CLUTCHES / BRAKES

Tension Control Systems for Light, Medium, and Heavy-Duty Tensioning

Warner Electric

WARNER ELECTRIC

A full range of tension control systems and components for light, medium and heavy-duty tensioning

The Warner Electric Difference

Electronic, pneumatic and electric technology tensioning solutions designed for economical operation, high performance and easy installation.

Warner Electric introduced the first electric brake more than 50 years ago and has pioneered significant advances in the field of tensioning since then. The Warner Electric tension control system, first introduced in 1965, is the established industry standard for reliability and performance.

Contents

Warner Electric Tension Control Systems

Warner Electric offers the most complete line of tensioning products available. Several different types of electric and pneumatic brakes designed specifically for tension applications range in torque ratings from 1 oz.in. through 1785 lb.ft. Controls vary from simple manual adjust models through sophisticated closed loop dancer and load cell systems.

Whether tensioning wire, film, foil, paper, kraft stock, or steel, Warner Electric offers the right tension system for your application. Let our tension specialists help you design the ideal system for your needs.

About This Catalog

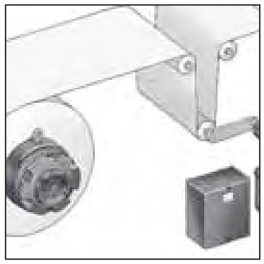
This Warner Electric Master Tension Systems Catalog provides the designer with a complete design guide. Matching system component performance characteristics to your application is made easier through the extensive "Design Considerations & Selection" section and product comparison charts. In addition to selection information, the catalog includes product specifications, dimensions, a glossary of terms, and an application data form. It is the most complete tensioning catalog and design guide available.

Warner capabilities:

- Control technologies from manual operation to closed loop dancer control
- Multiple technologies – Electric, pneumatic and electronic
- Full roll to core control
- Consistent tension, even during flying splices and emergency stops
- Web flutter eliminated to allow better registration control
- Reduction of material waste, downtime and maintenance
- Material flexibility – Thin films, heavy mylar, rolled metals, newsprint, paperboard, laminate foils, wire
- Global distribution
- Local, professional service.

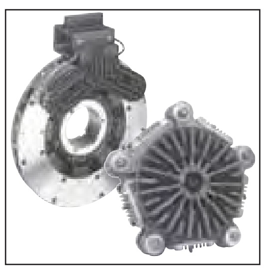
PTDA

Tension Control Systems



Tension Controls

Tension Brakes and Clutches



ModEvo Pneumatic Brakes

Sensors

Modular Control Units

MCS2000 Series Digital Web Tension Controls

The MCS2000 Web Tension Controller handles all winding, intermediate zone and unwinding applications. MCS2000 easily interfaces to the appropriate clutch/brake driver or motor drive. The digital controller ends the problem of handling large diameter ratios greater than 10:1. See page 46.

- P-I-D parameter programming
- Automatic P-I-D parameter adaption
- Dual outputs in either current or voltage operation modes
- Auto-splice circuit
- Optically isolated I/O
- PLC compatible
- Auto ranging of sensors
- Programmed via hand held programmer or Windows PC program
- Programmable based parameters may be saved on a plug-in memory card
- Multilingual programming
- Usable for unwind/zone/rewind: Electric or Pneumatic Clutches and Brakes, AC, DC, Servo or Stepping Motor Drives.

Analog Controls

TCS Series Analog/Manual Controls

The TCS-200 is a manual analog control for the Electro Disc Tensioning Brake. The control is a constant-current output type that uses a front panel or remote potentiometer to adjust the output. The TCS-200-1/-1H is a manual analog control for any 24 VDC tension brake. It can also accept a 0-10 VDC or 4-20mA analog input for adjusting the output. See page 56.

TCS-200

- Input: 24–30 VAC, 50/60 Hz
- Output: 0-270 mA continuous per magnet up to 12 electro disc magnets, adjustable 3.24 amps
- Torque adjust, brake on, run, brake off switch on front panel
- Remote torque adjust, roll follower inputs

TCS-200-1 Selectable Voltage

- Input: 115/230 VAC, 50/60 Hz
- Output: 0-24 VDC adjustable, 4.25 amps continuous
- Torque adjust, brake on/off, run switch
- Remote torque adjust, roll follower inputs

TCS-200-1H

- Input: 115/230 VAC, 50/60 Hz
- Output: 0-24 VDC adjustable, 5.8 amps continuous
- Torque adjust, brake on/off, run switch
- Remote torque adjust, roll follower, analog voltage or current option

MCS-204 Analog Tension Control

The MCS-204 is a solid-state control designed for manual or analog input to operate one or two 24 VDC tension brakes. It is designed for use with the MCS-166 power supply. See page 57.

- Input 24–28 VDC @ 3 amps
- Operates from torque adjust control knob on front, remote potentiometer, roll follower, or current loop
- Panel mount with exposed wiring or wall/shelf mount enclosure with conduit entrance.

TCS-220 Analog Tension Control

The TCS-220 operates an Electro Disc or other electromagnetic tension brake from an analog input (customer supplied) or the manual setting of the “Torque Adjust” dial on the control face. See page 58.

- Input: 48 VDC. 1.6 amps continuous, 6 amps intermittent. Analog inputs from roll follower or current loop.
- Output per magnet is 0–270 mA running, 270–500 mA stopping
- Cabinet mounting enclosure with exposed wiring or wall/shelf mounting enclosure with conduit entrance.

MCS-208 Analog Tension Control

The MCS-208 operates pneumatic tension brakes through an E to P transducer, which varies air pressure accordingly. Control output is based on an analog input (customer supplied) or the manual setting of the “Torque Adjust” dial on the control face. See page 59.

- Input: 26 VDC. Analog inputs from roll follower or current loop
- Output: 1–9 VDC; 1–5 mA, 4–20 mA, or 10–50 mA, depending on transducer needs
- Cabinet mounting enclosure with exposed wiring or wall/shelf mounting enclosure with conduit entrance.

TCS-320 Analog Splicer Control

The TCS-320 is a solid state splicer control that operates two Electro Disc or other electromagnetic tension brakes, one brake controlling and one brake holding, or two tension brakes operating simultaneously. It can also be used as a dual brake control operating up to 24 MTB brake magnets. See page 60.

- Input: 48 VDC, 3.2 amps continuous, 12 amps intermittent
- Output per magnet is 0–270 mA running, 270–500 mA stopping, 9–90 mA holding
- Available as open frame or with NEMA 4 enclosure

Dancer Controls

MCS-203 Dancer Control

The MCS-203 automatically controls web tension through a dancer roll and sensor. It has 24 VDC output for use with TB, ATTB & ATTC, and Magnetic Particle clutches and brakes. See page 61.

- Operates two 24 VDC tension brakes in parallel when using dual MCS-166 power supplies
- Full P-I-D loop adjustment and system gain adjustment for optimum control.
- Available in open frame or enclosed wall/shelf mount enclosure.

TCS-210 Dancer Control

The TCS-210 automatically controls web tension through a dancer roll and position sensor. It outputs to an Electro Disc or other electromagnetic tension brake. See page 62.

- Input: 48 VDC, 1.6 amps continuous, 6 amps intermittent
- Output per magnet: 0–270 mA running, 270–500 mA stopping
- Cabinet mounting enclosure with exposed wiring or wall/shelf mounting enclosure with conduit entrance.

MCS-207 Pneumatic Dancer Control

This control provides automatic web tensioning using a dancer roll and pivot point sensor. See page 63.

- Operates most pneumatic clutches and brakes
- Automatic control for precise tensioning with minimal operator involvement
- Full P-I-D loop and system gain adjustments for optimum control
- Switch selectable output operates E to P transducers (0–10VDC) or I to P transducers (1–5mA, 4–20mA, 20–50mA) with zero and span adjustments.

TCS-310 Dancer Splicer Control

The TCS-310 is an automatic splicer control that operates two Electro Disc or other electromagnetic tension brakes, one brake controlling and one brake holding, or two tension brakes operating simultaneously. It can also be used as a dual brake control operating up to 24 MTB brake magnets. See page 64.

- Input: 48 VDC, 3.2 amps continuous, 12 amps intermittent
- Output per magnet is 0–270 mA running, 270–500 mA stopping, 0–90 mA holding
- Available as open frame or with NEMA 4 enclosure

Power Supplies

MCS-166 Power Supply Module

The MCS-166 Power Supply Module provides power for the MCS-203, MCS-204, MCS-207, or MCS-208 control modules. See page 65.

- 120V/220V/240 VAC, 50/60 Hz
- 24 VDC, 1.5 amp output
- May be connected in parallel for increased current capacity.

TCS-167 Power Supply

The TCS-167 Power Supply provides power for either the TCS-210 or TCS-220 control modules. See page 65.

- 120V/240 VAC, 50/60 Hz operation, switch selectable
- Output: 9 VDC @ 1.5 amps and 48 VDC @ 1.6 amps continuous, 6 amps intermittent
- Internally fused for protection.
- Available in open frame or enclosed wall/shelf mount enclosure.

TCS-168 Power Supply

The TCS-168 Power Supply provides power to either the TCS-310 or 320 dancer tension controls. See page 65.

- Input switch selectable for 120 or 240 VAC, 50/60Hz
- Output 3.2 amps continuous, 12 amps intermittent

Warner Electric

Products for Controlling Tension

Electric Brakes & Clutches

TB Series Basic Tension

Annular style 24 VDC tension brakes for light to medium duty unwind tension applications.

- Sizes: 1.7" to 15.25" diameter
- Torque range: 0.50 lb.ft. to 256 lb.ft.
- Thermal range: .019 HP to 1.09 HP

ATT Series Advanced Technology

Designed for intermediate web tension ranges. Three size ranges.

- One piece clutch design for easy shaft mounting
- Brakes are flange mounted and the armature is the only rotating member
- Clutch torque ranges 7 to 41 lb.ft. Brake torque ranges from 8 to 62 lb.ft.
- Replaceable friction faces and armature rings.

MTB Series Modular Tension

Modular Tension Brakes (Electro-Disc) are modular caliper type electric brakes used for unwind tensioning. Torque is varied by disc diameter and by changing the number of magnets on the friction disc(s).

- 10", 13", 15" and 20" diameters
- Torque ranges to 1120 lb.ft.
- Thermal capacities to 8 HP
- Brakes rebuildable by changing only friction pads and armature disks.

M Series Permanent Magnet

Permanent magnet brakes and clutches are ideal for light tensioning applications, such as film and fine wires. They require no external power, have a wide range of torque adjustment, have no friction surfaces to wear, and offer chatter-free torque control even at very low speeds.

- Torque range from 1 oz.in. through 65 lb.in.
- Manual torque adjustment
- Constant torque with varying speeds.

Magnetic Particle

Self-contained magnetic particle clutches and brakes for a wide range of unwind/rewind applications offer smooth operation at very low speed and electronic control compatibility.

- Torque range from 2 lb.in. through 578 lb.ft.
- Shaft or flange mounting
- Fan cooled in largest sizes.

Pneumatic Brakes & Clutches

Mistral

Mistral Pneumatic Tension Brakes' compact design meets the special needs of the corrugating industry.

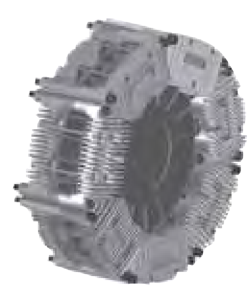
- Fan cooled for longer life
- Three sizes for multiple applications
- Torque range: 1 lb.ft. to 442.5 lb.ft.
- Thermal capacity to 3.5 HP
- Three sizes from 9" to 16" diameter. Eases handling small roll ends.

Magnum

Note: Being Discontinued.

AD Series Air Disc Brakes

Note: Being Discontinued



ModEvo

Modular Pneumatic Tension Brake allows for a wide range of tension applications with the modular design. Actuator configuration with different friction material coefficients allow for much greater range capabilities.

- Torque range from 16 lb.ft. to 3180 lb.ft.
- Optional guards and cooling fan assemblies
- Thermal capacities to 18 HP
- Optional high speed armatures

Sensing Devices

Ultrasonic Sensors

- Analog outputs with selectable 0–10V – 4–20mA
- Input voltage 20–30VDC
- Range control zero and span
- Short circuit protected
- 80" max. distance
- Response time 50 mSec

Pivot Point Sensors

The TCS-605-1 and TCS-605-5 pivot point sensors close the feed back loop to the tension control by sensing dancer roll position.

- TCS-605-1 is a single turn potentiometer with a resistance of 1KΩ for normal dancer operating ranges within 60° of arm rotation.
- TCS-605-2 is a single-turn potentiometer with a resistance of 5KΩ for normal dancer operating within a 60° range used with AC & DC drives.
- TCS-605-5 is a five-turn potentiometer with a resistance of 1KΩ for festooned dancer systems, with a 300° rotational range.

Load Cell Sensors

These devices are used in tension systems to provide closed loop feedback of the actual tension on the web.

FM – Foot Mounted

The foot mounted style load cells (used with pillow blocks) provide easy and convenient mounting to the roll that is being measured. It is a strain gauge style unit that is ideal for heavy tension applications.

- Load ratings: 22, 56, 112, 225, 562, 1122, 2248 lbs.
- Sensitivity (output): 1 mV/V at nominal load
- Power Supply: 10 to 15 VDC

ES – End Shaft Mounted

The end shaft style load cells mount to the end of the roll that is being measured. It is a LVDT (Linear Variable Differential Transformer) style which can withstand overloads up to 10 times its rated load capacity. There are several models offered: dead shaft (no bearing), live shaft and cantilever where a single load cell can be used to measure the tension on the roll. Some units are powered with DC voltage and other units are powered with AC voltage. The AC units offer a price advantage over the DC.

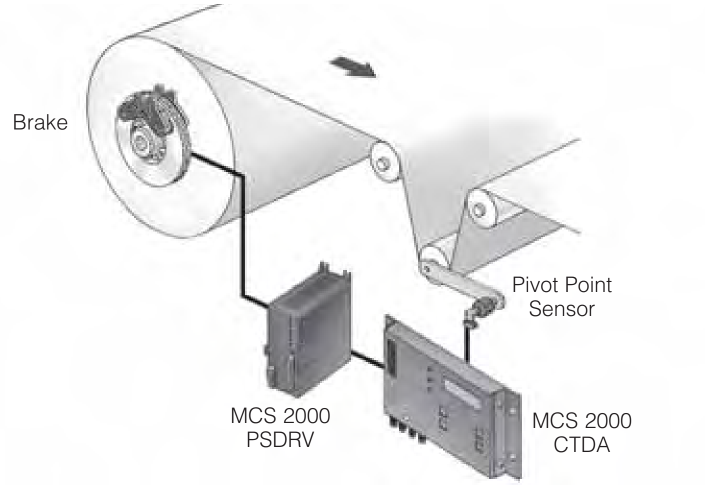
- Load Ratings: 20, 50, 90, 200, 500
- Sensitivity (output): 3VDC at nominal load
- Power Supply: ±12 to ±15 VDC, ±5%

Tension Control Systems

Application Examples

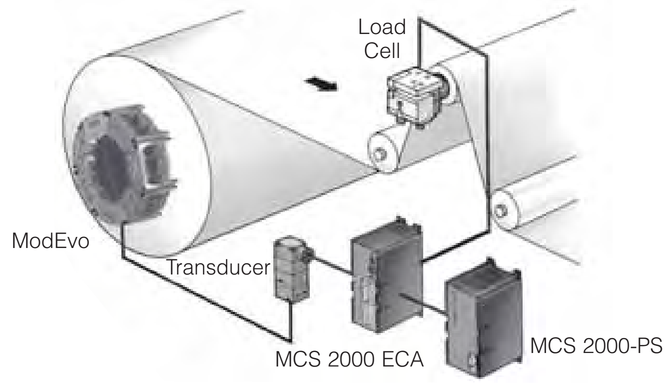
Dancer Control

The dancer control system consists of a power supply, dancer control, pivot point sensor, and controlling element, i.e., tension brake or clutch. Dancers provide the web tension while the control and controlling element stabilize dancer operation for unwind, intermediate zone or rewind tension.



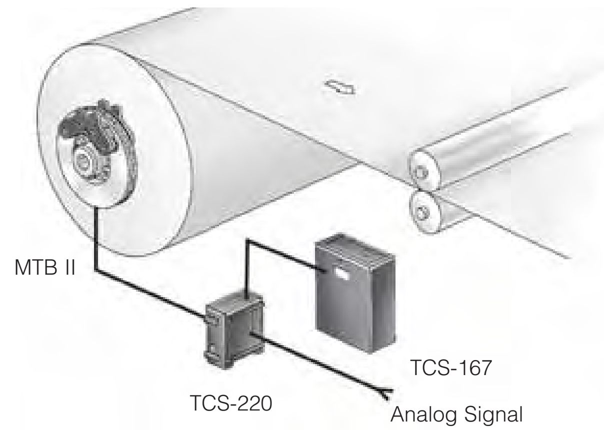
Load Cell Control

Load cell control system consists of the load cell controller, power supply, load cells and controlling element, i.e., tension brake or clutch. Load cells measure the pull force on the web and compare that force to the set point tension in the control. The control increases or decreases the retarding force. Load cells are used for unwind, intermediate zone or rewind tension control.



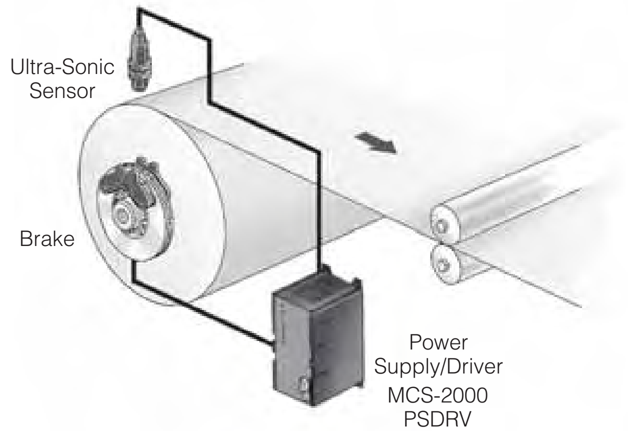
Analog Control

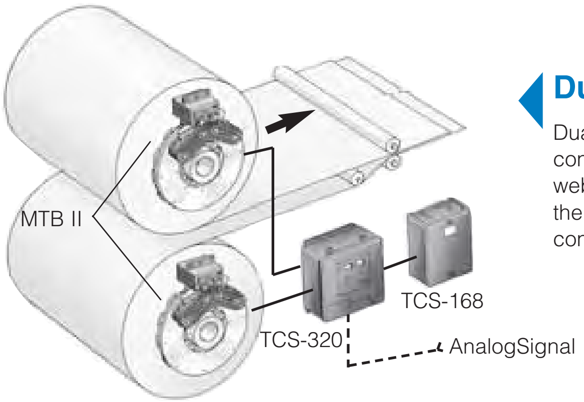
The analog system consists of a control module, power supply, and a controlling element, i.e., tension brake or clutch. The analog controller provides output proportional to the input signal for use in unwind, intermediate zone or rewind tensioning.



Electronic Control

Electronic control systems are very similar to analog control systems with the exception of using an electronic sensing element such as an ultrasonic or photoelectric sensor. The sensor monitors diameter change in either the unwind or rewind rolls, and provides a corresponding change in output.



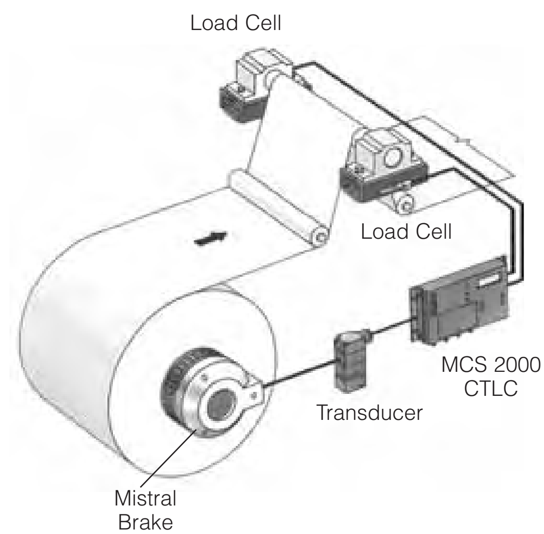


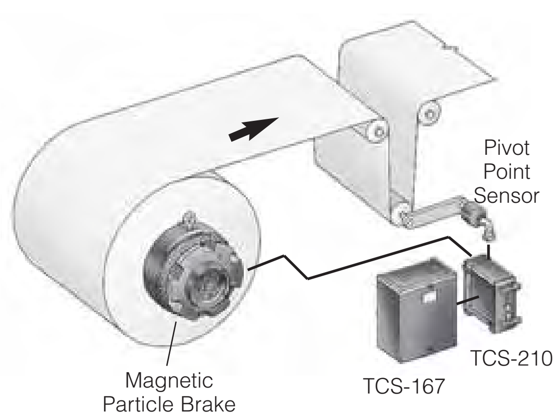
Dual Brake Unwind

Dual brake unwind incorporates modular tension brakes and an analog control system. The brakes retard the unwind roll, creating tension in the web. An external, customer-provided signal adjusts the output current to the brakes to maintain the proper tension. The dual channel controller controls each brake independently or simultaneously.

Single Roll Pneumatic Brake Unwind

Pneumatic brake retards the rewind roll, providing the required tension. Tension is set by the loading force applied to the load cells, which send a signal to the controller. The controller signal to the electric/pneumatic transducer controls the air pressure to the brake.





Single Roll Magnetic Particle Brake Unwind

The magnetic particle brake retards the unwind roll, maintaining tension provided by the dancer roll's weight. The pivot point sensor signals the controller to vary the current to the brake.

Tension Control Systems

System Configurations

Technical Considerations – Tension Zones

I. A tension zone in a web processing machine is defined as that area between which the web is captured, or isolated. Virtually any machine can be broken down into tension zones, and it is important to do so to properly address maintaining the tension required.

Simple machines, such as rewinders or inspection machines, may have only one zone (see Fig. 1). The primary goal here is to control tension so that the rewound package is accurately wound. Typically, the winder (A) would be a simple line speed motor drive, with tension controlled by a brake system at the unwind (D). The method of brake control (i.e.: open or closed loop) would be determined by the accuracy demands of the application. For simple diameter compensation, an ultrasonic sensor measuring the diameter of the roll can produce satisfactory results. Greater accuracy may require closed loop feedback, such as from a dancer or load cell.

II. More commonly, a machine will have driven nip rolls in the center, or processing section (see Fig. 2). A simple slitter/rewinder is an example. In this case, there are two separate tension zones to deal with and the tension levels may be different in each zone. Different tension levels are possible because the web is captured at the driven nip rolls, thus creating separate and distinct unwind and rewind zones. The driven nip rolls (B) will typically be powered by a motor drive that establishes machine line speed. Processing tension will be controlled by a brake system at the unwind (D), and a clutch or motor drive will control the winder tension (A). Again, the method of control will be dictated by the accuracy of tension control required in each zone. If process tension levels can vary by 10% or greater, a simple open loop brake control system may suffice. More accurate control would require a closed loop system, such as dancer or load cell feedback. Likewise, in the winder zone, open loop control may be sufficiently accurate, or closed loop or taper tension control may be required.

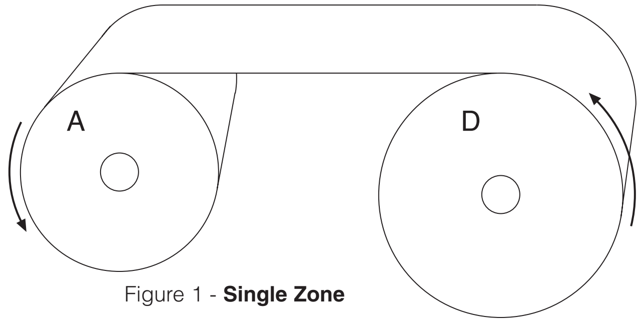


Figure 1 - **Single Zone**

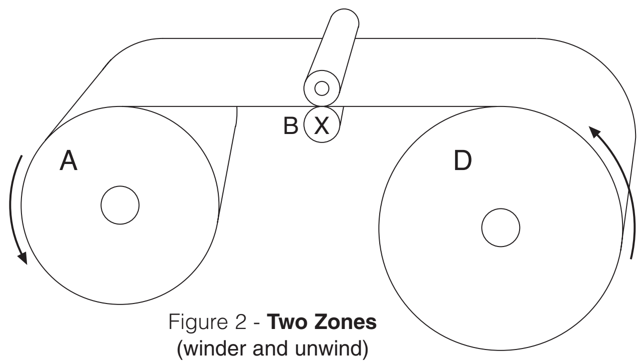


Figure 2 - **Two Zones**
(winder and unwind)

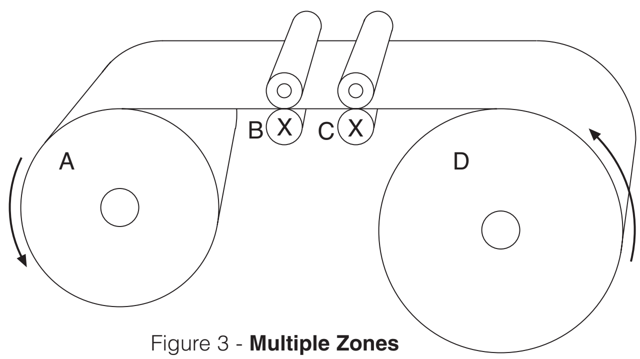


Figure 3 - **Multiple Zones**
(winder, intermediate, unwind)

III. More complex machines will usually have multiple intermediate zones in addition to the unwind and rewind zones (see Fig. 3). One of the intermediate zone drives will typically establish line speed, and the control of drive rolls for the other zones will relate to this drive. In some instances, a simple master/slave relationship with a speed differential ratio will provide the draw tension necessary in that zone (i.e. Fig. 3 – B & C). In other cases, this may be accomplished with closed loop (dancer or load cell) trim. The rewind (A) and unwind (D) would be handled as described in II. Multiple intermediate zones can become very complex, particularly if high degrees of accuracy are required. As a general rule of thumb, control of any zone should be accomplished at one end of the zone only. Control systems at both ends of the zone (for that zone) will generally result in instability of tension levels.

Reliable and accurate control for all system design layouts

Open loop tension control systems provide the least expensive manner to provide a degree of web tension control with the minimal amount of components. Open loop tension control can apply to unwind, intermediate, or rewind tension applications.

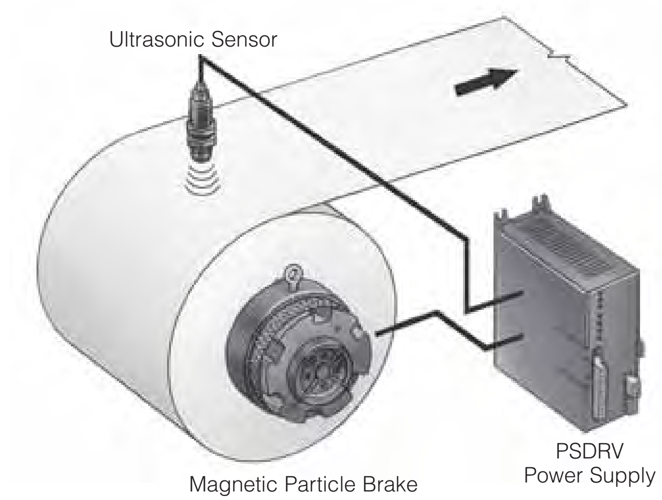
Although not as sophisticated as most closed loop tension control systems, a degree of controllability is achieved. Using open loop tension systems, one does sacrifice such things as web storage for acceleration, deceleration, and E-stop conditions. Tension variations during machine start or stop are common with this type of system.

The most common of the various tension systems are generally comprised of the controlled device; i.e., brake, clutch, etc., a simple controller or power supply, and a controlling element, i.e., a potentiometer or some type of analog sensor.

Because of system simplicity, tension is maintained for diameter compensation only in an unwind or rewind system, and no compensation is provided for acceleration, deceleration, E-stop or out of round roll conditions. Tension variations of 25% or more may be possible during acceleration or deceleration, and 10% or more during running due to out of round rolls or variations in the process machines.

These types of systems lend themselves nicely to applications where tension variations are not a concern, and hold back on a rewind role or scrap wind up is needed. Operator adjustments are usually required when material tensions or roll diameters are changed initially.

