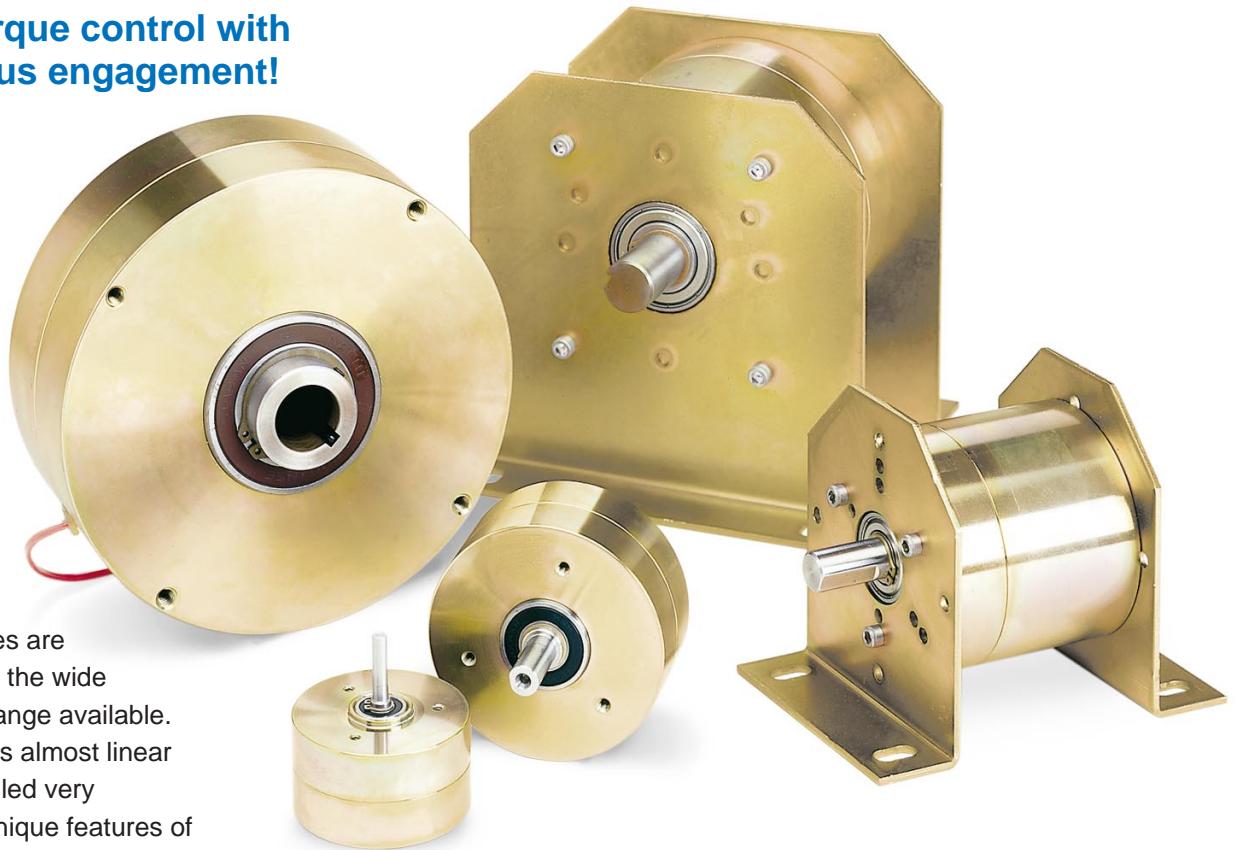# WARNER

Magnetic Particle Clutches and Brakes

WARNER ELECTRIC®

DANA

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, and soft starts and stops.
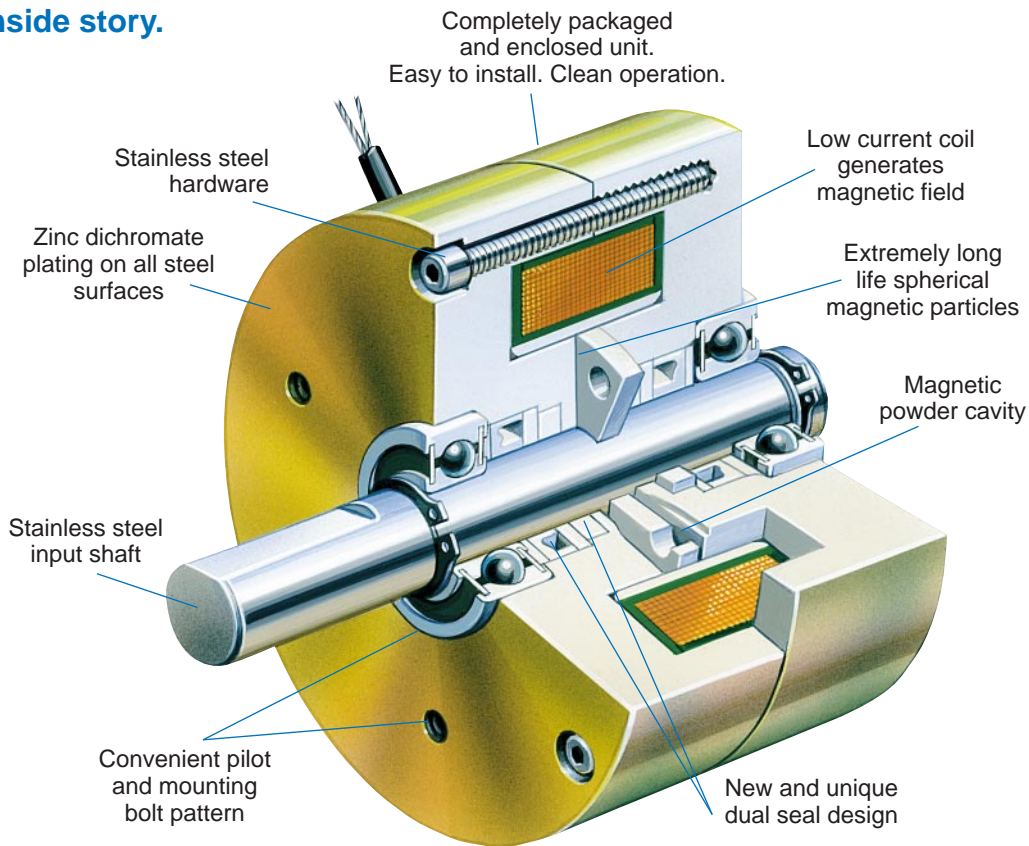
Specials are our business

