The Backlash-free Flexible Shaft Coupling for

Machine Tools
Printing Machinery
Positioning Drives

ROBA®-ES

- Simple plug-in blind assembly
- Vibrational damping
- Maintenance-free
ROBA®-ES smoothes vibration critical drive systems.

An elastomeric coupling in high precision servo axis drives?
Of course, but only if it is the mayr® ROBA®-ES!
The ROBA®-ES is not just another elastomeric coupling.
The ROBA®-ES is a zero-backlash shaft coupling with damping and torque transmission properties not possible with conventional couplings.

ROBA®-ES, the alternative for traditional torsionally rigid shaft couplings.
- Zero-backlash torque transmission due to optional elastomeric elements where the hardness, stiffness and damping behaviour can be varied.
- Compensation of radial, axial and angular shaft misalignments.
- Simple plug-in blind assembly, maintenance media and temperature resistant guarantee highest operational reliability.

ROBA®-ES - flexible and backlash-free
smartflex® - torsionally rigid and backlash-free
Backlash is the angular tolerance between input and output, also known as circumferential backlash. Many traditional flexible couplings have backlash due to their design.

mayr®-couplings in the series ROBA®-ES, smartflex® and ROBA®-DS for backlash-free torque transmission.

The couplings differentiate in their damping behaviour and torsional stiffness.

- The ROBA®-ES is torsionally flexible and vibrational damping. Its torsionally stiffness is 2-4 times higher compared to tooth belt drives.
- The smartflex® and ROBA®-DS are torsionally rigid all-steel flexible couplings with the smallest torsional angle with maximum torque. Due to their transmission element designs in steel they do not have any damping features.
ROBA®-ES

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Coupling design + selection 12 – 13

mayr®
power transmission
sets the standards for innovative and technically economic solutions.
You profit from our
quality - experience - competence

Contact us directly under

mayr®
+49-8341/804-241
or at your local sales office

STRUCTURAL SHAPES

Type 940. 22._
ROBA®-ES with keyways

Page 6

drawn displaced

Type 940. 00._
ROBA®-ES with clamping hubs

Page 7

Type 940. _11._
ROBA®-ES with shrink discs

Pages 8 – 9
Elastomeric elements

The elastomeric elements are the central component of the ROBA®-ES coupling. They define the application range and behaviour of the shaft connection by the permissible torque, stiffness, damping and misalignment values.

By the use of a new polyurethane material and a special injection moulding a high degree of dimensional stability and uniformity of the teeth of elastomeric element is achieved.

The elastomeric elements are available in different shore hardessess.

The teeth of the flexible elastomeric element are laterally chamfered to ease blind assembly.

<table>
<thead>
<tr>
<th>Elastomeric element Hardness [Shore]</th>
<th>Colour</th>
<th>Permissible temperature range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Continuous temperature</td>
</tr>
<tr>
<td>80 Sh A</td>
<td>blue</td>
<td>-50 to +80 °C</td>
</tr>
<tr>
<td>92 Sh A</td>
<td>yellow</td>
<td>-40 to +90 °C</td>
</tr>
<tr>
<td>98 Sh A</td>
<td>red</td>
<td>-30 to +90 °C</td>
</tr>
<tr>
<td>64 Sh D</td>
<td>green</td>
<td>-30 to +100 °C</td>
</tr>
</tbody>
</table>

Temperature influence

The temperatures arising during operation effect a considerable influence on the design of the ROBA®-ES coupling (see selection on page 12).

Medium resistance

The elastomeric elements are resistant against
• pure mineral oils (lubricating oils)
• and anhydrous grease

The resistance against fuels is similar, for example
• standard petrol
• diesel oil
• kerosene

Damage can occur in case of the longer action of
• alcohol or
• aromatic fuels (super petrol)

The elastomer used is resistant against hydrolisis. Water or seawater does not cause any essential alteration of the mechanical characteristics even after many years contact contrary to other polyurethane material. However, hot water reduces the mechanical strength.

Please contact the factory in case of difficult environmental conditions.

Selection

ROBA®-ES couplings can be varied essentially in their features by using different elastomeric elements. Due to their different damping characteristics and the stiffness of the elastomer not being linear this element has more parameters contrary to a steel-shaft connection which should be considered for a selection.