Open Loop System



Typical Components

For the simplest of unwind systems, the following components might be used:

- Tension brake coupled to the unwind roll, i.e., ATTB, TB, magnetic particle, or MTB, or pneumatic brake
- Tension controller to provide control current or voltage to the brake, i.e., TCS-200-1, MCS-166/MCS-204, TCS-167/TCS-220, MCS-166/MCS-208
- Control, either the manually adjusted type with a control potentiometer, or through an external potentiometer coupled to a follower arm, or ultrasonic or analog proximity sensor monitoring roll diameter.

Flying Splicer

Specially designed solid state splicer control holds the unused roll stationary while tensioning the operating roll. Dancer variation sensing and subsequent adjustment are virtually instantaneous for accurate tensioning during the splice, typically at less than 1% variation.

Tension Control Systems

System Configurations

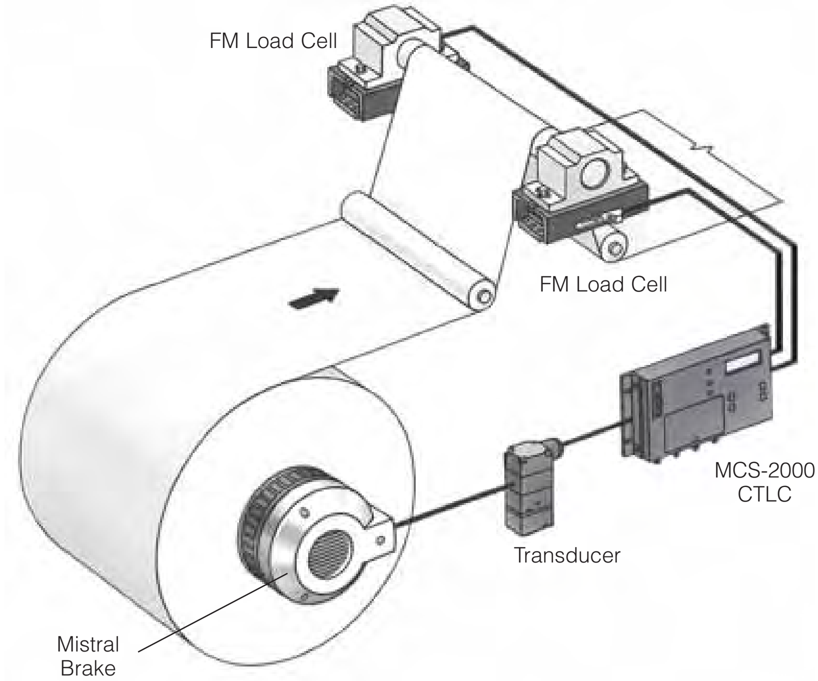
Closed Loop System

Closed loop tension systems provide very precise and accurate tension control during steady state running conditions as well as acceleration, deceleration, and E-stop conditions. Because the material web is monitored constantly, either by load cells or from a dancer by position, changes are detected immediately and the controlled device is changed instantaneously to maintain accurate tension control.

The two most common methods of providing closed loop tension control are via load cells that monitor the force on the web directly or via dancers, which provide tension by the load imposed by the dancer roll and dancer position and velocity are monitored, usually by a precision potentiometer. Even the most minute changes are sensed and compensated for in a closed loop system.

Closed loop tension control systems require the least amount of operator involvement during running. Normally, the operator sets only the tension level required for the material being run, once the system has been properly set up and adjusted. Closed loop system controllers compensate for changes in roll diameter and conditions, acceleration, deceleration, and machine variations.

Although closed loop tension control systems offer the most advantageous method of providing web tension control, be it dancer or load cell, there are some limitations to each type of system. In dancer systems, more space is required in the machine to accommodate the dancer arm and rollers, and some method, preferably an air cylinder and regulator, is required for loading. Load cell systems, on the other hand, require less space for mounting, but storage is non-existent for acceleration or deceleration, and balancing of all machine rollers. Web contact is required because of load cells' high sensitivity.



Typical System Components

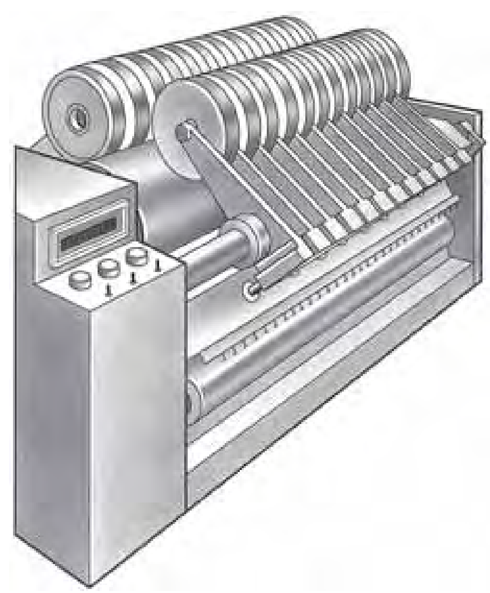
The typical components of a closed loop tension system are:

- Tension brake coupled to the unwind roll; i.e., TB, MTB, magnetic particle, pneumatic brake
- Controller to provide proper signal to control device; i.e., MCS2000EAC/ MCS2000PSDRV, MCS-166/MCS-203, TCS-167/TCS-210, MCS-166/MCS-207
- Controlling element, either load cell or dancer pivot point sensor potentiometer

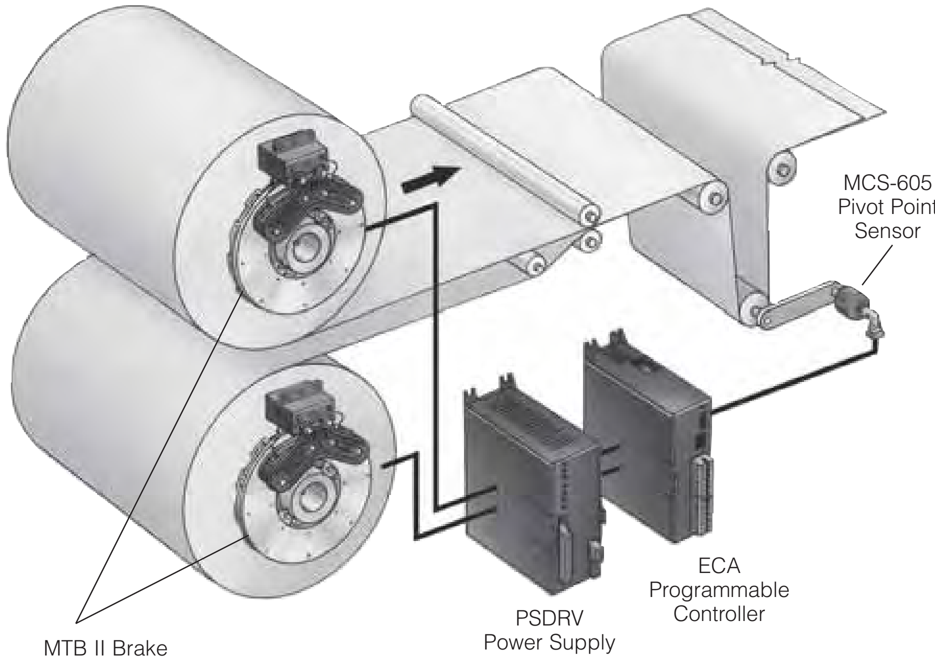
In general, closed loop tension control is the preferred method in more complex machines where precise tension control is required due to process requirements, such as precise registration, multiple color printing or coating to an exact thickness.

Slitter/Rewinder

Slitter/rewinders process an unlimited number of materials including paper, wires, and foils. Modularity and broad torque capability make Warner Electric the ideal system for the complete range of slitter/rewinder tensioning requirements.



Dual Output and Splicer System



Dual output tension control systems, often referred to as splicer controls, offer the user a multitude of options for the way they may be set up and used. Dual output tension controls have the capability of operating both outputs simultaneously from a single input or operating each output alternately, one being controlled by the sensing input and the other in a holding mode. This allows the controls to be used on either zero speed or flying splicers.

Control types include both analog, such as the TCS-310 dancer control and the TCS-320 remote/analog controller, and digital such as the MCS2000 ECA. Dual output controllers work like the single output controllers, except a few more features are included to provide switching between the output channels when operated as splicer controls.

The remote/analog splicer control provides an output proportional to the input. Typically, this is an open loop controller and does not compensate for acceleration, deceleration, or E-stops in the system. In addition, it provides no compensation for out of round roll conditions or variations associated with machine functions. This is the most basic type of controller and, in many cases, requires operator intervention to compensate for changing roll conditions.

The dancer splicer control, TCS-310, has additional features to provide automatic compensation for acceleration, deceleration, E-stop, out of round roll conditions and variations in the machine functions. A three-term control loop (P-I-D) is used to provide these functions. Set-up adjustments are provided to tune the system for optimum performance and, once set, requires no additional adjustment. With the dancer splicer system, operator involvement during a run is eliminated, and precise tension control is achieved.

The digital tension controller, MCS2000 ECA, allows the user a multitude of functions for both the type of inputs being used and the outputs for the controlled element. Because of its modularity, the user can tailor the MCS2000 system to specific application requirements. This system can be used as an open loop controller being controlled by a manual potentiometer, a roll follower pot, or some type of analog input sensor, i.e., ultrasonic or photoelectric.

The same controller can also be used with either a dancer or load cell and an optional input module for closed loop control. By changing the parameters, this is easily accomplished without having to change to a different control.

Depending on application requirements and the control selected, the optimum system for machine function and control can be selected.

Tension Control Systems

System Configurations

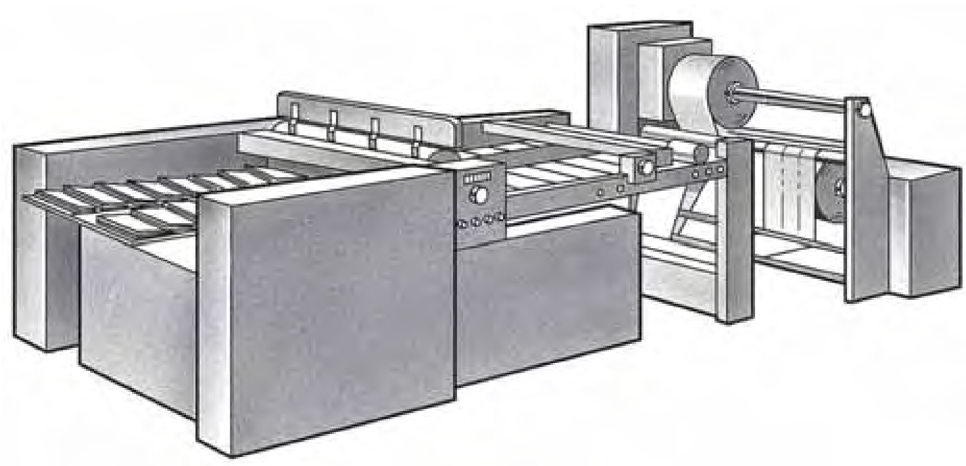
Typical Components for Splicer System

For Modular MTB Brakes Only

- Modular tension brake, MTB Series.
- Dual output tension controller, i.e., TCS-310 for dancer system, TCS-320 for remote/analog system, for providing current to brake magnets.
- Power supply, TCS-168, to provide control and brake power.
- Controlling element, i.e., pivot point sensor for dancer system; external pot, remote signal, or analog sensor for remote/analog controller.

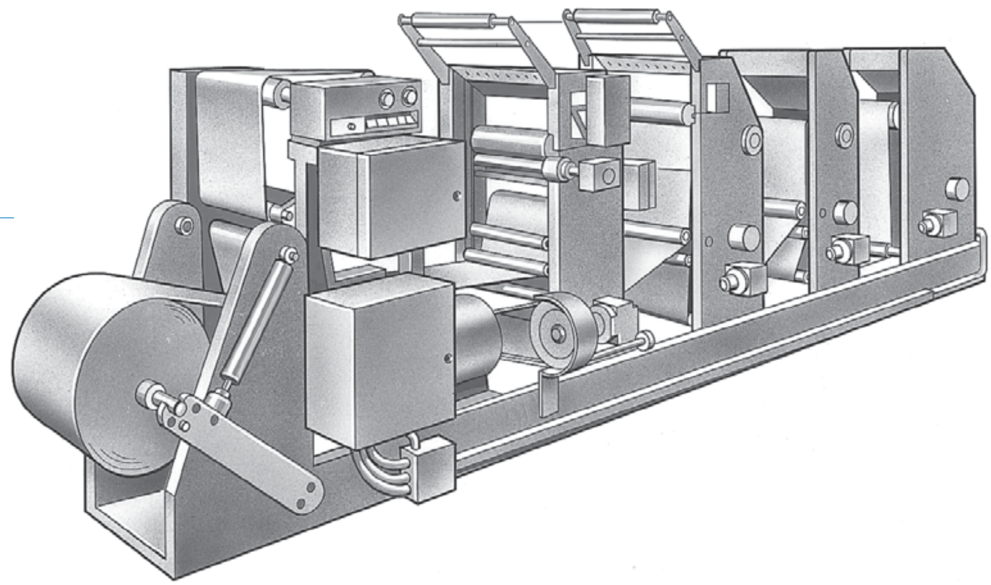
For other Brake/Clutch Systems

- Tension brake, clutch, or electronic motor drive, i.e., TB's, MTB's, ATT's, magnetic particles or pneumatic.
- Tension controllers, MCS2000 ECA and appropriate output modules and/or input modules as necessary depending on system type.
- Control element, i.e., dancer potentiometer, load cells, tachometers, or analog sensors, depending on application requirements.



Bag Making Machines

The smooth, consistent tension provided by Warner Electric tension control systems eliminates most reject bags caused by uneven reel tension. On preprinted bags, Warner Electric tension brakes and control systems allow superior registration control to keep the printed area in its optimum position.



Business Forms Press

Unique control circuitry allows Warner Electric tensioning systems to maintain exact web tension for intermittent web processing operations. From the beginning of each roll to its core, operator adjustment is unnecessary, even at the highest production speeds.

Unwind Tension Application Data Form

Warner Electric, Inc.
449 Gardner Street, South Beloit, Illinois 61080
Phone: 1-800-825-9050 • FAX: 815-389-6678 • E-mail: www.warnerelectric.com

Company Name:________________________________ Date:______________

Address:____

City:______________________________ State:________ Zip:______________

Contact:______________________________ Title:______________

Phone:______________________________ Fax:______________________________

E-mail:______________________________________

Type of Equipment:____

SYSTEM DATA:

Please check those that apply.

A. Application

- ☐ New
- ☐ Existing
  - If existing, what is currently being used?
  - ______________________________
  - ______________________________

B. Controlling Element

- ☐ Load Cell
- ☐ Dancer
  - ☐ Standard
  - ☐ Festoon
- ☐ Analog
  - ☐ Roll Follower
  - ☐ Sensor
- ☐ Other______________________________
  - ______________________________

C. System Type Preference

- ☐ Brake
- ☐ Drive System
  - ☐ Center Wind
  - ☐ Surface
  - ☐ AC
  - ☐ DC
  - ☐ Other______________________________
  - ______________________________

D. Web Motion

- ☐ Continuous
- ☐ Intermittent
  - If Intermittent;
  - Draw length: ____________ in inches
  - Draw time:____________ seconds
  - Dwell time:____________seconds

APPLICATION DATA:

A. Material: ______________________________

*Web Width:____________________ inches

*Thickness:____________________ inch, pts, mils
Circle appropriate measure

*Tension:
Pounds/Inch:____________________ pounds
Total Tension:____________________pounds

B. Linear Speed:____________________ft./min.

C. Core Diameter:____________________inches

D. Max Diameter:____________________ inches

E. Full Roll Weight:____________________ pounds

F. Core Weight:____________________ pounds

Machine Parmeters

G. Accel Time:____________________seconds

H. Decel Time:____________________ seconds

I. E-Stop Time:____________________seconds

*** If additional application data is pertinent, please use second sheet.**

Intermediate Tension Application Data Form

Warner Electric, Inc.

449 Gardner Street, South Beloit, Illinois 61080
Phone: 1-800-825-9050 • FAX: 815-389-6678 • E-mail: www.warnerelectric.com

Company Name:______________________________ Date:______________

Address:____

City:__________________________ State:________ Zip:____________

Contact:__________________________ Title:________________

Phone:______________________ Fax:______________________

E-mail:______________________________

Type of Equipment:____

SYSTEM DATA:

Please check those that apply.

A. Application

- ☐ New
- ☐ Existing

If existing, what is currently being used?

____

____

B. Controlling Element

- ☐ Load Cell
- ☐ Dancer
  - ☐ Standard
  - ☐ Festoon
- ☐ Analog
  - ☐ Roll Follower
  - ☐ Sensor
- ☐ Other______________________________

____

C. System Type Preference

- ☐ Brake
- ☐ Clutch
- ☐ Drive System
  - ☐ Center Wind
  - ☐ Surface
  - ☐ AC
  - ☐ DC
  - ☐ Other______________________________

____

D. Web Motion

- ☐ Continuous
- ☐ Intermittent

If Intermittent;

Draw length: ____________ in inches

Draw time:____________ seconds

Dwell time:____________ seconds

APPLICATION DATA:

A. Material: ______________________________

*Web Width:____________ inches

*Thickness:____________ inch, pts, mils
Circle appropriate measure

*Tension:
Pounds/Inch:____________ pounds
Total Tension:____________ pounds

B. Linear Speed:____________ ft./min.

C. Core Diameter:____________ inches

D. Max Diameter:____________ inches

E. Full Roll Weight:____________ pounds

F. Core Weight:____________ pounds

Nip Roll Information

G. Nip Roll Matieral:______________________________

H. Nip Roll Diameter:____________ inches

I. Nip Roll Width:____________ inches

J. Nip Roll Thickness:____________ inches

K. Nip Roll Weight:____________ pounds

L. Number of Nip Rolls:______________________________

M. Nip Roll Contact Pressure:____________ pounds

Machine Parmeters

N. Accel Time:____________ seconds

H. Decel Time:____________ seconds

I. E-Stop Time:____________ seconds

*** If additional application data is pertinent, please use second sheet.**

Rewind Tension Application Data Form

Warner Electric, Inc.

449 Gardner Street, South Beloit, Illinois 61080
Phone: 1-800-825-9050 • FAX: 815-389-6678 • E-mail: www.warnerelectric.com

Company Name:________________________________ Date:______________

Address:____

City:______________________________ State:________ Zip:______________

Contact:____________________________ Title:______________________

Phone:________________________ Fax:____________________________

E-mail:____________________________________

Type of Equipment:____

SYSTEM DATA:

Please check those that apply.

A. Application

- ☐ New
- ☐ Existing

If existing, what is currently being used?

____

____

B. Controlling Element

- ☐ Load Cell
- ☐ Dancer
  - ☐ Standard
  - ☐ Festoon
- ☐ Analog
  - ☐ Roll Follower
  - ☐ Sensor
- ☐ Other______________________

____

C. System Type Preference

- ☐ Brake
- ☐ Clutch
- ☐ Drive System
  - ☐ Center Wind
  - ☐ Surface
  - ☐ AC
  - ☐ DC
  - ☐ Other______________________

____

D. Web Motion

- ☐ Continuous
- ☐ Intermittent

If Intermittent;

Draw length: __________ in inches

Draw time:__________ seconds

Dwell time: __________seconds

APPLICATION DATA:

A. Material: ______________________

*Web Width:______________ inches

*Thickness:______________ inch, pts, mils

Circle appropriate measure

*Tension:

Pounds/Inch:______________ pounds

Total Tension:______________ pounds

B. Linear Speed:______________ft./min.

C. Core Diameter:______________inches

D. Max Diameter:______________ inches

E. Full Roll Weight:______________ pounds

F. Core Weight:______________ pounds

Machine Parmeters

G. Accel Time:______________ seconds

H. Decel Time:______________ seconds

I. E-Stop Time:______________ seconds

Taper Tension Requirements

J. Taper Tension

- ☐ No
- ☐ Yes

If Yes, what percentage__________ %

K. Is holding required at stop?

- ☐ No
- ☐ Yes

*** If additional application data is pertinent, please use second sheet.**

Application Data Form Supplemental Information

Warner Electric, Inc.

449 Gardner Street, South Beloit, Illinois 61080

Phone: 1-800-825-9050 • FAX: 815-389-6678 • E-mail: www.warnerelectric.com

Company Name:______________________Date:__________

Address:______________________________________

City:____________________ State:______ Zip:__________

Contact:____________________ Title:______________

Phone:__________________ Fax:__________________

E-mail:______________________________

Type of Equipment:______________________________

Additional Application Information

Application Data Form Supplemental Information

Warner Electric, Inc.

449 Gardner Street, South Beloit, Illinois 61080
Phone: 1-800-825-9050 • FAX: 815-389-6678 • E-mail: www.warnerelectric.com

Company Name:____Date:______________

Address:____

City:_________________________________ State:_______ Zip:______________

Contact:______________________________________ Title:________________

Phone:_____________________________ Fax:____________________________

E-mail:____

Type of Equipment:____

Additional Application Information

Tension Brakes and Clutches

Design Considerations and Selection

Brakes and clutches used for tensioning (constant slip) have one thing in common. Generally, heat dissipation capacity is the primary criteria for sizing, followed by torque capacity. Beyond this, each has unique sizing requirements that differ greatly. Information on particular Warner Electric tension brakes and clutches start on page 68.

Brakes (Unwinds or Payoffs)

Thermal Requirements

Thermal requirements for a brake equals web HP; which is

$$HP = \frac{\text{Tension (lbs.) x Linear Speed (FPM)}}{33{,}000}$$

This energy is constant throughout the unwinding process. Although energy is a function of torque and slip speed, slip speed is at its slowest when torque required is at its greatest (full roll), and slip speed is at its fastest when torque required is at its least (core). All that is needed, then to determine thermal capacity required in an unwind brake is tension and linear speed.

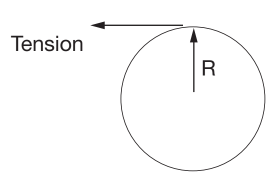
Caution should be taken, however, on machines that run more than one material at different line speeds. All combinations of tensions and line speeds should be checked to insure that brake sizing satisfies the most demanding condition (i.e. – the highest web HP).

Torque Requirements

There are generally three conditions under which a brake must supply sufficient torque: running torque, E-Stop (or emergency stop) torque and controlled stop torque (normal deceleration).

a. Running Torque

This is the torque required to maintain constant tension at any point in the roll being unwound. Since torque is force x distance, with force being tension and distance being roll radius, then torque must change as radius changes if tension is to remain constant. Moreover, the maximum running torque will be at full roll, since that has the largest radius.



b. E-Stop Torque, Web Break

This is the torque required to stop the roll in the event of a web break or a safety related machine stop. There are basically two types of stop conditions to be considered: web break where only the roll inertia stop time and RPM are major considerations, and controlled E-Stop where stopping is required due to some safety related issue, but web tension must be maintained.

During web break E-Stop controlling tension is not a major concern, but getting the roll stopped in a specified time to minimize spillage. The time frame to stop may be a company specification or an OSHA requirement.

For a web break E-Stop, the torque required is a function of roll inertia, roll RPM and E-Stop time requirements.

$$T(\text{torque}) = \frac{WR^2 \times RPM}{308 \times t}$$

where T = Torque (lb.ft.)
t = E-Stop time requirement of machine

Since the roll inertia is greatest when the roll is full, this condition is normally used for calculating the worst-case E-Stop web break torque. RPM can be determined by dividing the linear speed by the roll diameter x pi (3.1416). E-Stop times as short as 2 seconds are not uncommon.

Note that if the control system is open loop (i.e. – ultra-sonic, manual, etc.), maximum E-Stop torque must be obtained by having the S-Stop switch on the machine turn the brake to full on, otherwise the torque available will only be running torque. In the closed loop mode (dancer or load cell), maximum E-Stop torque will automatically be applied.

c. E-Stop Torque, controlled

In a controlled stop, the brake must stop the roll during the time the machine stops, all the while maintaining tension on the unwind roll. This differs from web break E-Stop torque in that the brake must stop the inertia as well as continue to maintain running torque or tension.

$$T = \frac{WR^2 \times RPM}{308 \times t} + \text{Maximum Running Torque}$$

where T = Torque (lb.ft.)
t = E-Stop time requirements of machine

It should be noted that controlled stops can only be accomplished in the closed loop mode, as feedback is required to maintain tension.

For the same stopping times, the controlled E-Stop will require more torque than the web break E-Stop, due to the additional load of maintaining tension. Controlled E-Stop torque is the worst case as the stop is the much faster than normal deceleration times.

E-Stop whether it be for controlled purposes or web break is generally a set function of the machine. Caution should be made in that the faster the E-Stop requirements, the more torque that is required of the system and the more stress that is placed on the components in the machine.

All categories must be investigated to determine the maximum torque capacity required for the application.

Other Considerations

In some instances, it may be desirable to have a gear ratio from the roll shaft to the brake, with the brake on the higher speed shaft. In addition to providing a torque multiplication equal to the gear ratio, this also serves to reduce the effective inertia that the brake sees, as reflected roll inertia is reduced by the square of the ratio. Note, however, that with brakes that have a specified drag, or minimum torque, that drag torque is also multiplied, which could result in inability to address minimum running torque at or close to core diameter.

Also, it is important to realize that employing a gear ratio **DOES NOT** reduce the heat dissipation requirement of the brake.

Another instance where a gear ratio may be needed is when any friction type brake is required to run at very low speeds, usually below 50 RPM. Although today's friction materials have been perfected to the point where static and dynamic coefficients or friction are very close, a certain amount of "sticktion" or stick slip phenomena may occur to the extent that precise control of tension may be compromised. Employing a speed-up gear ratio can make the brake operate at a more efficient speed.

Clutches (Rewinds or Winders)

Although motor drives are the more common choice for winders, clutches can be used quite successfully, and offer a more economical alternative. Typically, the input to the clutch will be a fixed RPM, and can be a take-off from the main machine drive, or an independent motor. RPM input should normally be a least 10% higher than the fastest output. To calculate this, determine the core RPM at fastest line speed, and increase this by at least 10%.

The output of the clutch will start at core RPM, and will gradually decrease as the diameter builds. As in the unwind brake, torque will vary in proportion to the diameter change, but unlike the brake, torque must increase as the diameter builds and the slip speed INCREASES. Slip speed increases because the fixed input RPM doesn't change, but the output RPM keeps decreasing as the roll diameter builds.

Energy dissipation capacity is the most critical sizing criteria in a winder clutch. Creation of heat is highest at full roll, since this is where slip speed AND torque are at their maximum. Maximum heat, or thermal HP, can be found by the following formulae:

$$HP = \frac{\text{Torque(lb.ft.) @ full roll} \times \text{Slip RPM @ full roll} \times 2 \times \text{Pi}}{33{,}000}$$

After the clutch size is selected based on the above thermal calculation, clutch torque capacity should be checked by calculating maximum torque required, which is maximum tension times full roll radius.

Taper Tension

With some materials, taper tension may be required. This is a means by which tension is gradually decreased as the roll diameter builds, and is employed if there is a risk of crushing cores due to build-up of internal pressure within the roll, or if telescoping (slippage to one side) of the wraps might occur. This becomes a function of the control, as the rate of torque increase must be reduced as diameter increases.

In single zone machines, where the unwind brake controls winder tension, taper tension can be handled in a similar fashion.

Control of the clutch can be either open loop (manual adjust or diameter compensation) or closed loop (dancer or load cell), depending upon the degree of precision needed.

For detailed sizing and selection for unwind, intermediate and rewind applications, see sizing selection section on pages 16 through 32.

Tension Control Systems

Design Considerations and Selection

Design considerations and selection can be broken down by the type of system being selected and the function it must perform. Sizing and application for an unwind will be different than that for a rewind. Also, depending on whether it will be for a clutch, or brake or for a drive, certain system parameters will be required.

Additionally, will the system require a simple remote/analog control, or will it require the option of a closed loop dancer or load cell controller? These factors must taken into consideration when sizing the proper system.

No matter which type of system is being considered, certain application parameters are necessary to make the calculations for selecting the proper components. The selection process is straight forward if the necessary data has been obtained.

An application data sheet should be used for each application to insure the necessary data is available when doing the calculations. In many cases, three or four data sheets may be used for a particular machine. Although this may seem excessive, parameters will often vary between unwind, intermediate, or rewind sections of the machine.

Unwind Sizing Tension Brakes

Once the selection data has been obtained, sizing and calculations can be started. An application example is included for both a brake sizing and a drive sizing, showing the comparison of the two type systems.

