Electromagnetic multiple-disc clutch
Type 522
Characteristics and features

- suitable for torque transmission with increasing differential speed between the drive elements
- high torque transfer despite compact dimensions
- designs up to 3800 Nm possible
- high switching frequency due to optimized heat dissipation
- negligible wear due to special friction lining
- oil running or dry running
- suitable for applications in harsh environments
- reduced shift speeds due to adapted control

Mönninghoff power transmission represents an infinite variant diversity that is applied by all areas of modern mechanical engineering.

Our technologies are mostly designed to operate under extreme conditions. We offer high precision products for medical robotics, fail-proof security for aerospace technology or synchronization solutions for the packaging or printing industry.

We thus address customers who have the highest standards for their own machines or systems. To them, we can offer highly complex, application-specific solutions.
Match code

Mönninghoff multiple-disc clutches are indicated by the following match code:


A  clutch size  
B  operating mode  
C  length of drive ring

Other individual characteristics:
• voltage  
• bore size with keyway

According to these characteristics, we design individual solutions concerning transmitted torque, engaging behavior or rotation speed.

Our engineers can assist with finding an application-specific clutch at any time. Together, we can develop individual and innovative solutions for extreme operating conditions.

Ordering example

Mönninghoff electromagnetic multiple-disc clutch  
Type 522.21.1.1

Operating mode  dry running  
Voltage  24 Vdc  
Bore size d  40mm H7, keyway acc to. DIN 6885/1
**Clutch size**

The selection of the correct size of a Mönninghoff electromagnetic multiple-disc clutch is determined by the required torque as well as the shift work.

- According to the required torque
  \[ M_S \geq M_{erf} \]
- According to the shift work
  \[ E_h \leq Q_h \]

The clutch must transfer load and acceleration torque \((M_L; M_b)\). The required safety is obtained by using a corresponding safety factor \((K)\).

\[
M_{erf} = (M_b \pm M_L) \cdot K
\]
\[
M_b = \frac{l \cdot \Delta n}{9,55 \cdot t} \quad [Nm]
\]
\[
Q_h = Q \cdot k_1 \cdot k_2 \quad [Nm]
\]
\[
E_h = \frac{l \cdot (\Delta n)^2 \cdot Z}{182,4} \quad [Nm]
\]

If the load and acceleration torque cannot be determined, the required torque can be derived from the driving power, taking the required safety into consideration.

\[ M_{erf} = 9550 \cdot \frac{P}{n} \cdot K \quad [Nm] \]

---

\( M_{erf} \) = required torque  
\( M_b \) = acceleration torque  
\( M_s \) = shift torque  
\( M_L \) = output load torque  
\( n \) = speed of rotations \([\text{min}^{-1}]\)  
\( \Delta n \) = differential speed of rotations \([\text{min}^{-1}]\)  
\( k_1 \) = correction factor  
\( k_2 \) = correction factor  
\( P \) = driving power \([\text{kW}]\)  
\( K \) = safety factor \([1,2 \text{ to } 4]\)  
\( l \) = moment of inertia \([\text{kgm}^2]\)  
\( Z \) = number of shift operations per hour  
\( Q \) = amount of heat  
\( E_h \) = shift energy per hour \([\text{Nm}]\)  
\( t \) = acceleration time \([\text{sec}]\)  

based on \( t_1 \)
**Determination of shift work**

The energy that is lost in the clutch depends on the shift curve and the shift frequency. The correction factors for the permissible shift work per hour $Q_h$ can be derived from the tables and graphs.

![Diagram of shift cycle](image)

**Course of a shift cycle**
- $t_g$ = time during which the clutch is closed
- $t_z$ = total cycle time
- $\Delta \omega$ = differential angular velocity

![Graph of $k_1$ vs $t_g/t_z$](image)

**Correction factor $k_1$ as a function of the shift frequency per hour**
- I valid for 522.32 - 522.33
- II valid for 522.24 - 522.28
- III valid for 522.21 - 522.22
- IV valid for 522.16

![Graph of $k_2$ vs $Z/h$](image)

**Correction factor $k_2$ as function $t_g/t_z$**

<table>
<thead>
<tr>
<th>Size</th>
<th>Amount of heat $Q$</th>
<th>dry running: bed ventilation $10^4$ [Nm/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>dry running: good ventilation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>oil lubrication: oil spray</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dry running: good ventilation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>oil lubrication: oil spray</td>
</tr>
<tr>
<td>16</td>
<td>0.43</td>
<td>0.71</td>
</tr>
<tr>
<td>21</td>
<td>0.49</td>
<td>0.99</td>
</tr>
<tr>
<td>22</td>
<td>0.86</td>
<td>1.38</td>
</tr>
<tr>
<td>24</td>
<td>1.2</td>
<td>1.73</td>
</tr>
<tr>
<td>26</td>
<td>1.5</td>
<td>2.19</td>
</tr>
<tr>
<td>28</td>
<td>1.9</td>
<td>2.65</td>
</tr>
<tr>
<td>31</td>
<td>2.3</td>
<td>3.34</td>
</tr>
<tr>
<td>32</td>
<td>2.9</td>
<td>5.06</td>
</tr>
<tr>
<td>33</td>
<td>4.4</td>
<td></td>
</tr>
</tbody>
</table>
Electromagnetic multiple-disc clutch - Type 522

Switching

Electromagnetic clutches are inductances. Engagement and disengagement are subject to the laws of induction, i.e. the induction current increases according to an e-function.