• **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.

• **Special Mounting Configurations**
Customer specified bolt patterns, special mounting brackets.

• **Metric units**

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.

• **Distributor Item**
Off the shelf availability. Interchangeable with industry standard sizes.

The inside story.

Completely packaged
and enclosed unit.
Easy to install. Clean operation.

Stainless steel
hardware

Zinc dichromate
plating on all steel
surfaces

Low current coil
generates
magnetic field

Extremely long
life spherical
magnetic particles

Magnetic
powder cavity

Stainless steel
input shaft

Convenient pilot
and mounting
bolt pattern

New and unique
dual seal design

Operating Principles

The magnetic particle unit consists of
four main components: 1) housing;
2) shaft/disc; 3) coil and 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
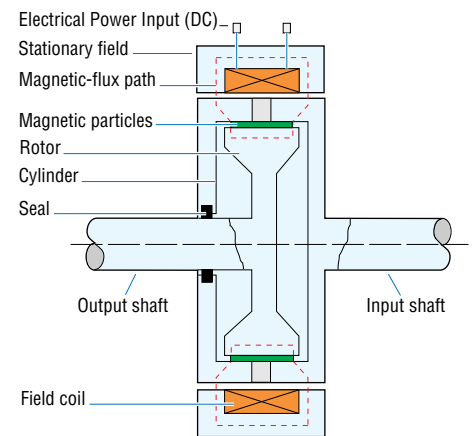filled with fine magnetic powder.
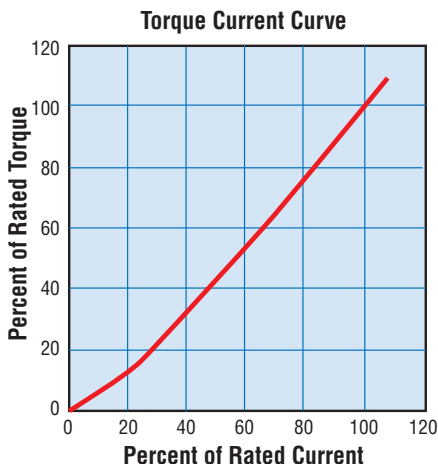
Engagement

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.

Cycling

By turning the current to the coil on and
off a cycling effect is achieved.

Torque Current Curve

Percent of Rated Torque (y-axis: 0, 20, 40, 60, 80, 100, 120)

Percent of Rated Current (x-axis: 0, 20, 40, 60, 80, 100, 120)

Electrical Power Input (DC)
Stationary field
Magnetic-flux path
Magnetic particles
Rotor
Cylinder
Seal
Output shaft
Input shaft
Field coil

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.

RPM

RPM must be known when calculating thermal energy (slip watts). For load simulation, torque limiting and similar applications, RPM is known. For web handling, the RPM is calculated as follows:

$$\text{Slip RPM*} = \frac{12 \times \text{Velocity (feet per min.)}}{\pi \times \text{Full Roll Dia.** (in.)}}$$

*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)

Tension applications are considered continuous slip applications. 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. Heat generated is usually described in terms of thermal energy or slip watts. Starting and stopping applications generate heat when the unit slips during the stopping and starting of the load.

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

Slip Watts = .0118 x Torque (lb.in.)
        x Slip RPM

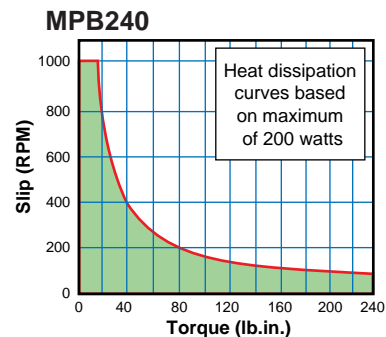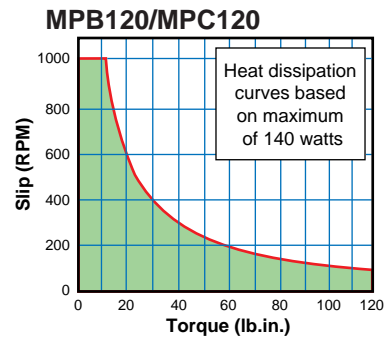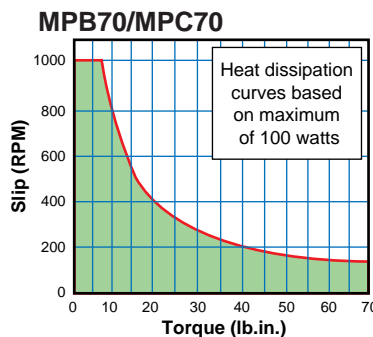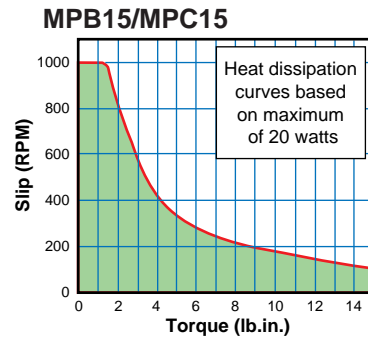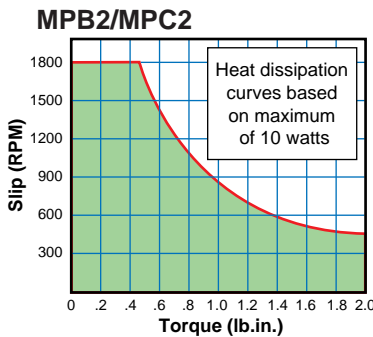• For cycling applications heat is generated intermittently, and is calculated using the following formula:

