</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
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<td>mm</td>
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<tr>
<td></td>
<td>J_{mR}</td>
<td>kgm^2</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
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<td>mm</td>
</tr>
<tr>
<td>C</td>
<td>Nm/rd.</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
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<tr>
<td>C_{R}</td>
<td>Nm/rd.</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
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<td>mm</td>
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<tr>
<td>0.04</td>
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<td>mm</td>
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<td>mm</td>
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<tr>
<td></td>
<td>L_z</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td>9.01</td>
<td>L_{z min}</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>L_z</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td>9.03</td>
<td>L_{z min}</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>L_z</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td>9.04</td>
<td>L_{z min}</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
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</table>
### Data sheet series 687/688

<table>
<thead>
<tr>
<th>Design</th>
<th>9.01 with length compensation, short design</th>
<th>9.04 without length compensation, double flange shaft design</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.02 with length compensation, tubular design</td>
<td>0.03 without length compensation, tubular design</td>
</tr>
</tbody>
</table>

#### Design

![Diagram of a shaft system](image)

#### Table

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>TC5</th>
<th>TDW</th>
<th>Lc</th>
<th>β</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kNm</td>
<td>kNm</td>
<td></td>
<td></td>
<td>DIN 5480</td>
</tr>
<tr>
<td>687/688.45</td>
<td>17</td>
<td>5.1</td>
<td>0.13</td>
<td>(25)°</td>
<td>68 x 1.75</td>
</tr>
<tr>
<td>687/688.55</td>
<td>25</td>
<td>7.3</td>
<td>0.29</td>
<td>(25)°</td>
<td>79 x 2</td>
</tr>
<tr>
<td>687/688.65</td>
<td>35</td>
<td>11</td>
<td>0.82</td>
<td>(25)°</td>
<td>88 x 2.5</td>
</tr>
</tbody>
</table>

| TC5 | TC5 = Functional limit torque*  
*If the permissible functional limit torque TC5 is to be fully utilized, the flange connection must be reinforced. |
|-----|-----------------------------------------------------------------|
| TDW | TDW = Reversing fatigue torque*  
*See specifications of drive shafts. |
| Lc  | Lc = Bearing capacity factor*  
*See specifications of drive shafts. |
| β   | β = Maximum deflection angle per joint  
*Tubular shafts with welded-on balancing plates have lower fatigue torques TDW. |
| W   | Tubular shafts with welded-on balancing plates have lower fatigue torques TDW. |
| DIN 5480 | 1) Effective spigot depth |
|       | 2) Number of flange holes |
Data sheet series 687/688

Design

NOTE: Hole patterns not optional. Each driveshaft size has a specific hole pattern.
Data sheet series 587

0.01 with length compensation, tubular design
0.02 with large length compensation, tubular design
0.03 without length compensation, tubular design
9.01 with length compensation, short design
9.02 with length compensation, short design
9.03 without length compensation, short design
9.04 without length compensation, double flange shaft design

Design

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>587.55</th>
<th>587.50</th>
<th>587.60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tcs (kNm)</td>
<td>43</td>
<td>52</td>
<td>57</td>
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<tr>
<td>Tdw (kNm)</td>
<td>13</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Lc</td>
<td>1,8</td>
<td>7,8</td>
<td>25,3</td>
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</table>

β (°) = Maximum deflection angle per joint

TCS = Functional limit torque*
If the permissible functional limit torque TCS is to be fully utilized, the flange connection (e.g., with dowel pins) must be reinforced. Yield torque 30% over TCS.

Tdw = Reversing fatigue torque*

Lc = Bearing capacity factor*

See specifications of driveshafts.

β = Maximum deflection angle per joint

1) Effective spigot depth
2) Number of flange holes (standard flange connection)
3) Number of flange holes (dowel pin connection)
## Data sheet series 587

### Standard flange connection

![Diagram of standard flange connection]

### Dowel pin connection according to DIN 15451

![Diagram of dowel pin connection]

### Specifications

<table>
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<th>587.60</th>
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<tbody>
<tr>
<td>0.03</td>
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<tr>
<td>9.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes

- **L_z min** = Shortest possible compressed length
- **L_a** = Length compensation
- **L_f min** = Shortest fixed length
- **L_z + L_a** = Maximum operating length
- **G** = Weight of shaft
- **G_R** = Weight per 1.000 mm tube
- **Jm** = Moment of inertia
- **Jm_R** = Moment of inertia per 1.000 mm tube
- **C** = Torsional stiffness of shaft without tube
- **C_R** = Torsional stiffness per 1.000 mm tube
- ***Larger length compensation available on request**
0.01 with length compensation, tubular design
0.02 with large length compensation, tubular design
0.03 without length compensation, tubular design
9.01 with length compensation, short design
9.02 with length compensation, short design
9.03 without length compensation, short design
9.04 without length compensation, double flange shaft design

Design

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>390.60</th>
<th>390.65</th>
<th>390.70</th>
<th>390.75</th>
<th>390.80</th>
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<tbody>
<tr>
<td>Tcs kNm</td>
<td>60</td>
<td>90</td>
<td>120</td>
<td>190</td>
<td>255</td>
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<tr>
<td>TDW kNm</td>
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<td>36</td>
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<td>15</td>
<td>15</td>
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<tr>
<td>A mm</td>
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<td>315</td>
<td>350</td>
<td>390</td>
<td>435</td>
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<tr>
<td>K mm</td>
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<td>265</td>
<td>300</td>
<td>330</td>
<td>370</td>
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<tr>
<td>B ± 0.1 mm</td>
<td>245</td>
<td>280</td>
<td>310</td>
<td>345</td>
<td>385</td>
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<tr>
<td>Bs ± 0.1 mm</td>
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<td>270</td>
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<td>340</td>
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<tr>
<td>C mm</td>
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Tcs = Functional limit torque*  
TDW = Reversing fatigue torque*  
kε = Bearing capacity factor*  
Lc = Maximum deflection angle per joint  
1) Effective spigot depth  
2) Number of flange holes  
3) Number of flange holes (dowel pin connection)  
4) 390.60 - 390.70 ± 0.2 mm  
390.75 - 390.80 ± 0.5 mm
## Data sheet series 390 Maximum bearing life

### Design

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<tr>
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<th>Shaft size</th>
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</table>

- Lz, min = Shortest possible compressed length
- Lz = Length compensation
- Lz, max = Shortest fixed length
- Lz + Lz = Maximum operating length
- G = Weight of shaft
- Gs = Weight per 1.000 mm tube
- Jm = Moment of inertia
- JmR = Moment of inertia per 1.000 mm tube
- C = Torsional stiffness of shaft without tube
- CR = Torsional stiffness per 1.000 mm tube
- Lz = Larger length compensation available on request

NOTE: Each driveshaft size has a specific hole pattern (see table). Other hole patterns available on request.
## Data sheet series 392/393 High torque capacity

0.01 with length compensation, tubular design  
0.02 with large length compensation, tubular design  
0.03 without length compensation, tubular design  
9.01 with length compensation, short design  
9.02 with length compensation, short design  
9.03 without length compensation, short design  
9.04 without length compensation, double flange shaft design

### Design

![Diagram of Design](image)

### Shaft size

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<tr>
<th>Shaft size</th>
<th>392.50</th>
<th>392.55</th>
<th>392.60</th>
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### Notes

- **TCS** = Functional limit torque
  - Yield torque 30% over TCS
- **TDW** = Reversing fatigue torque
- **Lc** = Bearing capacity factor
- **β** = Maximum deflection angle per joint
- **F1** = See specifications of driveshafts.
- **1) Effective spigot depth**
- **2) Number of flange holes**
Data sheet series 392/393 High torque capacity

Design

L2

Flange connection with face key

L1

Each driveshaft size has a specific hole pattern (see table). Other hole patterns available on request.