- \( t_1 \) and \( t_2 \) can be electrically influenced by taking appropriate measures
- It is advisable to use direct current for shifting
- When determining the size, the engage time is considered to be approximately 30% of the total acceleration time, which normally results in additional safety

### Technical data

<table>
<thead>
<tr>
<th>Size</th>
<th>( t_1 ) (ms)</th>
<th>( t_1 ) (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>120/170</td>
<td>60/35</td>
</tr>
<tr>
<td>21</td>
<td>140/200</td>
<td>60/40</td>
</tr>
<tr>
<td>22</td>
<td>200/280</td>
<td>35/50</td>
</tr>
<tr>
<td>24</td>
<td>310/400</td>
<td>40/60</td>
</tr>
<tr>
<td>26</td>
<td>400/480</td>
<td>50/80</td>
</tr>
<tr>
<td>28</td>
<td>480/550</td>
<td>50/90</td>
</tr>
<tr>
<td>31</td>
<td>600/750</td>
<td>60/100</td>
</tr>
<tr>
<td>32</td>
<td>800/1000</td>
<td></td>
</tr>
</tbody>
</table>

- \( i \) = induction current
- \( M_U \) = torque to be transferred / static torque
- \( M_S \) = torque to be shifted
- \( t_1 \) = engage time
- \( t_2 \) = disengage time
- \( t_{11} \) = response delay
## Electromagnetic multiple-disc clutch - Type 522

### Clutch size

![Clutch size](image)

**Type 522.___.1**  
with normal drive ring

**Type 522.___.2**  
with long drive ring

**Type 522.___.4**  
with mass-slipring

---

### Technical data

<table>
<thead>
<tr>
<th>Size</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16</td>
<td>21</td>
<td>22</td>
<td>24</td>
<td>26</td>
<td>28</td>
<td>31</td>
<td>32</td>
<td>33</td>
</tr>
<tr>
<td>torque oil running</td>
<td>M\textsubscript{d} dyn</td>
<td>[Nm]</td>
<td>60</td>
<td>100</td>
<td>200</td>
<td>400</td>
<td>600</td>
<td>800</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>M\textsubscript{stat}</td>
<td></td>
<td>72</td>
<td>120</td>
<td>240</td>
<td>480</td>
<td>720</td>
<td>960</td>
<td>1450</td>
</tr>
<tr>
<td></td>
<td>M\textsubscript{d} dyn</td>
<td></td>
<td>80</td>
<td>135</td>
<td>270</td>
<td>540</td>
<td>800</td>
<td>1000</td>
<td>1600</td>
</tr>
<tr>
<td></td>
<td>M\textsubscript{stat}</td>
<td></td>
<td>105</td>
<td>175</td>
<td>350</td>
<td>700</td>
<td>1050</td>
<td>1300</td>
<td>2100</td>
</tr>
<tr>
<td>max. speed oil running</td>
<td>[min(^{-1})]</td>
<td>3000</td>
<td>2500</td>
<td>2500</td>
<td>1500</td>
<td>1500</td>
<td>1500</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>M\textsubscript{stat}</td>
<td></td>
<td>72</td>
<td>120</td>
<td>240</td>
<td>480</td>
<td>720</td>
<td>960</td>
<td>1450</td>
</tr>
<tr>
<td></td>
<td>dry running</td>
<td></td>
<td>80</td>
<td>135</td>
<td>270</td>
<td>540</td>
<td>800</td>
<td>1000</td>
<td>1600</td>
</tr>
<tr>
<td></td>
<td>M\textsubscript{stat}</td>
<td></td>
<td>105</td>
<td>175</td>
<td>350</td>
<td>700</td>
<td>1050</td>
<td>1300</td>
<td>2100</td>
</tr>
<tr>
<td>input power</td>
<td>[W]</td>
<td>35</td>
<td>43</td>
<td>63</td>
<td>93</td>
<td>100</td>
<td>120</td>
<td>125</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>105</td>
<td>175</td>
<td>350</td>
<td>700</td>
<td>1050</td>
<td>1300</td>
<td>2100</td>
<td>2700</td>
<td></td>
</tr>
<tr>
<td>weight</td>
<td>[kg]</td>
<td>3,1</td>
<td>5,8</td>
<td>8,1</td>
<td>12,8</td>
<td>17,5</td>
<td>23,2</td>
<td>33</td>
<td>50</td>
</tr>
<tr>
<td>number of plates inside plates</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>outside plates</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>bore</td>
<td>keyway acc. to DIN 6885/1</td>
<td>d H7</td>
<td>20</td>
<td>25</td>
<td>40</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>dimensions</td>
<td>D</td>
<td>[mm]</td>
<td>115</td>
<td>146</td>
<td>166</td>
<td>195</td>
<td>214</td>
<td>240</td>
<td>284</td>
</tr>
<tr>
<td></td>
<td>d\textsubscript{15}</td>
<td></td>
<td>4 x M6</td>
<td>4 x M8</td>
<td>4 x M8</td>
<td>4 x M12</td>
<td>4 x M12</td>
<td>4 x M12</td>
<td>6 x M16</td>
</tr>
<tr>
<td></td>
<td>d\textsubscript{12}</td>
<td></td>
<td>4 x M6</td>
<td>4 x M8</td>
<td>4 x M8</td>
<td>4 x M12</td>
<td>4 x M12</td>
<td>4 x M12</td>
<td>6 x M16</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td></td>
<td>53</td>
<td>63</td>
<td>67</td>
<td>73</td>
<td>81</td>
<td>90</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td>L\textsubscript{1}</td>
<td></td>
<td>60,5</td>
<td>70</td>
<td>76,5</td>
<td>83</td>
<td>91</td>
<td>99</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>L\textsubscript{2}</td>
<td></td>
<td>63,5</td>
<td>73,5</td>
<td>78,5</td>
<td>84,5</td>
<td>92,5</td>
<td>102,5</td>
<td>111,5</td>
</tr>
<tr>
<td></td>
<td>L\textsubscript{3}</td>
<td></td>
<td>0,4</td>
<td>0,7</td>
<td>0,8</td>
<td>0,9</td>
<td>1,0</td>
<td>1,0</td>
<td>1,1</td>
</tr>
<tr>
<td></td>
<td>l</td>
<td></td>
<td>5</td>
<td>6</td>
<td>6,5</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>l\textsubscript{1}</td>
<td></td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>l\textsubscript{2}</td>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>l\textsubscript{3}</td>
<td></td>
<td>2,5</td>
<td>3,5</td>
<td>4,5</td>
<td>5,5</td>
<td>5,5</td>
<td>5,5</td>
<td>6,5</td>
</tr>
<tr>
<td></td>
<td>l\textsubscript{4}</td>
<td></td>
<td>3,5</td>
<td>3,5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4,5</td>
</tr>
<tr>
<td></td>
<td>l\textsubscript{5}</td>
<td></td>
<td>11</td>
<td>11</td>
<td>15</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>l\textsubscript{6}</td>
<td></td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>13</td>
<td>11</td>
<td>13,5</td>
</tr>
</tbody>
</table>
Operating mode