$$\text{Watts} = 2.67 \times \text{Inertia (lb.in.}^2)$$
$$\times \left(\frac{\text{RPM}}{10,000}\right)^2 \times \text{F} \frac{\text{cycle}}{\text{min.}}$$

Duty Cycle

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.

Quick Selection Charts

MPB2/MPC2

Heat dissipation curves based on maximum of 10 watts

MPB70/MPC70

Heat dissipation curves based on maximum of 100 watts

MPB15/MPC15

Heat dissipation curves based on maximum of 20 watts

MPB120/MPC120

Heat dissipation curves based on maximum of 140 watts

MPB240

Heat dissipation curves based on maximum of 200 watts

Torque

Tension applications calculate torque as a function of roll radius and tension. Soft/controlled stopping applications calculate torque as a function of inertia, speed and desired time to stop the load. Torque limiting applications calculate torque as the allowable drive through torque. Calculate the torque requirement based on the formulas for the different applications:

• To calculate torque for a web handling application, determine the desired tension in the web then calculate the required torque as follows:

Torque (lb.in.) =

$$\frac{\text{Tension (lbs.) x Roll Dia.* (in.)}}{2}$$

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

• To calculate torque for soft/controlled stop or cycling applications first determine the inertia (WR^2), and apply it to the formula below:

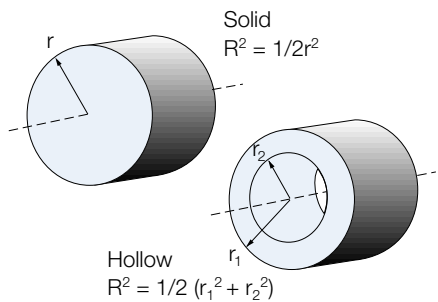$$\text{Torque (lb.in.)} = \frac{\text{Inertia (lb.in.}^2) \times \text{RPM}}{3,690 \times \text{time(s)}}$$

Inertia (WR^2) =

[(weight of body) x (radius of gyration*)]^2

*to calculate for a cylinder about its axis:
Solid cylinder =   R^2 = 1/2r^2
Hollow cylinder = R^2 = 1/2(r$_1^2$+r$_2^2$)

Solid
$R^2 = 1/2r^2$

Hollow
$R^2 = 1/2\,(r_1^2 + r_2^2)$

Reflected Inertia (rotational)

In mechanical systems it is common for the rotating parts to operate at different speeds. In clutch and brake applications the WR^2 is calculated for each part operating at different speeds then reduced to and equivalent WR^2 at the clutch or brake mounting shaft speed. All the rotating parts' WR^2 are added together and treated as a unit.

The formula for determining the equivalent WR^2 of a rotating part referred to the clutch or brake shaft is as follows:

$$WR_e^2 = \; WR^2 \times \left(\frac{N}{Ncb}\right)^2$$

Where:

WR^2 = inertia of the rotating part at N (RPM)

N = speed (RPM) of the rotating part

N_{cb} = speed (RPM) of the clutch or brake shaft

Reflected Inertia (linear)

In complex systems involving both linear and rotating motion, the linearly moving parts can be reduced to the clutch or brake speed by the following equation:

$$WR^2e = \; W \times \left(\frac{V}{2\pi N}\right)^2$$

Where:

W = Weight of body

V = Velocity in feet per minute

N = RPM of the clutch or brake shaft

This equation can only be used when the linear speed has a continuous fixed relation to the rotating speed, such as a conveyor driven by a motor.

• To determine torque in an overload protection, torque limiting or soft start application use the following equation:

$$\text{Torque (lb.in.)} = \frac{HP \times 63{,}000}{RPM}$$

Tension Value Chart

Material	tn (lbs.in. of web width)
Aluminum foils	0.5 to 1.5 (1.0 aver.)/mil
Cellophanes	0.5 to 1.0/mil
Acetate	0.5/mil
Mylar (Polyester)	0.25 to 0.30/mil
Polyethylene	0.25 to 0.30/mil
Polypropylene	0.25 to 0.30/mil
Polystyrene	1.0/mil
Saran	0.05 to 0.20 (0.10 aver.)/mil
Vinyl	0.05 to 0.20 (0.10 aver.)/mil

Paper and Laminations

20#/R—32.54 gm/m²	0.50 to 1.0
40#/R—65.08 gm/m²	1.0 to 2.0
60#/R—97.62 gm/m²	1.5 to 3.0
80#/R—130.0 gm/m²	2.0 to 4.0

Paper

15 lbs./ream (3,000 sq. ft.)	0.5
20 lbs./ream	0.75
30 lbs./ream	1.0
40 lbs./ream	1.5
80 lbs./ream	2.5

Laminations

25 lb. paper/.005" PE/.00032" FOIL/.001" PE	3.0
.001" Cello/.0005" PT/.001" Cello	1.5

When these substrates are coated with polyethylene, nylon polypropylene EVA, EAA, and EEA, add the following tension to the values listed above for the substrate only.