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<th>Design</th>
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<td>0.03</td>
<td>L2 mm</td>
<td>770</td>
<td>865</td>
<td>945</td>
<td>1.060</td>
<td>1.130</td>
<td>1.200</td>
<td>1.300</td>
<td>1.520</td>
<td>1.680</td>
</tr>
<tr>
<td></td>
<td>L2 mm</td>
<td>65</td>
<td>75</td>
<td>75</td>
<td>85</td>
<td>85</td>
<td>70</td>
<td>70</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>G kg</td>
<td>123</td>
<td>197</td>
<td>260</td>
<td>371</td>
<td>457</td>
<td>602</td>
<td>832</td>
<td>1.000</td>
<td>1.657</td>
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<tr>
<td>0.04</td>
<td>L2 mm</td>
<td>580</td>
<td>660</td>
<td>720</td>
<td>820</td>
<td>900</td>
<td>820</td>
<td>940</td>
<td>1.060</td>
<td>1.160</td>
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<tr>
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<td>G kg</td>
<td>94</td>
<td>145</td>
<td>207</td>
<td>288</td>
<td>391</td>
<td>485</td>
<td>653</td>
<td>890</td>
<td>1.443</td>
</tr>
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</table>

L2 min = Shortest possible compressed length
L2 = Length compensation
L2 + L2 = Maximum operating length
L2 = Torque of shaft without tube
C = Torsional stiffness of shaft per 1,000 mm tube
C = Larger length compensation available on request
G = Weight of shaft
G = Weight per 1,000 mm tube
Jm = Moment of inertia
Jm = Moment of inertia per 1,000 mm tube

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**Data sheet series 492 Maximum torque capacity**

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>TCS [kNm]</th>
<th>TOW [kNm]</th>
<th>Lc</th>
<th>β</th>
<th>A [mm]</th>
<th>K [mm]</th>
<th>B [mm]</th>
<th>G [mm]</th>
<th>H [mm]</th>
<th><img src="image.png" alt="Diagram" /></th>
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<tbody>
<tr>
<td>0.01</td>
<td>210</td>
<td>100</td>
<td>110</td>
<td>7</td>
<td>285</td>
<td>255</td>
<td>35</td>
<td>35</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>0.03</td>
<td>250</td>
<td>115</td>
<td>330</td>
<td>7</td>
<td>315</td>
<td>340</td>
<td>35</td>
<td>40</td>
<td>17</td>
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<tr>
<td>9.01</td>
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<td>160</td>
<td>855</td>
<td>7</td>
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<td>390</td>
<td>40</td>
<td>45</td>
<td>19</td>
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<tr>
<td>9.02</td>
<td>440</td>
<td>210</td>
<td>2.120</td>
<td>10</td>
<td>390</td>
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</tr>
<tr>
<td>9.03</td>
<td>410</td>
<td>280</td>
<td>7.390</td>
<td>15</td>
<td>435</td>
<td>395</td>
<td>50</td>
<td>50</td>
<td>19</td>
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<tr>
<td>9.04</td>
<td>650</td>
<td>250</td>
<td>17.370</td>
<td>10</td>
<td>480</td>
<td>445</td>
<td>55</td>
<td>55</td>
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<td>510</td>
<td>65</td>
<td>65</td>
<td>23</td>
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</tbody>
</table>

**Key definitions:**
- **TCS** = Functional limit torque*
- **TOW** = Yield torque 30% over TCS
- **Lc** = Reversing fatigue torque*
- **β** = Bearing capacity factor*
- **A**, **K**, **B**, **G**, **H** = Dimensions in millimeters
- **M** = Number of flange holes
- **S** = Dimensions in millimeters
- **W** = Dimensions in millimeters

* See specifications of driveshafts.

1) Number of flange bolts.
### Data sheet series 492 Maximum torque capacity

**Design**

Flange connection with Hirth-serration

- 10-hole flange
- 12-hole flange
- 16-hole flange

Each driveshaft size has a specific hole pattern (see table). Other hole patterns available on request.

<table>
<thead>
<tr>
<th>Design</th>
<th>Shaft size</th>
<th>492.60</th>
<th>492.65</th>
<th>492.70</th>
<th>492.75</th>
<th>492.80</th>
<th>492.85</th>
<th>492.90</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01</td>
<td>L_{z_{\text{min}}} mm</td>
<td>1.440</td>
<td>1.520</td>
<td>1.680</td>
<td>1.750</td>
<td>1.900</td>
<td>2.130</td>
<td>2.415</td>
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<tr>
<td></td>
<td>L_z mm</td>
<td>135</td>
<td>135</td>
<td>150</td>
<td>170</td>
<td>170</td>
<td>190</td>
<td>210</td>
</tr>
<tr>
<td></td>
<td>G kg</td>
<td>472</td>
<td>568</td>
<td>788</td>
<td>1.025</td>
<td>1.355</td>
<td>1.873</td>
<td>2.750</td>
</tr>
<tr>
<td></td>
<td>G_{R} kg</td>
<td>121.7</td>
<td>193.5</td>
<td>227.3</td>
<td>255.6</td>
<td>311.3</td>
<td>361.4</td>
<td>501.9</td>
</tr>
<tr>
<td></td>
<td>J_m kg/m²</td>
<td>4.16</td>
<td>5.16</td>
<td>7.73</td>
<td>15</td>
<td>30.7</td>
<td>50.4</td>
<td>92.7</td>
</tr>
<tr>
<td></td>
<td>J_{mR} kg/m²</td>
<td>1.52</td>
<td>2.36</td>
<td>3.80</td>
<td>5.38</td>
<td>7.88</td>
<td>12.28</td>
<td>21.1</td>
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<tr>
<td></td>
<td>C Nm/rad.</td>
<td>3.32 x 10⁶</td>
<td>4.31 x 10⁶</td>
<td>5.97 x 10⁶</td>
<td>6.76 x 10⁶</td>
<td>9.7 x 10⁶</td>
<td>13.64 x 10⁶</td>
<td>19.44 x 10⁶</td>
</tr>
<tr>
<td></td>
<td>C_{R} Nm/rad.</td>
<td>1.55 x 10⁷</td>
<td>2.41 x 10⁷</td>
<td>3.87 x 10⁷</td>
<td>5.48 x 10⁷</td>
<td>8.03 x 10⁷</td>
<td>12.51 x 10⁷</td>
<td>21.5 x 10⁷</td>
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<tr>
<td>0.03</td>
<td>L_{z_{\text{min}}} mm</td>
<td>940</td>
<td>1.020</td>
<td>1.130</td>
<td>1.220</td>
<td>1.320</td>
<td>1.450</td>
<td>1.620</td>
</tr>
<tr>
<td></td>
<td>L_z mm</td>
<td>121.7</td>
<td>193.5</td>
<td>227.3</td>
<td>255.6</td>
<td>311.3</td>
<td>361.4</td>
<td>501.9</td>
</tr>
<tr>
<td>9.01</td>
<td>L_z mm</td>
<td>1.380</td>
<td>1.460</td>
<td>1.620</td>
<td>1.700</td>
<td>1.840</td>
<td>2.050</td>
<td>2.340</td>
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<tr>
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<td>G kg</td>
<td>311</td>
<td>407</td>
<td>557</td>
<td>819</td>
<td>1.040</td>
<td>1.330</td>
<td>1.880</td>
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<tr>
<td></td>
<td>G_{R} kg</td>
<td>121.7</td>
<td>193.5</td>
<td>227.3</td>
<td>255.6</td>
<td>311.3</td>
<td>361.4</td>
<td>501.9</td>
</tr>
<tr>
<td>9.04</td>
<td>L_z mm</td>
<td>800</td>
<td>880</td>
<td>960</td>
<td>1.040</td>
<td>1.120</td>
<td>1.200</td>
<td>1.320</td>
</tr>
<tr>
<td></td>
<td>G kg</td>
<td>284</td>
<td>374</td>
<td>479</td>
<td>590</td>
<td>870</td>
<td>1.190</td>
<td>1.734</td>
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</tbody>
</table>

- L_{z_{\text{min}}} = Shortest possible compressed length
- L_a = Length compensation
- L_{y_{\text{min}}} = Shortest fixed length
- L_z + L_a = Maximum operating length
- G = Weight of shaft
- G_{R} = Weight per 1.000 mm tube
- C = Torsional stiffness of shaft without tube
- C_{R} = Torsional stiffness per 1.000 mm tube
- J_m = Moment of inertia
- J_{mR} = Moment of inertia per 1.000 mm tube

Length dimensions (L_{z}/L_a) of the designs 0.02 · 9.02 · 9.03 available on request.
Data sheet series 498

0.01 with length compensation, tubular design
0.03 without length compensation, tubular design
9.04 without length compensation, double flange shaft design