Therefore, the coupling has to be selected carefully (see selection on page 12).
### Torques

<table>
<thead>
<tr>
<th>Size</th>
<th>( T_{K_E}^{(6)} ) [Nm]</th>
<th>( T_{K_{MAX}}^{(6)} ) [Nm]</th>
<th>( T_{K_{MAX}}^{(6)} ) [Nm]</th>
<th>( T_{K_{MAX}}^{(6)} ) [Nm]</th>
<th>( T_{K_{MAX}}^{(6)} ) [Nm]</th>
<th>( T_{K_{MAX}}^{(6)} ) [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>16</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>19</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>17</td>
<td>34</td>
</tr>
<tr>
<td>24</td>
<td>17</td>
<td>34</td>
<td>35</td>
<td>70</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>28</td>
<td>46</td>
<td>92</td>
<td>95</td>
<td>190</td>
<td>160</td>
<td>320</td>
</tr>
<tr>
<td>38</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>300</td>
<td>650</td>
</tr>
<tr>
<td>42</td>
<td>-</td>
<td>-</td>
<td>265</td>
<td>530</td>
<td>450</td>
<td>900</td>
</tr>
<tr>
<td>48</td>
<td>-</td>
<td>-</td>
<td>310</td>
<td>620</td>
<td>525</td>
<td>1050</td>
</tr>
</tbody>
</table>

Only available with AP-design (page 9):
- 14-32: Torsions: 4-8 [Nm/rad.]
- 19-37.5: Torsions: 4-8 [Nm/rad.]
- 24-50: Torsions: 12-24 [Nm/rad.]

### Permissible misalignment values

<table>
<thead>
<tr>
<th>Size</th>
<th>Axial ( \Delta K_a ) 80 Sh A</th>
<th>Radial ( \Delta K_r ) 98 Sh A</th>
<th>Angular ( \Delta K ) 64 Sh D</th>
<th>80 Sh A</th>
<th>92 Sh A</th>
<th>98 Sh A</th>
<th>64 Sh D</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>1.0</td>
<td>0.21</td>
<td>-</td>
<td>1.1</td>
<td>1.0</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>19</td>
<td>1.2</td>
<td>0.15</td>
<td>0.09</td>
<td>0.06</td>
<td>1.1</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>24</td>
<td>1.4</td>
<td>0.18</td>
<td>0.1</td>
<td>0.07</td>
<td>1.1</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>28</td>
<td>1.5</td>
<td>0.2</td>
<td>0.15</td>
<td>0.08</td>
<td>1.3</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>38</td>
<td>1.8</td>
<td>-</td>
<td>0.12</td>
<td>0.09</td>
<td>-</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>42</td>
<td>2.0</td>
<td>-</td>
<td>0.14</td>
<td>0.1</td>
<td>-</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>48</td>
<td>2.1</td>
<td>0.21</td>
<td>0.16</td>
<td>0.11</td>
<td>-</td>
<td>1.0</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Only available with P-design (page 9):
- 14-32: Torsions: 1.0-2.1 [Nm/rad.]
- 19-37.5: Torsions: 1.2-1.4 [Nm/rad.]
- 24-50: Torsions: 1.4-2.1 [Nm/rad.]

### Spring characteristic

<table>
<thead>
<tr>
<th>Size</th>
<th>Static torsional stiffness ( C_T ) 80 Sh A</th>
<th>Dynamic torsional stiffness ( C_T ) 98 Sh A</th>
<th>Static radial stiffness ( C_r ) 98 Sh A</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>50</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>19</td>
<td>350</td>
<td>900</td>
<td>900</td>
</tr>
<tr>
<td>24</td>
<td>820</td>
<td>3700</td>
<td>3700</td>
</tr>
<tr>
<td>28</td>
<td>1300</td>
<td>4200</td>
<td>4200</td>
</tr>
<tr>
<td>38</td>
<td>5600</td>
<td>9000</td>
<td>9000</td>
</tr>
<tr>
<td>42</td>
<td>9800</td>
<td>13800</td>
<td>13800</td>
</tr>
<tr>
<td>48</td>
<td>12000</td>
<td>28500</td>
<td>28500</td>
</tr>
</tbody>
</table>

Only available with AP-design (page 9):
- 14-32: Static torsional stiffness: 50-80 [Nm/rad.]
- 19-37.5: Static torsional stiffness: 280-660 [Nm/rad.]
- 24-50: Static torsional stiffness: 600-1700 [Nm/rad.]