Application Data

Material: Paper; 30 lb. Basis weight
Tension: 36 lbs. max.
Roll weight: 1,100 lb. avg.
Web Width: 24 inches
Linear Speed: 800 ft./min.
Core diameter: 3.00 inches
Max. roll diameter: 42.00 inches
Machine Acceleration Time: 15 seconds
Machine Deceleration Time: 15 seconds
Machine E-Stop Time: 3.8 seconds

Note: Tension = Material Tension (PLI) X Web Width

Sizing for a Unwind Tension Brake System

1. Energy Rate

Energy Rate = Tension x Linear Speed

ER = 36 X 800

ER = 28,800 ft. lbs./minute

2. Thermal Horsepower

$$\text{Thermal HP} = \frac{\text{Energy Rate}}{\mathbf{33{,}000}}$$

$$\text{HP} = \frac{28{,}800}{\mathbf{33{,}000}}$$

HP = 0.873 HP

3. Minimum Roll Speed

$$\text{Min. Roll Speed} = \frac{\text{Linear Speed X } \mathbf{3.82}}{\text{Max. Roll Diameter (in.)}}$$

$$\text{Min. Roll Speed} = \frac{800 \times \mathbf{3.82}}{42}$$

Min. Roll Speed = 72.76 RPM

4. Maximum Roll Speed

$$\text{Max. Roll Speed} = \frac{\text{Linear Speed X } \mathbf{3.82}}{\text{Core Diameter (in.)}}$$

$$\text{Max. Roll Speed} = \frac{800 \times \mathbf{3.82}}{3}$$

Max. Roll Speed = 1,018.67 RPM

5. Selection Speed

$$\text{Selection Speed} = \frac{\text{(Max. Roll Speed – Minimum Roll Speed)}}{\mathbf{10}} + \text{Min Roll Speed}$$

$$\text{Selection Speed} = \frac{(1{,}018.67 - 72.76)}{\mathbf{10}} + 72.76$$

$$\text{Selection Speed} = \frac{945.91}{\mathbf{10}} + 72.76$$

Selection Speed = 94.591 + 72.76

Selection Speed = 167.35 RPM (Selection Speed)

Ref: Appropriate thermal curves on various catalog pages for possible brake selections (Selection Speed vs. Thermal)

6. Minimum Roll Torque

$$\text{Minimum Roll Torque} = \text{Tension} \times \frac{\text{Core Dia (in.)}}{\mathbf{24}}$$

$$\text{Minimum Roll Torque} = 36 \times \frac{3}{\mathbf{24}}$$

Minimum Roll Torque = 36 x 0.125

Minimum Roll Torque = 4.5 lb. ft.

7. Maximum Roll Torque

$$\text{Maximum Roll Torque} = \text{Tension} \times \frac{\text{Max. Roll Dia. (in.)}}{\mathbf{24}}$$

$$\text{Maximum Roll Torque} = 36 \times \frac{42}{\mathbf{24}}$$

Maximum Roll Torque = 36 x 1.75

Maximum Roll Torque = 63.00 lb. ft.

Note: Refer to appropriate Running Torque vs. Speed Curves

Note: Constant values in formulas are in bold.

8. Full Roll Inertia, WR^2

$$\text{Full Roll Inertia} = \frac{\text{Weight x Max. Dia. (in)}^2}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}100 \times (42)^2}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}100 \times 1{,}746}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}940{,}400}{\mathbf{1152}}$$

Full Roll Inertia = 1,684.38 lb. ft.^{2}

9. Roll Deceleration Torque (Normal Controlled Stop)

$$\text{Roll Decel Torque} = \frac{\text{Roll Inertia x Min. Roll Speed}}{\mathbf{308} \text{ x Machine Decel Time}}$$

$$+ \text{ Max. Running Torque}$$

$$\text{Roll Decel Torque} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 15} + 63$$

$$\text{Roll Decel Torque} = \frac{122{,}555.49}{4{,}620} + 63$$

Roll Decel Torque = 26.53 + 63

Roll Decel Torque = 89.53 lb. ft.

10. Roll E-Stop Torque, Web Break

$$\text{Roll E-Stop Torque, Web Break} = \frac{\text{Roll Inertia x Min Roll Speed}}{\mathbf{308} \text{ x Machine E-Stop Time}}$$

$$\text{Roll E-Stop Torque, Web Break} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 3.8}$$

$$\text{Roll E-Stop Torque, Web Break} = \frac{122{,}555.49}{1{,}170.4}$$

Roll E-Stop Torque, Web Break = 104.71 lb. ft.

- This formula can also be used to check tension during acceleration. Using acceleration time of 15 seconds, torque =

  $$\frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 15} = 26.5 \text{ lb. ft.}$$

  Dividing this torque by the radius give tension, so

  $$\text{Tension} = \frac{26.5}{(42/\mathbf{24})} = 15.0 \text{ lbs.}$$

Since tension requirement is 36 lbs., acceleration is OK. If acceleration tension exceeds specified tension, a powered unwind should be considered or changing the time requirements.

Note: Constant values in formulas are in bold.

11. Roll E-Stop Torque, Controlled

$$\text{Roll E-Stop Torque, Controlled} = \frac{\text{Roll Inertia x Min Roll Speed}}{\mathbf{308} \text{ x Machine E-Stop Time}}$$

$$+ \text{ Max. Running Torque}$$

$$\text{Roll E-Stop Torque, Controlled} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 3.8} + 63$$

$$\text{Roll E-Stop Torque, Controlled} = \frac{122{,}555.49}{1{,}170.4} + 63$$

Roll E-Stop Torque, Controlled = 104.71 +63

Roll E-Stop Torque, Controlled = 167.71 lb. ft.

Refer: Appropriate torque vs. speed curves for selection of possible brakes.

Final brake sizing is determined by thermal vs. selection speed and torque vs. speed for both running and E-Stop conditions. These specifications are found in the brake selection sections starting on page 68.

A cross check of minimum running torque to minimum torque of the unit selected must also be made. If the brake minimum torque value is above the minimum running torque value, then either gearing between the unwind roll and the brake will be required, or a larger core diameter or higher tension value must be used.

Note: Not all types of tension brakes in this catalog may be suited for a particular application. Selecting a brake that is not capable of handling the system requirements will result in premature wear out or failure.

If in doubt about sizing and selection, contact your local Warner Electric Distributor, Warner Sales Representative, or the factory.

Sizing for an Unwind Tension Drive System

Sizing for an unwind tension drive system is similar to a brake system; however, a few additional calculations are required to insure that the proper motor is selected. As before, the same system data is used to make the calculations and selection.

1. Energy Rate

$$\text{Energy Rate} = \text{Tension} \times \text{Linear Speed} \times \left\{\frac{\text{Max. Dia.(in.)}}{\text{Min. Dia (in.)}}\right\}$$

$$\text{Energy Rate} = 36 \times 800 \times \frac{42}{3}$$

$$\text{Energy Rate} = 36 \times 800 \times 14$$

Energy Rate = 403, 200 ft. lbs./minute

2. Thermal Horsepower

$$\text{Thermal Horsepower} = \frac{\text{Energy Rate}}{\mathbf{33{,}000}}$$

$$\text{Thermal Horsepower} = \frac{403{,}200.00}{\mathbf{33{,}000}}$$

Thermal Horsepower = 12.22 HP

3. Minimum Roll Speed

$$\text{Min. Roll Speed} = \frac{\text{Linear Speed X } \mathbf{3.82}}{\text{Max. Roll Diameter (in.)}}$$

$$\text{Min. Roll Speed} = \frac{800 \times \mathbf{3.82}}{42}$$

Min. Roll Speed = 72.76 RPM

4. Maximum Roll Speed

$$\text{Max. Roll Speed} = \frac{\text{Linear Speed X } \mathbf{3.82}}{\text{Core Diameter (in.)}}$$

$$\text{Max. Roll Speed} = \frac{800 \times \mathbf{3.82}}{3}$$

Max. Roll Speed = 1,018.67 RPM

5. Minimum Roll Torque

$$\text{Minimum Roll Torque} = \text{Tension} \times \frac{\text{Core Dia (in.)}}{\mathbf{24}}$$

$$\text{Minimum Roll Torque} = 36 \times \frac{3}{\mathbf{24}}$$

$$\text{Minimum Roll Torque} = 36 \times 0.125$$

Minimum Roll Torque = 4.5 lb. ft.

6. Maximum Roll Torque

$$\text{Maximum Roll Torque} = \text{Tension} \times \frac{\text{Max. Roll Dia. (in.)}}{\mathbf{24}}$$

$$\text{Maximum Roll Torque} = 36 \times \frac{42}{\mathbf{24}}$$

$$\text{Maximum Roll Torque} = 36 \times 1.75$$

Maximum Roll Torque = 63.00 lb. ft.

7. Full Roll Inertia, WR^2

$$\text{Full Roll Inertia} = \frac{\text{Weight} \times \text{Max. Dia. (in)}^2}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}100 \times (42)^2}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}100 \times 1{,}746}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}940{,}400}{\mathbf{1152}}$$

Full Roll Inertia = 1,684.38 lb. ft.^{2}

8. Acceleration Torque to Start Full Roll

$$\text{Acceleration Torque} = \frac{\text{Inertia} \times \text{Min Roll Speed}}{\mathbf{308} \times \text{Machine Accel Time}} + \text{Max. Roll Torque}$$

$$\text{Acceleration Torque} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 15} + 63$$

$$\text{Acceleration Torque} = \frac{122{,}555.49}{4{,}620.0} + 63$$

$$\text{Acceleration Torque} = 26.53 + 63.00$$

Acceleration Torque = 89.53 lb.ft.

9. Roll Deceleration Torque (Normal Controlled Stop)

$$\text{Roll Decel Torque} = \frac{\text{Roll Inertia} \times \text{Min. Roll Speed}}{\mathbf{308} \times \text{Machine Decel Time}} + \text{Max. Roll Torque}$$

$$\text{Roll Decel Torque} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 15} + 63$$

$$\text{Roll Decel Torque} = \frac{122{,}555.49}{4{,}620} + 63$$

$$\text{Roll Decel Torque} = 26.53 + 63$$

Roll Decel Torque = 89.53 lb. ft.

10. Roll E-Stop Torque, Web Break

$$\text{Roll E-Stop Torque, Web Break} = \frac{\text{Roll Inertia} \times \text{Min Roll Speed}}{\mathbf{308} \times \text{Machine E-Stop Time}}$$

$$\text{Roll E-Stop Torque, Web Break} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 3.8}$$

Note: Constant values in formulas are in bold.

$$\text{Roll E-Stop Torque, Web Break} = \frac{122{,}555.49}{1{,}170.4}$$

Roll E-Stop Torque, Web Break = 104.71 lb. ft.

11. Roll E-Stop Torque, Controlled

$$\text{Roll E-Stop Torque, Controlled} = \frac{\text{Roll Inertia x Min Roll Speed}}{\mathbf{308} \text{ x Machine E-Stop Time}} + \text{Max. Running Torque}$$

$$\text{Roll E-Stop Torque, Controlled} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 3.8} + 63$$

$$\text{Roll E-Stop Torque, Controlled} = \frac{122{,}555.49}{1{,}170.4} + 63$$

Roll E-Stop Torque, Controlled = 104.71 +63

Roll E-Stop Torque, Controlled = 167.71 lb. ft.

Not only does horsepower have to be calculated on thermal capacity, but horsepower must also be calculated based on both running and E-Stop torque requirements. In many cases, this will dictate a larger horsepower rating than was previously calculated for thermal capacity.

Generally, most AC and DC motors used with a drive, as is the case with most tension systems, produce 3 lb.ft. of torque over the entire speed range. The drives also provide increased current capacity for acceleration and deceleration for short time periods in the range or 150% of nominal ratings. This translates to a torque rating of 4.5 lb. ft. per horsepower.

12. Horsepower Based on Running Torque

$$\text{Running Horsepower} = \frac{\text{Maximum Running Torque}}{\mathbf{3.0}}$$

$$\text{Running Horsepower} = \frac{63.00}{\mathbf{3.00}}$$

Running Horsepower = 21 HP

13. Horsepower Based on E-Stop Torque

Normally controlled E-Stop torque will be the worst-case conditions for calculating this horsepower requirement.

$$\text{E-Stop Horsepower} = \frac{\text{E-Stop Torque, Controlled}}{\mathbf{3.0 \times 1.5}}$$

$$\text{E-Stop Horsepower} = \frac{167.71}{\mathbf{4.5}}$$

E-Stop Horsepower = 37.27 HP

As can be seen, the horsepower requirements for torque are much higher than those calculated for just thermal capacity. The motor and drive must be selected based on the largest of the three horsepower requirements.

Note: Constant values in formulas are in bold.

14. Motor HP Comparisons for Thermal and Torque

Thermal HP = 12.22 HP

Running Torque HP = 21.00 HP

Accel/Decel Torque HP = 19.89 HP

E-Stop Torque HP = 37.27

Based on the largest of the three requirements, in this case the E-Stop requirements of 37.27 HP; a 40 HP motor and drive system is required.

Note: Often a service factor will be added that will further increase the motor and drive size. This will generally depend on the severity of the application, environment, etc.

Service factors of 1.25 to 2.5 are typical for most applications.

Sizing and selection for different types of unwind systems, whether they be electric or pneumatic brakes, AC or DC drive systems, is basically the same. Though some differences may exist in the sizing and selection processes, most of the differences are revealed in the actual calculations, which are based on the type of system being considered. Acceleration, deceleration, and E-Stop requirements must be calculated for dancer and load cell type systems.

With analog or manual type systems, sizing process differences are not a factor, as the signal providing the control is a function of roll diameter only, and true machine function feedback is provided.

If deceleration and E-Stop capabilities are necessary to maintain accurate tension, then either a dancer or load cell type system must be considered. These are the only type systems that employ the full closed loop feedback needed for deceleration and E-Stop.

Control systems can be selected from the appropriate tables, page 44.

Note: In some cases a reducer or gearbox may be required between the motor or brake and the unwind roll spindle.

When sizing a reducer or gearbox, the speed is increased by the ratio and the torque is reduced by the ratio. Additionally, the efficiency of the reduction must be taken into account as this will slightly increase the required torque.

Intermediate Sizing

Intermediate sizing and selection typically involves a roll that retards or pulls the web to create tension.

A brake usually provides the retarding force, while a clutch driven by a constant speed motor or a variable AC or DC drive system provides pull force.

A few additional parameters are considered in addition to those used in sizing and selecting an unwind.

Application Data

Material: Paper; 30 lb. Basis weight
Tension: 36 lbs. max.
Roll weight: 1,100 lb. avg.
Web Width: 24 inches
Linear Speed: 800 ft./min.
Core diameter: 3.00 inches
Max. roll diameter: 42.00 inches
Machine Acceleration Time: 15 seconds
Machine Deceleration Time: 15 seconds
Machine E-Stop Time: 3.8 seconds
Location of Controlling Element: Nip Rolls, S-Wrap
Roller Diameter: 6.00 inches
Roller Width: 30.00 inches
Roller Weight: 100 lbs.
Nip Roll Pressure: 25 lbs.

Sizing an Intermediate Tension Brake System

1. Nip Roll Speed

$$\text{Nip Roll Speed} = \frac{\text{Linear Speed} \times \mathbf{3.82}}{\text{Nip Roll Diameter}}$$

$$\text{Nip Roll Speed} = \frac{800 \text{ X } \mathbf{3.82}}{6.00}$$

Nip Roll Speed = 509.33 RPM

2. Tension Torque

$$\text{Tension Torque} = \text{Tension} \times \frac{\text{Nip Roll Diameter}}{\mathbf{24}}$$

$$\text{Tension Torque} = 36 \times \frac{6.00}{\mathbf{24}}$$

Tension Torque = 36 x 0.25

Tension Torque = 9.00 lb. ft.

3. Torque Due to Nip Roll Pressure

$$\text{Nip Roll Torque} = \text{Nip Roll Force} \times \frac{\text{Nip Roll Diameter}}{\mathbf{24}}$$

$$\text{Nip Roll Torque} = 25 \times \frac{6.00}{\mathbf{24}}$$

Nip Roll Torque = 25 x 0.25

Nip Roll Torque = 6.25 lb. ft.

Note: Constant values in formulas are in bold.

4. Torque Required for Tensioning

Total Torque = Tension Torque – Nip Roll Torque

Total Torque = 9.00 – 6.25

Total Torque = 2.75 lb. ft.

5. Energy Rate Required from Brake

Energy Rate = 2 x Pi X Nip Roll Speed x Nip Roll Torque

Energy Rate = 2 x 3.1415927 x 509.33 x 2.75

Energy Rate = 8,800.59 ft. lbs./minute

6. Thermal Horsepower

$$\text{Thermal Horsepower} = \frac{\text{Energy Rate}}{\mathbf{33,000}}$$

$$\text{Thermal Horsepower} = \frac{8,800.59}{\mathbf{33,000}}$$

Thermal Horsepower = 0.267 HP

Initial brake sizing is based on thermal requirements and operating speeds from the appropriate speed vs. thermal curves for the brake type being considered. This information is found in the brake selection section starting on page 68.

7. Normal Deceleration Torque

$$\text{Deceleration Torque} = \frac{\text{Nip Roll Inertia} \times \text{Nip Roll Speed}}{\mathbf{308} \times \text{Machine Deceleration Time}} + \text{Total Running Torque}$$

$$WR^2 = \frac{\text{Nip Roll Diameter}^2 \times \text{Nip Roll Weight}}{\mathbf{1152}}$$

$$WR^2 = \frac{6^2 \times 100}{\mathbf{1152}}$$

$WR^2 = 3.125 \text{ lb.ft.}^2$

$$\text{Deceleration Torque} = \frac{3.125 \times 509.33}{\mathbf{308} \times 15} + 2.75$$

$$\text{Deceleration Torque} = \frac{1591.66}{4620} + 2.75$$

Deceleration Torque = 0.345 + 2.75

Deceleration Torque = 3.095 lb. ft.

8. E-Stop Torque

$$\text{E-Stop Torque} = \frac{\text{Nip Roll Inertia} \times \text{Nip Roll Speed}}{\mathbf{308} \times \text{Machine E-Stop Time}} + \text{Total Running Torque}$$

$$\text{E-Stop Torque} = \frac{3.125 \times 509.33}{\mathbf{308} \times 3.8} + 2.75$$

$$\text{E-Stop Torque} = \frac{1591.66}{1170.4} + 2.75$$

E-Stop Torque = 1.36 + 2.75

E-Stop Torque = 4.11 lb. ft.

Final brake selection is based on running torque and E-Stop torque, based on torque vs. speed curves. The brake must have sufficient torque capability to handle the application. The appropriate curves for the brake type being considered should be consulted.

Note: Not all brake types will be suitable for a given application.

Sizing an Intermediate Tension Clutch System

Clutch sizing for an intermediate tension system is similar to brake sizing except the clutch input speed is recommended to be 50 to 100 RPM higher than the maximum output speed to assure proper controllability.

Using the same parameters as that for the brake sizing, sizing a clutch is as follows:

1. Nip Roll Speed

$$\text{Nip Roll Speed} = \frac{\text{Linear Speed} \times \mathbf{3.82}}{\text{Nip Roll Diameter}}$$

$$\text{Nip Roll Speed} = \frac{800 \text{ X } \mathbf{3.82}}{6.00}$$

Nip Roll Speed = 509.33 RPM

2. Tension Torque

$$\text{Tension Torque} = \text{Tension} \times \frac{\text{Nip Roll Diameter}}{\mathbf{24}}$$

$$\text{Tension Torque} = 36 \times \frac{6.00}{\mathbf{24}}$$

Tension Torque = 36 x 0.25

Tension Torque = 9.00 lb. ft.

3. Torque Due to Nip Roll Pressure

$$\text{Nip Roll Torque} = \text{Nip Roll Force} \times \frac{\text{Nip Roll Diameter}}{\mathbf{24}}$$

$$\text{Nip Roll Torque} = 25 \times \frac{6.00}{\mathbf{24}}$$

Nip Roll Torque = 25 x 0.25

Nip Roll Torque = 6.25 lb. ft.

4. Total Torque Required for Tensioning

Total Torque = Tension Torque + Nip Roll Torque

Total Torque = 9.00 + 6.25

Total Torque = 15.25 lb. ft.

Note: Constant values in formulas are in bold.

5 Clutch Input Speed

$$\text{Clutch Input Speed} = \frac{\text{k x Linear Speed}}{\text{Nip Roll Diameter}}$$

k = 4.2 for 50 RPM Slip Difference

k = 4.57 for 100 RPM Slip Difference

$$\text{Clutch Input Speed} = \frac{4.57 \times 800}{6}$$

$$\text{Clutch Input Speed} = \frac{3656}{6}$$

Clutch Input Speed = 609.33 RPM

6. Energy Rate

Energy Rate = 2 x(Pi) π x Total Torque x Slip Speed Difference

Energy Rate = 2 x 3.1415927 x 15.25 x 100

Energy Rate = 9,581.86 ft. lbs./minute

7. Thermal Horsepower

$$\text{Thermal Horsepower} = \frac{\text{Energy Rate}}{\mathbf{33{,}000}}$$

$$\text{Thermal Horsepower} = \frac{9{,}581.86}{\mathbf{33{,}000}}$$

Thermal Horsepower = 0.3 HP

8. Acceleration Torque

$$\text{Acceleration Torque} = \frac{\text{Nip Roll Inertia x Nip Roll Speed}}{\mathbf{308} \text{ x Machine Acceleration Time}} + \text{Total Running Torque}$$

$$\text{Acceleration Torque} = \frac{3.125 \times 509.33}{\mathbf{308} \times 15} + 15.25$$

$$\text{Acceleration Torque} = \frac{1591.66}{4620} + 15.25$$

Acceleration Torque = 0.345 + 15.25

Acceleration Torque = 15.595 lb. ft.

Final clutch sizing is based on running torque and acceleration torque requirements that are based on slip RPM between input and output. The appropriate torque vs. speed curves should be consulted to insure that the clutch being considered has the necessary torque capacity for the application. See clutch information starting on page 68.

Not every model of clutch will be suitable for a given application.

Sizing an Intermediate Tension Drive System

Sizing a tension drive system for an intermediate tension zone is as easy as sizing a clutch or brake. Often a reducer or gear head will be used between the motor and nip rolls being controlled.

Using the same application parameters as that for the previous brake and clutch, sizing a drive is as follows:

1. Nip Roll Speed

$$\text{Nip Roll Speed} = \frac{\text{Linear Speed} \times \mathbf{3.82}}{\text{Nip Roll Diameter}}$$

$$\text{Nip Roll Speed} = \frac{800 \times \mathbf{3.82}}{6.00}$$

Nip Roll Speed = 509.33 RPM

2. Tension Torque

$$\text{Tension Torque} = \text{Tension} \times \frac{\text{Nip Roll Diameter}}{\mathbf{24}}$$

$$\text{Tension Torque} = 36 \times \frac{6.00}{\mathbf{24}}$$

Tension Torque = 36 x 0.25

Tension Torque = 9.00 lb. ft.

3. Torque Due to Nip Roll Pressure

$$\text{Nip Roll Torque} = \text{Nip Roll Force} \times \frac{\text{Nip Roll Diameter}}{\mathbf{24}}$$

$$\text{Nip Roll Torque} = 25 \times \frac{6.00}{\mathbf{24}}$$

Nip Roll Torque = 25 x 0.25

Nip Roll Torque = 6.25 lb. ft.

4. Total Torque Required for Tensioning

Total Torque = Tension Torque + Nip Roll Torque

Total Torque = 9.00 + 6.25

Total Torque = 15.25 lb. ft.

5. Energy Rate

Energy Rate = 2 x (Pi) π x Total Torque x Nip Roll RPM

Energy Rate = 2 x 3.1415927 x 15.25 x 509.33

Energy Rate = 48,803.3 ft. lbs./minute

6. Thermal Horsepower

$$\text{Thermal Horsepower} = \frac{\text{Energy Rate}}{\mathbf{33{,}000}}$$

$$\text{Thermal Horsepower} = \frac{48{,}803.3}{\mathbf{33{,}000}}$$

Thermal Horsepower = 1.48 HP

Initial motor selection would be for a 1.5 HP. However, this must be checked to insure that the motor will have sufficient torque capacity to handle the application.

In this application, a ratio between the nip rolls and the motor would be advantageous as it will allow the motor to operate closer to its base speed of 1,750 RPM.

To determine the ratio for the reducer or gear head, assume the maximum motor speed is 1,750 RPM.

7. Reduction Ratio between Motor and Nip Rolls

$$\text{Reduction Ratio} = \frac{\text{Motor Base Speed}}{\text{Nip Roll Speed}}$$

$$\text{Reduction Ratio} = \frac{1750}{509.33}$$

Reduction Ratio = 3.44 : 1

Based on this maximum ratio of 3.44 to 1, a 3:1 ratio would be selected for use between the motor and nip rolls. This would be a standard ratio and would be more readily available in comparison to a 3.44:1 ration.

8. Acceleration Torque

$$\text{Acceleration Torque} = \frac{\text{Nip Roll Inertia} \times \text{Nip Roll Speed}}{\mathbf{308} \times \text{Machine Acceleration Time}} + \text{Total Running Torque}$$

$$\text{Acceleration Torque} = \frac{3.125 \times 509.33}{\mathbf{308} \times 15} + 15.25$$

$$\text{Acceleration Torque} = \frac{1591.66}{4620} + 15.25$$

Acceleration Torque = 0.345 + 15.25

Acceleration Torque = 15.595 lb. ft.

9. Deceleration Torque

$$\text{Deceleration Torque} = \frac{\text{Nip Roll Inertia} \times \text{Nip Roll Speed}}{\mathbf{308} \times \text{Machine Deceleration Time}} + \text{Total Running Torque}$$

$$\text{Deceleration Torque} = \frac{3.125 \times 509.33}{\mathbf{308} \times 15} + 15.25$$

$$\text{Deceleration Torque} = \frac{1591.66}{4620} + 15.25$$

Deceleration Torque = 0.345 + 15.25

Deceleration Torque = 15.595 lb. ft.

Note: Constant values in formulas are in bold.

10. E-Stop Torque

$$\text{E-Stop Torque} = \frac{\text{Nip Roll Inertia x Nip Roll Speed}}{\mathbf{308} \text{ x Machine E-Stop Time}} + \text{Total Running Torque}$$

$$\text{E-Stop Torque} = \frac{3.125 \text{ x } 509.33}{\mathbf{308} \text{ x } 3.8} + 15.25$$

$$\text{E-Stop Torque} = \frac{1591.66}{1170.4} + 15.25$$

E-Stop Torque = 1.36 + 15.25

E-Stop Torque = 16.61 lb. ft.

Because a 3:1 reduction is used between the nip rolls and motor, the reflected torque the motor must produce is reduced by this ratio.

11. Running Torque reflected to Motor with ratio

$$\text{Motor Run Torque}_{(\text{reflected})} = \frac{\dfrac{\text{Roll Running Torque}}{\text{Ratio}}}{\text{Efficiency of Reduction}}$$

$$\text{Motor Run Torque}_{(\text{reflected})} = \frac{\dfrac{15.25}{3.00}}{0.85}$$

$\text{Motor Run Torque}_{(\text{reflected})} = 5.98$ lb. ft.

12. Acceleration Torque reflected to Motor with ratio

$$\text{Motor Accel Torque}_{(\text{reflected})} = \frac{\dfrac{\text{Roll Acceleration Torque}}{\text{Ratio}}}{\text{Efficiency of Reduction}}$$

$$\text{Motor Accel Torque}_{(\text{reflected})} = \frac{\dfrac{15.595}{3.00}}{0.85}$$

$\text{Motor Accel Torque}_{(\text{reflected})} = 6.12$ lb. ft.

13. Deceleration Torque reflected to Motor with ratio

$$\text{Motor Decel Torque}_{(\text{reflected})} = \frac{\dfrac{\text{Roll Acceleration Torque}}{\text{Ratio}}}{\text{Efficiency of Reduction}}$$

$$\text{Motor Decel Torque}_{(\text{reflected})} = \frac{\dfrac{15.595}{3.00}}{0.85}$$

$\text{Motor Decel Torque}_{(\text{reflected})} = 6.12$ lb. ft.

