Magnetic particle clutches and brakes

Accurate torque control with instantaneous engagement!

Warner Electric Precision Tork™ magnetic particle clutches and brakes are unique because of the wide operating torque range available. Torque to current is almost linear and can be controlled very accurately. The unique features of the magnetic particle clutches and brakes make them ideal for:

- tension control
- load simulation
- cycling/indexing
- soft starts and stops

Features and Benefits

**Torque independent of slip speed**
- Torque is transmitted through magnetic particle chains which are formed by an electromagnetic field. The torque is independent of slip speed, depending only on circuit current, and is infinitely variable from 0 (disengaged) to rated torque.

**Precise engagement**
- Precision Tork magnetic particle clutches and brakes engage to transmit torque with speed and precision. Response of the particles to the field is virtually instantaneous, providing perfectly controlled, jerk-free engagement.

**Customer specified engagement**
- Engagement time may be very gradual or extremely fast. The frequency and torque of the engagement/disengagement sequence is limited only by the capabilities of the control circuitry.

**No wearing parts**
- There are no friction surfaces to grab or wear, and the units are not affected by changes in atmospheric or other environmental conditions.

**Efficient/Compact design**
- High torque to size ratio and low consumption of electric power.

**Versatile mounting**
- Convenient bolt circle for easy mounting.
- Mounting brackets available for all sizes.
- Brakes are available with solid shafts and through bore.
- Can be mounted horizontally or vertically to solve virtually any motion control requirement.

**Modular**
- Customised products
- Interchangeable with industry standard sizes

Specials are our business

**Special Shaft Configurations**
- Customer specified shaft configurations for easy machine mounting and retrofitting.

**Wash Down Environment**
- Stainless steel units available for extreme environments.

**Special Torque**
- Maximum torque configurations to meet customer specifications.

**Metric units**
- On request, regarding quantities
Operating Principles

The magnetic particle unit consists of four main components:

1) Housing
2) Shaft/disc
3) Coil
4) Magnetic powder

The coil is assembled inside the housing. The shaft/disc fits inside the housing/coil assembly with an air gap between the two; the air gap is filled with fine magnetic powder.

Engagement

When DC current is applied to the magnetic particle unit, a magnetic flux (chain) is formed, linking the shaft/disc to the housing. As the current is increased the magnetic flux becomes stronger, increasing the torque. The magnetic flux creates extremely smooth torque and virtually no “stick-slip”.

Disengagement

When DC current is removed the magnetic powder is free to move within the cavity, allowing the input shaft to rotate freely.
Magnetic particle clutches and brakes

Selection

Sizing

To properly size magnetic particle clutches or brakes the thermal energy (slip watts) and torque transmitted must be considered. If thermal energy and torque are known for the application, select the unit from the charts to the right.

Speed

\[ V \text{ (RPM)}^* = \frac{\text{Velocity (m/min)}}{\pi \cdot \phi \text{ coil}^{**} \text{ (m)}} \]

* In rewind applications the motor RPM should be higher (10%) than the fastest spool RPM.

** In applications with the web running over a pulley or in a nip roll application use the pulley diameter as the roll diameter.

Thermal Energy (slip watts)

1- When a brake or clutch is slipping, heat is generated. Heat is described in terms of “energy rate” and is a function of speed, inertia, and cycle rate.

For continuous slip applications, such as tension control in an unwind or rewind application slip watts are calculated using the following formula:

\[ \text{Slip Watts} = 0.103 \cdot \text{torque (Nm)} \cdot \text{speed (RPM)} \]

2- For cycling applications heat is generated intermittently, and is calculated using the following formula:

\[ \text{Slip Watts} = 0.00077 \cdot J (\text{kgm}^2) \cdot \frac{\text{speed (RPM)}^2}{10000} \cdot \frac{\text{f cycle}}{\text{min}} \]

The average heat input must be below the clutch or brake’s heat dissipation rating. If the application generates intermittent heat dissipation, use the average speed for the thermal energy (slip watts) calculations.

Torque

1- Tension applications calculate torque as a function of roll radius and tension.

\[ C \text{ (Nm)} = \frac{T (\text{N}) \cdot D}{2} \]

2- Soft/controlled stopping applications calculate torque as a function of inertia, speed and desired time to stop the load.

\[ C \text{ (Nm)} = \frac{J (\text{kgm}^2) \cdot N (\text{RPM})}{9.55 \cdot \text{Time (s)}} \]
Magnetic particle clutches and brakes

Quick Selection Charts

**MPB2 / MPC2**

- Heat dissipation: 10 watts max.

**MPB15 / MPC15**

- Heat dissipation: 20 watts max.

**MPB70 / MPC70**

- Heat dissipation: 100 watts max.

**MPB120 / MPC120**


**MPB240**

- Heat dissipation: 200 watts max.
Magnetic particle clutches and brakes

Applications

Warner Electric Precision Tork™ magnetic particle clutches and brakes are the ideal solution for controlling and maintaining torque. If the application is tensioning, load simulation, torque limiting, or soft starts and stops the magnetic particle unit is the preferred torque controlling device.