Coating Thickness

0.0005" to 0.0001	0.12
0.0011" to 0.002	0.25

Calculating Web Tension

For sizing brakes on applications in which the applied web tension is unknown, use the following information to determine the approximate tension value.

Applied Web Tension (lbs.) = Approx. Material Tension (lb.in.)

x Roll Width (in.)

Example:

The tension for a twelve inch wide roll of 20# paper stock is unknown. What is the prescribed tension?

Material	tn (lbs.in. of web width)
Cellophane	
.00075"	0.5
.001"	0.75
.002"	1.0
Nylon and Cast Propylene (non-Oriented)	
.00075"	0.15
.001"	0.25
.002"	0.5
Paperboard	
8 pt.	3.0
12 pt.	4.0
15 pt.	5.0
20 pt.	7.0
25 pt.	9.0
30 pt.	11.0
Mylar and Oriented Propylene	
0.0005"	0.25
0.001"	0.5
0.002"	1.0

| Material	tn (lbs./strand)
Aluminum Wire	
#20 AWG	4.00
#18 AWG	5.50
#16 AWG	9.00
#14 AWG	10.00
#12 AWG	12.00
#10 AWG	15.00
#8 AWG	25.00
Copper Wire	
#20 AWG	8.00
#18 AWG	10.00
#16 AWG	12.00
#14 AWG	15.00
#12 AWG	18.00
#10 AWG	20.00
#8 AWG	25.00

Solution:

The approximate tension value as noted in the chart above for 20# paper stock is 0.75 lb.in.; thus the tension for this application is (0.75 lb.in. x 12) = 9 lbs.

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
- Labeling Applications
- Textile Processing
- Material 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

Controlled Acceleration/Deceleration
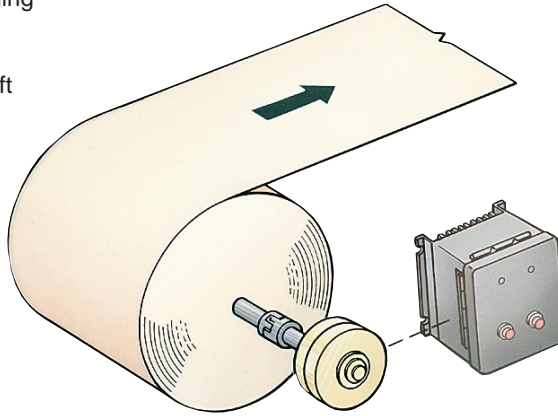
Controlled soft stop

Particle brakes and the MCS-153 control provide soft stopping of large rotating loads. By controlling the input current, the load is decelerated in a controlled manner without torque spikes, shock, or vibration.
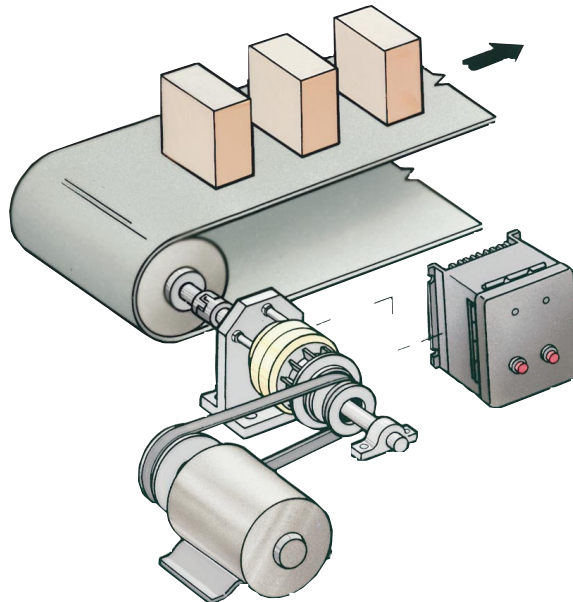
Application Example:
Information Required:
RPM: 1,000
Time to Stop: 3 seconds
Inertia*:   400 lb.in.^{2}

*If inertia is not known see page 3 to calculate.

How to Size:
Maximum Torque (lb.in.) =

$$= \frac{\text{Inertia (lb.in.}^2\text{) x RPM}}{3{,}690 \text{ x time(s)}}$$

$$= \frac{400 \text{ x } 1{,}000}{3{,}690 \text{ x } 3}$$

$$= 36 \text{ lb-in}$$

Select a brake that exceeds the maximum torque requirements from the Specification Chart – MPB70.

Controlled soft start

Particle clutches and the MCS-153 control provide soft controlled acceleration to prevent tipping or shock during start up.

Application Example:
Information Required:
RPM: 500
Time to Start: 4 sec.
Inertia*:   50 lb.in.^{2}

*If inertia is not known see page 3 to calculate

How to Size:
Maximum Torque (lb.in.) =

$$= \frac{\text{Inertia (lb.in.}^2\text{) x RPM}}{3{,}690 \text{ x time(s)}}$$

$$= \frac{50 \text{ x } 500}{3{,}690 \text{ x } 4}$$

$$= 1.7 \text{ lb.in.}$$

Select a clutch that exceeds the maximum torque requirements from the Specification Chart – MPC2.