14. E-Stop Torque reflected to Motor with ratio

$$\text{Motor E-Stop Torque}_{(\text{reflected})} = \frac{\dfrac{\text{Roll E-Stop Torque}}{\text{Ratio}}}{\text{Efficiency of Reduction}}$$

$$\text{Motor E-Stop Torque}_{(\text{reflected})} = \frac{\dfrac{16.61}{3.00}}{0.85}$$

$\text{Motor E-Stop Torque}_{(\text{reflected})} = 6.514$ lb. ft.

Note: Constant values in formulas are in bold.

The final selection of the motor is based on the torque/HP capabilities. Motors will normally produce 3 lb.ft. of torque per HP over the speed range when used with either an AC or DC drive. Knowing this, horsepower requirements can be based on the various torque requirements and the motor selected accordingly. Additionally, most AC and DC drives provide a 150% overload capability for a limited time for acceleration, deceleration, and E-Stop conditions.

15. Motor HP based on Running Torque

$$\text{Motor HP} = \frac{\text{Running Torque}}{\mathbf{3.00}}$$

$$\text{Motor HP} = \frac{5.98}{\mathbf{3.00}}$$

Motor HP = 1.99 HP

16. Motor HP based on Acceleration Torque

$$\text{Motor HP} = \frac{\text{Acceleration Torque}}{\mathbf{4.50}}$$

$$\text{Motor HP} = \frac{6.12}{\mathbf{4.50}}$$

Motor HP = 1.36 HP

17. Motor HP based on Deceleration Torque

$$\text{Motor HP} = \frac{\text{Deceleration Torque}}{\mathbf{4.50}}$$

$$\text{Motor HP} = \frac{6.12}{\mathbf{4.50}}$$

Motor HP = 1.36 HP

18. Motor HP based on E-Stop Torque

$$\text{Motor HP} = \frac{\text{E-Stop Torque}}{\mathbf{4.50}}$$

$$\text{Motor HP} = \frac{6.514}{\mathbf{4.50}}$$

Motor HP = 1.45 HP

19. Motor HP Comparisons for Thermal and Torque

Thermal HP = 1.48 HP

Running Torque HP = 1.99 HP

Accel/Decel Torque HP = 1.36 HP

E-Stop Torque HP = 1.45

20. Minimum Motor Horsepower Selection

Minimum Motor Horsepower Selected = 2.00 HP.

This would be the absolute minimum motor horsepower that would satisfy the requirements for this application.

Note: The 2 HP motor sized does not take into account any type of service factor for the application. Typically a service factor or 1.5 to 2.5 depending on the severity of the application, environment, hours per day operated, etc. are not unrealistic.

By adding a service factor to the final requirements, you can handle any additional friction, drag, etc. that may not be known and can be handled safely. Additionally, this will also help improve the life of the motor and system as well.

Using a service factor of 1.5 in this case, the motor HP would be 2 x 1.5 = 3.00 HP for final motor size selection. This would be much more preferred over using a 2 HP in this particular application.

Rewind Sizing

Rewind tension systems are different from unwind tension systems only in that the material is being rewound on a roll. Many of the calculations are similar. However, rewind tension systems will use either a tension clutch or tension drive.

Selection data required for sizing a tension rewind system is similar to that of an unwind system. The application data form under the rewind section can be used for obtaining the proper data.

For purposes of our application example, the parameters used on the previous unwind and intermediate sections will be used.

Application Data

Material: Paper; 30 lb. Basis weight
Tension: 36 lbs. max.
Roll weight: 1,100 lb. avg.
Web Width: 24 inches
Linear Speed: 800 ft./min.
Core diameter: 3.00 inches
Max. roll diameter: 42.00 inches
Machine Acceleration Time: 15 seconds
Machine Deceleration Time: 15 seconds
Machine E-Stop Time: 3.8 seconds
Taper Tension Requirements: None

Note: Tension = Material Tension (PLI) X Web Width

Sizing for a Rewind Tension Clutch System

1. **Energy Rate**

$$\text{Energy Rate} = \text{Tension} \times \text{Linear Speed} \times \left\{\frac{\text{Max. Dia.(in.)}}{\text{Min. Dia (in.)}}\right\}$$

$$\text{Energy Rate} = 36 \times 800 \times \frac{42}{3}$$

$$\text{Energy Rate} = 36 \times 800 \times 14$$

Energy Rate = 403, 200 ft. lbs./minute

2. **Thermal Horsepower**

$$\text{Thermal Horsepower} = \frac{\text{Energy Rate}}{\mathbf{33{,}000}}$$

$$\text{Thermal Horsepower} = \frac{403{,}200.00}{\mathbf{33{,}000}}$$

Thermal Horsepower = 12.22 HP

3. **Minimum Roll Speed**

$$\text{Min. Roll Speed} = \frac{\text{Linear Speed X } \mathbf{3.82}}{\text{Max. Roll Diameter (in.)}}$$

$$\text{Min. Roll Speed} = \frac{800 \times \mathbf{3.82}}{42}$$

Min. Roll Speed = 72.76 RPM

4. **Maximum Roll Speed**

$$\text{Max. Roll Speed} = \frac{\text{Linear Speed X 3.82}}{\text{Core Diameter (in.)}}$$

$$\text{Max. Roll Speed} = \frac{800 \times \mathbf{3.82}}{3}$$

Max. Roll Speed = 1,018.67 RPM

5. **Clutch Input Speed**

Clutch Input Speed = Maximum Roll Speed + Slip

Note: Slip Minimum = 50 RPM
Slip Maximum = 100 RPM

Clutch Input Speed = 1018.67 + 50

Clutch Input Speed = 1068.67 RPM

Note: Clutch input speed must be at least 50 RPM greater than the maximum roll speed to provide a slip difference for controlling the output. If a locked rotor condition is used, the slip torque cannot be controlled, especially at core diameter.

6. **Slip Speed at Core**

Slip Speed at Core = Clutch Input Speed – Maximum Roll Speed

Slip Speed at Core = 1068.67 – 1018.67

Slip Speed at Core = 50 RPM

7. **Slip Speed at Full Roll**

Slip Speed at Full Roll = Clutch Input Speed – Minimum Roll Speed

Slip Speed at Full Roll = 1068.68 – 72.76

Slip Speed at Full Roll = 995.91 RPM

Thermal selection curves for the appropriate clutches should be checked to insure the clutch chosen can handle the thermal requirements at the worst case slip speed. See clutch information starting on page 68.

In this example, a slip speed of 995.91 RPM and a thermal capacity of 12.22 HP would be checked against the curves to insure that the clutch selected would have sufficient capacity to handle these requirements.

8. **Minimum Torque at core**

$$\text{Minimum Roll Torque} = \text{Tension} \times \frac{\text{Core Dia (in.)}}{\mathbf{24}}$$

$$\text{Minimum Roll Torque} = 36 \times \frac{3}{\mathbf{24}}$$

Minimum Roll Torque = 36 x 0.125

Minimum Roll Torque = 4.5 lb. ft.

Note: Constant values in formulas are in bold.

Tension Control Systems

Design Considerations and Selection

9. Maximum Torque at full roll

$$\text{Maximum Roll Torque} = \text{Tension} \times \frac{\text{Max. Roll Dia. (in.)}}{\mathbf{24}}$$

$$\text{Maximum Roll Torque} = 36 \times \frac{42}{\mathbf{24}}$$

Maximum Roll Torque = 36 x 1.75

Maximum Roll Torque = 63.00 lb. ft

Once maximum running torque has been determined, refer the appropriate clutch torque curves to insure that the clutch has sufficient torque at the maximum slip speed. Clutch information starts on page 68.

If the clutch selected initially does not have sufficient torque at the maximum slip speed, the next larger size unit should be checked and selected.

Acceleration torque is the final step that must be considered when selecting a clutch for a rewind application. Acceleration torque for starting the roll is in addition to the running torque needed to maintain web tension.

Worst case for acceleration torque occurs when the roll is near its maximum roll diameter. If worst-case conditions can be met, there will be no problems when starting the roll at core diameter.

10. Acceleration Torque at Full Roll

$$\text{Acceleration Torque} = \frac{\text{Full Roll Inertia x Full Roll Speed}}{\text{308 x Machine Acceleration Time}} + \text{Maximum Run Torque}$$

$$\text{Full Roll Inertia} = \frac{\text{Full Roll Weight x Max. Roll Dia}^2\text{(in.)}}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}100 \times 42^2}{\mathbf{1152}}$$

Full Roll Inertia = 1,684.375 lb. ft.^{2}

$$\text{Acceleration Torque} = \frac{1{,}684.375 \times 72.76}{\mathbf{308} \times 15} + 63.00$$

$$\text{Acceleration Torque} = \frac{122{,}555.13}{4620} + 63.00$$

Acceleration Torque = 26.527 + 63.00

Acceleration Torque = 89.53 lb. ft.

This torque is required at the maximum slip speed of the clutch to insure the roll can be accelerated while under tension.

As can be seen, the thermal requirements for a rewind clutch are much higher than those required for the same application in an unwind situation.

Generally if the roll build diameter exceeds a 3:1 range, it is more than likely that a clutch will not be sufficient for a rewind application.

If in doubt during the sizing and selection, do not hesitate to contact your Warner Electric Distributor, Warner Electric Sales Representative, or the factory directly.

Sizing for a Rewind Tension Drive System

Sizing a motor for a rewind drive application is almost identical to that of an unwind system.

In this example, tension is constant to simplify sizing. In many applications, taper tension may be required due to the material being processed.

1. Energy Rate

$$\text{Energy Rate} = \text{Tension x Linear Speed x} \left\{\frac{\text{Max. Dia.(in.)}}{\text{Min. Dia.(in.)}}\right\}$$

$$\text{Energy Rate} = 36 \times 800 \times \frac{42}{3}$$

Energy Rate = 36 x 800 x 14

Energy Rate = 403, 200.00 ft. lbs./minute

2. Thermal Horsepower

$$\text{Thermal Horsepower} = \frac{\text{Energy Rate}}{\mathbf{33{,}000}}$$

$$\text{Thermal Horsepower} = \frac{403{,}200.00}{\mathbf{33{,}000}}$$

Thermal Horsepower = 12.22 HP

3. Minimum Roll Speed

$$\text{Min. Roll Speed} = \frac{\text{Linear Speed X } \mathbf{3.82}}{\text{Max. Roll Diameter (in.)}}$$

$$\text{Min. Roll Speed} = \frac{800 \times \mathbf{3.82}}{42}$$

Min. Roll Speed = 72.76 RPM

4. Maximum Roll Speed

$$\text{Max. Roll Speed} = \frac{\text{Linear Speed X } \mathbf{3.82}}{\text{Core Diameter (in.)}}$$

$$\text{Max. Roll Speed} = \frac{800 \times \mathbf{3.82}}{3}$$

Max. Roll Speed = 1,018.67 RPM

5. Minimum Roll Torque

$$\text{Minimum Roll Torque} = \text{Tension} \times \frac{\text{Core Dia (in.)}}{\mathbf{24}}$$

$$\text{Minimum Roll Torque} = 36 \times \frac{3}{\mathbf{24}}$$

Minimum Roll Torque = 36 x 0.125

Minimum Roll Torque = 4.5 lb. ft.

Note: Constant values in formulas are in bold.

6. Maximum Roll Torque

$$\text{Maximum Roll Torque} = \text{Tension} \times \frac{\text{Max. Roll Dia. (in.)}}{\mathbf{24}}$$

$$\text{Maximum Roll Torque} = 36 \times \frac{42}{\mathbf{24}}$$

Maximum Roll Torque = 36 x 1.75

Maximum Roll Torque = 63.00 lb. ft.

7. Full Roll Inertia, WR^2

$$\text{Full Roll Inertia} = \frac{\text{Weight} \times \text{Max. Dia. (in)}^2}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}100 \times (42)^2}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}100 \times 1{,}746}{\mathbf{1152}}$$

$$\text{Full Roll Inertia} = \frac{1{,}940{,}400}{\mathbf{1152}}$$

Full Roll Inertia = 1,684.38 lb. ft.^{2}

8. Acceleration Torque to Start Full Roll

$$\text{Acceleration Torque} = \frac{\text{Inertia} \times \text{Min Roll Speed}}{\mathbf{308} \times \text{Machine Accel Time}} + \text{Max. Roll Torque}$$

$$\text{Acceleration Torque} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 15} + 63$$

$$\text{Acceleration Torque} = \frac{122{,}555.49}{4{,}620.0} + 63$$

Acceleration Torque = 26.53 + 63.00

Acceleration Torque = 89.53 lb.ft.

9. Roll Deceleration Torque (Normal Controlled Stop)

$$\text{Roll Decel Torque} = \frac{\text{Roll Inertia} \times \text{Min. Roll Speed}}{\mathbf{308} \times \text{Machine Decel Time}} + \text{Max. Running Torque}$$

$$\text{Roll Decel Torque} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 15} + 63$$

$$\text{Roll Decel Torque} = \frac{122{,}555.49}{4{,}620} + 63$$

Roll Decel Torque = 26.53 + 63

Roll Decel Torque = 89.53 lb. ft.

10. Roll E-Stop Torque, Controlled

$$\text{Roll E-Stop Torque, Controlled} = \frac{\text{Roll Inertia} \times \text{Min Roll Speed}}{\mathbf{308} \times \text{Machine E-Stop Time}} + \text{Max. Running Torque}$$

$$\text{Roll E-Stop Torque, Controlled} = \frac{1{,}684.38 \times 72.76}{\mathbf{308} \times 3.8} + 63$$

$$\text{Roll E-Stop Torque, Controlled} = \frac{122{,}555.49}{1{,}170.4} + 63$$

Roll E-Stop Torque, Controlled = 104.71 + 63

Roll E-Stop Torque, Controlled = 167.71 lb. ft.

11. Horsepower Based on Running Torque

$$\text{Running Horsepower} = \frac{\text{Maximum Running Torque}}{\mathbf{3.0}}$$

$$\text{Running Horsepower} = \frac{63.00}{\mathbf{3.00}}$$

Running Horsepower = 21 HP

12. Motor HP based on Acceleration Torque

$$\text{Motor HP} = \frac{\text{Acceleration Torque}}{\mathbf{4.50}}$$

$$\text{Motor HP} = \frac{89.53}{\mathbf{4.50}}$$

Motor HP = 19.89 HP

13. Motor HP based on Deceleration Torque

$$\text{Motor HP} = \frac{\text{Deceleration Torque}}{\mathbf{4.50}}$$

$$\text{Motor HP} = \frac{89.53}{\mathbf{4.50}}$$

Motor HP = 19.89 HP

14. Horsepower Based on E-Stop Torque

Normally controlled E-Stop torque will be the worst-case conditions for calculating this horsepower requirement.

$$\text{E-Stop Horsepower} = \frac{\text{E-Stop Torque, Controlled}}{\mathbf{3.0} \times 1.5}$$

$$\text{E-Stop Horsepower} = \frac{167.71}{\mathbf{4.5}}$$

E-Stop Horsepower = 37.27 HP

15. Motor HP Comparisons for Thermal and Torque

Thermal HP = 12.22 HP

Running Torque HP = 21.00 HP

Accel/Decel Torque HP = 19.89 HP

E-Stop Torque HP = 37.27

Note: Constant values in formulas are in bold.

Tension Control Systems

Design Considerations and Selection

Not only must the motor selected be able to handle the heat dissipation of the application, but it also must be capable of providing the necessary torque to maintain proper tension.

Typically an AC or DC motor controlled by a frequency and/or vector drive, or a regenerative DC drive produces 3 lb.ft. of torque per horsepower over the rated motor speed range.

The HP ratings based on the largest of the 4 conditions of step 15 would be the HP rating selected for the application. In this case, since a 37.27 HP motor is not a standard, the next larger size motor would be selected. This application would require a 40 HP motor and drive system.

In many applications a reduction or gear head would be used between the motor and rewind roll. Often this will reduce the HP rating of the required motor as a torque advantage is realized with the reducer or gear head. It should be noted that the maximum ratio that can be used should never exceed a 30:1 ratio or problems will result at the low-end torque range of the motor possibly.

In the example above, no service factor was taken into account and in many cases a service factor of 1.25 to 2.5 may be considered. This would take into account any unknown friction, bearing drag, etc. in the system.

In this example if a service factor of 1.25 is used, then the motor HP and drive system would be 50 HP. By going to the larger system, motor life and trouble free operation would be realized.

For additional assistance in sizing and selecting a tension rewind drive system contact your Warner Electric Authorized Distributor, Warner Electric Sales Representative, or the factory technical support.

Calculating Web Tensions

For sizing any clutch, brake or drive tension system, tension must be known to perform the calculations. In many cases, the tension ranges for the materials being processed will be known. However, tensions may have to be calculated and/or even estimated for a given application.

To determine an estimated tension value when the actual value is unknown, certain parameters must be known. These are:

1. Material being processed
2. Web width of material, minimum and maximum
3. Paper weights, material thickness or gauge, or wire diameter, or paperboard points

Approximate Tension value = Web Width x Approximate Material Tension

Note: When dealing with film and foil materials, tension values given are normally pounds per mil per inch of material width.

Approximate Tension Values

The values shown are typically for unwind and intermediate tension systems. Values for rewind systems are normally 1.5 to 2 times higher in many cases, especially when dealing with slitter-rewinders.

Tension Value Charts

Material	Tension Pounds per inch of web width
Paper (Based on 3,000 sq. ft. / ream)	
15 lb.	0.50 lb./in.
20 lb.	0.67 lb./in.
30 lb.	1.00 lb./in.
40 lb.	1.33 lb./in.
50 lb.	1.67 lb./in.
60 lb.	2.00 lb./in.
70 lb.	2.33 lb./in.
80 lb.	2.67 lb./in.
100 lb.	3.33 lb./in.
120 lb.	4.00 lb./in.
140 lb.	4.67 lb./in.
160 lb.	5.33 lb./in.
180 lb.	6.00 lb./in.
200 lb.	6.67 lb./in.
Paperboard (Based on points thickness)	
8 pt.	3.00 lb./in.
10 pt.	3.75 lb./in.
12 pt.	4.75 lb./in.
15 pt.	5.63 lb./in.
20 pt.	6.00 lb./in.
25 pt.	9.38 lb./in.
30 pt.	11.25 lb./in.
35 pt.	13.13 lb./in.
40 pt.	15.00 lb./in.
45 pt.	16.88 lb./in.
50 pt.	18.75 lb./in.

Note: Typical tension is 0.375 lbs./point

Material	Tension Pounds per mil of web width
Films and Foils	
Aluminum Foil	0.5 to 1.5 lbs./mil./in. Typically 1.0 lb./mil./in.
Acetate	0.50 lbs./mil./inch
Cellophane	0.50 to 1.0 lbs./mil./in. Typically 0.75 lbs./mil./in.
Polyester	0.50 to 1.0 lbs./mil./in. Typically 0.75 lbs./mil./in.
Polyethylene	0.25 to 0.3 lbs./mil./in.
Polypropylene (Non-orientated)	0.25 to 0.3 lbs./mil./in.
Propylene (Oriented)	0.5 lbs./mil./in.
Polystyrene	1.0 lbs./mil./in.
Saran	0.05 to 0.2 lbs./mil./in. Typically o.1 lb./mil./in.
Vinyl	0.05 to 0.2 lbs./mil./in. Typically 0.1 lb./mil./in.
Mylar	0.5 lbs./mil./in.
Oriented Propylene	0.5 lbs./mil./in.
Metals and Steels	
Beryllium Copper	8.0 lbs./mil./in.
Titanium, Tungsten, High Carbon Steel, and Stainless Steel	8.0 lbs./mil./in.
Low Carbon Steels	See Chart
Non-Ferrous Metals	See Chart

Thickness	Low Carbon Steels (lbs./in. width)	Non-Ferrous Metals (lbs./in. width)
0.005	30.00	22.00
0.010	65.00	42.00
0.015	70.00	59.00
0.020	85.00	70.00
0.025	105.00	80.00
0.030	120.00	90.00
0.035	134.00	98.00
0.040	145.00	105.00
0.045	158.00	110.00
0.050	170.00	115.00
0.055	180.00	120.00
0.060	190.00	125.00
0.065	195.00	130.00
0.070	202.00	135.00
0.075	206.00	139.00
0.080	210.00	142.00
0.085	212.00	146.00
0.090	215.00	150.00
0.095	217.00	152.00
0.100	219.00	155.00
0.110	220.00	
0.120	220.00	
0.130	218.00	
0.140	214.00	
0.150	210.00	

Note: These values are for actual tensions; typically they are run at less.

Tension Control Systems

Design Considerations and Selection

Wire Tensions

AWG Wire Size	Aluminum Wire	Copper Wire
	Tension Pounds per strand of wire	
30 AWG	0.35	1.2
28 AWG	0.69	2.2
26 AWG	1.10	3.3
24 AWG	1.75	5.0
22 AWG	2.77	7.5
20 AWG	4.42	11.5
18 AWG	7.00	17.0
16 AWG	11.20	26.0
14 AWG	17.80	38.0
12 AWG	28.30	56.5
10 AWG	44.80	81.0
8 AWG	71.40	110.0
6 AWG	113.00	175.0
4 AWG	180.00	278.0

Note: In many cases, only hold back is required rather than full tensioning where there is a permanent set in the material. The actual tension values times a factor of 0.25 to 0.50 is sufficient to provide the necessary holdback.

Material Densities

When the weights of the unwind or rewind rolls are not known, they can be estimated by knowing the roll width, core diameter, maximum roll diameter, material type and material density.

Roll weights can be obtained by looking at the process tracking tags found on most rolls. When this is not possible, an estimated weight can be calculated.

Roll weight must be known to calculate roll inertia for acceleration, deceleration, and E-stop requirements for system selection.

Roll weight = Roll Volume x Material Density

Volume = Max Roll Diameter ^{2} x Roll Width x 0.00045

Note: Maximum Roll Diameter and Roll Width are in inches.

Application Example

Determine the estimated roll weight of a 42 inch diameter roll, 24 inches wide, paper.

Volume = 42^2 x 24 x 0.00045

= 19.05 cubic feet

Weight = Volume x Density

= 19.05 x 57 (Density of Paper)

= 1,086 pounds

Note: This does not take into account the core spindle shaft weight. If an extremely accurate weight of all components is necessary, core spindle shaft weight can be calculated separately and added to the roll weight.

Material Densities

Material	Typical Density (lbs./ft.^{3})
Papers, Films, and Foils	
Paper	57.00-75.00
Paperboard	88.00
Acetate	81.50
Aluminum Foil	45.00
Cellophane	57.00
Polyester	78.00
Polyethylene	57.50
Polypropylene	56.00
Polystyrene	66.00
Vinyl	86.00
Saran	107.50
Mylar	112.00
Metals	
Aluminum	165.00
Beryllium Copper	514.00
Copper	542.00-576.00
Tin	407.50
Titanium	281.00
Tungsten	1,224.00
Steel (typical)	483.00-495.00

Additional Design Considerations

Considerations additional to the sizing process for the controlling device (brakes or clutches) are discussed below.

Torque

Although torque calculations are similar for unwind, intermediate and rewind tension applications, both minimum and maximum torque values of the controlling device must be considered for the application to be successful.

Minimum torque is the amount of force the controlling device must apply to maintain constant tension in the web. If the minimum torque exceeds the minimum torque necessary to maintain web tension, the system cannot control properly, web tension will increase, and waste may result.

Maximum torque is the force provided by the controlling device to maintain proper web tension in worst-case conditions. If maximum torque is less than that required by the application, tension will be less than desirable and may result in poor process.

E-Stop torque is the force the controlling device can apply during machine E-Stop conditions. This E-Stop torque depends on the type of controlling device used and the control system employed. Not all control systems or controlling devices, i.e., brakes, clutches, etc., have E-Stop capabilities. If E-Stop requirements are mandated by the application, then both the controller system and controlling device must have the capabilities to provide this.

If the controlling device cannot produce the necessary torque, then web spillage will occur and damage to machinery may result.

The controlling device must be large enough to cope with all application torque requirements. Even though most brakes and clutches have both static and dynamic torque capabilities, dynamic torque is more important than static torque in tension applications.

Heat Dissipation

When a clutch, brake, or motor operates in a slipping mode or the motor is generating torque, heat is built up as a result of the mechanical energy being converted to thermal energy. The controlling device must be able to dissipate this (heat) energy. If it doesn't, it will fail, either electrically, mechanically, or both.

The heat dissipation capacity of the controlling device must always exceed the heat produced by the application. Environmental considerations must also be analyzed to insure proper operation. High ambient temperature, enclosures surrounding the controlling device limiting the airflow, or marginal heat dissipation capacity have to be considered.

Some controlling devices may need additional cooling with fans or blowers to increase air flow.

The controlling device must be selected properly to handle the application's heat dissipation. This is probably one of the most critical factors in sizing and selection.

Speed

Brakes, clutches, and motors have minimum and maximum speed ranges. Applications must always be checked to insure that the requirements fall within the capabilities of the controlling device.

Failing to operate the controlling devices within their specifications may result in the application failing to meet the specified requirements; failure of the components mechanically and electrically, or even may result in serious damage or injury.

Selection RPM is used to properly size a unit so that over sizing is minimized and an optimum system can be specified.

Inertia

By definition, inertia is that property of a body that makes it continue in the state of motion or rest in which it may be placed until acted upon by some force.

Inertia is an important factor in tensioning applications because it has an effect in the sizing of the controlling device during acceleration, deceleration, and E-Stop conditions.

Failure to consider inertia during the calculations can definitely result in a system being undersized and unable to provide optimum performance. This may result in instability at start up and overrunning during deceleration and stopping. The end result in all cased will be poor product quality and, usually, excessive scrap.

With the exception of intermediate tension applications and analog control systems, inertias are constantly changing in unwind and rewind applications. Worst-case inertia calculations are normally used for sizing and selecting purposes.

Charts

Charts are provided for all clutches and brakes included in the catalog. They provide a means of selecting the correct controlling device for a given application. Performance charts and product specifications for brakes and clutches start on page 68.

The charts provide thermal vs. selection speed data, the means of selecting the unit based on thermal requirements.

Never select a controlling device whose thermal limits are near or equal to those of the application. The next larger size unit should always be considered or the factory should be consulted for additional options.

Selection charts are also provided for running torque vs. speed and E-Stop torque vs. speed. These charts provide a means of checking the preliminary unit selection based on thermal requirements and torques.

The appropriate charts must be used in the sizing and selection process.

Additional Calculations

Additional calculations can be made to determine roll stop time, web pay out during stop, and web storage requirements. These become important when using a dancer or load cell control system to ensure optimum performance and to insure the controlling element selected will do the job.

1. Normal Roll Deceleration Stop Time

Normal Roll Decel Stop time =

$$\frac{WR^2 \times \text{Minimum Roll RPM}}{\mathbf{308} \times [\text{Brake Dynamic Torque available} - \text{Maximum Running Torque (Full Roll)}]}$$

2. Roll E-Stop Time

Roll E-Stop Time =

$$\frac{WR^2 \times \text{Minimum Roll RPM}}{\mathbf{308} \times [\text{Brake Dynamic Torque available} - \text{E-Stop Torque Required}]}$$

Determine web payout during normal deceleration stop and E-Stop conditions to determine the amount of web spillage. The calculations that follow may signal a need to upsize the brake or improve the dancer design.

1. Determining Web Payout during normal deceleration

Web Payout during normal deceleration =

$$\frac{\text{Linear Speed (FPM)} \times \text{Roll Stop time (deceleration)}}{\mathbf{120}}$$

2. Determining Web Payout during E-Stop

Web Payout during E-Stop =

$$\frac{\text{Linear Speed (FPM)} \times \text{Roll E-Stop time}}{\mathbf{120}}$$

3. Machine Web Draw during normal deceleration

Machine Web Draw during deceleration =

$$\frac{\text{Linear Speed (FPM)} \times \text{Machine Decel time}}{\mathbf{120}}$$

4. Machine Web Draw during E-Stop

Machine Web Draw during E-Stop =

$$\frac{\text{Linear Speed (FPM)} \times \text{Machine E-Stop time}}{\mathbf{120}}$$

Once these values are calculated, web spillage can be determined and the brake selected will be found adequate or its size will have to be increased. Another alternative is dancer design improvements. See dancer design section for calculations and suggestions.

Web Spillage = Web Payout of Roll – Machine Web Draw

This should be calculated for both normal deceleration and E-Stop calculations.

Note: If the numbers calculated are negative, then no payout or spillage will occur.

Often during E-Stop, web spillage will be evident from the above calculations. If this is not a concern and the brake selected can handle the heat dissipation and torque requirements for running and deceleration, the controlling element has been correctly selected.