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1) Perm. max. torques for Type 940.00._ and 940.11._ dependent on bore diameters d3/d4, see tables 1, 2 and 3, pages 7, 8 and 9.

6) Perm. alternating torques, see clutch design page 12.
ROBA®-ES couplings are supplied either without a bore (machining by customer) or with finish bore and keyway J S9 (DIN 6885/1). There is a set screw in the hub for an axial attachment which is displaced by 180° to the keyway (Fig. 4).

Up to size 38 aluminium is used as hub material and steel from size 42. Preferred bores are available ex stock.

---

**Order example:**

To be included when ordering, please state:

<table>
<thead>
<tr>
<th>size</th>
<th>type</th>
<th>bore Ø</th>
<th>bore Ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>940. _ 22._</td>
<td>d5 H7</td>
<td>d5 H7</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example: order number 42/940.022.F/Ø d5 30/Ø d5 30

*only up to size 28

---

We reserve the right to make dimensional and design alterations.
ROBA®-ES couplings with clamping hubs are designed for fast and safe assembly or disassembly. They don’t have a keyway. The tightening torque (TA) of the clamping screws must be observed in order to guarantee a reliable, friction torque transmission.

Please observe the max. permissible torques (Table 1). The hubs are made of aluminium up to size 38, from size 42 on steel is used. On request the clamping hub can be additionally designed with keyway.

Table 1  The transmittable torques of the clamping connection consider the max. tolerance with shaft k6/bore F7. The torque decreases in case of larger tolerances.

<table>
<thead>
<tr>
<th>order number</th>
<th>42/940.000.F/Ø d3 30/Ø d3 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>sizes</td>
<td>14 to 48</td>
</tr>
</tbody>
</table>

2) Further sizes and types on request

We reserve the right to make dimensional and design alterations.

Order example:

To be included when ordering, please state:

<table>
<thead>
<tr>
<th>Order No.</th>
<th>940. _ 00._</th>
</tr>
</thead>
<tbody>
<tr>
<td>size</td>
<td>d3 F7</td>
</tr>
<tr>
<td>bore Ø</td>
<td>d3 F7</td>
</tr>
</tbody>
</table>

Example: order number 42/940.000.F/Ø d3 30/Ø d3 30

*only up to size 28
The hub body consists of aluminium for this design, the ring is made of annealed, phosphated steel. The dimensions are as the P-design (page 9). Optimum true running is achieved by the symmetry, the missing keyways and radial bores. Therefore, essential higher speeds than with other hub designs (observe diagram balancing, page 11) are possible.

The torque is transmitted to the shaft via friction. Therefore, observe the max. torques of this shaft-hub connection (Table 2).

<table>
<thead>
<tr>
<th>size</th>
<th>mass moments of inertia J [kgm²]</th>
<th>weight [kg]</th>
<th>max. speed nmax. [rpm]</th>
<th>bore ø d₄</th>
<th>tightening torques [Nm]</th>
<th>dimensions [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>0,07x10⁻⁴</td>
<td>0,049</td>
<td>28000</td>
<td>6</td>
<td>14</td>
<td>1,3</td>
</tr>
<tr>
<td>19</td>
<td>0,31x10⁻⁴</td>
<td>0,12</td>
<td>21000</td>
<td>10</td>
<td>20</td>
<td>3,0</td>
</tr>
<tr>
<td>24</td>
<td>1,35x10⁻⁴</td>
<td>0,28</td>
<td>15500</td>
<td>15</td>
<td>28</td>
<td>6,0</td>
</tr>
<tr>
<td>28</td>
<td>3,13x10⁻⁴</td>
<td>0,45</td>
<td>13200</td>
<td>19</td>
<td>38</td>
<td>6,0</td>
</tr>
<tr>
<td>38</td>
<td>9,60x10⁻⁴</td>
<td>0,95</td>
<td>10500</td>
<td>20</td>
<td>45</td>
<td>10,0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>size</th>
<th>preferred bores ø d₄ and friction transmittable torques Tₕ [Nm] of the shrink discs</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>ø 6 7 9 11 13 15 17 24 33 38 55 61 67 73 78 84 88 141 153 177 203 216 256 282 308 343 373 141</td>
</tr>
<tr>
<td>19</td>
<td>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -</td>
</tr>
<tr>
<td>24</td>
<td>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -</td>
</tr>
<tr>
<td>28</td>
<td>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -</td>
</tr>
<tr>
<td>38</td>
<td>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -</td>
</tr>
</tbody>
</table>

Table 2 The transmittable torques of the shrink connection consider the max. tolerance with shaft k6/bore H7.