Typical Applications

- Wire Processing (winding, hooking, cutting)
- Paper/Foil/Film Processing
- Labelling Applications
- Textile Processing
- Load profile simulation on:
  - Exercise Equipment
  - Flight Simulators
  - Healthcare Equipment
- Life testing on:
  - Motors
  - Gears
  - Pulleys
  - Belts
  - Chains
  - Many other Rotating Devices
- Conveyors
- Bottle Capping

Rewind stand under load cell control

Unwind stand under dancer control
Magnetic particle clutches and brakes

Tensioning

Magnetic particle clutches and brakes offer smooth controlled torque for tensioning in both the unwind zone and rewind zone. Torque produced from the magnetic particle clutches and brakes is independent of slip speed, offering a distinct advantage over competing technologies. Since torque can be varied infinitely by varying the input current, the magnetic particle clutches and brakes are ideal in an open loop system. To close the loop in the tensioning system, combine the magnetic particle clutch or brake with a Warner Electric sensor and control, resulting in more precise control of tension.

Particle clutches and the MCS2000-CTDA control provide accurate closed loop tension control for rewind applications.

Application example:

Information
Full roll Ø : 0.5 m
required: Tension : 22 N
Velocity : 122 m/min

Max torque = \( \frac{\text{Tension} \cdot \text{full roll} \ \text{Ø}}{2} \)
= \( \frac{22 \cdot 0.5}{2} \)
= 5.5 Nm

Max. torque = Tension \cdot full roll \ Ø
= 22 \cdot 0.5
= 5.5 Nm

S = \frac{\pi \cdot D}{\pi \cdot 0.5}
=\frac{122}{78} R P M

Heat dissipation = 0.103 \cdot \text{torque} \cdot \text{slip}
= 0.103 \cdot 5.5 \cdot 78
= 44.46 watts

Select a clutch that exceeds the maximum torque and thermal energy requirements from Quick Selection Chart - **MPC120**.

Particle clutches and the MCS202-E1 control provide accurate closed loop tension control for rewind applications.

Application example:

Information
Core Ø : 0.08 m
required: Full roll Ø : 0.23 m
Tension : 22 N
Velocity : 90 m/min
Input speed : 500 RPM*

Max torque = \( \frac{\text{Tension} \cdot \text{full roll} \ \text{Ø}}{2} \)
= \( \frac{22 \cdot 0.23}{2} \)
= 2.53 Nm

Full roll Ø = \frac{\text{Speed} \cdot \pi \cdot \text{D}}{(\pi \cdot 0.23)}
= \frac{90}{375} R P M
= 250 \ - \ 125
= 375 R P M

Thermal Energy = 0.103 \cdot \text{Torque} \cdot \text{slip}
= 0.103 \cdot 2.53 \cdot 375
= 97.72 watts

Select a brake that exceeds the maximum torque and thermal energy requirements from Quick Selection Chart - **MPB70**.

* To maximize tension control and minimize heat generated, select a drive system that will result in an actual input speed as close to, but not less than, 30 RPM greater than the core RPM. In this example, 388 + 30 = 418, would be ideal but 500 RPM was more readily available.
Magnetic particle clutches and brakes

Dimensions and specifications

<table>
<thead>
<tr>
<th>Models</th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>C (mm)</th>
<th>D (mm)</th>
<th>E (mm)</th>
<th>F (mm)</th>
<th>G (output) (Pouce)</th>
<th>H (input) (Pouce)</th>
<th>I (Pouce)</th>
<th>J (Number)</th>
<th>K (Pouce)</th>
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Models Drag Rated Rated Response Response Max. heat Max. Weight
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Optional Mounting Bracket (for mounting MPB Brakes and MPC Clutches)

Model Drag Rated Rated Response Response Max. heat Max. speed Weight
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<thead>
<tr>
<th></th>
<th>torque</th>
<th>torque</th>
<th>voltage</th>
<th>zero with</th>
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<th>resistance</th>
<th>force</th>
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<th>(kgcm²)</th>
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<td>7.1</td>
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Dimensions in mm
### Magnetic particle clutches and brakes

#### Dimensions and specifications

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<tr>
<th>Models</th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>C (mm)</th>
<th>D (mm)</th>
<th>E (mm)</th>
<th>F (mm)</th>
<th>G (Inch)</th>
<th>H Inch</th>
<th>I (shaft) Inch</th>
<th>J (bore) Inch</th>
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<td>#6-32 on 1.350 BC</td>
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*Minimum speed = 30 RPM*
The TCS250 card was designed especially for controlling powder brakes and for increasing their yield. In fact, this permits complete elimination of residual magnetism in the powder and therefore it is possible to work in low torque ranges without limits.

The components used are professional type and this assures absolute reliability over time. Its limited size facilitates wall mounting.

Connection is easy and is done via 10-pole connector fastened to the terminals with screws.

**Specifications**

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<th>24 VAC or 24 VDC</th>
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<tr>
<td>Operating temperature</td>
<td>+50° max</td>
</tr>
<tr>
<td>Size</td>
<td>171 x 120 x 95 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>1,500 kg</td>
</tr>
</tbody>
</table>

**Dimensions (mm)**

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>171</td>
</tr>
<tr>
<td>153</td>
</tr>
<tr>
<td>121</td>
</tr>
<tr>
<td>112</td>
</tr>
<tr>
<td>112</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>65</td>
</tr>
<tr>
<td>59</td>
</tr>
<tr>
<td>17</td>
</tr>
</tbody>
</table>

**TCS250-T Card with transformer**

**TCS250-C Only card**

**B90-26325C Potentiometer**

**Service manual MC544**

**Brake current regulated**

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**Brake TB 28 31**

**Brake MPB 34 41**

**Clutch MPC 34 41**

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**Pot.**

**Roll dancer**

**External reference (0-10 VDC)**