It may be necessary with E-Stop requirements, to repeat calculations for torque and brake selection until a controlling element can be selected that will match all the parameters.

Selection Conclusions

No matter which type of tension system is selected, unwind, intermediate, or rewind, this is intended as a general sizing selection guide that will probably cover the vast majority of applications. Some instances will surely be encountered where the sizing and selection covered in the previous pages may not apply. In these cases, your local Warner Electric Representative can provide the necessary guidance and assistance to correctly size and select a tension control system.

The sizing and selection process is quite straightforward, although some work is involved. In summary, sizing and selection can be broken down into three simple steps:

1. Selection of the controlling device, i.e., Brake or clutch
2. Controller, Power Supply, etc., i.e., Remote/Analog, Dancer, Load Cell, or Splicer
3. Input Sensing Element, i.e., Dancer Pot, Load Cell, Analog sensor

With the wide variety of tension products available, Warner Electric can offer complete tension packages for almost any application encountered. Because of its vast experience and knowledgeable professionals, Warner Electric can solve your tensioning needs.

Web Storage

A load cell does not provide material storage for machine acceleration. As the machine draws material during the acceleration period, it is pulling against the inertia of the unwind roll. If the roll is large, the acceleration rate is high, and the material is light, the web may break. Therefore, it may be necessary to provide storage in the web path to release material as the roll comes up to speed. Another option would be to use a drive to help bring the roll up to speed. For further information or assistance, please contact your Warner Electric Distributor or Warner Electric Representative.

Note: Constant values in formulas are in bold.

Designing the Optimum Dancer Storage System

For closed loop dancer controlled systems, the actual web tension is determined by the downward pressure of the dancer roll or by the loading on the dancer on the web. Consequently, special attention should go into the design of the dancer arm system to provide both consistent tension and adequate web storage for optimum web stop performance.

Load Cell vs. Dancer

Deciding between a load cell and a dancer system requires consideration of many inter-related factors. Sometimes a load cell control is selected when the material being tensioned is not flexible and will not easily wrap around a dancer roll. For example, medium to heavy gauge metals are often tensioned with load cell systems.

Load cell systems can also be selected because of space limitations in the application, or because they are easier to retrofit to existing applications. In retrofit applications, precision balance or rollers may be required if line speeds are greater than 650 feet per minute.

Dancer tension control is still the preferred method of control in many applications. For example, high speed printing applications may require the "forgiveness" of a dancer system to take-up or release material during the dynamically unstable conditions seen at the unwind or rewind roll. The reasons for unstable conditions include fast decelerations or accelerations, out-of-round rolls, and flying splices. A dancer system should be considered when speeds are high and tension control requires extreme precision.

Dancer Roll Design and Construction

The dancer roll and control arms are the heart of this tension control system. Dancer construction is simple, but very important.

For optimum performance, the dancer should be a thin walled tubing and be loaded by massless, low friction air cylinders. A rolling diaphragm device is most commonly used. For greatest accuracy, the wrap on the dancer roll should be exactly 180 degrees.

Anything attached to the dancer for loading will detract from the dancer's ability to act as a buffer and should be made as light and (in the case of air cylinders) efficient as possible.

Construction of Dancer Arms for Webs

Dancer arms should utilize boxed construction to provide rigidity so that the web does not cause the arms to twist. This also insures that the web will track properly over the dancer roller.

The pivot point should be bearing mounted so the dancer arm can move freely. The dancer roller should also be bearing mounted and the bearings should be small in diameter and as frictionless as possible.

This will help reduce the bearing drag and friction changes which affect good tensioning. Standard feed conveyor rollers and bearings are usually sufficient.

Construction of Dancer Arms for Wire

Wire dancers usually employ a single arm. The pivot point and dancer roller should both be bearing mounted to minimize friction and drag. Standard wire rollers are very good dancer rollers for these type systems. These rollers usually contain excellent integral bearings.

Dancer Systems

Dancer Design and Considerations

Warner Electric dancer control systems are designed to control tension in unwind, intermediate, or rewind applications for materials such as paper, foil, films, cloth, metals or wire. The system consists of four parts:

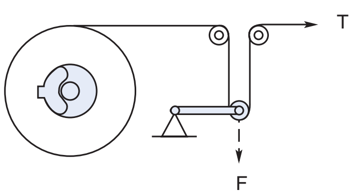
1. The controlling device, i.e. brake, clutch, or drive motor, AC or DC
2. The controller
3. A pivot point sensor which determines the position of the dancer roll
4. The dancer arm and roll assembly (customer supplied)

Dancer Arm Design

Various configurations of dancer arms exist, but their purpose is the same. The dancer provides a means of creating tension on the web by providing a force opposite to the direction the web is pulled.

The effective force applied to the arm to create the desired tension is a function of the number of dancer rollers on the dancer arm.

Single Roll Dancer



$F = 2 \times N \times T$

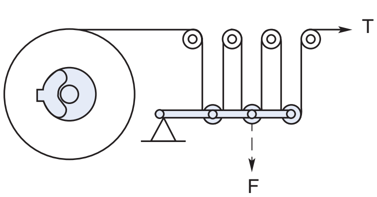
Where:

F = Effective loading force against the web

T = Tension desired in the web

N = Number of dancer rollers

Multiple Roll Dancers



$F = 2 \times N \times T$

Where:

F = Effective loading force against the web

T = Tension desired in the web

N = Number of dancer rollers

The more dancer rollers on the dancer arm, the higher the effective force must be to provide the same tension.

Dancer arms should be made of lightweight material to minimize the added effect of weight to the system as well as to keep the inertia as low as possible. Depending on the application and the amount of room available, this will dictate the type of design used and physical size.

The following figures depicting basic dancer designs are intended for guideline only. These are not the only configurations that can be used. Variations on these designs or other designs are acceptable as long as loading and storage requirements can be met.

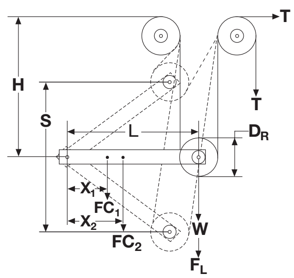


Figure 1 – Horizontal Dancer with Vertical Movement

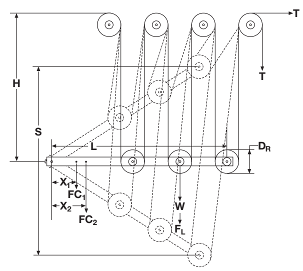


Figure 2 – Multiple Roll Dancer with Vertical Movement

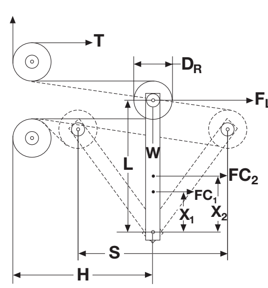


Figure 3 – Vertical Dancer with Horizontal Movement

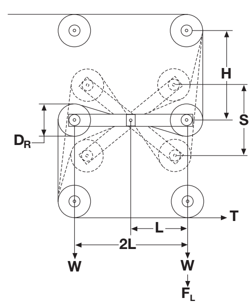


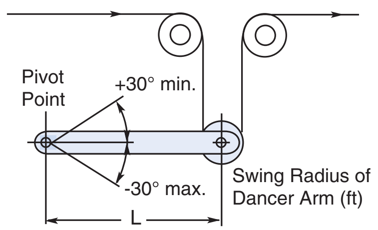
Figure 4 – S-Wrap Dancer with Vertical Movement

Dancer Systems

The following calculations offer a guide for designing a dancer arm. These will provide for an optimum system and for proper loading and storage with the system.

1. Determine Dancer Arm Length, L

This can be done by calculating the length based on the maximum operating linear speed of the system or from the chart below.



a. Calculating Length

$$L = 12 + \frac{\text{Max Web Speed (FPM)} - 200}{100}$$

Minimum L to maximum L should normally be 12" to 40".

b. Chart Determination

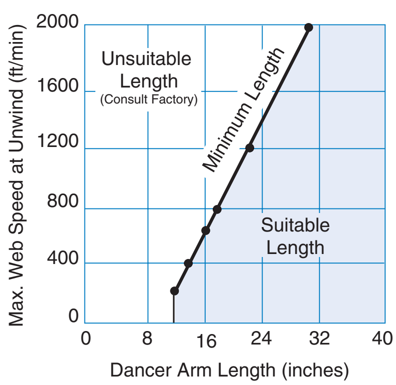


Chart 1 – Dancer Arm Length vs. Web Speed

2. Determine Swing Height of Dancer Arm, S

$S = 1.04 \times L + D_R$

Where:

L = Length of arm calculated or chosen in Step 1.

D_R = Diameter of dancer roller

3. Determine Height from edge of web to centerline of Dancer Pivot Point, H

$$H = \frac{S + D_R}{2}$$

Where:

S = Swing height calculated from Step 2.

D_R = Diameter of dancer roller

Because wide ranges of tensions are required from most systems, some type of loading is usually used to make setting the tension easier. The preferred method is to use a pneumatic cylinder [normally a low inertia, friction less type (Bello-fram) cylinder]. Weights or springs can be used, but these add weight and inertia to the system and are sometimes very difficult to stabilize.

4. Selecting the Loading Point, X

$X_{MIN} = 0.25 \times L$

$X_{MAX} = 0.33 \times L$

Where :

L = Length of the dancer arm

5.* Calculating Cylinder Force Required, F_C

$$F_C = \frac{F \times L}{X}$$

Where:

F = Effective force of the dancer

L = Length of the dancer calculated in Step 1

X = Loading point calculated in Step 4

6. Calculating Cylinder Stroke required

Stroke = 2 x X Tan30 or 1.155 x X

Where:

X = Loading point from Step 4

By following these guidelines, a dancer design with the +/- 30 degree swing will be achieved. This is the range the Warner Electric pivot point sensors require for optimum control performance.

The following chart depicts the percentage of tension variations based on the dancer position in a properly designed dancer.

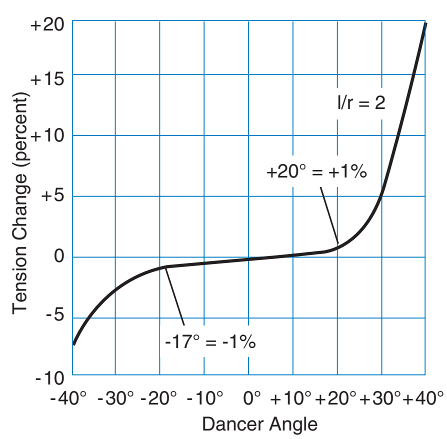


Chart 2 - Tension variation vs. dancer arm angle

* See page 157 for effective cylinder force at a given air pressure.

Tension Control Systems

Design Considerations and Selection

The following notes are provided for information purposes and should be considered in the design of a dancer arm. Following these guidelines will result in a more optimized system.

I. Horizontal Dancer with Vertical Movement

A. Downward Loaded Dancer

$$\text{Tension} = \frac{\text{Downward Loading Force}}{2 \times \text{Number of Dancer Rolls}}$$

Total Downward loading force at dancer roll =

Downward force created by loading +
weight of dancer arm

In this case, the pressure required will be less because the dancer weight adds to the total loading force.

B. Upward Loaded Dancer Arm

$$\text{Tension} = \frac{\text{Upward Loading Force}}{2 \times \text{Number of Dancer Rollers}}$$

Total Upward loading force at dancer roll =

Upward force created by loading -
weight of dancer arm

In this case, the pressure required will be greater because the dancer weight subtracts from the total loading force.

II. Vertical Dancer with Horizontal Movement

Dancer weight in this case is no longer a factor on the loading force on the dancer.

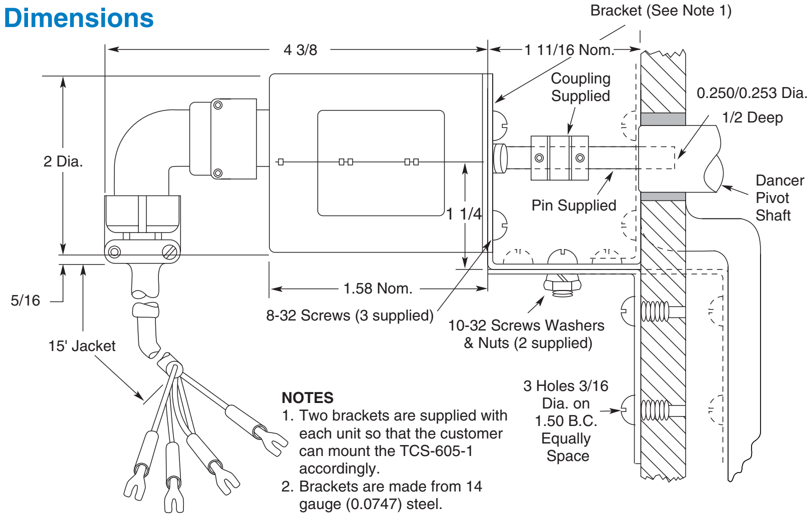
$$\text{Tension} = \frac{\text{Loading Force}}{2 \times \text{Number of Dancer Rollers}}$$

Caution must be used when this type dancer and diaphragm type cylinders as the rod assembly is supported by the cylinder bushing only. Secondary support is necessary to keep the cylinder shaft from binding.

TCS-605-1
TCS-605-2
TCS-605-5

Warner Electric pivot point sensor is a precision electronic positioning device which is used with the MCS-203, MCS-207, TCS-210 or TCS-310 dancer control system to provide smooth control of unwind stands operating at any speed. The sensor is mounted at one end of the dancer roll pivot shaft where it monitors the angular position, direction of travel and relative speed of dancer arm movement. TCS-605-2 used with drive systems.

Dimensions



NOTES
1. Two brackets are supplied with each unit so that the customer can mount the TCS-605-1 accordingly.
2. Brackets are made from 14 gauge (0.0747) steel.

Intermittent Motion Sensor Coupling

The Intermittent Motion Sensor Coupling is a two part coupling designed for applications where the web is started and stopped by intermittent motion. The design allows for an adjustable deadband so that the dancer arm can move before motion is translated to the pivot point sensor. This allows for smoother control of the tensioning device and prevents unwanted hunting and instability in the system. If your application requires this type of coupling, contact your Warner Electric tension specialist to determine if it is right for you.

Figure 1

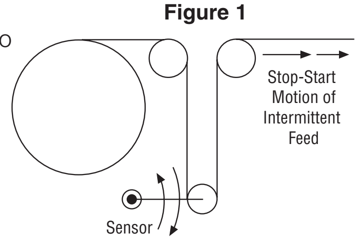
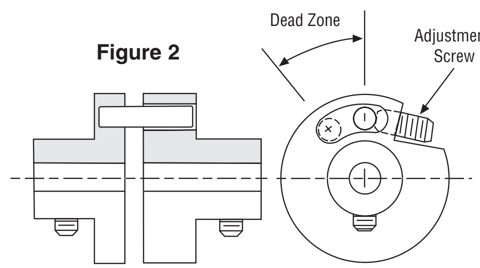


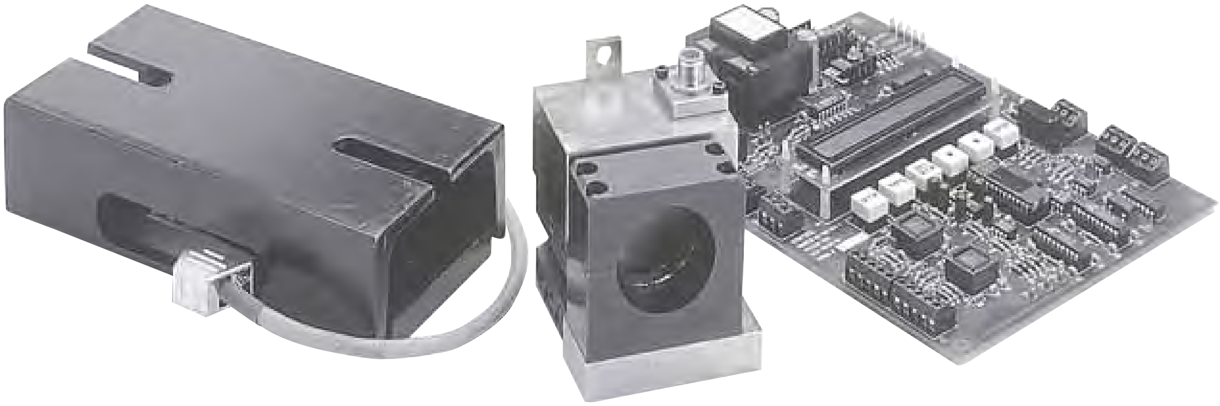
Figure 2



Specifications

Model No.	Part No.	Description
TCS-605-1	7330-448-002	Single turn potentiometer for dancer arm systems where the range of rotary motion from full-up to full-down dancer position is normally maintained within 60° (1KΩ)
TCS-605-2	7330-448-004	Single turn potentiometer for drive systems (5KΩ)
TCS-605-5	7330-448-003	Five turn potentiometer for festooned dancer systems (1KΩ)
Accessories		
	6910-101-001	Intermittent motion sensor coupling
	284-8000-003	Coupling for Pivot Point Sensors
	7330-101-001	TCS-605 Cable Assembly Only
	7330-101-002	TCS-605-1 Sensor Assembly Only
	7330-101-003	TCS-605-5 Sensor Assembly Only

Load Cell Sensors



Foot Mounted and End Shaft Mounted Series

FM Series Sensors

The foot mounted style load cells (used with pillow blocks) provide easy and convenient mounting to the roll that is being measured. It is a strain gauge style unit that is ideal for heavy tension applications.

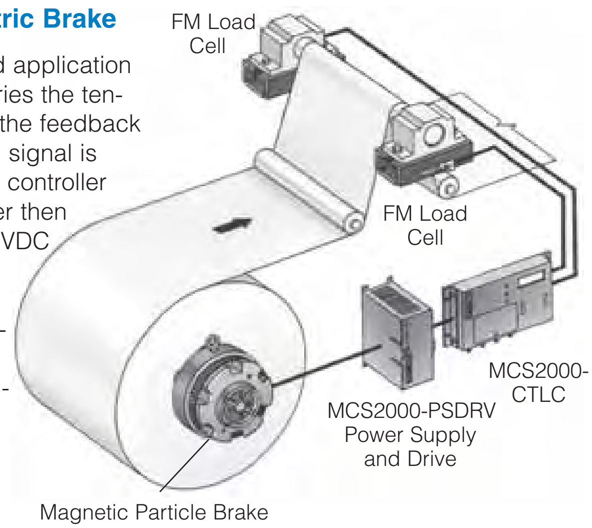
ES Series Sensors

The end shaft style load cells mount to the end of the roll that is being measured. It is a LVDT (Linear Variable Differential Transformer) style that can withstand overloads up to 10 times its rated load capacity. Several models are offered: dead shaft (no bearing), live shaft and cantilever where a single load cell can be used to measure the tension on the roll. Some units are powered with DC voltage and others are powered with AC. The AC units offer a price advantage over the DC.

Typical System Configuration Examples

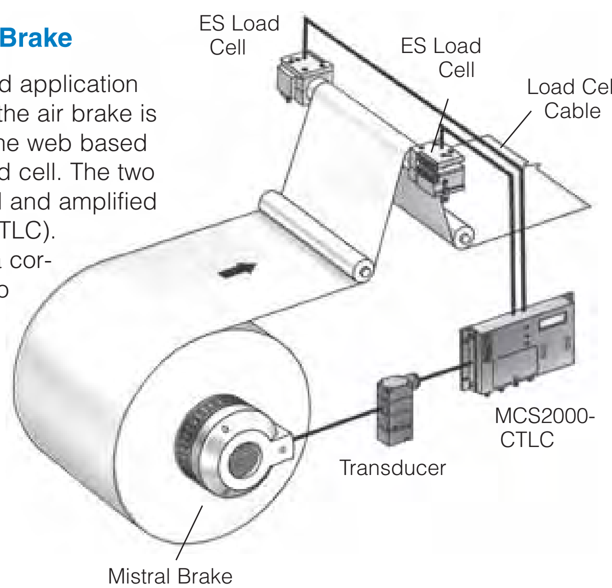
FM Load Cell with an Electric Brake

This is a single load cell unwind application example. The electric brake varies the tension on the web depending on the feedback from the load cell. The load cell signal is amplified and interpreted in the controller (MCS2000-CTLC). The controller then puts out a corresponding 0–10 VDC signal to the power supply and drive (MCS2000-PSDRV). The PSDRV then amplifies and interprets the signal from the controller and puts out a corresponding 0–24 VDC signal to the brake to apply either more or less braking.



ES Load Cell with a Pneumatically Operated Brake

This is a dual load cell unwind application example. In this application, the air brake is used to vary the tension on the web based on the feedback from the load cell. The two load cell signals are summed and amplified in the controller (MCS2000-CTLC). The controller then puts out a corresponding 0–20 mA signal to the transducer, which converts this signal from current to pressure to command the brake to apply either more or less braking.



Specifications

FM Series Foot Mounted Load Cells

Load Ratings	**N**	100	250	500	1,000	2,500	5,000	10K
	(lbs.)	(22)	(56)	(112)	(225)	(562)	(1,124)	(2,248)
Size		01	01	01	01	01	01	02

Input Power ±12 to ±15 VDC, ±5%
Output Signal 5 VDC factory setting at nominal load (can be rescaled for 25% load at +10 VDC output)
Ambient Temperature 0–70°C (F)
Temperature Drift 0.1% of rating per °C
Non-Linearity & Repeatability <0.5%
Power Consumption 1 watt
Cable 16 ft. provided with load cell.

Deflection:
6mm at full load rating

FM Series Model Numbers
F M 0 1 – 1 0 0 0 – A C
Model Size Load in N Amplifier built in

ES Series End Shaft Mounted Load Cells

AC10 requires a power supply/amplifier
Load Ratings 60 lbs., 170 lbs., 500 lbs.
Input Power 15 Vrms @ 5 KHz
Output Signal 3.2 volts AC/inch displacement/volt excitation
Output Impedance 780 ohms ±30%
Ambient Temperature –60° to +250°F (–50° to +620°C)
Temperature Drift 0.02%
Linearity & Repeatability 0.1% of full scale
Overload Protection 10 times maximum rated load of unit
Cable Two 30 ft. cables provided with load cells.

Deflection:
6mm at full load rating

ES AC10 Series Load Ratings
A 60 lbs.
B 170 lbs.
C 500 lbs.

ES AC10 Series Model Numbers
A C 1 0 A 1 2 S _
Model Load Rating Shaft dia.* Shaft Mounting Configurations
*See below for shaft diameters

Shaft Mounting Configurations
W1 = split bushing
W2 = solid bushing
S = system which includes one W1 load cell, one W2 load cell, two 30 ft. cables and a power supply (PSAC10)

PSAC10 Power Supply/Amplifier

Input Power 115/230 VAC, 50–60 Hz
Output Signal –10 to +10 VDC scaleable
Ambient Temperature 32°F to +160°F (0°C to +70°C)
Maximum cable distance between load cell and power supply board 100 feet
Part Number PSAC10 (For a 10 x 8 x 4 Housing add –H)

*ES, A30, B30 & C30 Series

Load Ratings
A30 8 lbs., 20 lbs., 50 lbs., 90 lbs.
B30 8 lbs., 20 lbs., 50 lbs., 90 lbs., 140 lbs., 200 lbs., 300 lbs., 500 lbs.
C30 8 lbs., 20 lbs., 50 lbs., 90 lbs., 140 lbs., 200 lbs., 300 lbs., 500 lbs.
Input Power 24 VDC at .040 amps (12 to 30 VDC acceptable, with LVDT output proportional)
Output Signal 3 VDC/unit
Ambient Temperature –60° to +250°F (–50° to +120°C)
Overload Protection 10 times rated load range

Deflection:
6mm at full load rating

Note: Tension cells are factory adjusted to provide an offset voltage with no load applied (no deflection). Using an input of 24 volts DC, the LVDT is set to provide an output of 3.5 volts into a resistive load of not less than 100,000 ohms. The voltage resulting from the maximum rated load then adds to or subtracts from the 3.5 volt offset. This results in an output of 6.5 volts in Compression.

ES A30, B30 & C30 Series Model Numbers
B A 3 0 P 1 2 K W 1
MS Connector Model Load Rating Shaft Dia. Code DC LVDT Shaft Mounting Configurations
*Other sizes available if needed.

Shaft diameter

inches	¾	1	1¼	1⁷⁄₁₆
code	12	16	20	23

– Other diameters are available

Shaft Mounting Configurations
W1 = split bushing
W2 = solid bushing

ES A30 & C30 Series Load Ratings

M*	8 lbs.	**U**	90 lbs.	**Y**	300 lbs.
P	20 lbs.	**X**	200 lbs.	**Z**	500 lbs.
T	50 lbs.	**W**	140 lbs.		*shaft size 70 3/4 only

Load Cell Selection

The following steps should be followed to determine the proper load cell size and style for your application.

1. Determine whether you will be using one or two load cells.

It is best for two sensing heads to be used, one at each end of the sensing roll. The two individual web tension inputs are averaged in the controller, which takes care of non-central alignment of the web over the sensing roll and slack edges from a non-uniform reel. The AC10 and C30 can only be used in dual load cell applications. The FM Series and A30 can be used in single load cell applications. The A30 is designed to be used with a single pulley or sheave mounting with a projection of 1 or 2 inches. An ES style cantilever unit is also available in lengths to 18". Consult the factory for more information.

2. Choose the load cell model that fits dimensionally.

The FM style is a foot mounted load cell (used with pillow blocks) that mounts perpendicular to the roll being measured. The ES style is an end shaft model where the mounting bolt centerline is on the axis of the measuring roll. There are two shaft mounting configurations with the ES style load cells. The "W1" cell clamps to the shaft while the "W2" cell allows for thermal expansion of the shaft. Both units have self aligning features. When using the dual load cell units (B30, C30 or AC10 series) one of each shaft mounting configuration must be used. It is recommended that a system be ordered in the AC10, B30 or C30 series (ex. AC10A12S) which will insure one "W1" load cell and one "W2" load cell is supplied as a matched pair.

The AC10 is an AC version load cell that is economically priced when compared with the other ES models, even with the added power supply board that is required to power it.

Available sizes and dimensions are listed on pages 42 & 43 for the ES or FM style units. Choose the unit(s) that will best fit the machine construction.

Tension Control Systems

Load Cell Sensors

3. Load Cell Force Calculations

The FM style load cell can be mounted regardless of orientation, but has to work in compression. Only the perpendicular force (resultant) is measured by the load cell. The perpendicular force can be at a maximum permitted angle of ±30°. The FM style is a strain gauge load cell and the maximum tension in the web used (T) should be the potential overload force.

The ES style load cells can be mounted at any angle around the axis of the measuring roll with any wrap angle. They work equally well in either tension or compression making it easy to adapt them to any new, retrofit, or replacement application. The mechanical structure and primary conversion element is designed to handle overloads at ten times the rated load range. Therefore, these units don't need to be oversized to provide adequate overload protection.

The following selection information is required to select a load cell:

T = maximum tension in the web (lbs.)

W = weight of the sensing roll (lbs.) acts vertically

X = wrap angle (degrees), 180° max.

Y = angle between resultant force of tension and vertical (degrees)

SF = Safety factor. Use 1 for ES style load cells and 2 for FM style load cells.

RF = Resulting force (lbs.)

4. Choose the load cell rating that is equal to or greater than the force calculation.

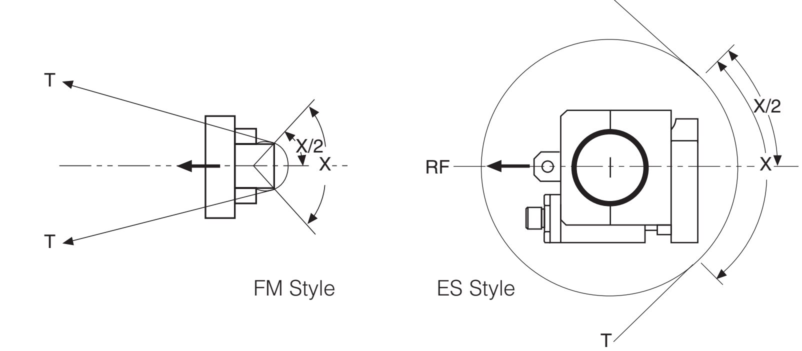
– Minimum rating of each cell should exceed 7% of maximum rating.