The torque decreases in case of larger tolerances.

**Order example:**

**To be included when ordering, please state:**

<table>
<thead>
<tr>
<th>size</th>
<th>type</th>
<th>bore Ø</th>
<th>bore Ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>940. _ 11.A</td>
<td>d₄ H₇</td>
<td>d₄ H₇</td>
<td></td>
</tr>
</tbody>
</table>

Example: order number 38/940.011.A/ø d₄ 30/ø d₄ 30 *only up to size 28
The hub body consists of steel (oiled), the ring is made of annealed phosphated steel. This design is available in a standard version and a version to DIN 69002. The DIN version has an elastomeric element with central, standard bore and standard bore diameters in the hubs.

The DIN variation has been designed for the use in spindles with short bores and multi-spindle heads. This DIN-design combines robustness with steel hubs precision. For designs with dynamic or alternating load this design should be selected.

## ROBA®-ES with shrink disc hub made of steel

### Type 940.11.

Sizes 14-32 to 48

<table>
<thead>
<tr>
<th>size</th>
<th>mass moments of inertia per hub and max. bore [kgm²]</th>
<th>weight [kg]</th>
<th>max. speed [rpm]</th>
<th>bore d₄ [mm]</th>
<th>tightening torques straining screws [N]</th>
<th>dimensions [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-32</td>
<td>0.11 x 10⁴&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0.1</td>
<td>28000</td>
<td>6-14-14</td>
<td>1.3</td>
<td>a: 10, b: 32, c: 10.5, d: 17, e: 8.5</td>
</tr>
<tr>
<td>19-37.5</td>
<td>0.37 x 10⁴&lt;sup&gt;4&lt;/sup&gt;</td>
<td>0.16</td>
<td>21000</td>
<td>10-16-16</td>
<td>3.0</td>
<td>4-12, b: 37.5, c: 18, d: 19, e: 9.5</td>
</tr>
<tr>
<td>19</td>
<td>0.46 x 10⁴</td>
<td>0.19</td>
<td>21000</td>
<td>10-20-19</td>
<td>3.0</td>
<td>4-12, b: 40, c: 18, d: 22, e: 9.5</td>
</tr>
<tr>
<td>24-50</td>
<td>1.36 x 10⁴</td>
<td>0.33</td>
<td>15500</td>
<td>15-24-24</td>
<td>6.0</td>
<td>4-14, b: 50, c: 27, d: 29, e: 12.5</td>
</tr>
<tr>
<td>24</td>
<td>2.01 x 10⁴</td>
<td>0.44</td>
<td>15500</td>
<td>15-28-25</td>
<td>6.0</td>
<td>4-14, b: 55, c: 27, d: 30, e: 12.5</td>
</tr>
<tr>
<td>28</td>
<td>4.38 x 10⁴</td>
<td>0.64</td>
<td>13200</td>
<td>19-38-35</td>
<td>6.0</td>
<td>5-15, b: 65, c: 30, d: 40, e: 14.5</td>
</tr>
<tr>
<td>38</td>
<td>13.2 x 10⁴</td>
<td>1.3</td>
<td>10500</td>
<td>20-45-45</td>
<td>10.0</td>
<td>5-18, b: 80, c: 38, d: 46</td>
</tr>
<tr>
<td>42</td>
<td>31.7 x 10⁴</td>
<td>2.3</td>
<td>9000</td>
<td>28-50-50</td>
<td>25.0</td>
<td>5-20, b: 95, c: 46, d: 55</td>
</tr>
<tr>
<td>48</td>
<td>52.0 x 10⁴</td>
<td>3.1</td>
<td>8000</td>
<td>35-60-60</td>
<td>30.0</td>
<td>5-21, b: 105, c: 51, d: 60</td>
</tr>
</tbody>
</table>

<sup>1</sup>Elastomeric elements with DIN-bore only with 98 Sh A. ROBA®-ES 940.11.P

We reserve the right to make dimensional and design alterations.