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® sensor and control, resulting in more precise control of tension.

Unwind stand under load cell control

Particle brakes and the TCS-240 load cell control with precision load cell sensors provide closed loop tension control.

Application Example:
Information Required:
Full Roll Diameter: 20 inches
Tension: 5 lbs.
Velocity: 400 fpm

How to Size:
Maximum Torque (lb.in.) =
$$\frac{\text{Full roll diameter (in.) x tension (lbs.)}}{2}$$
$$= \frac{20 \times 5}{2}$$
$$= \frac{100}{2}$$
$$= 50 \text{ lb.in.}$$

$$\text{Slip RPM} = \frac{\text{Velocity (fpm) x 12}}{\text{Full roll diameter x } \pi}$$
$$= \frac{400 \times 12}{20 \times \pi}$$
$$= 76 \text{ RPM}$$

Thermal Energy (Slip Watts) =
.0118 x Torque (lb.in.) x RPM
$$= .0118 \times 50 \times 76$$
$$= 45 \text{ Watts}$$

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

Rewind stand under dancer control

Particle clutches and the MCS-203 control provide accurate closed loop tension control for rewind applications.

Application Example:

Information Required:
Core Diameter: 3 inches
Full Roll Diameter: 9 inches
Tension: 5 lbs.
Velocity: 300 fpm
Input RPM: 500 RPM*

Maximum Torque (lb.in.) =
$$\frac{\text{tension (lbs.) x full roll diameter (in.)}}{2}$$
$$= \frac{5 \times 9}{2}$$
$$= 23 \text{ lb-in}$$

$$\text{Core RPM} = \frac{12 \times \text{Velocity (fpm)}}{\pi \times (\text{core diameter})}$$
$$= \frac{12 \times 300}{\pi \times 3}$$
$$= 382 \text{ RPM}$$

$$\text{Full Roll RPM} = \frac{12 \times \text{Velocity (fpm)}}{\pi \times \text{Full Roll Dia.}}$$
$$= \frac{12 \times 300}{\pi \times 9}$$
$$= 127 \text{ RPM}$$

Slip RPM = Input RPM – Full Roll RPM
$$= 500 – 127$$
$$= 372.68$$

Thermal Energy (slip watts) =
$$= .0118 \times \text{Torque} \times \text{Slip RPM}$$
$$= .0118 \times 22 \times 373$$
$$= 99 \text{ watts}$$

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

*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, 382 + 30 = 412, would be ideal but 500 RPM was more readily available.

Applications

Torque Limiting/ Overload Protection

The magnetic particle clutches and brakes combined with a Warner® CBC control are effective means to providing protection in the case of jam ups. The magnetic particle clutch and the CBC control can provide precise adjustable torque in torque limiting applications.
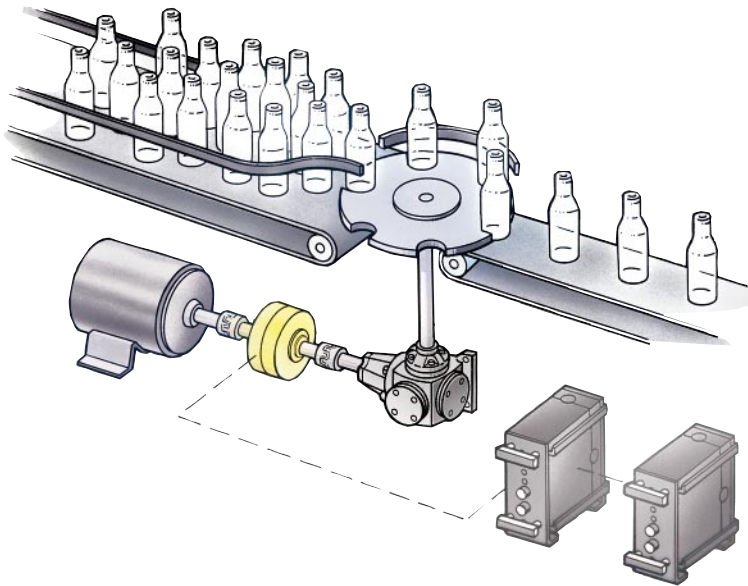
Application Example
Information Required:
Motor HP: 1 HP
Motor RPM :   700 RPM

How to Size:
Maximum Torque (lb.in.) =

$$= \frac{HP \times 63,000}{RPM}$$

$$= \frac{1 \times 63,000}{700}$$

$$= 90 \text{ lb.in.}$$

Select a clutch that exceeds the maximum torque requirements from the Selection Chart – MPC120.

Load Simulation

By combining the magnetic particle brake with a microprocessor control, virtually any load simulation can be obtained. The control is programmed with the profile or condition that is to be simulated. The control then feeds the profile to the magnetic particle brake in terms of input current. The brake reads the input current and provides load torque to simulate the condition.

If the application requires programming load profiles, adjusting load torque, or simulating friction or drag loads, the magnetic particle clutches and brakes are the ideal solution.
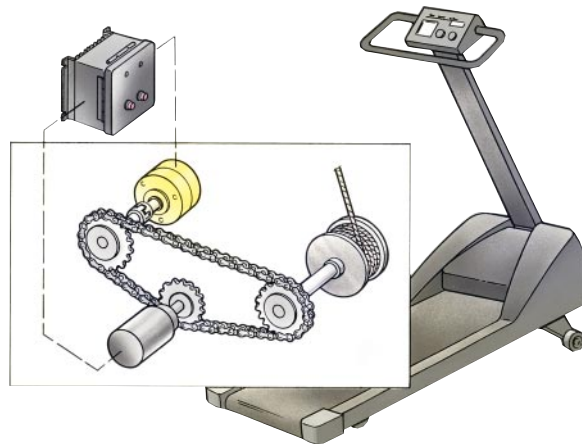
Exercise Equipment
Brake models provide a smooth controllable resistance for exercise machines. When integrated with a microprocessor control, programming load profiles is possible.