Mönninghoff electromagnet multiple-disc clutches are available in two operating modes:

- Type 522._.1._ for dry running
- Type 522._.2._ for oil running

To reduce the engagement time, fast excitation can be achieved by applying up to three times the rated voltage. When oil is used and particularly if the oil is cooled internally, the rise time can be affected considerably and may double or triple (observe oil instructions).

Use oil with a viscosity up to $25 \times 10^{-6} \text{ m}^2\text{s}^{-1}$ by $50 \, ^\circ\mathrm{C}$ ($3\,^\circ\mathrm{E} / 50 \, ^\circ\mathrm{C}$).

Voltage

- standard voltage is 24 Vdc direct current
- special voltages as an example 48 Vdc on request

Technical characteristics

- the positioning of the discs outside the magnetic field permits the use of special friction materials for both oil and dry lubrication
- the expanding springs of the outside discs open the disc stack when the coil is switched off. Consequently, friction and wear in neutral are negligible
- the adjustment of the air gap is easily accessible

At a glance

- special friction materials for oil and dry running
- wide variety of bore sizes
- engageable at relative speed
- frictionally engaged transmission of torque
Mönninghoff clutches can be combined with a variety of many other power transmission elements. Such complex high-tech systems can solve any application-specific tasks and can fulfill any customer-specific wishes.

In many cases, a combination of different drive elements is needed to solve the applications particular problems and difficulties. Being not just supplier but technological partner to our customers, our extensive engineering is part of extraordinary and challenging power transmission projects.

Our product is the know-how, with hardware as an added bonus.
Driven by excellence

Why Mönninghoff

- intensive dialog with our customers engineers
- decades of experience and competence
- deep understanding for all areas of mechanical engineering
- highly modern and flexible machine park
- enthusiasm for quality
- flexibility, inventiveness and communication skills of our employees
- commitment to Germany and Bochum as industrial location

How to reach us

Sales
sales@moenninghoff.de
+49 234 3335-250

Helps you find a customer-specific power transmission solution for extraordinary circumstances.

Order Management
confirmation@moenninghoff.de
+49 234 3335-353

For the competent processing and smooth handling of your orders and delivery dates.

Service
service@moenninghoff.de
+49 234 3335-333

Feels committed to protect and preserve the high value of your machine and to secure its availability.

www.moenninghoff.de/en