### Preferred bores d₄ (shrink disc) and friction transmittable torques Tₚ [Nm]

<table>
<thead>
<tr>
<th>size</th>
<th>d₄ (shrink disc)</th>
<th>φ₄ (steel design)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-32</td>
<td>6, 7, 8, 9, 10</td>
<td>6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>19-37.5</td>
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<td>-</td>
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<tr>
<td>19</td>
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<td>24-50</td>
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<td>42</td>
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<td>-</td>
</tr>
<tr>
<td>48</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Order example:

**Possible a₄ₗ see table of dimension**

<table>
<thead>
<tr>
<th>Order No.:</th>
<th>type</th>
<th>bore Ø</th>
<th>bore Ø</th>
<th>design</th>
</tr>
</thead>
<tbody>
<tr>
<td>940.11. H₆</td>
<td>d₄ H₆</td>
<td>d₄ H₆</td>
<td>DIN</td>
<td></td>
</tr>
</tbody>
</table>

**Example:** order number 42/940.011.F/Ø d₄ 30/Ø d₄ 30  *only up to size 28*
Technical explanations

ROBA®-ES couplings consist of two coupling hubs and one flexible intermediate ring in the form of a star (Fig. 1).

ROBA®-ES couplings are designed especially for backlash-free use at comparatively high speeds.

ROBA®-ES couplings are mainly used in measurement and control techniques as well as in material processing.

Supply condition

ROBA®-ES couplings are supplied ready for assembly. The flexible elastomeric element is pressed under a slight pretension (Fig. 2) into the claws which are machined in a special shape.

Due to this pre-tension the principle of the backlash-free torque transmission is achieved.

ROBA®-ES couplings are supplied in four torque variations, i.e. with four alternative flexible intermediate rings different in shore hardness and colour (see type chart, page 5).

Due to the small dimensions and low inertia, excellent installation possibilities, even in compact areas, are achieved.

Mounting examples

Shaft misalignments

The ROBA®-ES coupling compensates radial, axial and angular shaft misalignments (Fig. 4) without influencing its backlash-free design. However, the permissible misalignments indicated on page 5 must not achieve simultaneously the maximum values. In case several kinds of misalignments occur simultaneously they influence each other, i.e. the permissible value of the misalignment depend on each other corresponding to Fig. 3.

The amount of the actual misalignments, in percentage of the maximum value, must not exceed 100%.

The permissible misalignment values indicated on page 5 refer to a coupling use with nominal torque, an ambient temperature of +30 °C and an operating speed of 1500 rpm.
Balancing

Keyway hubs and clamping hubs:
The keyway hubs and clamping hubs rotate with max. speed with a circumferential speed of 30 m/s. They are not balanced as standard.

Shrink disc hubs:
The shrink disc hubs keep the balance quality $G = 6.3$ up to the speed $n_G$ (corresponds to approx. 30 m/s) without balancing. Balancing is recommended in case the speed is higher. The hubs are balanced single. The diagram indicates reference values for which we recommend to balance the coupling elements.

The quiet running of a machine or equipment depends not only on balancing quality of the coupling, but also on many parameters as stiffness or distance of the adjacent bearings. Therefore, there is no fixed rule at which conditions balancing is necessary.

Assembly - Mounting indications

Due to its optimum construction the ROBA®-ES coupling offers the possibility to connect the coupling axially after the hubs have been assembled onto the input or output shafts. Any additional fitting and special housings are not necessary (see mounting examples page 10).

Please observe!!!
The installation or the installation dimensions must be maintained to avoid thrust load on the faces of the flexible element.

By observing the installation dimensions (especially dimension "E", as shown on pages 6 – 9) it is guaranteed that the flexible element can move axially.

For elastomeric elements with different amount of dimples the side with more dimples must be assembled at first (facilitates assembly).

When pushing both coupling halves together an axial assembly force must be exerted due to the pre-tension of the flexible element.

The axial assembly force can be decreased by slightly greasing the elastomeric element. ATTENTION: Only use greases on mineral oil base and without additions, vaseline can also be used.

Assembly of the shrink disc hub (ROBA®-ES Type 940._11._)
The cone surfaces of the shrink disc hubs are greased in the factory with a special grease (if necessary, grease it again with a special grease after cleaning).