Design

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>498.00</th>
<th>498.05</th>
<th>498.10</th>
<th>498.15</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TCS</strong> kNm</td>
<td>1.880</td>
<td>1.620</td>
<td>1.430</td>
<td>2.340</td>
</tr>
<tr>
<td><strong>TOW</strong> kNm</td>
<td>900</td>
<td>780</td>
<td>680</td>
<td>1.220</td>
</tr>
<tr>
<td><strong>Lc</strong></td>
<td>0.115</td>
<td>0.144</td>
<td>0.194</td>
<td>0.224</td>
</tr>
<tr>
<td></td>
<td>$x 10^5$</td>
<td>$x 10^5$</td>
<td>$x 10^6$</td>
<td>$x 10^6$</td>
</tr>
<tr>
<td><strong>β</strong></td>
<td>5°</td>
<td>10°</td>
<td>15°</td>
<td>5°</td>
</tr>
<tr>
<td><strong>A</strong> mm</td>
<td>600</td>
<td>650</td>
<td>700</td>
<td>700</td>
</tr>
<tr>
<td><strong>K</strong> mm</td>
<td>600</td>
<td>650</td>
<td>700</td>
<td>700</td>
</tr>
<tr>
<td><strong>B</strong> mm</td>
<td>555</td>
<td>605</td>
<td>655</td>
<td>695</td>
</tr>
<tr>
<td><strong>G</strong> mm</td>
<td>75</td>
<td>90</td>
<td>90</td>
<td>95</td>
</tr>
<tr>
<td><strong>H</strong> mm</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>32</td>
</tr>
<tr>
<td><strong>I1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>M</strong> mm</td>
<td>370</td>
<td>370</td>
<td>390</td>
<td>410</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>498.20</th>
<th>498.25</th>
<th>498.30</th>
<th>498.35</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TCS</strong> kNm</td>
<td>4.420</td>
<td>3.800</td>
<td>3.300</td>
<td>5.300</td>
</tr>
<tr>
<td><strong>TOW</strong> kNm</td>
<td>2.120</td>
<td>1.850</td>
<td>1.600</td>
<td>2.550</td>
</tr>
<tr>
<td><strong>Lc</strong></td>
<td>1.69</td>
<td>2.14</td>
<td>2.55</td>
<td>3.26</td>
</tr>
<tr>
<td></td>
<td>$x 10^6$</td>
<td>$x 10^6$</td>
<td>$x 10^6$</td>
<td>$x 10^6$</td>
</tr>
<tr>
<td><strong>β</strong></td>
<td>5°</td>
<td>10°</td>
<td>15°</td>
<td>5°</td>
</tr>
<tr>
<td><strong>A</strong> mm</td>
<td>800</td>
<td>850</td>
<td>900</td>
<td>950</td>
</tr>
<tr>
<td><strong>K</strong> mm</td>
<td>800</td>
<td>850</td>
<td>900</td>
<td>950</td>
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<td><strong>B</strong> mm</td>
<td>745</td>
<td>785</td>
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<td>885</td>
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<td><strong>G</strong> mm</td>
<td>100</td>
<td>105</td>
<td>110</td>
<td>120</td>
</tr>
<tr>
<td><strong>H</strong> mm</td>
<td>32</td>
<td>38</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td><strong>I1</strong></td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
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<td><strong>M</strong> mm</td>
<td>480</td>
<td>480</td>
<td>500</td>
<td>530</td>
</tr>
</tbody>
</table>

**TCS** = Functional limit torque*

**TOW** = Reversing fatigue torque*

**Lc** = Bearing capacity factor*

* See specifications of driveshafts.

β = Maximum deflection angle per joint

1) Number of flange holes

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Data sheet series 498

Design

Flange connection with Hirth-serration

Each driveshaft size has a specific hole pattern (see table). Other hole patterns available on request.

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>498.40</th>
<th>498.45</th>
<th>498.50</th>
<th>498.55</th>
<th>498.60</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCs kNm</td>
<td>8.700</td>
<td>10.000</td>
<td>11.500</td>
<td>13.200</td>
<td>15.000</td>
</tr>
<tr>
<td>TDW kNm</td>
<td>4.200</td>
<td>4.800</td>
<td>5.500</td>
<td>6.300</td>
<td>7.200</td>
</tr>
<tr>
<td>Lc</td>
<td>16.1 x 10^3</td>
<td>23.78 x 10^3</td>
<td>38.73 x 10^3</td>
<td>56.3 x 10^3</td>
<td>70.8 x 10^3</td>
</tr>
<tr>
<td>β (°)</td>
<td>5 x 10^3</td>
<td>10 x 10^3</td>
<td>15 x 10^3</td>
<td>20 x 10^3</td>
<td>25 x 10^3</td>
</tr>
<tr>
<td>A (mm)</td>
<td>1.000</td>
<td>1.050</td>
<td>1.100</td>
<td>1.150</td>
<td>1.200</td>
</tr>
<tr>
<td>B (mm)</td>
<td>925</td>
<td>975</td>
<td>1.025</td>
<td>1.065</td>
<td>1.115</td>
</tr>
<tr>
<td>D (mm)</td>
<td>125</td>
<td>130</td>
<td>135</td>
<td>140</td>
<td>150</td>
</tr>
<tr>
<td>H (mm)</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>M (mm)</td>
<td>625</td>
<td>625</td>
<td>655</td>
<td>645</td>
<td>645</td>
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</tbody>
</table>

GWB™ driveshaft series „598“ in fully forged design with maximum torque capacity are available on request.

Length dimensions (Lz/Ld/La) of the designs 0.01 · 0.03 · 9.04 available on request.
# Data sheet series 587/190/390 Super short designs

9.06 driveshaft with length compensation, super short design

## Series 587

![Diagram of 9.06 driveshaft with length compensation](image)

### Design

<table>
<thead>
<tr>
<th>Parameter</th>
<th>587.50</th>
<th>190.55</th>
<th>390.60</th>
<th>190.65</th>
<th>390.70</th>
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</thead>
<tbody>
<tr>
<td>TCS</td>
<td>43</td>
<td>33</td>
<td>60</td>
<td>68</td>
<td>130</td>
</tr>
<tr>
<td>TDW</td>
<td>13</td>
<td>11</td>
<td>23</td>
<td>25</td>
<td>53</td>
</tr>
<tr>
<td>Lc</td>
<td>1.84</td>
<td>7</td>
<td>58.5</td>
<td>166</td>
<td>510</td>
</tr>
<tr>
<td>β</td>
<td>5°</td>
<td>5°</td>
<td>5°</td>
<td>5°</td>
<td>5°</td>
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<tr>
<td>A</td>
<td>275</td>
<td>305</td>
<td>348</td>
<td>360</td>
<td>405</td>
</tr>
<tr>
<td>K</td>
<td>215</td>
<td>250</td>
<td>285</td>
<td>315</td>
<td>350</td>
</tr>
<tr>
<td>B (± 0.1 mm)</td>
<td>248</td>
<td>275</td>
<td>314</td>
<td>328</td>
<td>370</td>
</tr>
<tr>
<td>C (H7)</td>
<td>140</td>
<td>140</td>
<td>175</td>
<td>175</td>
<td>220</td>
</tr>
<tr>
<td>F1</td>
<td>4.5</td>
<td>5.5</td>
<td>6</td>
<td>6</td>
<td>6.5</td>
</tr>
<tr>
<td>G</td>
<td>15</td>
<td>15</td>
<td>18</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>H (± 0.2 mm)</td>
<td>14.1</td>
<td>16.1</td>
<td>18.1</td>
<td>18.1</td>
<td>20.1</td>
</tr>
<tr>
<td>β2</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>M</td>
<td>68</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>108</td>
</tr>
<tr>
<td>W (DIN 5482/5480)</td>
<td>90 x 2.5</td>
<td>100 x 94</td>
<td>115 x 2.5</td>
<td>130 x 3</td>
<td>150 x 3</td>
</tr>
</tbody>
</table>

**Notes:**
- TCS = Functional limit torque* 
- TDW = Reversing fatigue torque* 
- Lc = Bearing capacity factor* 
- See specifications of driveshafts. 
- β = Maximum deflection angle per joint 
- β1 = Effective spigot depth 
- β2 = Number of flange holes 

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Data sheet series 587/190/390 Super short designs

Series 190/390

Design

9.06

<table>
<thead>
<tr>
<th>Design</th>
<th>Shaft size</th>
<th>587.50</th>
<th>190.55</th>
<th>390.60</th>
<th>190.65</th>
<th>390.70</th>
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<tbody>
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<td>9.06</td>
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<td>495</td>
<td>545</td>
<td>600</td>
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<td>L_a</td>
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<td>40</td>
<td>80</td>
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<td>80</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>60</td>
<td>98</td>
<td>131</td>
<td>169</td>
<td>252</td>
</tr>
<tr>
<td></td>
<td>J_m</td>
<td>0.33</td>
<td>0.624</td>
<td>1.250</td>
<td>2.286</td>
<td>3.455</td>
</tr>
</tbody>
</table>

L_z = Shortest compressed length
L_a = Length compensation
L_z + L_a = Maximum operating length
G  = Weight of shaft
J_m = Moment of inertia
Data sheet series 330 Quick release couplings

Design
with spiral serration for higher speeds

Connection for series 687/688
Connection for series 587
Connection for series 392
with face key

For hole distribution, see data sheets of the corresponding driveshaft.