5. Choose accessories

a. For ES style load cells choose shaft diameter. Chart is on page 43.
b. For the A30, B30 or C30 models choose cables L1A25 or L1A99 which are 25 or 99 ft. cables. Other lengths are available. A cable is needed for each load cell ordered.
c. For the AC10 model the PSAC10 (power supply amplifier) is needed. Specify without or PSAC10-H with housing.

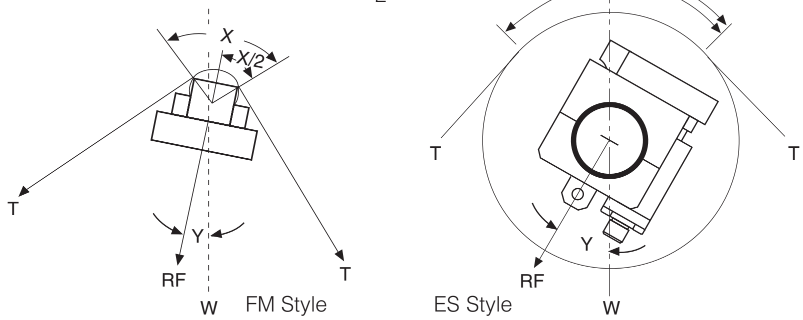
Case 1: Resultant force points horizontal

Load = SF x T(lbs.) x sin (X/2)



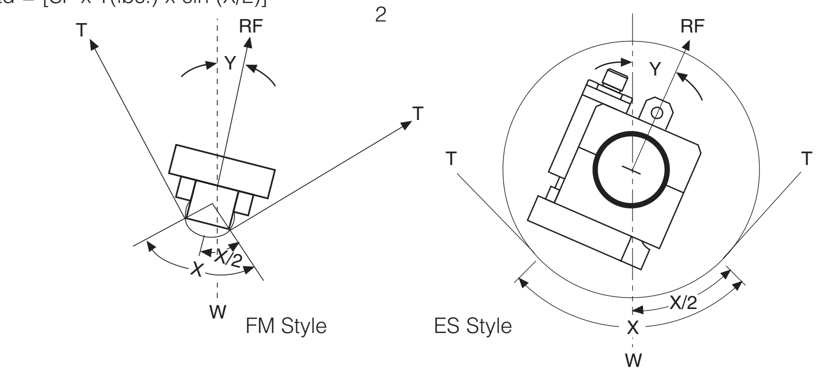
Case 2: Resultant force points down

$$\text{Load} = [SF \times T(\text{lbs.}) \times \sin(X/2)] + \frac{[W(\text{lbs.}) \times \cos Y]}{2}$$



Case 3: Resultant force points upward

$$\text{Load} = [SF \times T(\text{lbs.}) \times \sin(X/2)] - \frac{[W(\text{lbs.}) \times \cos Y]}{2}$$

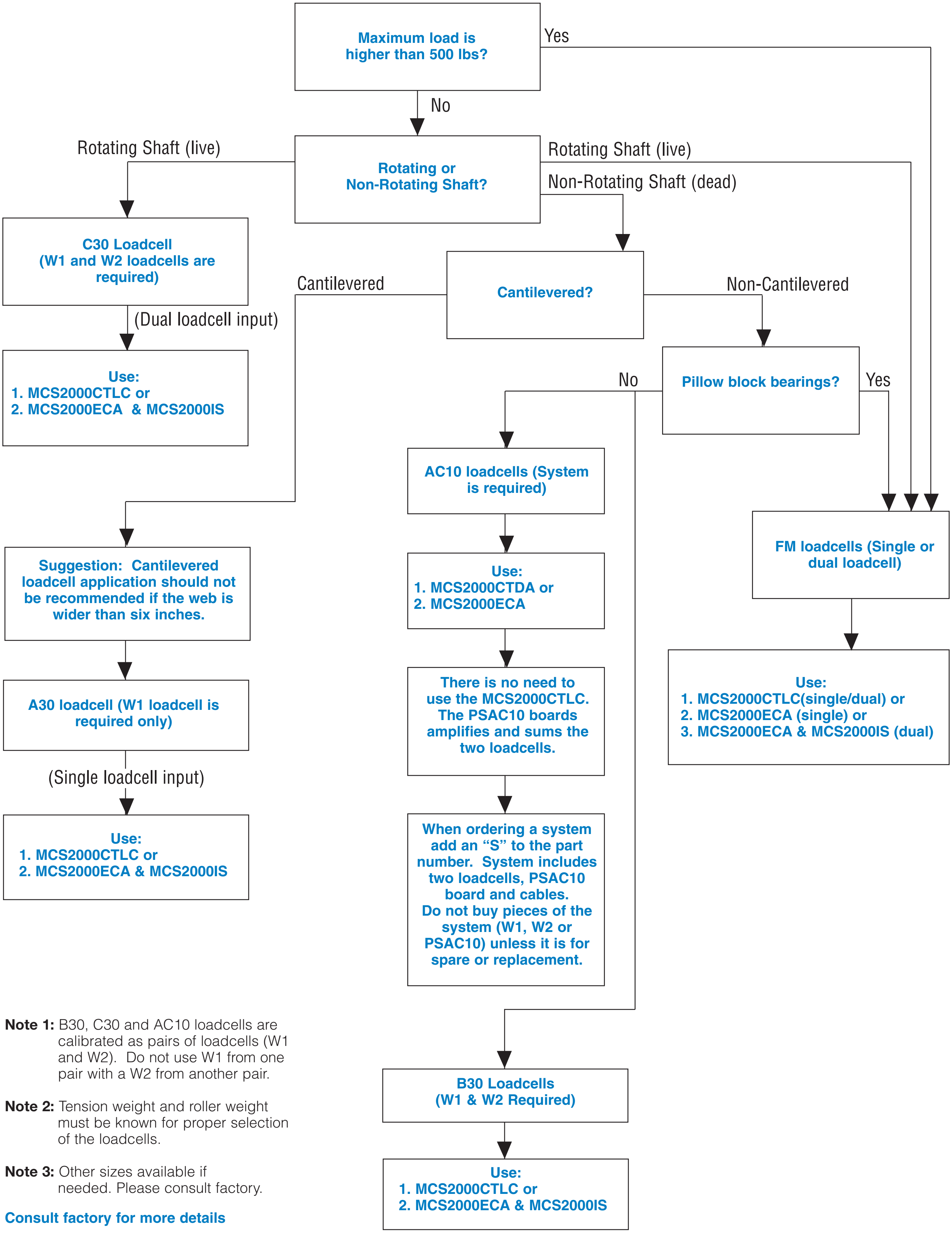


Sin/Cos Table

Degrees	Sin	Cos
0°	.0000	1.000
5°	.0872	.9962
10°	.1736	.9848
15°	.2588	.9659
20°	.3420	.9397
25°	.4226	.9063
30°	.5000	.8660

Degrees	Sin	Cos
35°	.5736	.8192
40°	.6428	.7660
45°	.7071	.7071
50°	.7660	.6428
55°	.8192	.5736
60°	.8660	.5000
65°	.9063	.4226

Degrees	Sin	Cos
70°	.9397	.3420
75°	.9659	.2588
80°	.9848	.1736
85°	.9962	.0872
90°	1.000	.0000



Note 1: B30, C30 and AC10 loadcells are calibrated as pairs of loadcells (W1 and W2). Do not use W1 from one pair with a W2 from another pair.

Note 2: Tension weight and roller weight must be known for proper selection of the loadcells.

Note 3: Other sizes available if needed. Please consult factory.

Consult factory for more details

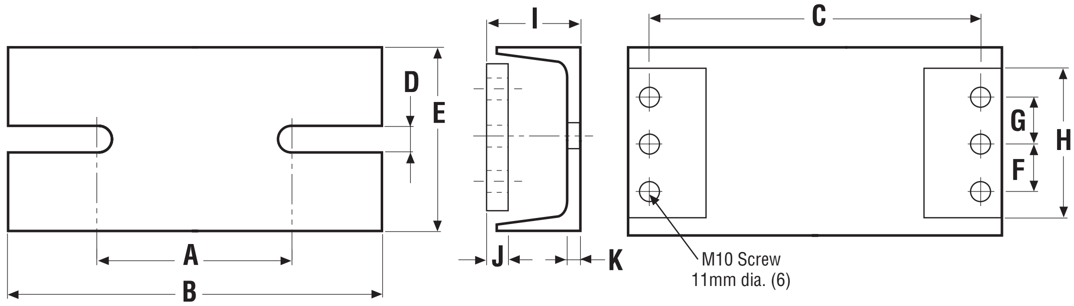
Tension Control Systems

Load Cell Sensors

Dimensions

FM Series

Foot mounted load cells



inches/(mm)

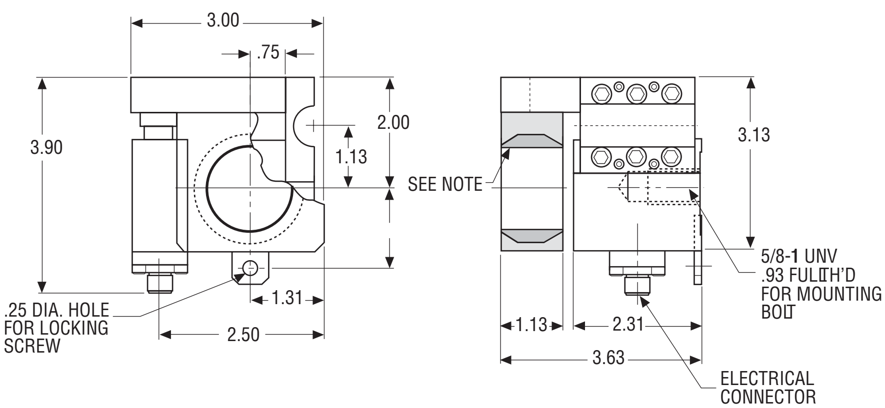
Size	Part Number	Load Ratings (lbs.)	A	B	C	D	E	F	G	H	I	J	K
	6910-840-100	**22**											
	6910-840-102	**56**											
1	6910-840-104	**112**	4.055	7.874	6.890	.512	4.016	.984	.984	3.150	2.047	.472	.236
	6910-840-106	**225**	(103)	(200)	(175)	(13)	(102)	(25)	(25)	(80)	(52)	(12)	(6)
	6910-840-108	**562**											
	6910-840-110	**1124**											
2	6910-840-112	**2248**	5.591 (142)	8.858 (225)	7.677 (195)	.669 (17)	5.00 (127)	.984 (25)	.984 (25)	3.937 (100)	2.165 (55)	.709 (18)	.236 (6)
	6910-101-089	Cable Assembly 16 ft.											

ES Series

End Shaft Mounted Load Cells

AC10

Dual Load Cell, Non-Rotating Shaft Load ratings 60 lbs., 170 lbs., 500 lbs.

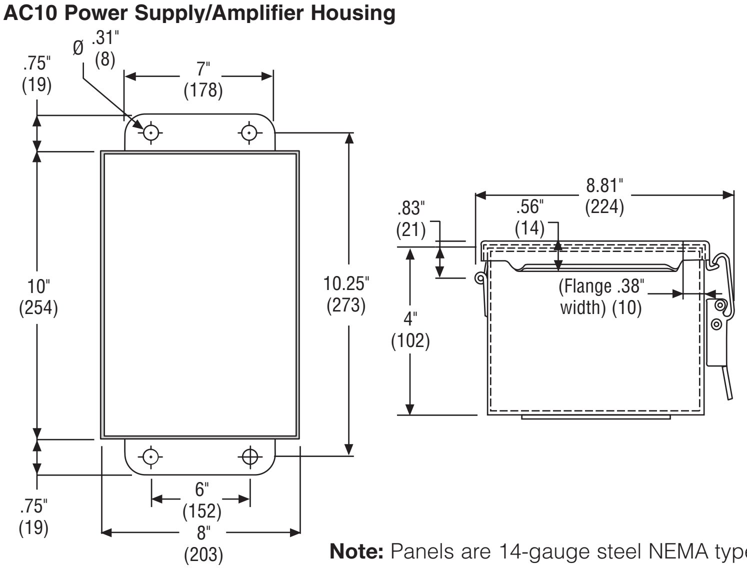


Cable Assembly
L1A30 30 ft. Cables

Note:
Stainless steel self-aligning bushing provided for shaft sizes 3/4", 1", 1-1/4" and 1-7/16" diameters. Other shaft diameters available on special order.

PSAC10-H

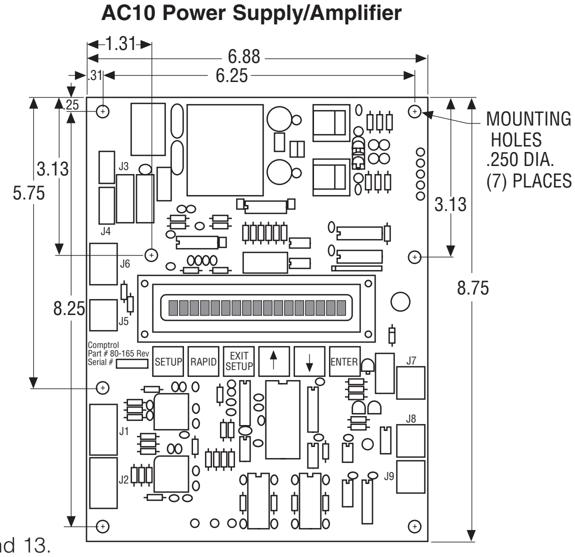
AC10 Power Supply/Amplifier Housing



Note: Panels are 14-gauge steel NEMA type 12 and 13.

PSAC10

AC10 Power Supply/Amplifier



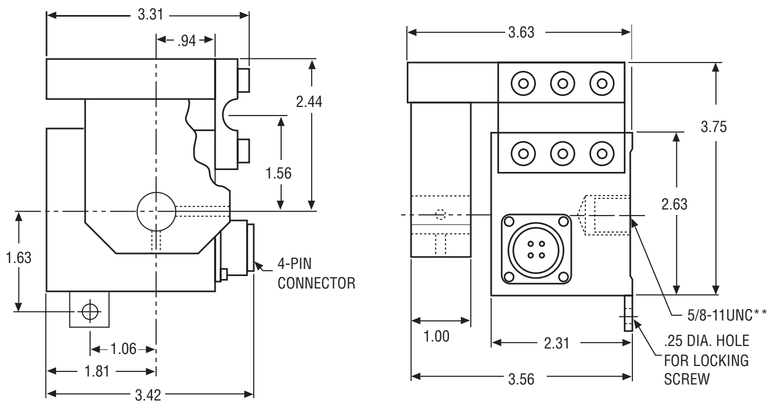
A30

Single Load Cell, Non-Rotating Shaft

Sheave or pulley mounting with projection of 1 or 2 inches.

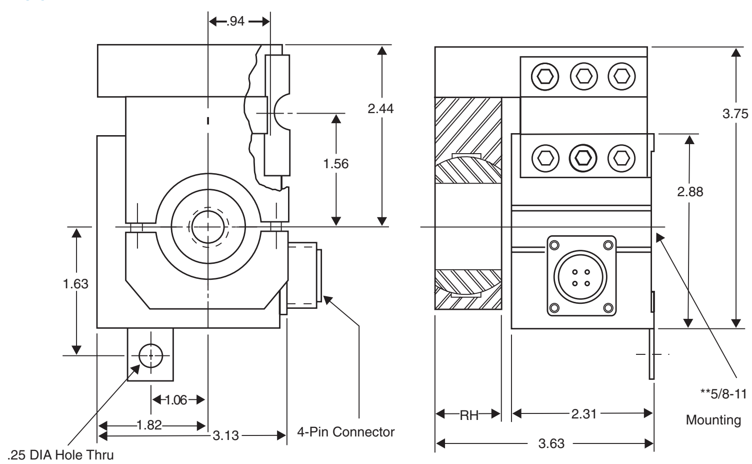
Cable Assemblies– For All 30 Series

L1A25 25 ft. with Connector
L1A99 99 ft. with Connector



Load Ratings: 20 lbs., 50 lbs., 90 lbs.
Note: Other load ratings available - consult factory.

B30



Load Ratings: 20 lbs., 50 lbs., 90 lbs., 200 lbs., 500 lbs.
Note: Other load ratings available - consult factory.

RH and RT dimensions based on shaft diameter

Inches	3/4	1.0	1-1/4	1-7/16
Code	12	16	20	23
RH	1.31	1.38	1.69	
RT	3.88		4.13	

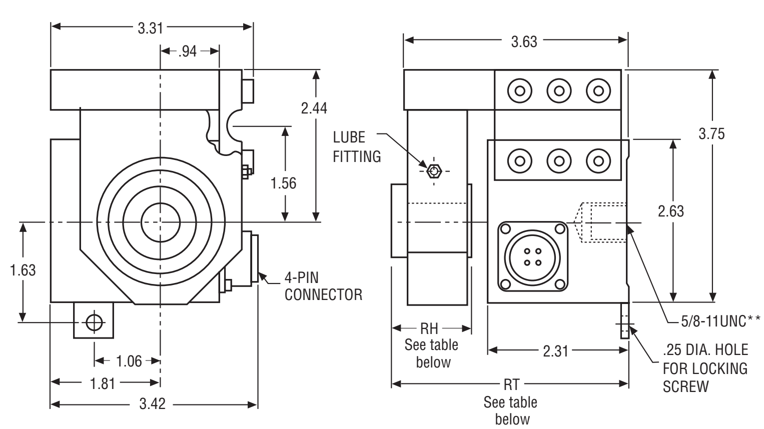
Standard Shaft Diameters

Shaft Diameter	Standard
0.75"	3/4"
1.00"	1"
1.25"	1-1/4"
1.4375"	1-7/16"

Other shaft sizes available on special order - consult factory

C30

Dual Load Cell, Rotating Shaft



Load Ratings: 20 lbs., 50 lbs., 90 lbs., 200 lbs., 500 lbs.
Note: Other load ratings available - consult factory.

Selecting the Correct Tension Control

Selecting the correct tension control is as important as selecting the proper tension clutch or brake. As the control is the heart of the system which provides the necessary controlling function in the application, selecting the wrong control or inadequate control can be as bad as incorrectly sizing the mechanical portion of the system.

Normally control selection can be very simple if a few simple questions can be answered regarding the application. By doing so, selection can be very easy and painless.

Selection Steps

The following steps outline a simple way of selecting the proper control system for the application.

1. Determine the type of system that is to be used. Will the system be load cell, dancer, or open loop analog control?
2. Next, determine the type of brake or clutch system that the control will be used with. Will this be an electric or pneumatic system?
3. Using the Quick Selection Chart, determine which models may be suitable for the application.

Once the determination of the control/controls has been made for the application, review the specifications for the various controls to determine the characteristics and features that best suit the application and your requirements.

Mechanical Elements

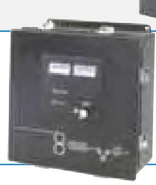
Once the control has been selected, be sure to check that it will work with the brake or clutch previously selected. This can be determined from the specific technical specification for the control selected. Remember, not all controls will work with all clutches and brakes.

If the control selected will not operate the controlling device selected, i.e., clutch or brake, then a different control must be selected.

Control – Quick Selection Guide

Model Number	Output Voltage	System Type: Open Loop: Manual Adjust	System Type: Open Loop: Analog Input Adjust	System Type: Closed Loop: Dancer	System Type: Closed Loop: Load Cell	Air or Electric	Page
MCS2000	0±10 (2 channel) (0–20mA)	●	●	●	●	Air/Electric	46
*TCS-200	0–24	●	●			Electric	56
TCS-200-1	0–24	●	●			Electric	56
TCS-200-1H	0–24	●	●			Electric	56
MCS-203	0–24			●		Electric	61
MCS-204	0–24	●	●			Electric	57
MCS-207	0–10 (1–50mA)			●		Air	63
MCS-208	0–10 (1–50mA)	●	●			Air	59
TCS-210	0–24 (48)			●		Electric	62
TCS-220	0–24 (48)	●	●			Electric	58
TCS-310	0–24 (48) (2 channel)			●		Electric	64
TCS-320	0–24 (48) (2 channel)	●	●			Electric	60

*For new applications, we recommend the TCS-200-1 or TCS-200-1H.

Control	Description	Page Number
MCS2000 	Fully digital control, PLC compatible, which can operate in both open (analog input follower) or closed (dancer or load cell) mode. Directly controls electric clutches and brakes, and air brakes via an electric/pneumatic transducer. Control has two output channels with fully programmable splice logic. Can also be used as a digital front end to an analog drive.	46
TCS-200 	Inexpensive analog control with manual or remote follower adjust for electric brakes. Also accepts roll follower potentiometer input. Requires 24-30 VAC input. For use with MTB Series electric brakes (page 68).	56
TCS-200-1 **TCS-200-1H** 	Extremely versatile and economical open loop control for all 24V electric brakes and clutches. Can be used for manual adjust, or will follow an analog (0–10V, 4–20mA) input, such as from an ultrasonic sensor or PLC. For use with MTB, TB and ATTB Series and magnetic particle electric brakes. (page 68)	56
MCS-203 	Closed loop dancer control for 24V electric clutches and brakes. For use with TB Series, ATTC and ATTB Series and Magnetic Particle clutches and brakes (page 68).	61
MCS-204 	Analog control for 24V electric clutches and brakes. Manual control, or analog (0–10V or 4–20mA) signal. For use with TB Series, ATTC and ATTB Series and Magnetic Particle clutches and brakes (page 68).	57
MCS-207 	Economical closed loop dancer control especially configured for air brakes. Provides a 0–10V or 4–20mA output to E/P transducers. For use with Pneumatic brakes (page 68).	63
MCS-208 	Economical open loop analog control especially configured for air brakes. Provides manual control, or accepts analog input (0–10V or 4–20mA). Same output as MCS-207. For use with Pneumatic brakes (page 68).	59
TCS-210 	Economical closed loop dancer control for all 24V brakes and clutches. Has reserve 48V supply for enhanced E-stop torque with certain brakes. For use with MTB Series electric brakes (page 68).	62
TCS-220 	Analog control for 24V electric clutches and brakes. Manual adjust, or follows analog (0–10V or 4–20mA) input. Reserve 48V overexcite for E-stops. For use with MTB Series electric brakes (page 68).	58
TCS-310 	Dancer splicer control (two output channels) for 24V electric brakes. Full splicing logic, and 48V overexcite for E-stops. For use with MTB Series electric brakes (page 68).	64
TCS-320 	Analog splicer control (two output channels) for 24V electric brakes. 48V overexcite for E-stops. For use with MTB Series electric brakes (page 68).	60

Flexible modular design is the key to trouble-free web tension control!

The MCS2000 Digital Web Tension Controller handles all winding and unwinding applications, either brake or motor operated.

Difficult setups with potentiometer adjustments are no longer a problem. The MCS2000 Web Tension Controller is easily programmed with only four push buttons on a panel-mounted programmer; a handheld programmer; or a Windows driven software package. All programmers employ a simple menu driven format. The unit can also “talk” to a PLC via the RS232 cable.

The power supply AC input auto-ranges from 95 to 264 VAC to avoid any match-up problems. The unit can be used in both open-loop and closed-loop systems. It can also be configured in an “open plus super-imposed/ closed-loop design for very precise tension control applications.

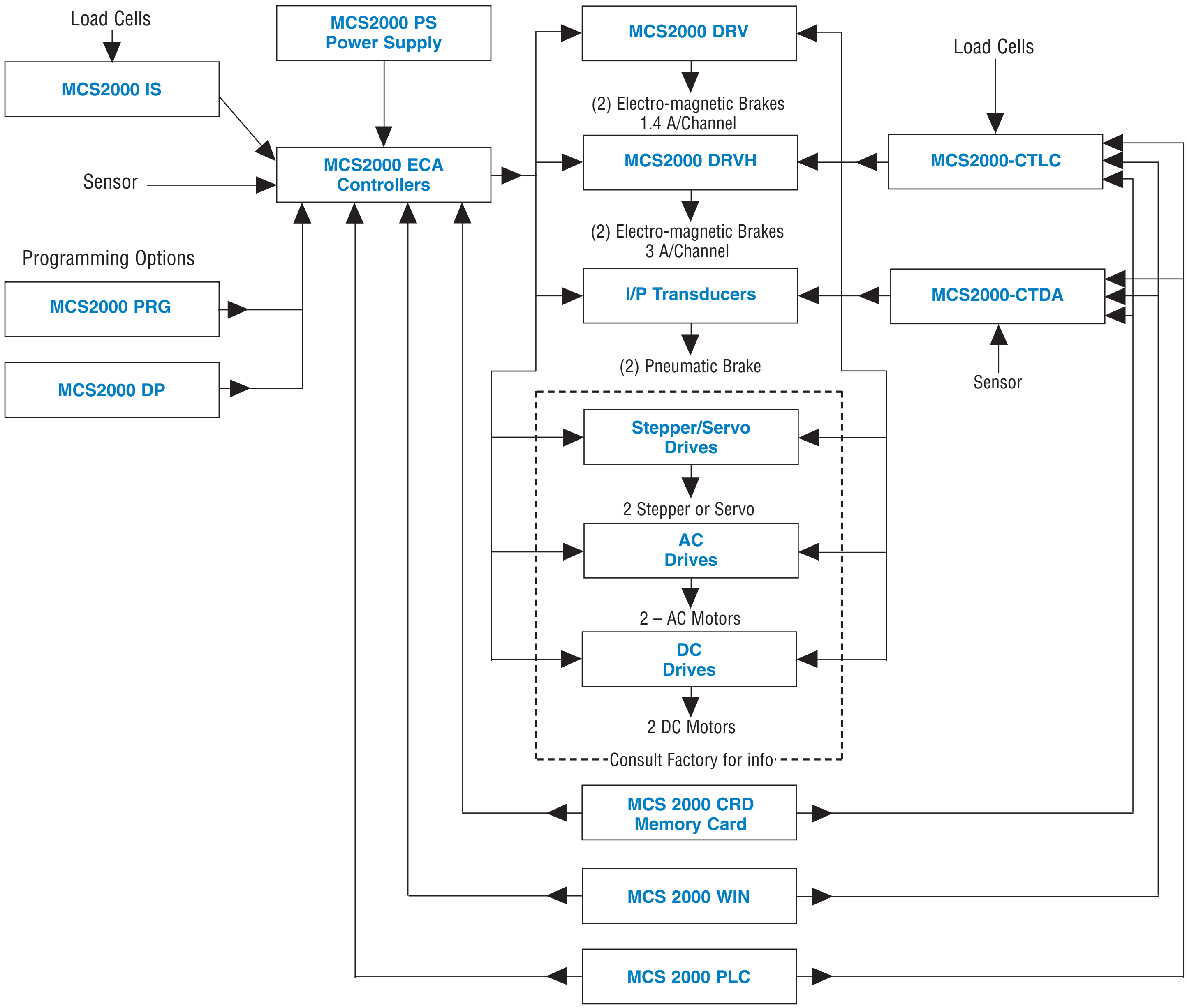
Two types of amplifiers are available for powering electro-magnetic brakes. The amplifiers have outputs for controlling two high-power brakes at 1.4 or 3 Amps per channel, continuous for each brake.

The MCS2000 modules are housed in metal enclosures designed for snap-fit assembly, eliminating screw attachment (patent applied for). All components are on printed circuit boards. Wiring connections are made with quick-disconnect screw terminals.