Clutches

Dimensions

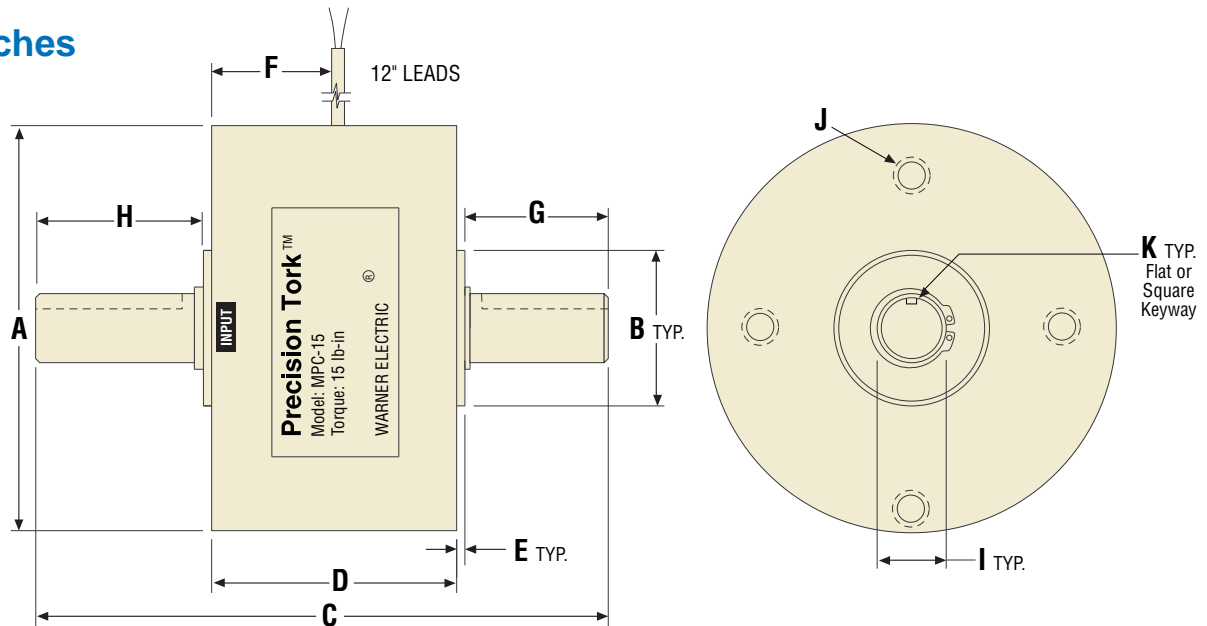| Model	A	B	C	D	E	F	G (Output)	H (Input)	I	J	K
MPC2	2.11	0.750/0.749	3.82	1.86	0.06	1.14	0.88	0.88	0.2497/0.2492	(3) #6-32 on 1.350 BC	Flat
MPC15	2.96	1.125/1.124	4.81	2.80	0.07	1.67	1.00	1.00	0.4997/0.4992	(3) #8-32 on 2.000 BC	Flat
MPC70	4.48	1.625/1.624	6.55	3.67	0.10	2.08	1.35	1.35	0.7497/0.7492	(4) #10-32 on 4.228 BC	0.188 Keyway
MPC120	5.25	1.625/1.624	7.02	4.00	0.10	2.40	1.50	1.35	0.7497/0.7492	(4) #1/4-20 on 4.812 BC	0.188 Keyway

Specifications

Model Number	Max. Drag Torque 0 Excit. (lb.in.)	Rated Torque (lb.in.)	Rated Voltage	Resistance (Ohms)	Rated Current (Amps)	Response Zero Force (Millisec)	Response With Force (Millisecs)	Inertia of Output Shaft (lb.in.²)	Max. Heat Dissipation (watts)	Max. Speed Recom. (RPM)	Weight
MPC2	0.40	2	24	303	0.079	8	4	1.33×10^{-3}	10	1,800	1
	0.40	2	90	1539	0.058	8	4	1.33×10^{-3}	10	1,800	1
MPC15	0.40	15	24	126	0.191	25	9	1.48×10^{-2}	20	1,000	6
	0.40	15	90	1501	0.060	25	9	1.48×10^{-2}	20	1,000	6
MPC70	1.00	70	24	35	0.677	70	17	8.84×10^{-2}	100	1,000	17
	1.00	70	90	613	0.147	70	17	8.84×10^{-2}	100	1,000	17
MPC120	2.00	120	24	33	0.742	90	25	3.82×10^{-1}	140	1,000	22
	2.00	120	90	475	0.190	90	25	3.82×10^{-1}	140	1,000	22