<table>
<thead>
<tr>
<th>Coupling size</th>
<th>330.10</th>
<th>330.20</th>
<th>330.30</th>
<th>330.40</th>
<th>330.50</th>
<th>330.55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaft connection</td>
<td>687/688.15</td>
<td>687/688.20</td>
<td>687/688.25</td>
<td>687/688.30</td>
<td>687/688.40</td>
<td>687/688.45</td>
</tr>
<tr>
<td>Model</td>
<td>Nr.</td>
<td>000</td>
<td>003</td>
<td>003</td>
<td>003</td>
<td>000</td>
</tr>
<tr>
<td>A</td>
<td>mm</td>
<td>100</td>
<td>130</td>
<td>150</td>
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<td>225</td>
</tr>
<tr>
<td>B</td>
<td>mm</td>
<td>84</td>
<td>101.5</td>
<td>130</td>
<td>155.5</td>
<td>196</td>
</tr>
<tr>
<td>C</td>
<td>mm</td>
<td>57</td>
<td>75</td>
<td>90</td>
<td>110</td>
<td>140</td>
</tr>
<tr>
<td>Ck</td>
<td>mm</td>
<td>57</td>
<td>75</td>
<td>90</td>
<td>110</td>
<td>140</td>
</tr>
<tr>
<td>D</td>
<td>mm</td>
<td>20</td>
<td>38</td>
<td>40</td>
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<td>45</td>
</tr>
<tr>
<td>F</td>
<td>mm</td>
<td>2.5</td>
<td>2.5</td>
<td>3.5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Fk</td>
<td>mm</td>
<td>2.3–0.2</td>
<td>2.3–0.15</td>
<td>2.3–0.2</td>
<td>2.3–0.15</td>
<td>4–0.2</td>
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<tr>
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<td>mm</td>
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<td>144</td>
</tr>
<tr>
<td>I</td>
<td>–</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
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<tr>
<td>K</td>
<td>M x 18</td>
<td>M x 18</td>
<td>M x 22</td>
<td>M x 25</td>
<td>M x 14 x 28</td>
<td>M x 16 x 35</td>
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<td>mm</td>
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<td>16.4</td>
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<tr>
<td>Ta</td>
<td>Nm</td>
<td>35</td>
<td>69</td>
<td>120</td>
<td>190</td>
<td>295</td>
</tr>
<tr>
<td>Extension</td>
<td>Nr.</td>
<td>2.365/13 M</td>
<td>2.365/17 M</td>
<td>2.365/19 M</td>
<td>22 M</td>
<td>24 R</td>
</tr>
<tr>
<td>Ta</td>
<td>Spindle</td>
<td>Nm</td>
<td>30</td>
<td>45</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>Socket wrench</td>
<td>Nr.</td>
<td>1/2&quot; D 19 SW 13</td>
<td>1/2&quot; D 19 SW 17</td>
<td>1/2&quot; D 19 SW 22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Operating instructions

Engaging and disengaging the coupling
Engaging and disengaging are done by operating the threaded spindle located in the inner part of the coupling. The spindle can be reached from two sides and be operated. The spindle is tightened by means of a socket wrench (see table).

Notice:
1. Before engaging the coupling, make sure that the coupling teeth are properly fitted.

2. The engagement direction is marked by arrows. The spindle may be tightened either clockwise or counterclockwise.

3. The joint with the coupling component falls back when disengaged. Caution: Danger of injury!

In case of a subsequent installation of the quick release coupling, the driveshaft must be correspondingly shorter. The threaded spindles of the coupling are lubricated by the supplier with MoS2. Relubrication is recommended from time to time.
Data sheet series 230 Quick release couplings

Design

with trapezoidal serration for speeds up to 1,000 rpm

Connection for series 390
Connection for series 392/393
with face key

For hole distribution, see data sheets of the corresponding drive shaft.

Design engineers. Other designs available on request.

For applications with speeds higher than 1,000 rpm, please contact Dana engineers. Other designs available on request.

<table>
<thead>
<tr>
<th>Coupling size</th>
<th>230.60</th>
<th>230.65</th>
<th>230.70</th>
<th>230.75</th>
<th>230.80</th>
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</tr>
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<td>Model</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nr.</td>
<td>000</td>
<td>001</td>
<td>000</td>
<td>001</td>
<td>000</td>
</tr>
<tr>
<td>A</td>
<td>mm</td>
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<td>285</td>
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<td>280</td>
</tr>
<tr>
<td>C¹</td>
<td>mm</td>
<td>175</td>
<td>125</td>
<td>175</td>
<td>175</td>
</tr>
<tr>
<td>C²</td>
<td>mm</td>
<td>175</td>
<td>125</td>
<td>175</td>
<td>175</td>
</tr>
<tr>
<td>D³</td>
<td>mm</td>
<td>64</td>
<td>64</td>
<td>66</td>
<td>66</td>
</tr>
<tr>
<td>F</td>
<td>mm</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Fkö</td>
<td>mm</td>
<td>6–0,2</td>
<td>6–0,2</td>
<td>7–0,5</td>
<td>7–0,5</td>
</tr>
<tr>
<td>G</td>
<td>mm</td>
<td>160</td>
<td>174</td>
<td>172</td>
<td>192</td>
</tr>
<tr>
<td>Gkö</td>
<td>mm</td>
<td>–</td>
<td>8</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>L³²</td>
<td>mm</td>
<td>23</td>
<td>23</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Gkö</td>
<td>kg</td>
<td>66</td>
<td>71</td>
<td>83</td>
<td>95</td>
</tr>
<tr>
<td>Ta Nut</td>
<td>Nm</td>
<td>580</td>
<td>580</td>
<td>780</td>
<td>780</td>
</tr>
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<td>Extension §</td>
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<td>400</td>
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</tr>
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<td>290</td>
<td>400</td>
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</tr>
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<td>Socket wrench §</td>
<td>Nr.</td>
<td>3/4&quot; D 32 SW 22</td>
<td>3/4&quot; D 32 SW 27</td>
<td>3/4&quot; D 32 SW 27</td>
<td>3/4&quot; D 32 SW 32</td>
</tr>
<tr>
<td>X = 4 spacers §</td>
<td>Nr.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Spigot fit H7
2. Disengaging movement for separation of the coupling
3. Number of stud bolts per flange
4. Dimensions of the bolt connections
   Stud bolt DIN 938
   Self-locking hexagon nut DIN 880
5. Jaw or ring extension in accordance with Dana standard N 4.2.5
6. Gedore socket spanner set for tightening the spindle
7. Rahsol torque meter
8. Force multiplier spanner x = 4 (TD 750)
9. Adjusting moment of the torque wrench 756 C = 238 Nm
10. Thread depth
11. Fit h6 up to series 390
    Fit f8 for series 392/393
12. Gkö = Weight of coupling
13. Ta = Tightening torques of flange bolttings and of the threaded coupling spindles

Torque wrench? Torque range

<table>
<thead>
<tr>
<th>Type</th>
<th>from</th>
<th>to</th>
</tr>
</thead>
<tbody>
<tr>
<td>756 B</td>
<td>20 Nm</td>
<td>100 Nm</td>
</tr>
<tr>
<td>756 C</td>
<td>80 Nm</td>
<td>300 Nm</td>
</tr>
<tr>
<td>756 D</td>
<td>280 Nm</td>
<td>760 Nm</td>
</tr>
</tbody>
</table>

For applications with speeds higher than 1,000 rpm, please contact Dana engineers. Other designs available on request.
Journal cross assemblies are only supplied as complete units. For orders, please state shaft size or, if known, the drawing number of the complete driveshaft. For lubrication of journal cross assemblies, see Installation and Maintenance/Safety Instructions.