Features

- Modular system
- Easy to program
- Plug-in memory card for saving parameters
- Programmable in English or French
- PLC compatible
- Optically isolated inputs and outputs
- Dual output in either current or voltage operation mode
- Auto scaling of sensors
- Capable of open-loop operation with an ultrasonic sensor
- Splicing capability
- Windows programming software
- Automatic voltage range of AC input (95-264 VAC)
- Short-circuit protection
- Quick-disconnect wiring terminals
- Capable of controlling dual channel rewind or unwind
- Automatic PID correction - from analog inputs
- 2 x 16 backlit LCD display for programming and parameter readout

Modular Configurations



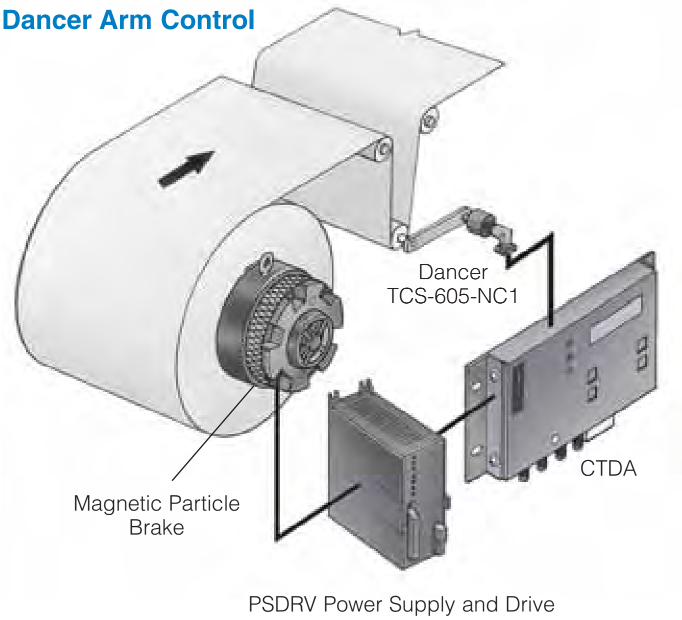
Ordering Information

Model	Feature	Part Number
MCS2000-CTDA	Closed loop dancer arm controller	6910-448-120
MCS2000-CTLC	Closed loop load cell controller	6910-448-121
MCS2000-ECA	Digital programmable controller	6910-448-096
MCS2000-WIN	Windows software	6910-101-096
MCS2000-PS	24 VDC power supply	6910-448-091
MCS2000-DRV	Dual channel 24 VDC driver	6910-448-092
MCS2000-DRVH	Dual channel 48 VDC driver	6910-448-095
MCS2000-PSDRV	24 VDC Power supply & 24 VDC driver	6910-448-093
MCS2000-PSDRVH	24 VDC Power supply & 48 VDC driver	6910-448-094
MCS2000-PSH	48 VDC Power supply, 6 AMP	6910-448-098
MCS2000-PSHA	48 VDC Power supply, 12 AMP	6910-448-088
MCS2000-IS	Dual load cell amplifier	6910-101-092

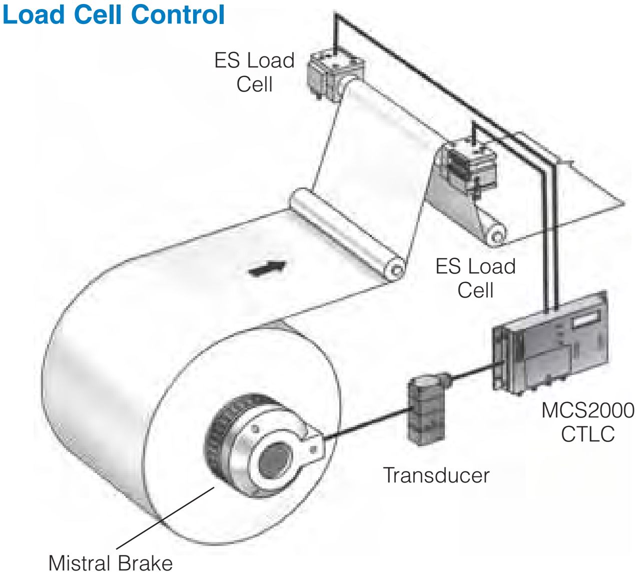
Model	Feature	Part Number
MCS2000-PRG	Handheld programmer	6910-101-090
MCS2000-CRD	Memory card	6910-101-091
MCS2000-DP	Panel mount programmer	6910-101-093
MCS2000-CBL	RS232 cable	6910-101-095
I/P Transducer	0-120 PSI	6910-101-066
Static Switch	Solid state switch	6910-101-007
TCS-605-1	1 turn pivot point sensor (1K)	7330-448-002
TCS-605-5	5 turn pivot point sensor (1K)	7330-448-003
Coupling	Intermittent motion sensor coupling	6910-101-001
Ultrasonic Sensor	4-40" sensing distance	7600-448-001
Ultrasonic Sensor	8-80" sensing distance	7600-448-002

Application Examples

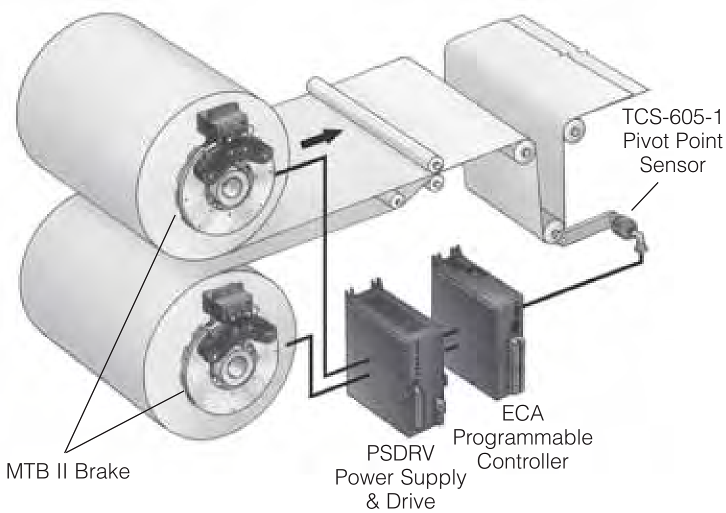
Dancer Arm Control



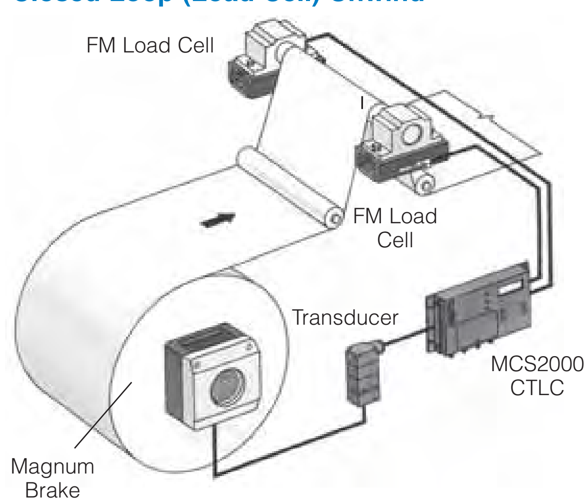
Load Cell Control



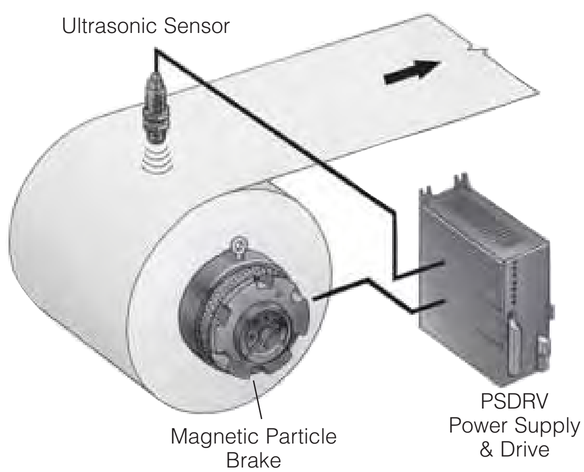
Closed Loop (Dancer Arm) Dual Unwind



Closed Loop (Load Cell) Unwind



Open Loop (Ultrasonic Sensor) Unwind



Closed Loop Control

MCS2000-CTDA

Dancer arm feedback

(P/N 6910-448-120)

MCS2000-CTLC

Load cell feedback

(P/N 6910-448-121)

Both units have especially been designed for user applications. They include all functions for web tension control. The units are equipped with standard power supply, controller front face keyboard and display. The CTLC unit is provided with 2 load cell inputs with selectable sensitivity from 10 mV to 10 V, compatible with most sensors on the market.

Applications

For every web or wire tension control application. Applicable regardless of controlling device (air brake, electric brake or motor).

Common Features

- Scaleable tension readout
- Password protected
- 8 different output options
- Fully digital
- Multi-purpose
- RS232 communications
- Memory card for storing up to 2 full programs
- Windows programming software
- Integral terminal reset
- 2 output channels
- Automatic sensor scaling
- External set point change
- Programmable output configuration
- Output sensor information
- Automatic or imposed PID correction
- Taper Tension Available on other models
- Manual/Auto Operation per front panel pushbutton

MCS2000-WINDOWS

(P/N 6910-101-096)

The Windows programming software package is an icon driven interface for easy setup and parameter changes to the control. It is compatible with any PC running under Windows 3.1 or above. The software can be run under two different modes: demo or connected. The demo mode allows software use without being connected to the control. In the connected mode, the PC and the MCS2000 control must be connected through the RS232 cable.

Specifications

Input Power/Output Power

Input supply	110-240 VAC, switch selectable
Ref. Output	10 VDC, 10mA max.
Sensor Output	±15 VDC, 100mA max.

Performance

Analog input/output resolution	12-bit ADC/DAC, 4096 steps

Analog Inputs

2 analog inputs	0–10 VDC, can be increased upon request (consult factory)
Sensor input	Range: ±10 VDC, delta min. of 4 VDC

Analog Outputs

2 output channels	0–±10 VDC or 0–20mA software adjustable
Brake Power Supply	For use with brake systems, requires power supply/driver module. (See page 51)
Open loop signal output	0–10 VDC, 10mA max.
Digital Inputs	(Activated by connecting the input to ground. Inputs are optically isolated if a separate external 24 VDC supply is used.) Set point adjustment Signal multiplier Open & closed-loop Limit output Integral reset Synchronize ABC input change ABC binary inputs
Digital Outputs	2 binary outputs for sensor error indication
Programming Options	Personal computer or PLC through RS232 cable
Display Options	(Can display 2 parameters on any of the programming options listed.) Set point / Output 1 Sensor value / Output 2 Analog 1 input / Error sensor 1 Analog 2 input / Error sensor 2 PID adaptation IN# for state of digital inputs
Indicator	Green power LED indicator on switch Output 1, 2: Green: 0 + 10 DC Red: 0 - 10 DC Out Window Indication Green: out of limits
Adjustments	Setpoint + Setpoint – Auto/Manual

Saving Options	**Switching Inputs**
Controller stores one full program. Memory card stores two full programs.	Electro-mechanical, rated 24 VDC Solid state, rated 40 VDC, minimum

MCS2000-ECA

(P/N 6910-448-096)

Digital Controller

The MCS2000-ECA is a digital tension controller that can be used in both open-loop and closed-loop systems. It can also be configured as an "open plus superimposed closed-loop" for very precise tension control.

Features

- Programmable output options
- Fully digital
- RS232 communications
- Memory card for storing up to 2 full programs
- Windows programming software
- Integral terminal reset
- 2 output channels
- Automatic sensor scaling
- External set point change
- Digital outputs from sensor input value

Specifications

Input Power/Output Power

Input Supply	24 VDC
Ref. Output	10 VDC, 10mA max.
Sensor Output	±15 VDC, 100mA max.

Performance

Analog input/output resolution	12-bit ADC/DAC, 4096 steps

Analog Inputs

2 analog inputs	0–10 VDC, can be increased upon request (consult factory)
Sensor input	Range: ±10 VDC, delta min. of 4 VDC

Analog Outputs

2 output channels	0–±10 VDC or 0–20mA software adjustable
Open loop signal output	0–10 VDC, 10mA max.

Digital Inputs	(Activated by connecting the input to ground. Inputs are optically isolated if a separate external 24 VDC supply is used.) Set point adjustment Signal multiplier Open & closed-loop Limit output Integral reset Synchronize ABC input change ABC binary inputs Inverse sensor polarity
Digital Outputs	2 binary outputs for sensor error indication
Programming Options	Personal computer or PLC through RS232 cable
Display Options	(Can display 2 parameters on any of the programming options listed.) VIA MCS2000-DP or MCS2000-PRG Set point Sensor value Analog 1 input Analog 2 input Output 1 Output 2 IN# for state of digital inputs Error sensor 1 Error sensor 2 PID adaptation
Indicator	Green power LED indicator

Saving Options	**Switching Inputs**
Controller stores one full program.	Electro-mechanical, rated 24 VDC
Memory card stores two full programs.	Solid state, rated 40 VDC, minimum

MCS2000-PS

(P/N 6910-448-091)

MCS2000-DRV, -DRVH, -PSDRV

(P/N 6910-448-092, 6910-448-095, 6910-448-093)

MCS2000-PSDRVH

(P/N 6910-448-094)

Power Supply

The MCS2000-PS Power Supply is designed to provide +24 VDC to the MCS2000-ECA Programmable Controller and/or the MCS2000-DRV module. If your system requires a 24 VDC power supply and an electro-magnetic brake driver, these components are available as a single package (MCS2000-PSDRV).

The packaged unit has the same features and specifications as the MCS2000-PS and MCS2000-DRV units alone.

Features

- Auto-ranging AC input
- Short circuit and overload protection
- Quick-disconnect terminals

Specifications

Input Power/Output Power

Input supply	110-230 VAC, ±15%, 50/60 Hz
Output supply	+24 VDC, 3.1A

MCS2000-PSH

Input supply	95-264 VAC, ±10%,
Output supply	48 VDC @ 6 Amps, 6910-448-098

MCS2000-PSHH

Input supply	95-264 VAC, ±10%,
Output supply	48 VDC @ 12 Amps, 6910-448-088

Drivers

MCS2000-DRV

This module serves as a dual-channel 24 VDC driver for two electro-magnetic brakes at 1.4 amps per channel. This module requires a separate 24 VDC power source for operation.

MCS2000-DRVH

This module serves as a high voltage dual channel 48 VDC driver for two electro-magnetic brakes at 3.0 amps per channel steady state, 6 amps peak for overcurrent. This module requires a separate 48 VDC power source for operation.

Power Supply/Drivers

MCS2000-PSDRV

Single package module with both power supply and dual channel driver in a single enclosure. This module can be used to power the MCS2000-ECA and operate two electro-mechanical brakes up to 1.4 amps/channel for closed-loop operation. For open-loop operation the module can be operated as a stand alone power supply driver.

MCS2000-PSDRVH

Single package module consisting of a 24VDC power supply and dual channel 48VDC driver. This module can be used to power the MCS2000-ECA and requires a separate 48VDC power supply to operate two electro-mechanical brakes up to 3.0 amps/channel for closed-loop operation. For open-loop operation the module can be operated as a stand alone power supply/driver with a separate 48VDC power supply.

Specifications

Input Power/Output Power	
Input supply	
DRV	+24VDC, ±10%, 1.4 Amps per channel
DRVH	+48VDC, ±10%, 3 Amps per channel
Ref. output	10 VDC, 10mA max.
Analog Inputs	
DRV, DRVH	Two 0–10 VDC inputs Two scalable inputs
DRVH	Additional two 0–20mA inputs
Analog Outputs	
DRV	Two 0–24 VDC 1.4A cont. 3A peak/ channel
DRVH	Two 0–48 VDC, 3A cont., 6A peak/channel w/o scaled outputs, 0–10DC, 10mA max.
Indicators	Two LED output indicators for channels A and B.
Adjustments	Anti-residual adjustment for each channel Offset adjustment for scalable input for each channel Gain adjustment for scalable input
Common Features	Short circuit and overload protection Quick disconnect terminals

MCS2000-DP
(P/N 6910-101-093)

Panel Mounted Programmer

A panel-mounted programming unit for the MCS2000-ECA Programmable Controller. A 6-foot shielded cable (provided with the unit) plugs into the 9-pin connector on top of the MCS2000-ECA.

Features

- 2 x 16 character backlit LCD display
- Powered by MCS2000-ECA Programmable Controller
- Easy-to-use menu-driven programming
- Requires only four push buttons for operation
- Can be used to display two different operating parameters while the system is running.

MCS2000-PRG
(P/N 6910-101-090)

Handheld Programmer

A handheld programming unit for use with the MCS2000-ECA Programmable Controller. A quick-disconnect cable (provided with the unit) plugs into a 4-position jack on the ECA.

Features

- 2 x 16 character backlit display
- Powered by MCS2000-ECA Programmable Controller
- Easy-to-use menu-driven programming
- Requires only four push buttons for operation
- Can be used to display two different operating parameters while the system is running.

MCS2000-CRD
(P/N 6910-101-091)

Memory Card

1 9/16" x 9/16" memory card for storing up to two full programs (port A or port B). Plugs into a slot in the MCS2000-ECA Programmable Controller.

Features

- Program memory (port A) can be downloaded off the card simply by cycling power to the MCS2000-ECA Programmable Controller.
- Card memory is protected against inadvertent erasures by a stray magnetic field.

MCS2000-IS

(P/N 6910-101-092)

Load Cell Interface

The interface sensor will sum and amplify the input signals from two load cells, and can be used with a number of different load cells. The interface should be positioned close to the load cells to ensure that no noise is injected into the low voltage signal before it is amplified.

Specifications

Input Power/Output Power	
Input supply	+24 VDC, ±10%, 300mA
Load cell supply	±15 VDC or ±5 VDC, 100mA max.
Analog Inputs	
2 load cell inputs	Range: Any voltage between 20 mV and 10 VDC, 5KΩ input impedance
Ultrasonic input	Range: 0–10 VDC, delta min. of 1 V, 10KΩ input impedance, Maximum gain: 1000
3 inputs for line speed	Range: 0–10 VDC, 10KΩ impedance
Analog Outputs (Short circuit protected)	
Calibrated load cell/ ultrasonic-sensor output	0–10 VDC, 10mA max.
Power for ultrasonic sensor	+24 VDC
Voltage reference	10 VDC, 10mA
Adjustments	Select polarity of ultrasonic sensor output, SW1 Select polarity of voltage reference, SW2 Setup min. & max. values for the load cell or ultrasonic input, SW3 Adjust gain of load cell inputs (p1, p2), 450 min., 1000 max. Adjust load cell offset (p3, p4), ±5 V Adjust gain of summed load cell (p5), 1 min., 2 max. Adjust gain on line speed (p6), 0–10 V Adjust offset for ultrasonic input (p7), 2.5 V max. Adjust gain for ultrasonic input (p8), 1 min., 5 max. Adjust gain for selected output (p9), 0.2 min., 1.1 max.
Indicators	Green power indicator Red 10-digit display indicates W3 setting

Electro-Pneumatic Transducer

(P/N 6910-101-066)

Used for interfacing with pneumatic brakes. Warner Electric offers a convenient package that consists of an air filter with automatic moisture drain, together with one I/P (current-pressure) transducer.

Specifications

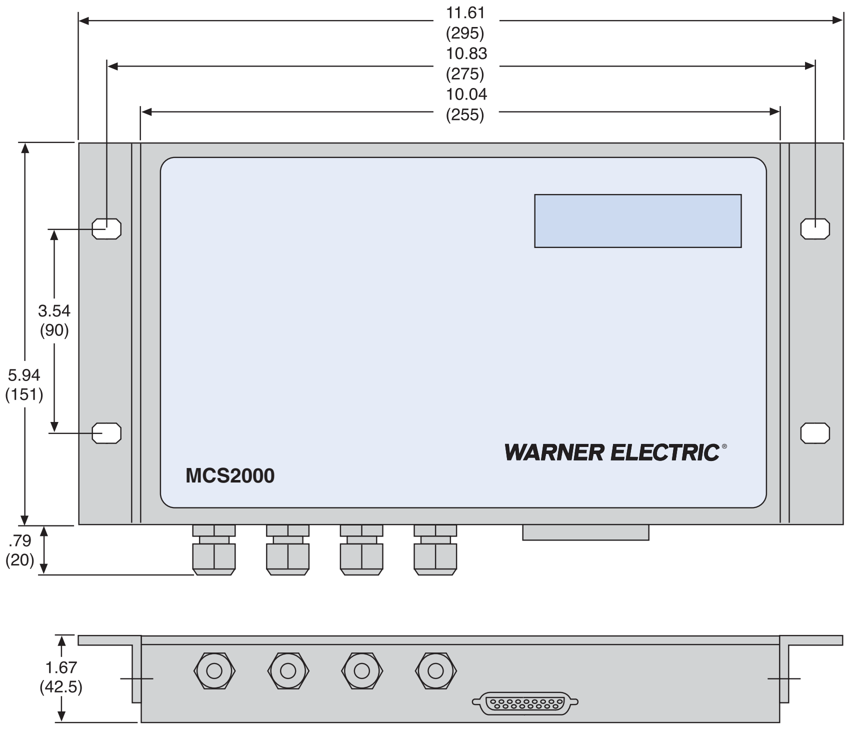
Input signal	4–20mA
Output range	0–120 Psig.
Supply pressure	20–150 Psig. **Note:** Supply pressure to the transducer must always be at least 5 Psig. above the maximum output pressure required for the brake.
Temperature range	-20˚F to 150˚F
Minimum air consumption	6.0 (SCFH) at 15 Psig.
Supply pressure effect	1.5 Psig. for 25 Psig. supply change
Pipe size	1/4” NPT (transducer and filter)

Tension Controls

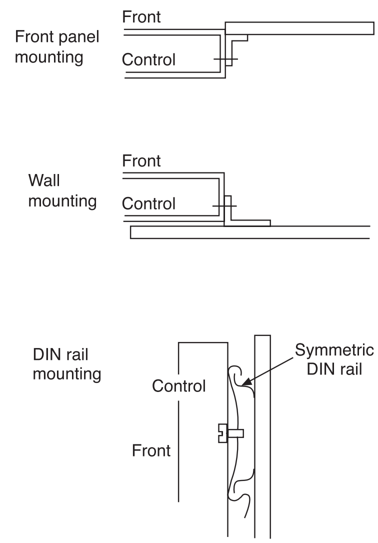
MCS2000 Series Web Tension Control Systems

Dimensions

Closed Loop Controls

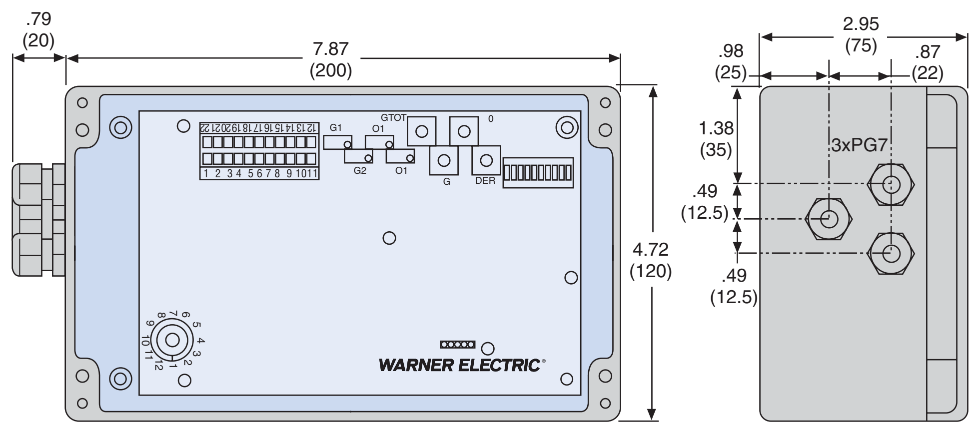


-CTDA, -CTLC

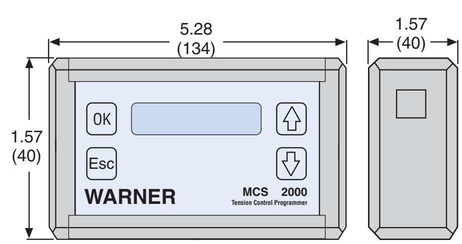


Mounting

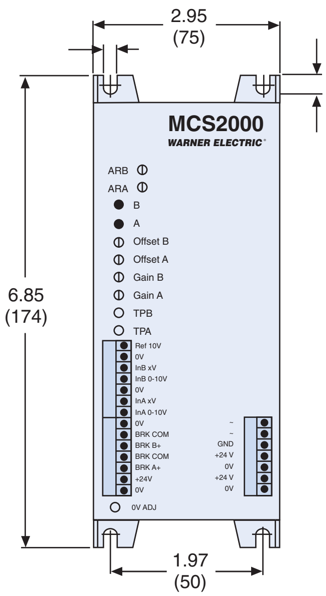
Load Cell Interface



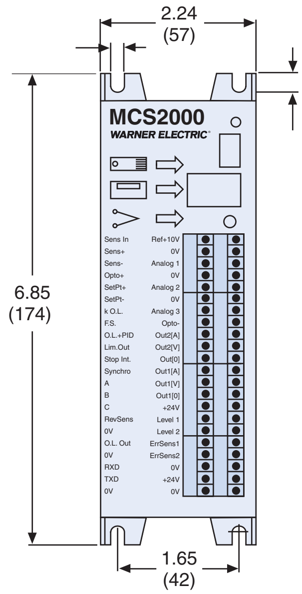
-IS



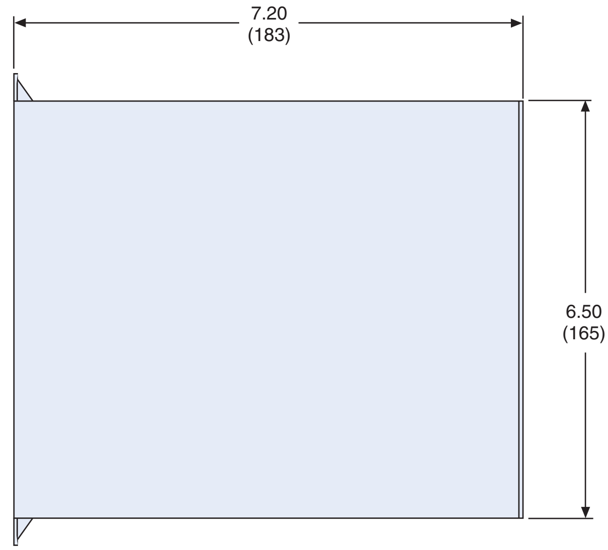
-PRG



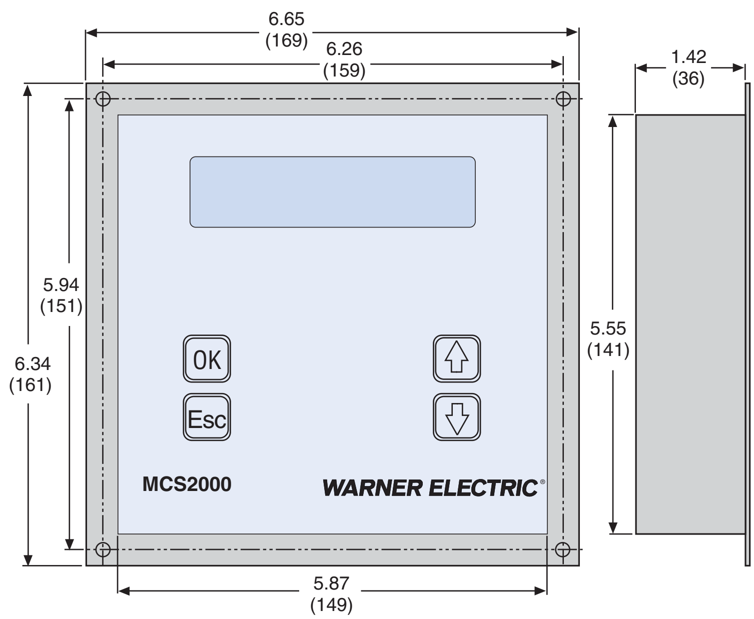
-PS
-DRV/DRVH
-PSDRV/PS DRVH



-ECA



Typical



-DP

Weight

MCS2000	Lbs.
-ECA	2.00
-PS	2.00
-DRV	2.00
-DRV8	2.00
-DRVH	2.00
-PSDRV	2.00
-PSDRV8	2.00
-PRG	0.50
-DP	1.50
-IS	1.50
-CTDA	4.50
-CTLC	4.50

Tension Controls

Analog/Manual Control for Electric Brake Systems

TCS-200-1
(P/N 6910-448-086)

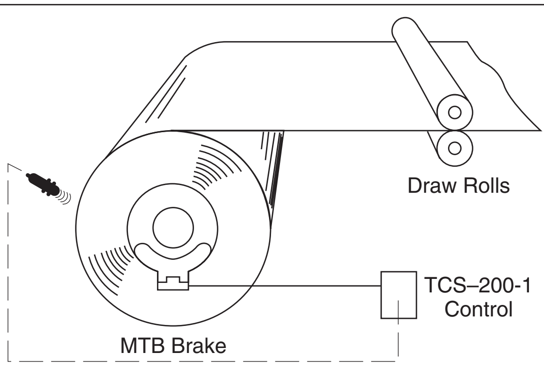
TCS-1H
(P/N 6910-448-087)

TCS-200
(P/N 6910-448-055)

Analog/Manual Control

The Analog/Manual Control is a basic, low cost, open loop control for manual type operation of Electro Disc tension brakes. A remote torque control function is available that enables the operator to control the desired tension from any convenient location. A roll follower feature provides automatic adjustment of brake torque proportional to roll diameter change. For the TCS-200-1 and TCS-200-1H analog inputs can be followed.