Optional Mounting Bracket (for mounting MPB Brakes and MPC Clutches)
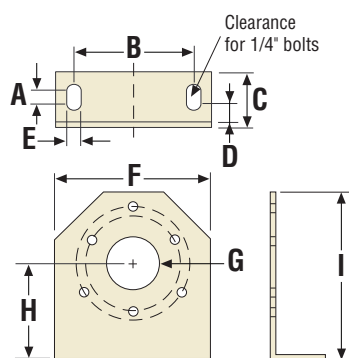
Model	Fits Size	A	B	C	D	E	F	G	H	I
MPB-2B	2	0.270 (6.9)	1.750 (44.5)	1.155 (29.3)	0.390 (9.9)	0.280 (7.1)	2.500 (63.5)	0.750 (19.1)	1.500 (38.1)	3.000 (76.2)
MPB-15B	7, 15, 35	0.270 (6.9)	2.500 (63.5)	1.155 (29.3)	0.390 (9.9)	0.280 (7.1)	3.500 (88.9)	1.125 (28.6)	2.000 (50.8)	4.000 (101.6)
MPB-70B	70	0.270 (6.9)	4.875 (123.8)	1.155 (29.3)	0.390 (9.9)	0.280 (7.1)	6.000 (152.4)	1.625 (41.3)	3.500 (88.9)	6.000 (152.4)
MPB-120B	120	0.270 (6.9)	4.875 (123.8)	1.155 (29.3)	0.390 (9.9)	0.280 (7.1)	6.000 (152.4)	1.625 (41.3)	3.500 (88.9)	6.250 (158.8)
MPB-240B	240	0.270 (6.9)	4.875 (123.8)	1.155 (29.3)	0.390 (9.9)	0.280 (7.1)	6.500 (165.1)	2.441 (62.0)	4.000 (101.6)	7.500 (190.5)

All dimensions are nominal unless otherwise noted. ( ) denotes (mm)

Brakes
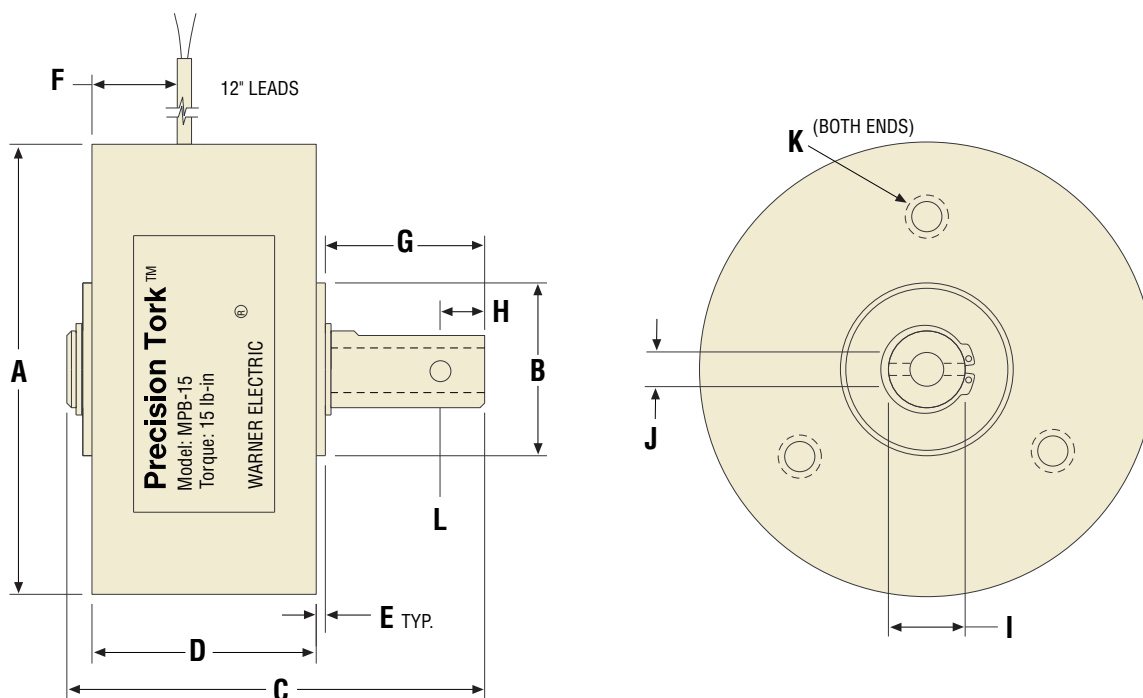
Dimensions

Model	A	B	C	D	E	F	G	H	I (Shaft)	J (Bore)	K	L
MPB2-1	2.11	0.750/0.749	2.23	1.15	0.06	0.72	0.88	–	0.2947/0.2492	Solid Shaft	(3) #6-32 on 1.350 BC	1 Flat
MPB15-1	2.93	1.125/1.124	3.05	1.46	0.07	0.86	1.35	–	0.3747/0.3742	Solid Shaft	(3) #8-32 on 2.000 BC	1 Flat
MPB15-2	2.93	1.125/1.124	2.05	1.46	0.07	0.86	0.35	0.18	0.499	0.375/0.376	(3) #8-32 on 2.000 BC	0.125 Thru Hole
MPB15-3	2.93	1.125/1.124	2.70	1.46	0.07	0.86	1.00	–	0.4997/0.4992	Solid Shaft	(3) #8-32 on 2.000 BC	1 Flat
MPB70-1	4.48	1.625/1.624	2.62	1.76	0.10	0.98	0.50	0.18	0.749	0.500/0.501	(4) #10-32 on 4.228 BC	0.125 Thru Hole
MPB70-2	4.48	1.625/1.624	3.37	1.76	0.10	0.98	1.25	–	0.7497/0.7492	Solid Shaft	(4) #10-32 on 4.228 BC	0.188 Keyway
MPB120-1	5.25	1.625/1.624	4.02	2.17	0.10	1.18	1.50	0.50	0.749	0.500/0.501	(4) #1/4-20 on 4.812 BC	0.156 Thru Hole
MPB120-2	5.25	1.625/1.624	4.02	2.17	0.10	1.18	1.50	–	0.7497/0.7492	Solid Shaft	(4) #1/4-20 on 4.812 BC	0.188 Keyway
MPB240-1	6.21	2.441/2.440	4.66	2.65	0.10	1.46	1.65	–	0.7497/0.7492	Solid Shaft	(4) #1/4-20 on 5.875 BC	0.188 Keyway
MPB240-2	6.21	2.441/2.440	3.51	2.65	0.10	1.46	0.50	–	1.377	0.875/0.876	(4) #1/4-20 on 5.875 BC	0.188 Keyway
MPB240-3	6.21	2.441/2.440	3.51	2.65	0.10	1.46	0.50	–	1.377	1.000/1.001	(4) #1/4-20 on 5.875 BC	0.250 Shallow Keyway