* The dimensions of the journal cross assemblies for series 392/393 are equal to 292.

Ultra heavy-duty unit pack sets for series 398 have been discontinued. They are still available for series 492 and 498 on request.
Data Sheet Flange connection with serration

Hirth-serration

- Flank angle 40°
- High transmission capacity
- Form locking
- Self-centering

<table>
<thead>
<tr>
<th>D (mm)</th>
<th>d (mm)</th>
<th>z</th>
<th>B (mm)</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>225</td>
<td>180</td>
<td>48</td>
<td>200</td>
<td>8 x M 12</td>
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<td>250</td>
<td>200</td>
<td>48</td>
<td>225</td>
<td>8 x M 14</td>
</tr>
<tr>
<td>285</td>
<td>225</td>
<td>60</td>
<td>255</td>
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<td>315</td>
<td>250</td>
<td>60</td>
<td>280</td>
<td>10 x M 16</td>
</tr>
<tr>
<td>350</td>
<td>280</td>
<td>72</td>
<td>315</td>
<td>12 x M 16</td>
</tr>
<tr>
<td>390</td>
<td>315</td>
<td>72</td>
<td>350</td>
<td>12 x M 18</td>
</tr>
<tr>
<td>435</td>
<td>345</td>
<td>96</td>
<td>395</td>
<td>16 x M 18</td>
</tr>
<tr>
<td>480</td>
<td>370</td>
<td>96</td>
<td>445</td>
<td>16 x M 20</td>
</tr>
<tr>
<td>550</td>
<td>440</td>
<td>96</td>
<td>510</td>
<td>16 x M 22</td>
</tr>
<tr>
<td>600</td>
<td>480</td>
<td>120</td>
<td>555</td>
<td>20 x M 24</td>
</tr>
<tr>
<td>650</td>
<td>520</td>
<td>120</td>
<td>605</td>
<td>20 x M 24</td>
</tr>
<tr>
<td>700</td>
<td>570</td>
<td>144</td>
<td>655</td>
<td>24 x M 24</td>
</tr>
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<td>750</td>
<td>600</td>
<td>144</td>
<td>695</td>
<td>24 x M 30</td>
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<td>800</td>
<td>650</td>
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<td>745</td>
<td>24 x M 30</td>
</tr>
<tr>
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<td>680</td>
<td>144</td>
<td>785</td>
<td>24 x M 36</td>
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<tr>
<td>900</td>
<td>710</td>
<td>144</td>
<td>835</td>
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<td>144</td>
<td>885</td>
<td>24 x M 36</td>
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<tr>
<td>1,000</td>
<td>800</td>
<td>180</td>
<td>925</td>
<td>20 x M 42 x 3</td>
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<td>1,050</td>
<td>840</td>
<td>180</td>
<td>975</td>
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<td>880</td>
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<td>180</td>
<td>1,065</td>
<td>20 x M 48 x 3</td>
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<tr>
<td>1,200</td>
<td>960</td>
<td>180</td>
<td>1,115</td>
<td>20 x M 48 x 3</td>
</tr>
</tbody>
</table>

Klingelnberg-serration

- Flank angle 25°
- High transmission capacity
- Form locking
- Self-centering

<table>
<thead>
<tr>
<th>D (mm)</th>
<th>d (mm)</th>
<th>z</th>
<th>B (mm)</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>65</td>
<td>16</td>
<td>84</td>
<td>4 x M 8</td>
</tr>
<tr>
<td>115</td>
<td>80</td>
<td>24</td>
<td>101,5</td>
<td>4 x M 10</td>
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<tr>
<td>145</td>
<td>110</td>
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<td>130</td>
<td>4 x M 10</td>
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<td>175</td>
<td>140</td>
<td>32</td>
<td>155,5</td>
<td>4 x M 16</td>
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<td>215</td>
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<td>4 x M 16</td>
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<td>275</td>
<td>220</td>
<td>48</td>
<td>245</td>
<td>4 x M 20</td>
</tr>
<tr>
<td>305</td>
<td>245</td>
<td>48</td>
<td>280</td>
<td>4 x M 20</td>
</tr>
<tr>
<td>340</td>
<td>280</td>
<td>72</td>
<td>310</td>
<td>4 x M 22</td>
</tr>
<tr>
<td>380</td>
<td>315</td>
<td>72</td>
<td>345</td>
<td>6 x M 24</td>
</tr>
<tr>
<td>425</td>
<td>355</td>
<td>96</td>
<td>385</td>
<td>6 x M 27</td>
</tr>
<tr>
<td>465</td>
<td>390</td>
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<tr>
<td>535</td>
<td>455</td>
<td>96</td>
<td>492</td>
<td>8 x M 30</td>
</tr>
</tbody>
</table>

D = Outside diameter
d = Inside diameter
Z = Number of teeth
B = Pitch diameter
i = Number of and size of bolts
Bolt material: 10.9

* Reduced number of bolts by special arrangement only (e.g., for use as quick-change system)
Other diameters available on request.
Data sheet Face key connection series 687/688/587/390

The driveshaft for series 687/688/587/390 can also be manufactured with face key connection on request.

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>A (mm)</th>
<th>B (x H)</th>
<th>X (mm)</th>
<th>Y (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>687/688.35</td>
<td>150</td>
<td>8 x 13</td>
<td>20</td>
<td>4,0</td>
</tr>
<tr>
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<td>4,5</td>
</tr>
<tr>
<td>687/688.55</td>
<td>180</td>
<td>10 x 17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>687/688.65</td>
<td>180</td>
<td>10 x 17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>587.50</td>
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<td>5,5</td>
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<td>40</td>
<td>7,0</td>
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<td>45</td>
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<td>390.80</td>
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<td>10 x 28</td>
<td>63</td>
<td>12,0</td>
</tr>
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</table>

1. Tolerance + 0,2 mm
2. Number of flange holes
(for 390.75 and 390.80, tolerance + 0,5 mm)
Data sheet Standard companion flanges

Standard companion flanges can be manufactured with cylindrical bore holes and face keyway (material C45; hardened and tempered 750 – 900 N/mm²) on request. For designs deviating from the standard, e.g., oil pressure connection, conical bore, flat journal, and material, relevant drawings are required.

Please state with your order:

<table>
<thead>
<tr>
<th>Shaft size</th>
<th>Flange dia. A</th>
<th>I x H</th>
<th>L</th>
<th>L1</th>
<th>Z</th>
<th>D</th>
<th>d</th>
<th>u</th>
<th>v</th>
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</thead>
<tbody>
<tr>
<td>= ____________</td>
<td>= ____________ mm</td>
<td>= __ number of holes x ∅ mm</td>
<td>= ____________ mm</td>
<td>= ____________ mm</td>
<td>= ____________ mm</td>
<td>= ____________ mm</td>
<td>= ____________ mm</td>
<td>= ____________ mm</td>
<td>= ____________ mm</td>
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</table>

<table>
<thead>
<tr>
<th>Driveshaft connection</th>
<th>Dimension</th>
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<tbody>
<tr>
<td>Shaft size (Φ A) mm</td>
<td>(I² x H²) mm</td>
</tr>
<tr>
<td>687/688.15</td>
<td>100</td>
</tr>
<tr>
<td>687/688.20</td>
<td>120</td>
</tr>
<tr>
<td>687/688.25</td>
<td>8 x 12,25</td>
</tr>
<tr>
<td>687/688.30</td>
<td>150</td>
</tr>
<tr>
<td>687/688.35</td>
<td>180</td>
</tr>
<tr>
<td>687/688.40</td>
<td>225</td>
</tr>
<tr>
<td>687/688.45</td>
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</tr>
<tr>
<td>687/688.50</td>
<td>285</td>
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<tr>
<td>687/688.55</td>
<td>315</td>
</tr>
<tr>
<td>687/688.60</td>
<td>350</td>
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<td>687/688.65</td>
<td>390</td>
</tr>
<tr>
<td>687/688.70</td>
<td>435</td>
</tr>
</tbody>
</table>

1. Tolerance + 0,2 mm
2. Number of flange holes
(for 390.75 and 390.80, tolerance + 0,5 mm)
Main components of the driveshafts

1. Flange yoke
2. Journal cross assembly
3. Tube yoke
4. Tube
5. Sliding muff
6. Yoke shaft
7. Cover tube assembly
Main components of the driveshafts

1a. Flange yoke for series 390
   (friction connection)
1b. Flange yoke for series 392/393
   (face key connection)
2. Journal cross assembly
3. Tube yoke
4. Tube
5. Tube yoke with sliding muff
6. Slip stub shaft
7. Cover tube assembly
Kinematics of Hooke's joints

1. The joints
In the theory of mechanics, the cardan joint (or Hooke's joint) is defined as a spatial or spherical drive unit with a non-uniform gear ratio or transmission. The transmission behavior of this joint is described by the following equation:

$$\beta = \text{Deflection angle of joint [°]}$$

$$\alpha_1 = \text{angle of rotation drive side}$$

$$\alpha_2 = \text{angle of rotation driven side}$$

In this equation, $\alpha_2$ is the momentary rotation angle of the driven shaft 2. The motion behavior of the driving and the driven ends is shown in the following diagram. The asynchronous and/or non-homokinematic running of the shaft 2 is shown in the periodical oscillation of the asynchronous line $\alpha_2$ around the synchronous line $\alpha_1$ (dotted line).