- Attach shrink disc hubs on both shaft ends, align them and tighten shrink disc bolts slightly until contact.
- Tighten shrink disc bolts uniformly step by step and crosswise to the indicated tightening torque (see pages 8 and 9) by means of a torque wrench.
- To dismantle, unscrew all shrink disc bolts to release some threads.
- Unscrew the shrink disc bolts located beside the extraction holes and screw them into the extraction holes until contact.
- Tighten shrink disc bolts uniformly step by step and crosswise, loosen the shrink disc from the conical shrink disc hub.

Safety regulations
The coupling rotates during operation. It must be secured from the user against unintended contact. Assembly and maintenance should be made by well trained specialists.
Selection of ROBA®-ES couplings

1. Approximate calculation of the coupling torque:
   1.1. \( T_N \) from the nominal capacity
   \[
   T_N = \frac{9550 \times \frac{P}{\text{AN/LN}}}{n}
   \]

   1.2. Dynamic torques \( T_S \) and \( T_W \) (5.1 and 5.2):
   - Excitation at the input side:
     - Shock torque: \( T_S = T_{AS} \times \frac{J_L}{J_A + J_L} \times S_A \)
     - Alternating torque: \( T_W = T_{AW} \times \frac{J_L}{J_A + J_L} \times V_R \)
   - Excitation at the load side:
     - Shock torque: \( T_S = T_{LS} \times \frac{J_A}{J_A + J_L} \times S_L \)
     - Alternating torque: \( T_W = T_{LW} \times \frac{J_A}{J_A + J_L} \times V_R \)

2. Comparison of the existing torques in the coupling with the permissible torques
   The coupling must be designed in this way that the existing loads do not exceed the permissible values in any operational condition (5.3).
   2.1. Load by the nominal torque
   \[
   T_{KN} \geq T_N \times S_A \times S_D
   \]
   2.2. Load by shock torques (5.4)
   \[
   T_{K_{\text{max}}} \geq T_S \times S_2 \times S_A + T_N \times S_A \times S_D
   \]
   2.3. Load during transit of the resonance (5.5)
   \[
   T_{K_{\text{max}}} \geq T_S \times S_2 \times S_A \times V_R + T_N \times S_A \times S_D
   \]
   2.4. Load by continuous alternating torque cycle operation (5.6 and 5.7)
   Permissible alternating torque of the coupling:
   - Aluminium hubs: \( T_{KW} = 0.25 \times T_{KN} \)
   - Steel hubs: \( T_{KW} = 0.35 \times T_{KN} \)
   - \( T_{KW} \geq T_W \times S_3 \times S_2 \times S_D \)

3. Examination of the permissible misalignment
   \[
   \Delta K_S \geq \Delta W_A \times S_A
   \]
   \[
   \Delta K_r \geq \Delta W_r \times S_2 \times S_n
   \]
   \[
   \Delta K_w \geq \Delta W_w \times S_3 \times S_n
   \]
   Observe Fig. 3 (page 10) in case several kinds of misalignment occur simultaneously.

4. Examination of the frictional resistance of the hub connection
   \( T_R > T_{\text{max}} \) is the max. torque which occurs in the coupling.
   Values for \( T_R \) are mentioned on pages 7, 8 and 9.

5. Explanations
   5.1. The determination of the torque existing on the coupling is valid, when the shaft coupling is the torsional softest element in the equipment and, therefore, the equipment can be considered as two-mass oscillator. If this is not the case the calculation of the torque existing on the coupling requires further calculation procedures.
   5.2. The shock factors \( S_A \) / \( S_L \) describe the shock process. A square process of the shock torque is the heaviest shock (\( S_A/S_L = 2.0 \)). An even sine process of the shock torque is a light shock (\( S_A/S_L = 1.2 \)).
   5.3. The torsional rigidity factor \( S_D \) can influence the dimensioning of the coupling considerably. It must be checked, if the coupling is between the object to be positioned and a measuring system (indirect measurement). If this is not the case \( S_D = 1 \) can be selected.
   5.4. \( T_s \), the impact torque existing in the coupling is the maximum torque existing in the coupling during the shock minus nominal drive torque which acts in the coupling during standard operation.
   \[
   T_s = T_{\text{max, impact}} - T_R
   \]
   5.5. In case a drive is operated supercritical, i. e. the operating speed \( n \) is over the resonance speed \( n_R \), the passing of the resonance generates special loads.
   In case of a very fast passing of the resonance below the operating speed only a few resonance peaks occur. The alternating torque in resonance can, therefore, be compared with the maximum torque of the coupling (also see 5.7).
   5.6. \( S_I \) allows the dependence on the frequency of the service life. The dependance on the frequency is only considered over 5 Hz.
   5.7. In case of worth mentioning vibrating excitation the resonance should be displaced off the operating area by selecting a suitable torsional stiffness of the coupling.
### Terms and factors for the coupling design