Specifications

Model Number	Max. Drag Torque 0 Excit. (lb.in.)	Rated Torque (lb.in.)	Rated Voltage	Resistance (Ohms)	Rated Current (Amps)	Response Zero Force (Millisec)	Response With Force (Millisecs)	Inertia of Output Shaft (lb.in.²)	Max. Heat Dissipation (watts)	Max. Speed Recom. (RPM)	Weight
MPB2	0.40	2	24	303	0.079	8	4	1.31×10^{-3}	10	1,800	1
	0.40	2	90	1,539	0.058	8	4	1.31×10^{-3}	10	1,800	1
MPB15	0.40	15	24	126	0.191	25	9	1.39×10^{-2}	20	1,000	3
	0.40	15	90	1,501	0.060	25	9	1.39×10^{-2}	20	1,000	3
MPB70	1.00	70	24	35	0.677	70	17	8.03×10^{-2}	100	1,000	7
	1.00	70	90	613	0.147	70	17	8.03×10^{-2}	100	1,000	7
MPB120	2.00	120	24	33	0.742	90	25	3.75×10^{-1}	140	1,000	12
	2.00	120	90	475	0.190	90	25	3.75×10^{-1}	140	1,000	12
MPB240	4.00	240	24	14	1.693	150	45	1.35	200	1,000	20
	4.00	240	90	186	0.485	150	45	1.35	200	1,000	20

Adjustable Torque

TCS-200-1 Manual/Analog

The TCS-200-1/-1H single channel controls are selectable voltage or current controlled power supplies designed to power up to a 16-magnet Electro Disc tension brake system, Electromagnetic Particle Brakes, TB Series brakes, or Advanced Technology tension brakes. These controls operate from a switch-selectable power source of 115 or 230 VAC. They can be operated manually from the front panel or remotely via an analog voltage input, a current input, a remote pot, or a roll follower. External inputs are also provided for remote brake Off, Run, and Stop functions, as well as front panel control of these functions.

Features
- Input: 115/230 VAC, 50/60 Hz
- Output: **-1,** 0–24 VDC adjustable, 4.25 Amps continuous
  -1H, 0–24 VDC adjustable, 5.8 Amps continuous
- Front panel torque adjust
- Front panel brake mode stop switch
  Modes: Stop – Brake Full On
  Run – Normal Operation
  Off – Brake Off
- Remote brake mode switch (same functions as mentioned above)
- Remote torque adjust
- Roll follower input
- 0–10 VDC analog voltage input
- 4–20mA analog current input

System Control

especially designed for user applications. The units are equipped with a power supply, control (PID) logic, front face keypad and display for programming. The MCS2000-ECA is the OEM version controller without the power supply and display. It has the same function and features as the user version. All the controller units can be used in open-loop, closed-loop and open + superimposed closed-loop for very precise tension control applications. The -CTDA and -ECA work with dancer systems and the -CTLC is for load cell systems. The -CTLC will accept one or two load cells that output anywhere between 5mV and 10VDC. It will sum and amplify any load cell available on the market.

The MCS2000-PSDRV works with the controller to provide two 0–24 VDC outputs for electric tension brakes. It is powered with 115/230 VAC at 1.4 Amps continuous or 3 Amps peak per channel.

MCS2000 Digital Web Tensioning

The MCS2000-CTDA/CTLC are digltal web tension controllers. They are

Features
- Input: 115/230 VAC
- Output: Two 0–10V outputs
- Scaleable tension readout
- Password protected
- Eight different output options
- Fully digital
- Multi-purpose
- RS-232 communications
- Memory card for storing up to two full programs
- Windows programming software
- Integral terminal reset
- Two output channels
- Automatic sensor scaling
- External set point change
- Programmable output configuration
- Output sensor information
- Automatic or imposed PID correction

Dancer/Remote Analog Control

MCS-203/MCS-204/ MCS-166

The MCS-203 is a basic dancer control that automatically controls web tension through the use of a dancer roll and sensor. It is single channel, but can operate two 24 VDC tension brakes in parallel when using two MCS-166 power supplies.

The MCS-204 is a basic remote analog control that can also be operated manually via a front panel tension adjustment potentiometer. It is also single channel with the possibility of

operating two 24 VDC tension brakes in parallel when using two MCS-166 power supplies.

Features
- Input: 115/230 VAC, 50/60 Hz
- Output: 0–24 VDC at 3 Amps max.
MCS-203 (only)
- Full P-I-D adjustment
- System gain display
MCS-204 (only)
- Front panel torque adjustment
- Remote potentionmeter adjustment
- Roll follower input
- Remote voltage or current analog signal following

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