A measure for the non-uniformity is the difference of the rotation angles $\alpha_2$ and $\alpha_1$ or the transmission ratio of the angular speeds $\omega_2$ and $\omega_1$. Expressed by an equation, that means:

a) Rotation angle difference:

$$\varphi_K = \alpha_2 - \alpha_1$$

(also called gimbal error)

$$\varphi_K = \arctan\left(\frac{1}{\cos\beta} \cdot \tan \alpha_1\right) - \alpha_1$$

$$\varphi_{K\text{ max.}} = \arctan\left(\frac{\cos\beta - 1}{2 \cos \beta \cdot \cos^2 \alpha_1}\right)$$

b) Ratio:

$$i = \frac{\omega_2}{\omega_1} = \frac{\cos\beta}{1 - \sin^2\beta \cdot \cos^2 \alpha_1}$$
The following diagram shows the ratio \( i = \omega_2 / \omega_1 \) for a full revolution of the universal joint for \( \beta = 60^\circ \).

The degree of non-uniformity \( U \) is defined by:

\[
U = i_{\text{max.}} - i_{\text{min.}} = \tan \beta \cdot \sin \beta
\]

Where:

\[
i_{\text{max.}} = \frac{1}{\cos \beta}
\]

\[
i_{\text{min.}} = \cos \beta
\]

The diagram shows the course of the degree of non-uniformity \( U \) and of the angular difference \( \Psi_{K,\text{max.}} \) as a function of the deflection angle of the joint from 0 to 45°.

From the motion equation it is evident that a homokinematic motion behavior corresponding to the dotted line under 45° – as shown in the diagram – can only be obtained for the deflection angle \( \beta = 0^\circ \). A synchronous or homokinematic running can be achieved by a suitable combination or connection of two or more joints.
Maximum permissible angle difference
The condition $\beta_1 = \beta_2$ is one of the essential requirements for a uniform output speed condition and cannot always be fulfilled. Therefore, designers and engineers will often ask for the permissible difference between the deflection angles of both joints.

Operating angles
The most common arrangements are the Z- and W-deflections. To begin, consider the system in which the shafts to be connected are in the same plane.

1. The deflection angles of both joints must be equal (i.e., $\beta_1 = \beta_2$)
2. The driveshaft
   The rotation angle difference $\psi_k$ or the gimbal error of a deflected universal joint can be offset under certain installation conditions with a second universal joint.
   The constructive solutions are the following:

1a) Z-deflection

1b) W- or M-deflection

2. The two joints must have a kinematic angular relationship of $90^\circ$ ($\pi/2$), (i.e., the yokes of the connecting shaft are in one plane).

For a more intensive study of universal shaft kinematics, please refer to the VDI-recommendation 2722 and to the relevant technical literature.
Product of speed and deflection angle

Greater differences of about 3° to 5° are acceptable without disadvantages in low-speed applications. For applications with varying deflection conditions, it is important to obtain uniformity, if possible over the complete deflection range.

Deflection in two planes means that the deflection is both horizontal and vertical. The combination of two identical types of deflection (Z/Z or W/W) and identical deflection angles ensure uniformity. For a combination of Z- and W-deflection, the inner yokes must be offset. Please consult with Dana application engineers to determine the proper amount of angular offset.

Determination of the maximum permissible operating deflection angle $\beta$

Depending on the driveshaft series, the maximum deflection angle per joint is $\beta = 5^\circ$ to $44^\circ$.

Due to the kinematic conditions of the cardan joint, as described before, the deflection angle must be limited in relation to the speed. Calculations and observations of many applications have shown that certain mass acceleration torques of the center part must not be exceeded in order to guarantee smooth running of the drive systems. This acceleration torque depends on the

$$D = n \cdot \beta$$

and the moment of inertia of the middle part of the shaft.

The parameter $D$ is proportional to the angular acceleration of the driveshaft center part $\varepsilon_2$.

$$\varepsilon_2 \sim D \sim n \cdot \beta$$

$n$ = Operating speed [rpm]

$\beta$ = Deflection angle of joint [$^\circ$]

$\varepsilon_2$ = Angular acceleration of driveshaft center part

The maximum permissible deflection angle at a given speed and an average driveshaft length can be determined from the following diagram.

For an exact determination, contact Dana.
Limits for the product of operating speed and deflection angle
### Speed

#### Checking the critical torsional speed

The plant or vehicle manufacturer has to prevent the use of drive-shafts within the critical torsional speed ranges of the drive. Therefore, the determination of the critical torsional speed ranges of the drive system is required. The values for the moment of inertia and torsional stiffness of the selected driveshaft can be taken from the data sheets or be supplied upon request.

#### Checking the critical bending speed

Except for short and rigid designs, driveshafts are flexible units with critical bending speeds and flexural vibrations that have to be checked. To accomplish this, the first and possibly second order critical bending speeds are important.

For safety reasons, the maximum permissible operating speed must be at a sufficient distance from the critical bending speed.

\[ n_{\text{perm. max.}} \leq 0.8 \cdot n_{\text{crit.}} \text{ [rpm]} \]

The critical bending speed for a particular shaft size is determined by the length and the tube diameter only (see diagram). For greater length dimensions, the tube diameter has to be increased.

For determination of the critical bending speed, see the following selection diagrams.

These diagrams only apply to driveshafts that are installed with solid bearing supports located close to the flange.

Different installations (e.g., units with elastic mounting bearing) must have lower critical bending speeds.

Depending on the type of the plant, excitations of second order can cause flexible vibrations. Please contact Dana engineers if the deflection angle exceeds 3° and for greater length dimensions.
Technical instructions for application

Series 687/688

Determination of the critical bending speed depending on the respective operating length

Example: 687.15 – 63,5 x 2,4
Joint size 687.15
Tube outer diameter 63,5 mm
Wall thickness 2,4 mm
Technical instructions for application

Series 587/390/392

Determination of the critical bending speed depending on the respective operating length

Example: 390.60 – 167.7 x 9.8
Joint size 390.60
Tube outer diameter 167.7 mm
Wall thickness 9.8 mm
**Technical instructions for application**

**Length dimensions**

The operating length of a driveshaft is determined by:
- the distance between the driving and the driven units
- the length compensation during operation

The following abbreviations are used:

- \( L_z \) = Compressed length
  This is the shortest length of the shaft. A further compression is not possible.
- \( L_a \) = Length compensation
  The driveshaft can be expanded by this amount. An expansion beyond that dimension is not permissible.
- \( L_z + L_a = \text{Maximum permissible operating length} \ L_{B_{\text{max}}} \)

During operation, the driveshaft can be expanded up to this length. The optimum working length \( L_B \) of a driveshaft is achieved if the length compensation is extracted by one-third of its length.

\[ L_B = L_z + \frac{1}{3} L_a \quad [\text{mm}] \]

This general rule applies to most of the arrangements. For applications where larger length alterations are expected, the operating length should be chosen in such a way that the movement will be within the limit of the permissible length compensation.

**Arrangements of driveshafts**

- Driveshaft with intermediate shaft
- Driveshaft with two intermediate shafts
- Two driveshafts with double intermediate bearing
Technical instructions for application

In such arrangements, the individual yoke positions and deflection angles should be adjusted with regard to one another in such a way that the degree of non-uniformity (see General theoretical instructions) and the reaction forces acting on the connection bearings (see Technical instructions for application) are minimized.