- **P_{AN/LN} [kW]**: Capacity at the input side/load side
- **T_R [Nm]**: Transmittable torque (friction tight, table pages 7, 8, 9)
- **T_{AS/AW} [Nm]**: Exciting torque input side
- **T_{LS/LW} [Nm]**: Exciting torque load side
- **T_N [Nm]**: Nominal drive torque
- **T_W [Nm]**: Alternating torque
- **T_S [Nm]**: Peak torque
- **T_{max} [Nm]**: Max. torque in the coupling
- **T_{KN} [Nm]**: Permissible nominal torque
- **T_{Kmax} [Nm]**: Permissible max. torque
- **T_{KW} [Nm]**: Permissible continuous alternating torque
- **J_A [kgm^2]**: Mass moment of inertia input side
- **J_L [kgm^2]**: Mass moment of inertia load side
- **\(\Delta K_a [mm]\)**: Permissible axial displacement
- **\(\Delta K_r [mm]\)**: Permissible radial misalignment
- **\(\Delta K_w [^\circ]\)**: Permissible angular misalignment
- **\(\Delta W_a [mm]\)**: Axial shaft displacement
- **\(\Delta W_r [mm]\)**: Radial shaft misalignment
- **\(\Delta W_w [mm]\)**: Angular shaft misalignment
- **c_T [Nm/rad]**: Torsional stiffness
- **n [rpm]**: Nominal speed
- **n_R [rpm]**: Resonance speed
- **S_{A/L} [-]**: Shock factor input side/load side
- **S_D [-]**: Torsional stiffness factor
- **S_Z [-]**: Starting factor/shock frequency
- **S_{S} [-]**: Temperature factor
- **S_f [-]**: Frequency factor
- **f [1/s]=[Hz]**: Load factor
- **f_R [Hz]**: Resonance frequency

### Operating factors:

**V_R = resonance factor**

**S_n = speed factor**

**S_D = rigidity factor**

<table>
<thead>
<tr>
<th>no positioning requirement</th>
<th>simple positioning equipment</th>
<th>machine tools</th>
<th>torsional angle transmitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2-5</td>
<td>3-8</td>
<td>10-&gt;</td>
</tr>
</tbody>
</table>

**S_Z = starting factor/shock frequency**

<table>
<thead>
<tr>
<th>S/h</th>
<th>0-100</th>
<th>101-200</th>
<th>201-400</th>
<th>401-800</th>
<th>801-1600</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S_Z)</td>
<td>1</td>
<td>1,2</td>
<td>1,4</td>
<td>1,6</td>
<td>1,8</td>
</tr>
</tbody>
</table>

\[n_R = \frac{30}{\pi} \sqrt{\frac{C_T dyn. \cdot J_A + J_L}{J_A \cdot J_L}} (rpm)\]

\[f_R = \frac{1}{2\pi} \sqrt{C_T dyn. \cdot J_A + J_L} (1/s)\]

**S_f = frequency factor**

<table>
<thead>
<tr>
<th>f in Hz</th>
<th>(\leq 5)</th>
<th>(&gt; 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S_f)</td>
<td>1</td>
<td>(\sqrt{\frac{f}{5}})</td>
</tr>
</tbody>
</table>

f indicates the load change per second (Hz = 1/s)

**S_L or S_A = shock factor**

<table>
<thead>
<tr>
<th>impacts</th>
<th>S_A or S_L</th>
</tr>
</thead>
<tbody>
<tr>
<td>slight impacts</td>
<td>1.2</td>
</tr>
<tr>
<td>medium impacts</td>
<td>1.6</td>
</tr>
<tr>
<td>heavy impacts</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**S_B = safety factor for temperature**

