Electromagnetic multiple-disc brake
Type 512
**Characteristics and features**

- suitable for torque transmission with increasing differential speed between the drive elements
- high torque transfer despite compact dimensions
- designs up to 1600 Nm possible
- particularly suitable for shifting operations with a high energy exchange
- negligible wear due to special friction lining
- only oil running
- maintenance free
- suitable for applications in harsh environments
- reduced shift speeds due to adapted control
- also available as electromagnetic multiple-disc brake

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.
**Electromagnetic multiple-disc brake - Type 512**

**Match code**

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

512 . A . B

A  brake size  
B  design

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 brake at any time. Together, we can develop individual and innovative solutions for extreme operating conditions.

**Ordering example**

Mönninghoff electromagnetic multiple-disc brake  
Type 512.21.1.1

- Operating mode: dry running  
- Voltage: 24 Vdc  
- Bore size d: 30 mm H7, keyway acc to. DIN 6885/1
Brake size

The selection of the correct size of a Mönninghoff electromagnetic multiple-disc brake 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 brake 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 \([Nm]\)
- \(t\) = acceleration time \([\text{sec}]\) based on \(t_1\)
Determination of shift work

The energy that is lost in the brake 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.

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

Correction factor $k_1$ as a function of the shift frequency per hour $V$
V valid for all sizes and types of brakes whose discs are surrounded by the field of force.

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

Amount of heat $Q$ as function of the amount of cooling oil; valid for brakes whose discs are surrounded by the field of force.
Electromagnetic multiple-disc brake - Type 512

Switching

Electromagnetic brakes 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>16</th>
<th>21</th>
<th>22</th>
<th>24</th>
<th>26</th>
<th>28</th>
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<tbody>
<tr>
<td>shift speeds acc. to VDE 0580:2011-11</td>
<td>( t_1 )</td>
<td>( t_2 )</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>( \text{[ms]} )</td>
<td>( \text{[ms]} )</td>
<td>( \text{[ms]} )</td>
<td>( \text{[ms]} )</td>
<td>( \text{[ms]} )</td>
<td>( \text{[ms]} )</td>
<td>( \text{[ms]} )</td>
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<tr>
<td>( 220/140 )</td>
<td>( 250/160 )</td>
<td>( 360/250 )</td>
<td>( 450/330 )</td>
<td>( 600/450 )</td>
<td>( 900/600 )</td>
<td></td>
</tr>
<tr>
<td>( 70/60 )</td>
<td>( 90/80 )</td>
<td>( 110/100 )</td>
<td>( 200/180 )</td>
<td>( 250/220 )</td>
<td>( 400/350s )</td>
<td></td>
</tr>
</tbody>
</table>

- \( i \) = induction current
- \( M_0 \) = torque to be transferred / static torque
- \( M_s \) = torque to be shifted
- \( t_1 \) = engage time
- \( t_2 \) = disengage time
- \( t_{11} \) = response delay

Switching diagram: normal shifting

230V~ 50±60 Hz

24V-
# Electromagnetic multiple-disc brake - Type 512

## Brake Size

![Brake Size Diagram]

Type 512 for oil running

## Technical Data

<table>
<thead>
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<td>24</td>
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<td>inertia $J_{\text{in}} [10^{-3}\text{kgm}^2]$</td>
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<td>0.5</td>
<td>1.45</td>
<td>4.8</td>
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<td>75</td>
<td>90</td>
<td>110</td>
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<td>100</td>
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<td>$d_3$</td>
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</tbody>
</table>
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Inner driver

Gear specifications acc. to DIN 867

Index 1: design 1 and 2 possesse 28 teeths
Index 2: design 3 possesses 31 teeths

- the surface hardness of the driver is 59 - 62 HRc
- case depth can vary from 0.2 to 0.6 mm

\[
\begin{align*}
  z &= \text{number of teeth} \\
  m &= \text{module} \\
  d_0 &= \text{reference diameter (} = z \cdot m) \\
  d_k &= \text{outside diameter} \\
  d_f &= \text{root diameter} \\
  \alpha_0 &= \text{pressure angle (} = 20^\circ) \\
\end{align*}
\]

Technical data

<table>
<thead>
<tr>
<th>Size</th>
<th>12</th>
<th>15</th>
<th>21</th>
<th>21</th>
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<tr>
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<td>28</td>
<td>31</td>
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<td>2.5</td>
<td>2.5</td>
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<tr>
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<td>50.5</td>
<td>63.5</td>
<td>66.4</td>
<td>73.2</td>
<td>88.2</td>
<td>110.0</td>
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<tr>
<td>root diameter</td>
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<td>43.96</td>
<td>52.64</td>
<td>58.68</td>
<td>63.40</td>
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<td>27.51</td>
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<td>34.48</td>
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<tr>
<td>profile displacement</td>
<td>+0.3</td>
<td>+0.31</td>
<td>+0.41</td>
<td>+0.42</td>
<td>+0.43</td>
<td>+0.43</td>
<td>-0.12</td>
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<tr>
<td>tooth length</td>
<td>12</td>
<td>18.5</td>
<td>21.5</td>
<td>21.5</td>
<td>23.5</td>
<td>30</td>
<td>33.0</td>
</tr>
</tbody>
</table>
Electromagnetic multiple-disc brake - Type 512

Voltage

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

Technical characteristic

- must run in oil
- the arrangement of the discs between the pole faces and the armature requires the discs to be made of a ferromagnetic material with good friction and wear properties, which are obtained by hardening and nitriding
- residual magnetism resulting from the hardening process is eliminated by the special design of the discs
- the shape of the discs prevents the oil from building up when the temperature drops, thus avoiding shift delays
- brakes whose discs are surrounded by the field of force are particularly suitable for shifting operations with a high energy exchange
- require no maintenance

At a glance

- optimized multiple-disc design
- frictionally engaged transmission of torque
- engageable at relative speed
System solutions

You need more?

Mönninghoff brakes 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

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

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

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