**Load on bearings of the connected units**

**Axial forces**

For the design of a driveshaft, it must be taken into account that axial forces can occur. These forces must be absorbed by axial thrust bearings of the connected units.

Axial forces will occur during length variations in the driveshaft. Additional axial forces are caused by increasing torque and by increasing pressure during lubrication of the splines. These forces will decrease automatically and can be accelerated by the installation of a relief valve.

The axial force $A_k$ is a combination of two components:

1. **Frictional force $F_{RL}$**
   This is the force that occurs in the length compensation. It can be determined from:
   
   $$F_{RL} = T \frac{H}{r_m} \cdot \cos \beta$$
   
   $F_{RL}$ = Frictional force from the length compensation [N]
   
   It depends on:
   
   $T$ = Torque of the driveshaft [Nm]
   
   $r_m$ = Pitch circle radius in the sliding parts of the driveshaft [m]
   
   $\mu$ = Friction coefficient (depends on spline treatment):
   
   - 0,08 for plastic-coated splines
   - 0,11 for steel/steel (greased)
   
   $\beta$ = Operating deflection angle

2. **Power $F_p$**
   This force occurs in the length compensation due to the increasing pressure in the lubrication grooves of the driveshaft.
   
   The force depends on the lubrication pressure (maximum permissible pressure is 15 bar).

---

**Dana’s environmental protection management policy**

An important feature of Dana’s environmental protection management policy is dedication to product responsibility. Because of this commitment, the effect of driveshafts on the environment is given considerable attention. GWB™ driveshafts are lubricated with lead-free grease, their paint finishes are low in solvents and free of heavy metals, and they are easy to maintain. After use, they can be introduced into the recycling process.
**Technical instructions for application**

**Calculation scheme of radial forces on connecting bearings**

**Driveshaft in Z-arrangement**

Position 0°, flange yoke right-angled to drawing plane, Position \( \pi/2 \), flange yoke in drawing plane

\[
\begin{align*}
\alpha &= 0° \\
A_1 &= B_1 = E_1 = 0 \\
B_1 &= T \cdot \cos \beta_1 \cdot b \cdot \frac{L}{a} \cdot (\tan \beta_1 - \tan \beta_2) \\
F_1 &= T \cdot \cos \beta_1 \cdot e \cdot \frac{L}{f} \cdot (\tan \beta_1 - \tan \beta_2) \\
E_1 &= T \cdot \cos \beta_1 \cdot (e + f) \cdot \frac{L}{f} \cdot (\tan \beta_1 - \tan \beta_2) \\
\alpha &= \pi/2 = 90° \\
A_2 &= B_2 = T \cdot \frac{\tan \beta_1}{a} \\
F_2 &= E_2 = T \cdot \frac{\sin \beta_2}{f} \cdot \cos \beta_1
\end{align*}
\]

**Driveshaft arrangement with equal deflection angles and equal bearing distances**

\[
\begin{align*}
\beta_1 &= \beta_2 \\
a &= f, b = e
\end{align*}
\]

\[
\begin{align*}
\alpha &= 0° \\
A_1 &= F_1 = B_1 = E_1 = 0 \\
B_1 &= E_1 = 2T \cdot \frac{\sin \beta_1 \cdot b}{L \cdot a} \\
A_2 &= B_2 = T \cdot \frac{\tan \beta_1}{a} \\
F_2 &= E_2 = T \cdot \frac{\tan \beta_1}{a}
\end{align*}
\]

**Driveshaft in W-arrangement**

Position 0°, flange yoke right-angled to drawing plane, Position \( \pi/2 \), flange yoke in drawing plane

\[
\begin{align*}
\alpha &= 0° \\
A_1 &= B_1 = E_1 = 0 \\
B_1 &= T \cdot \cos \beta_1 \cdot (a + b) \cdot \frac{L}{a} \cdot (\tan \beta_1 + \tan \beta_2) \\
F_1 &= T \cdot \cos \beta_1 \cdot e \cdot \frac{L}{f} \cdot (\tan \beta_1 + \tan \beta_2) \\
E_1 &= T \cdot \cos \beta_1 \cdot (e + f) \cdot \frac{L}{f} \cdot (\tan \beta_1 + \tan \beta_2) \\
\alpha &= \pi/2 = 90° \\
A_2 &= B_2 = T \cdot \frac{\tan \beta_1}{a} \\
F_2 &= E_2 = T \cdot \frac{\sin \beta_2}{f} \cdot \cos \beta_1
\end{align*}
\]

**Driveshaft arrangement with equal deflection angles and equal bearing distances**

\[
\begin{align*}
\beta_1 &= \beta_2 \\
a &= f, b = e
\end{align*}
\]

\[
\begin{align*}
\alpha &= 0° \\
A_1 &= F_1 = 2T \cdot \frac{\sin \beta_1 \cdot b}{L \cdot a} \\
B_1 &= E_1 = 2T \cdot \frac{\sin \beta_1 \cdot (a + b)}{L \cdot a} \\
\alpha &= \pi/2 = 90° \quad \text{See Z-arrangement } \alpha = \pi/2
\end{align*}
\]
Balancing of driveshafts

The balancing of driveshafts is performed to equalize eccentrically running masses, therefore preventing vibrations and reducing the load on any connected equipment.

Balancing is carried out in accordance with ISO Standard 1940, “Balance quality of rotating rigid bodies”. According to this standard, the permissible residual unbalance is dependent on the operating speed and mass of the balanced components.

Dana’s experience has shown that balancing is not normally required for rotational speeds below 500 rpm. In individual cases, this range may be extended or reduced, depending on the overall drivetrain characteristics.

Driveshafts are balanced in two planes, normally to a balancing accuracy between G16 and G40.

- **Balancing speed**
  The balancing speed is normally the maximum speed of the system or vehicle.

- **Quality grade**
  In defining a quality grade, it is necessary to consider the reproducibility levels achievable in the customer’s own test rig during verification testing. Quality grades are dependent on the following variables:

  - Type of balancing machine (hard, rigid or soft suspension)
  - Accuracy of the measuring system
  - Mounting tolerances
  - Joint bearing radial and axial play
  - Angular backlash in longitudinal displacement direction

Field analyses have shown that the sum of these factors may result in inaccuracies of up to 100%. This observation has given rise to the definition of the following balancing quality grades:

- **Producer balancing**: G16
- **Customer verification tests**: G32

<table>
<thead>
<tr>
<th>G 40</th>
<th>Car wheels, wheel rims, wheel sets, driveshafts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crankshaft/drives of elastically mounted, fast four-cycle Engines (gasoline or diesel) with six or more cylinders Crankshaft/drives of engines of cars, trucks, and locomotives</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>G 16</th>
<th>Driveshafts (propeller shafts, cardan shafts) with special requirements</th>
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<tbody>
<tr>
<td></td>
<td>Parts of crushing machines and agricultural machinery</td>
</tr>
<tr>
<td></td>
<td>Individual components of engines (gasoline or diesel) for cars, trucks, and locomotives</td>
</tr>
<tr>
<td></td>
<td>Crankshaft/drives of engines with six or more cylinders under special requirements</td>
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</table>

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<th>G 6,3</th>
<th>Parts of process plant machines</th>
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<tbody>
<tr>
<td></td>
<td>Marine main turbine gears (merchant service)</td>
</tr>
<tr>
<td></td>
<td>Fans, flywheels, centrifuge drums</td>
</tr>
<tr>
<td></td>
<td>Paper machinery rolls, print rolls</td>
</tr>
<tr>
<td></td>
<td>Assembled aircraft gas turbine rotors</td>
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<td></td>
<td>Pump impellers</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>G 2,5</th>
<th>Gas and steam turbines, including marine main turbines (merchant service)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rigid turbo-generator rotors</td>
</tr>
<tr>
<td></td>
<td>Turbo-compressors, turbine-driven pumps</td>
</tr>
<tr>
<td></td>
<td>Machine tool drives</td>
</tr>
<tr>
<td></td>
<td>Computer memory drums and discs</td>
</tr>
</tbody>
</table>

*Extract from DIN ISO 1940/Part 1*
Selection of GWB™ driveshafts

The design of driveshafts must exclude all possible danger to people and material by secured calculation and test results, as well as other suitable steps (see Installation and Maintenance/Safety Instructions).

The selection procedure described on these pages is only a general recommendation. Please consult Dana engineers for the final design for your application.