<table>
<thead>
<tr>
<th>T [°C]</th>
<th>(-30^\circ)</th>
<th>(+30^\circ)</th>
<th>(+60^\circ)</th>
<th>(+90^\circ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S_B)</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**ROBA®-ES**

- blue: elastomeric element 80 Sh A
- yellow: elastomeric element 92 Sh A
- red: elastomeric element 98 Sh A
- green: elastomeric element 64 Sh D
In addition to the backlash-free, flexible ROBA®-ES mayr® offers two further backlash-free couplings for compensation of shaft misalignments and torsionally rigid torque transmission. Combinations of ROBA®-ES couplings and EAS®-NC-safety clutches additionally offer reliable protection of overload damage together with the backlash-free connection of two shafts. For detailed catalogues on our ROBA®-DS and smartflex® couplings as well as EAS-NC® clutches please contact your nearest mayr® representation.

**ROBA®-DS torsionally rigid all-steel flexible coupling**

ROBA®-DS couplings guarantee reliable torque transmission even under difficult conditions and can be used at high temperatures. The coupling operates similar to a cardan joint, however, disk packages compensate axial, radial and angular misalignments of the shafts. These packs are alternately connected with input or output hub/sleeve. A backlash-free torque transmission is guaranteed. Various backlash-free shaft hub connections as well as keyway connections are available.

**smartflex® backlash-free, torsionally rigid steel bellows coupling**

Smartflex®-couplings have an increased misalignment capability with radial shaft misalignment up to three times that of standard steel bellows coupling. Reduced costs by using them. Highly competitive price/value ratio, fast and easy shaft attachment, high reliability and no maintenance are the result. These shaft couplings can especially be used for dynamic and reversing drives due to the backlash-free shaft attachment, backlash-free torque transmission and high torsional rigidity, but also for drives where problems arise with standard all-steel couplings.

**EAS®-NC elastic backlash-free**

The EAS®-NC limits the torque to an exact adjustable value and reliably prevents costly overload damage on your machines and equipment. The ROBA®-ES is the compensating component in the drive system. It compensates shaft misalignment and damps vibrations. All components connected with the torque transmission operate backlash-free. EAS®-NC and ROBA®-ES cope with critical drive axes.
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### Note:
If a country is not shown, please refer to headquarters or our web site to be advised of the nearest responsible agent.
Delivery Programme

Safety clutches/ torque limiters

- **EAS®-Compact®/EAS®-NC**
  Positive, absolutely backlash-free torque limiter
- **EAS®-smartic®**
  Economic torque limiters with fast assembly
- **EAS®-element clutch/EAS®-elements**
  Load disconnecting protection for high torques
- **EAS®-axial**
  Exact limitation of tensile and compressive forces
- **EAS®-Sp/EAS®-Sm/EAS®-Zr**
  Residual torque free disconnecting torque limiter with ON/OFF function
- **ROBA®-slip hubs**
  Load holding, friction type torque limiting clutch
- **ROBA®-contitorque**
  Magnetic continuous slip clutch

Shaft couplings

- **smartflex®**
  Perfect precision coupling for servo and stepper motors
- **ROBA®-ES**
  Backlash-free and damping of vibration critical drives
- **ROBA®-DS/ROBA®-D**
  Backlash-free, torsionally rigid all-steel coupling
- **EAS®-control-DS**
  Low cost torque-measuring coupling

Electromagnetic brakes/clutches

- **ROBA-stop® Standard**
  Multi-functionally all-round safety brake
- **ROBA-stop®-M motor brakes**
  Robust, cost effective motor brake
- **ROBA-stop®-S**
  Waterproof, robust monobloc brake
- **ROBA-stop®-Z/ROBA-stop®-silenzio®**
  Double security elevator brake
- **ROBA®-diskstop®**
  Compact quiet disk brake
- **ROBA®-topstop®**
  Brake systems for gravity loaded axes
- **ROBA®-linearstop**
  Backlash-free brake system for linear motor axes
- **ROBATIC®/ROBA®-quick/ROBA®-takt**
  Energise to engage electromagnetic pole face clutches and brakes, CBU

DC drives

- **tendo®-PM**
  Permanent-magnet D.C. motors
- **tendo®-SC**
  1 and 4 O transistor controllers