The selection of a driveshaft should be based on the following conditions:

1. Specifications of driveshafts
2. Selection by bearing life
3. Operational dependability
4. Operating angles
5. Speed
6. Length dimensions
7. Load on bearings of the connected units

1. Specifications of driveshafts

$T_{CS} = \text{Functional limit torque [Nm]}$
Up to this maximum permissible torque, a load may be applied to a driveshaft for a limited frequency without the working capability being affected by permanent deformation of any driveshaft functional area. This does not result in any unpermissible effect on bearing life.

Yield torque
This torque level leads to irreversible plastic deformation of the driveshaft which could result in a failure of the complete drive system.

$T_{DW} = \text{Reversing fatigue torque [Nm]}$
At this torque, the driveshaft is permanently solid at alternating loads. The values for driveshafts of series 687/688 with welded balancing plates are lower. With a fatigue torque of this order, the transmission capacity of the flange connection must be checked.

$T_{DSch} = \text{Pulsating fatigue torque [Nm]}$
At this torque, the driveshaft is permanently solid at pulsating loads.

$T_{DSch} = 1.4 \cdot T_{DW}$

$L_C = \text{Bearing capacity factor}$
The bearing capacity factor takes into consideration the dynamic service life $C_{dyn}$ (see DIN/ISO 281) of the bearings and the joint geometry $R$. The $L_C$ values for the different shaft sizes are shown in the tables (see data sheets).

When selecting driveshafts, the bearing life and the operating strength must be considered separately. According to the load state, the reversing fatigue torque $T_{DW}$ or the pulsating fatigue torque $T_{DSch}$ must also be taken into consideration.
Selection of GWB™ driveshafts

2. Selection by bearing life

By bearing capacity factor \( L_C \)

The bearing life \( L_h \) of a driveshaft depends on the bearing capacity factor \( L_C \) and is based on the following formula:

\[
L_h = \frac{L_C \cdot 10^{10}}{n \cdot \beta \cdot T^{10/3} \cdot K_1}
\]

If the desired bearing life \( L_h \) is given, the joint size can be calculated by the bearing capacity factor \( L_C \).

\[
L_C = \frac{L_h \cdot n \cdot \beta \cdot T^{10/3} \cdot K_1}{10^{10}}
\]

The \( L_C \) values can be taken from the tables (see data sheets).

\( L_C \) = Bearing capacity factor

\( n \) = Operating speed [rpm]

\( \beta \) = Operating deflection angle [°]

\( T \) = Operating torque [kNm]

\( K_1 \) = Shock factor

If operating data are based on a duty cycle, a more precise durability can be calculated.

Drives with internal combustion engines may cause torque peaks that must be considered by factor \( K_1 \).

Electric motor/turbine \( K_1 = 1,00 \)

Gasoline engine
4 cylinder and more \( K_1 = 1,15 \)

Diesel engine
4 cylinder and more \( K_1 = 1,20 \)

The values shown in the tables are general values. If a flexible coupling is used, the shock factor is lower. Principally the data of the motor and/or coupling manufacturer must be observed.

3. Operating dependability

The operating dependability can be determined if a certain duty cycle is given. The calculated service life of a driveshaft under normal working conditions has to achieve or exceed the required service life.

Duty cycles are often not available. In such cases, Dana engineers will make use for almost 70 years of experience as a manufacturer of driveshafts to provide an optimal selection.

Calculations are based on the peak torque \( T \) and the maximum peak torque \( T_{SP} \) that may occur. The peak torque is determined according to the type of operation and the torque characteristic. It should be lower than the corresponding torques \( T_{DSch} \) and \( T_{DW} \):

\[
T_N \cdot K = T < T_{DSch} \text{ or } T_{DW}
\]
## Selection of GWB™ Driveshafts

### Typical Types of Torques:

**Pulsating Stress**

\[ T < T_{DSch} \]

**Alternating Stress**

\[ T < T_{DW} \]

The maximum peak torque \( T_{SP} \) is the extremely rarely occurring torque of the system (crash, emergency case).

This maximum torque \( T_{SP} \) should not exceed the functional limited torque \( T_{CS} \) of the driveshaft.

\[ T_{SP} < T_{CS} \]

\[ T_{SP} = \text{Maximum peak torque} \quad [\text{Nm}] \]

\[ T_{N} = \text{Nominal torque} \quad [\text{Nm}] \]

\[ T_{CS} = \text{Functional limit torque of the driveshaft} \quad [\text{Nm}] \]

(See data sheets)

---

### Service Factor \( K \)

The service factors shown in the following tables should be used as approximate values only.

#### Light Shock Load: \( K = 1,1 - 1,5 \)

- Driven machines
- Centrifugal pumps
- Generators (continuous load)
- Conveyors (continuous load)
- Small ventilators
- Machine tools
- Printing machines

#### Medium Shock Load: \( K = 1,5 - 2 \)

- Driven machines
- Centrifugal pumps
- Generators (non-continuous load)
- Conveyors (non-continuous load)
- Medium ventilators
- Wood handling machines
- Small paper and textile machines
- Pumps (multi-cylinder)
- Compressors (multi-cylinder)
- Road and bar mills
- Locomotive primary drives

#### Heavy Shock Load: \( K = 2 - 3 \)

- Driven machines
- Large ventilators
- Marine transmissions
- Calender drives
- Transport roller tables
- Small pinch rolls
- Small tube mills
- Heavy paper and textile machines
- Compressors (single-cylinder)
- Pumps (single-cylinder)

#### Extra-Heavy Shock Load: \( K = 3 - 5 \)

- Driven machines
- Continuous working roller tables
- Medium section mills
- Continuous slabbing and blooming mills
- Continuous heavy tube mills
- Reversing working roller tables
- Vibration conveyors
- Scale breakers
- Straightening machines
- Cold rolling mills
- Reeling drives
- Blooming stands

#### Extreme Shock Load: \( K = 5 - 10 \)

- Driven machines
- Feed roller drives
- Wrapper roll drives
- Plate-shears
- Reversing slabbing and blooming mills
Additional information and ordering instructions

Selection of driveshafts

The selection of a GWB™ driveshaft is determined not only by the maximum permissible torque of the shaft and the connections but also by a variety of other factors.

For the exact determination and selection of driveshafts, see the Selection of Driveshafts pages in this brochure.

Dana engineers can precisely calculate the correct size of the shaft and joint for your application with the use of computer programs created specifically for this purpose.

In order to best match your requirements, you’ll be asked to provide the following information:

- Installation length of the driveshaft
- Maximum joint angle requirement
- Required length compensation
- Maximum rotation speed of the shaft
- Shaft end connection details
- Maximum torque to be transmitted
- Nominal torque to be transmitted
- Load occurrences
- Description of the equipment and working conditions

Specific applications

Driveshafts in railway transmissions

The selection of driveshafts in the secondary system of railway vehicles must be based on the maximum torque that can be transmitted to the track (wheel slip or adhesion torque).

Driveshafts in crane travel drives

The particular operating conditions for travel drives of cranes have been taken into consideration in the DIN-standard 15 450. As a result, driveshafts for these applications can be selected by using that standard.

Driveshafts in marine transmissions

These driveshafts are subject to acceptance and must correspond to the standards of the respective classification society.

Driveshafts for other forms of passenger conveyance

Driveshafts used in amusement park equipment, ski lifts or similar lift systems, elevators, and rail vehicles must be in accordance with the standards and specifications of the appropriate licensing and supervisory authorities.

Driveshafts in explosive environments (Atex-outline)

For the use of driveshafts in areas with danger of explosion, an EC-conformity certificate acc. to EC-outline 94/9/EG can be provided.

The possible categories for the product „driveshaft“ are:

a) in general: ΞII 3 GDc T6
b) for driveshafts with adapted features: ΞII 2 GDc T6

The driveshaft should not be used under the following operating conditions:

- Within the critical bending speed range of the drive
- Within the critical torsional speed range of the drive
- At operating angles which exceed the specified maximum (refer to drawing confirmed with order)
- At dynamic and static operating torques which exceed the specified limit (refer to drawing confirmed with order)
- At speed x deflection angle \( n \times \| \) conditions which exceed the limit (refer to GWB catalogue)
- For usage time which exceeds the calculated bearing lifetime of the joint bearings

If you’d like more information on GWB driveshafts, or would like to discuss specific application requirements with an engineer, please call Dana at 0049 (0)201-8124-0 or visit www.gwbdriveshaft.com, www.dana.com.
After-sales service Spicer Gelenkwellenbau GmbH

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