Typical System Configuration



The complete system consists of:

1. Tension brake
2. Analog tension control
3. Control power supply
4. Optional sensor inputs (customer supplied)

The control unit maintains a current output to the tension brake based on an analog input or the manual setting of the control tension adjustment dials. Varying the current from the control creates more or less brake torque for tension adjustability.

Specifications

Input	
TCS-200	24–30 VAC, ±10%, 56/60 Hz, single phase
TCS-200-1, TCS-200-1H	115/230 VAC, ±10%, 50/60 Hz, single phase
Output	
TCS-200	PWM full wave rectified, 0–3.24 amps current controlled
TCS-200-1	Adjustable 0–24 VDC, 4.25 amps maximum continuous
TCS-200-1H	Adjustable 0–24 VDC Maximum of 5.8 amps continuous
	Can be used with any 24 VDC tension brake. TCS-200 requires sense coil for operation. Sense Coil – 275-3893 TCS-200-1 and TCS-200-1H can be used with or without sense coil.
Ambient Temperature	
TCS-200	–20° to +115°F (–29° to +46°C)
TCS-200-1, TCS-200-1H	–20° to +125°F (–29° to +51°C)
Sensor Inputs	
Remote Torque Adjust	
TCS-200, TCS-200-1, TCS-200-1H	1000 ohms
Roll Follower	
TCS-200	10K ohms
TCS-200-1, TCS-200-1H	1000 ohms
Analog Voltage Input	
TCS-200-1, TCS-200-1H	0–10 VDC (optically isolated when used with an external 15–35 VDC supply)
Analog Current Input	
TCS-200-1, TCS-200-1H	4–20 mA (optically isolated when used with an external 15–35 VDC supply)
Auxiliary Inputs	
Brake Off (all models)	Removes output current to the brakes. Puts the brake at zero current.
Brake On (all models)	Applies full voltage to the connected brake.
Front Panel Adjust	
Tension Adjust (all models)	Provides current adjust to the brake from 0–100%. In the remote mode, provides for maximum output level set to the brake.
Brake Mode Switch (all models)	Allows for full brake on, run, or brake off modes of operation to the brake.
Indicators (all models)	Green LED power indicator showing AC power is applied to the control. Red LED short circuit indicator showing shorted output condition. Resettable by going to brake off mode with front panel switch.
General (all models)	The control chassis must be considered NEMA 1 and should be kept clear of areas where foreign material, dust, grease, or oil might affect control operation.

Note: When used with other than MTB magnets, inductive load must be supplied – PN 275-3843. Consult factory for details.

MCS-204

(P/N 6910-448-017)

(Shown with Housing)

Remote/Analog control

The MCS-204 control, also completely solid state, is designed for manual or analog input control. The MCS-204 can control two 24 VDC tension brakes in parallel. It also has an antiresidual (magnetism) circuit, a brake on and a highly accessible terminal strip for rapid connection. It is designed for use with the MCS-166 power supply.

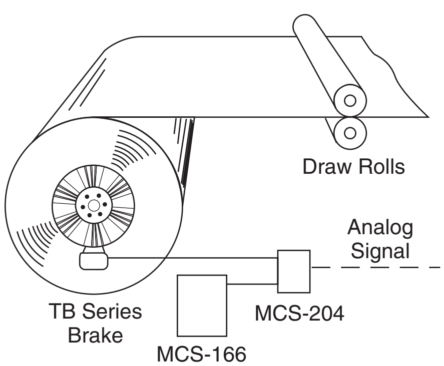
MCS-166 Power Supply (page 65).

Specifications

Input	24-28 VDC @ 3 Amps (from MCS-166, 1.5 amps for single MCS-166; 3.0 amps from dual MCS-166's) or other power source.
Output	Pulse with modulated 0-24 VDC for 24 volt Warner Electric tension brakes.
Ambient Temperature	–20° to +113°F (–29° to +45°C).
External Inputs	
Torque Adjust	Controls tension by applying the desired amount of current to the brake.
Brake On	Applies full current to tension brake.
Brake Off	Removes brake current and applies antiresidual voltage to eliminate brake drag. Useful when changing rolls.
Operating Modes	
Local Torque Adjust	Knob on front panel.
Remote Torque Adjust	Via remote potentiometer.
Roll Follower	Using external potentiometer.
Current Loop	1–5 mA, 4–20 mA, 10–50 mA. Voltage Input: 0–14.5 VDC.
Mounting	Available for panel mounting with exposed wiring or wall/shelf mounting with conduit entrance. Must be ordered with either wall/shelf or panel enclosures.

Requires enclosure, see page 66.

Typical System Configuration



The complete system consists of:

1. Tension brake
2. Analog tension control
3. Control power supply
4. Analog signal input (customer supplied)

The control unit maintains a current output to the tension brake based on an analog input or the manual setting of the control tension adjustment dials. Varying the current from the control creates more or less brake torque for tension adjustability.

Tension Controls

Analog Control for Electric Brake Systems

TCS-220

(P/N 6910-448-027)

(Shown with Housing)

The remote analog input control is an open loop system designed to allow easy interface with existing or specially designed customer controls to complete a closed loop system. The system also offers complete operator controllability for manual tensioning control.

TCS-167 Power Supply, (page 65).

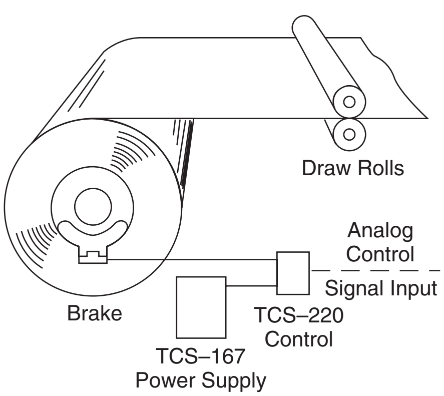
Note: When used with other than MTB magnets, a resistor, 68 ohms, 25 watts, must be added. Consult factory for details.

Specifications

Input	**TCS-220** – 48 VDC @ 1.6 Amps continuous, 48 VDC @ 6 Amps intermittent, 1.6% duty cycle, 30 sec. on time, 8–12 VDC @ 1.5 Amps. **TCS-167** – 120 VAC, 50/60 Hz or 240 VAC, 50/60 Hz (Switch selectable).
Output	**TCS-220/TCS-167** – 0–270 mA/magnet (running); 270–500 mA/magnet (stopping).
Ambient Temperature	–20° to +113°F (–29° to +45°C).
External Inputs	
Torque Adjust	Controls tension by applying the desired amount of current to the brake.
Emergengy Stop	Applies full current to tension brake.
Brake Off	Removes brake current and applies antiresidual current to eliminate brake drag. Useful when changing rolls.
Operating Modes	
Local Torque Adjust	Knob on front panel.
Remote Torque Adjust	Via 1K to 10K ohm potentiometer.
Roll Follower	Via 1k to 10k ohm potentiometer.
Current Loop	1–5 mA, 4–20 mA, 10–50 mA current source.
Voltage Input	0–14.5 VDC.
Adjustments	
Torque Adjust/Span	Controls output manually in local torque mode. Sets maximum control span in remote torque adjust, roll follower, current loop; or voltage input mode.
Zero adjust	Potentiometer adjustment for setting zero output level. Front panel access.
Brake off input	Terminal strip connection which provides for removal of brake current and applies antiresidual current to eliminate brake drag. Used primarily when changing rolls.
Brake on input	Terminal strip connection applies full current to brake when activated regardless of input control signal. Used for emergency stops.
Mounting	**TCS-220** – available as panel mounted with exposed wiring, or wall/shelf mounted with conduit entrance. **TCS-167** – Available with open frame or wall/shelf mounted enclosure with conduit

Requires enclosure, see page 66.

Typical System Configuration



The complete system consists of:

1. Tension brake
2. Analog tension control
3. Control power supply
4. Analog signal input (customer supplied)

The control unit maintains a current output to the tension brake based on an analog input or the manual setting of the control tension adjustment dials. Varying the current from the control creates more or less brake torque for tension adjustability.

MCS-208

(P/N 6910-448-067)

(Shown with Housing)

The MCS-208 control, also completely solid state, is designed for manual or analog input control. The MCS-208 features a highly accessible terminal strip for rapid connection, and it is designed for use with the MCS-166 Power Supply.

The remote analog input control is an open loop system designed to allow easy interface with existing or specially designed customer controls to complete a closed loop system. The system also offers complete operator controllability for manual tensioning control.

MCS-166 Power Supply, (page 65).

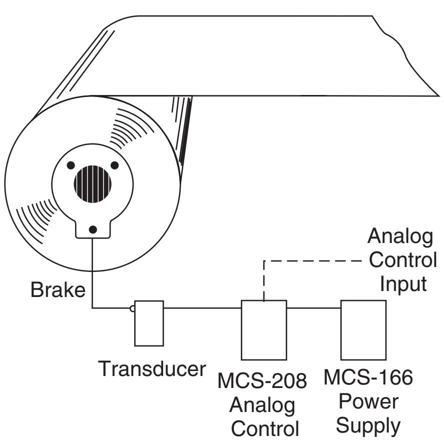
Note: When used with other than MTB magnets, a 68 ohm, 25 watt resistor must be added. Consult factory for details.

Specifications

Input Power	24–28 VDC, 0.5 amps maximum (from MCS-166 power supply or other source)
Outputs	Switch selectable current or voltage Voltage: 0–10 VDC Current: 1–5 mA, 4–20 mA, 10–50 mA Will operate most electric to pneumatic transducers available.
Ambient Temperature	+32° to +120°F (0° to +49°C).
External Inputs	
Brake On	Applies maximum output signal (voltage or current) to the transducer
Brake Off	Removes output from the transducer and applies minimum levels
Adjustments	
Front Panel	**Zero Adjust:** Provides for adjustment of minimum input to correspond to minimum output levels **Torque Adjust/Span:** Provides for manual adjust in manual mode, or span adjustment when in other operating modes
Operating Modes	Local torque adjust Remote torque adjust Roll follower Analog voltage input Analog current input
Mounting	Available with panel mounting with exposed wiring or wall/shelf mounting with conduit entrances. **Note:** Must be ordered with wall/shelf enclosure or with panel mount enclosure.

Requires enclosure, see page 66.

Typical System Configuration



The complete system consists of:

1. Pneumatic tension brake
2. Analog tension control
3. Control power supply
4. Analog signal input (customer supplied)
5. E to P transducer

The control unit maintains a current output to the tension brake based on an analog input or the manual setting of the control tension adjustment dials. Varying the current from the control creates more or less brake torque for tension adjustability.

Tension Controls

Analog Splicer Control for Electric Brake Systems

TCS-320

(P/N 6910-448-043)

The analog splicer control provides dual brake functions with manual operator or analog input control requiring simultaneous brake tensioning and holding.

The system also offers complete operator controllability for manual tensioning control.

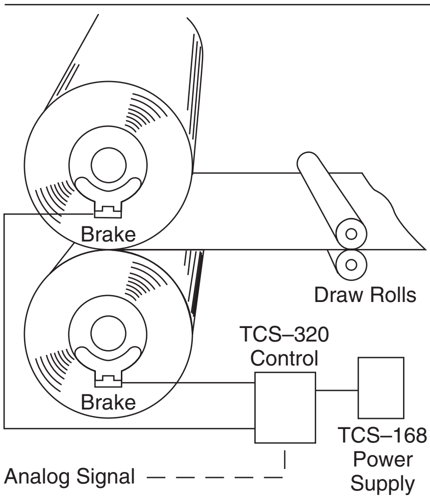
TCS-168 Power Supply, (page 65).

Note: When used with other than MTB magnets, a 68 ohm, 25 watt resistor must be added. Consult factory for details.

Specifications

Input	**TCS-320** – 48 VDC @ 3.2 Amps continuous, 48 VDC @ 12 Amps intermittent, 1.6% duty cycle, 30 sec. on time, 8–12 VDC @ 3.0 Amps. **TCS-168** – 120 VAC, 50/60 Hz or 240 VAC, 50/60 Hz (Switch selectable).
Output	**TCS-320/TCS-168** – 0–270 mA/magnet (running); 270–500 mA/magnet (stopping) on controlled output channel, 0 to 90 mA/magnet (typ.) on holding output channel.
Ambient Temperature	–20° to +113°F (–29° to +45°C).
External Inputs	
Torque Adjust	Controls tension by applying the desired amount of torque to the brake.
Brake On	Applies full current to tension brake.
Brake Off	Removes brake current and applies antiresidual current to eliminate brake drag. Useful when changing rolls.
Operating Modes	
Local Torque Adjust	Knob on front panel.
Remote Torque Adjust	Via 1K to 10K ohm potentiometer.
Roll Follower	Via 1k to 10k ohm potentiometer.
Current Loop	1–5 mA, 4–20 mA, 10–50 mA current source.
Voltage Input	0–14.5 V DC.
Adjustments	
Torque Adjust/Span	Controls output manually in local torque mode. Sets maximum control span in remote torque adjust, roll follower, current loop, or voltage input mode.
Zero adjust	Potentiometer adjustment for setting zero output level. Front panel access.
Brake off input	Terminal strip connection which provides for removal of brake current and applies antiresidual current to eliminate brake drag.
Brake on input	Terminal strip connection applies full current to brake when activated regardless of input control signal. Used for emergency stops.
Mounting	**TCS-168** – available with open frame or wall/shelf mounted enclosure with conduit entrance. **TCS-320** – available as open frame or a NEMA 4 enclosure with remote control station.

Typical System Configuration



The complete system consists of:

1. Two tension brakes
2. Analog splicer control
3. Control power supply
4. Analog signal input (customer supplied)

The control unit maintains a current output to the tension brake based on an analog input or the manual setting of the control tension adjustment dials. Varying the current from the control creates more or less brake torque for tension adjustability.

The TCS-320 can function as a splicer control or a dual brake control. With the use of the jumper board (included), the TCS-320 can control up to 24 magnets.

MCS-203

(P/N 6910-448-014)

(Shown with Housing)

The completely solid state MCS-203 Dancer Control Module is designed for automatic web tensioning through the use of a dancer roll. The MCS-203 can control two 24 VDC tension brakes in parallel. It works on the concept of a P-I-D controller and has internal P, I & D adjustments for optimum performance regardless of brake size.

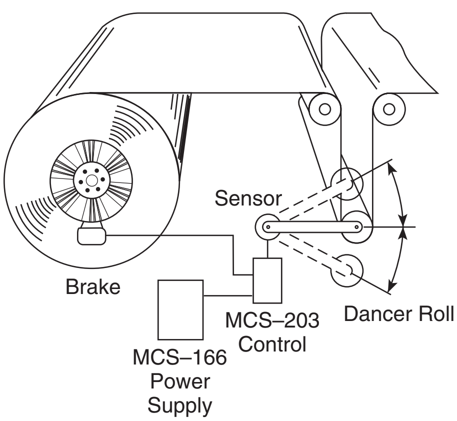
MCS-166 Power Supply, (page 65).

Specifications

Input	24–28 VDC @ 3 Amps (from MCS-166, 1.5 amps for single MCS-166; 3.0 amps from dual MCS-166's) or other power source.
Output	Pulse width modulated 0–24 VDC for 24 volt Warner Electric tension brakes.
Ambient Temperature	–20° to +113°F (–29° to +45°C).
External Inputs	
Dancer Potentiometer	Provides the feedback signal of dancer position and movement for input to the control.
Brake On	Applies full current to tension brake.
Brake Off	Removes brake current and applies antiresidual current to eliminate brake drag. Useful when changing rolls.
Antidrift Input	Nullifies integrator portion of control for faster brake response. Important for splicing and mid-roll starting.
Mounting	Available for panel mounting with exposed wiring or wall/shelf mounting with conduit entrance. Must be ordered with either wall/shelf or panel enclosures.

Requires enclosure, see page 66.

Typical System Configuration



The complete system consists of:

1. Tension brake
2. Dancer tension control
3. Control power supply
4. Pivot point sensor
5. Dancer roll assembly (customer supplied)

The control unit maintains a current output to the tension brake based on an analog input or the manual setting of the control tension adjustment dials. Varying the current from the control creates more or less brake torque for tension adjustability.

Tension Controls

Dancer Control for Electric Brake Systems

TCS-210

(P/N 6910-448-026)

(Shown with Housing)

This closed loop tension control system automatically controls tension on unwinding materials such as paper, film, foil, cloth and wire.

TCS-167 Power Supply, (page 65).

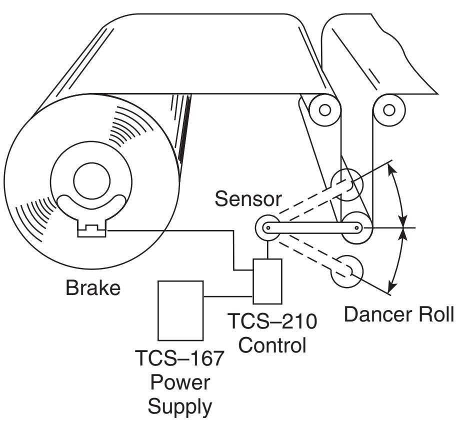
Note: When used with other than MTB magnets, a 68 ohm, 25 watt resistor must be added. Consult factory for details.

Specifications

Input	**TCS-210** – 48 VDC @ 1.6 Amps continuous, 48 VDC @ 6 Amps intermittent, 1.6% duty cycle, 30 sec. on time, 8–12 VDC @ 1.5 Amps. **TCS-167** – 120 VAC, 50/60 Hz or 240 VAC, 50/60 Hz (Switch selectable).
Output	**TCS-210/TCS-167** – 0–270 mA/magnet (running); 270–500 mA/magnet (stopping).
Ambient Temperature	–20° to +113°F (–29° to +45°C).
External Inputs	
Dancer Potentiometer	Provides the feedback signal of dancer position and movement for input to the control.
Brake On	Applies holding brake voltage.
Anti-Drift Input	Nullifies integrator portion of control for faster brake response. Important at startup and for mid-roll starts.
Brake Off	Removes brake current and applies antiresidual current to eliminate brake drag. Useful when changing rolls.
Mounting	**TCS-210** – available as panel mounted with exposed wiring, or wall/shelf mounted with conduit entrance. **TCS-167** – available with open frame or wall/shelf mounted enclosure with conduit entrance.

Requires enclosure, see page 66.

Typical System Configuration



The complete system consists of five components:

1. Tension brake
2. Dancer tension control
3. Control power supply
4. Pivot point sensor
5. Dancer roll assembly (customer supplied)

The weight of the dancer roll or loading on the dancer determines the tension on the web and the remainder of the system operates to hold the dancer roll as steady as possible. When the dancer position changes, the Warner Electric pivot point sensor tracks the direction and speed of the change and sends an electric signal to the closed loop control, which, in turn, relays a corrective signal to the Electro Disc tension brake. Increasing current to the Electro Disc increases braking torque to elevate the dancer to the desired position, while reducing brake current lowers the dancer.

The closed loop dancer control system is completely automatic, limiting the need for operator involvement and the potential for inaccurate tension control. The system offers exceedingly rapid response that, in effect, corrects tension errors before they reach the work area of the processing machine.

MCS-207

(P/N 6910-448-066)

(Shown with Housing)

The dancer control, MCS-207 is designed for automatic web tensioning through the use of a dancer roll.The MCS-207 can control either a voltage to pneumatic or current to pneumatic transducer with an air operated clutch or brake. It works on the concept of a P-I-D controller and has internal adjustments of the P-I-D loops for optimum performance regardless of the brake size.

MCS-166 Power Supply, (page 65).

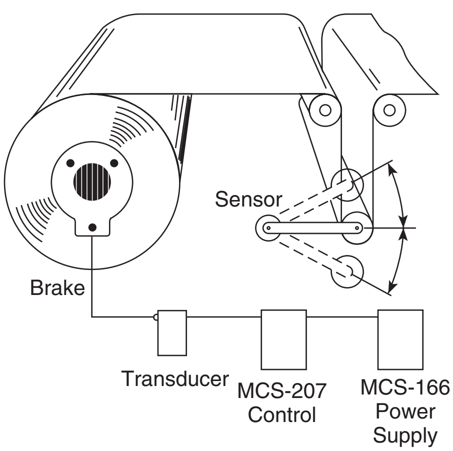
Note: When used with other than MTB magnets, a 68 ohm, 25 watt resistor must be added. Consult factory for details.

Specifications

Input	24–28 VDC, 0.5 amps maximum (from MCS-166 or other power source)
Output	Switch selectable current or voltage Voltage: 0–10 VDC Current: 1–5 mA, 4–20mA, 10–50mA Will operate most electric to pneumatic transducers available.
Ambient Temperature	+32° to +120°F (0° to +49°C).
Control Input	Pivot point sensor, MCS-605-1 or TCS-605-5
External Inputs	
Brake On	Applies maximum output signal (voltage or current) to the transducer
Brake Off	Removes output from the transducer and applies minimum level
Anti-Drift	Provides integrator reset function for mid-roll starting
Adjustments	
Front Panel	**Dancer Position:** sets dancer operating position **Gain:** Controls overall system response based on change of dancer input signal
Mounting	Available as panel mounted with exposed wiring, or wall/shelf mounted with conduit entrance. **Note:** Must be ordered with wall/shelf enclosure or with panel mount enclosure.

Requires enclosure, see page 66.

Typical System Configuration



The complete system consists of:

1. Pneumatic tension brake
2. Dancer tension control
3. Control power supply
4. Pivot point sensor
5. E to P transducer
6. Dancer roll assembly (customer supplied)

The control unit maintains an output to the tension brake based on an analog input or the manual setting of the control tension adjustment dials. Varying the signal from the control creates more or less brake torque for tension adjustability.

Tension Controls

Dancer Splicer Control for Electric Brake Systems

TCS-310

(P/N 6910-448-042)

This closed loop tension control system automatically controls tension on unwinding materials such as paper, film, foil, cloth and wire.

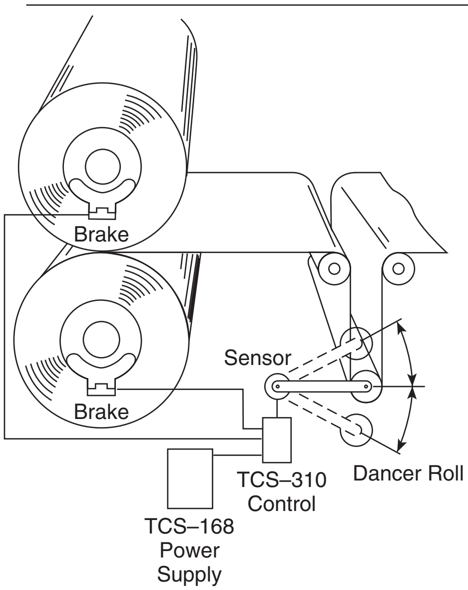
TCS-168 Power Supply, (page 65).

Note: When used with other than MTB magnets, a 68 ohm, 25 watt resistor must be added. Consult factory for details.

Specifications

Input	**TCS-310** – 48 VDC @ 3.2 Amps continuous, 48 VDC @ 12 Amps intermittent, 1.6% duty cycle, 30 sec. on time, 8–12 VDC @ 3.0 Amps. **TCS-168** – 120 VAC, 50/60 Hz or 240 VAC, 50/60 Hz (Switch selectable).
Output	**TCS-310/TCS-168** – 0–270 mA/magnet (running); 270–500 mA/magnet (stopping) on controlled output channel 0 to 90 mA holding channel.
Ambient Temperature	–20° to +113°F (–29° to +45°C).
External Inputs	
Dancer Potentiometer	Provides the feedback signal of dancer position and movement for input to the control.
Brake On	Applies holding brake voltage.
Anti-Drift Input	Nullifies integrator portion of control for faster brake response. Important for start-ups.
Brake Off	Removes brake current and applies antiresidual current to eliminate brake drag. Useful when changing rolls.
Mounting	**TCS-310** – available as open frame or as NEMA 4 enclosure with remote control station. **TCS-168** – available with open frame or wall/shelf mounted enclosure with conduit entrance.

Typical System Configuration



The complete system consists of five components:

1. Two tension brakes
2. Dancer splicer control
3. Control power supply
4. Pivot point sensor
5. Dancer roll assembly (customer supplied)

The weight of the dancer roll or loading on the dancer determines the tension on the web and the remainder of the system operates to hold the dancer roll as steady as possible. When the dancer position changes, the Warner Electric pivot point sensor tracks the direction and speed of the change and sends an electric signal to the closed loop control, which, in turn, relays a corrective signal to the Electro Disc tension brake. Increasing current to the Electro Disc increases braking torque to elevate the dancer to the desired position, while reducing brake current lowers the dancer.

The closed loop dancer control system is completely automatic, limiting the need for operator involvement and the potential for inaccurate tension control. The system offers exceedingly rapid response that, in effect, corrects tension errors before they reach the work area of the processing machine.

Tension Controls

Power Supplies and Accessories

MCS-166

(P/N 6910-448-013)

(Shown with Housing)

Power Supply for MCS-203, MCS-204, MCS-207, and MCS-208 Controls

Warner Electric's MCS-166 is the companion power supply module to be used with MCS-203 and MCS-204 tension controls. The MCS-166 supplies the 24–28 VDC that these systems require. The MCS-166 is a modular unit designed to couple with its respective control or it can be mounted separately. It is also fused for overload protection, has a voltage indicator light, and is internally protected against 240 VAC input when set for 120 VAC.

Specifications

Input

120 VAC 50/60 Hz or 240 VAC 50/60 Hz (switch selectable).

Output

24–28 VDC (1.5 Amps).

Note: For dual brake application, two MCS-166's are required, 3.0 amps output.

Ambient Temperature

–20° to +113°F (–29° to +45°C).

Mounting

Available for panel mounting with exposed wiring or wall/shelf mounting with conduit entrance. Must be ordered with either wall/shelf or panel enclosures.

Requires enclosure, see page 66.

TCS-167

(P/N 6910-448-025)

The TCS-167 power supply is designed to provide the correct power input to MCS-207, TCS-210, and TCS-220 tension controls. Its switch selectable input allows the user to adapt to 120 or 240 VAC. It has dual voltage circuits to provide low voltage power and anti-residual output as well as power to operate a brake. The TCS-167 is available with an enclosure or open frame for control panel mounting.

Specifications

Input

120 VAC or 220/240 VAC, ± 10%, 50/60 Hz, 1 phase. (switch selectable)

Output

Unregulated 9-12 VDC @ 1.5 Amps

Unregulated 48 VDC @ 1.6 Amps continuous, 48 VDC @ 6 Amps intermittent, 1.6% duty cycle, 30 seconds on time.

Ambient Temperature

-20°F. to +113°F. (-29°C. to +45°C.)

Mounting

Open frame or enclosed wall/shelf mount with conduit entrance

TCS-168

(P/N 6910-448-032)

The TCS-168 power supply is designed to provide the correct power input to the TCS-310 Dancer Splicer Control and the TCS-320 Analog Splicer Control. Its switch selectable input allows the user to adapt to 120 or 240 VAC. It has dual voltage circuits to provide low voltage power and anti-residual output as well as power to operate two brakes. The TCS-168 is available with an enclosure or open frame for control panel mounting.

Specifications

Input

120 VAC or 220/240 VAC, +_ 10%, 50/60 Hz, 1 phase. (switch selectable)

Output

Unregulated 9-12 VDC @ 3 Amps

Unregulated 48 VDC @ 3.2 Amps continuous, 48 VDC @ 6 Amps intermittent, 1.6% duty cycle, 30 seconds on time.

Ambient Temperature

-20°F. to +113°F. (-29°C. to +45°C.)

Mounting

Open frame or enclosed wall/shelf mount with conduit entrance

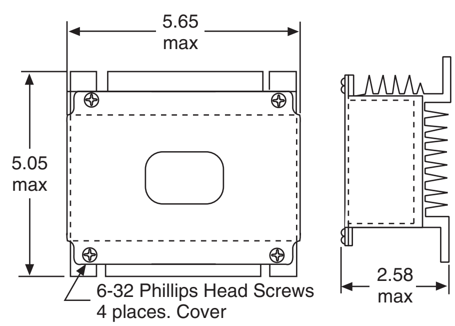
Magnet Selector Static Switch

The magnet selector switch allows magnets to be dynamically or statically added or removed from the tension system to be tailored to the application need. Examples include shedding magnets for narrow, light webs near core or adding magnets for emergency stops.

Each selector switch provides two circuits, each capable of switching up to four magnets.

How to Order

To order, specify Magnet Selector Static Switch 6910-101-007.

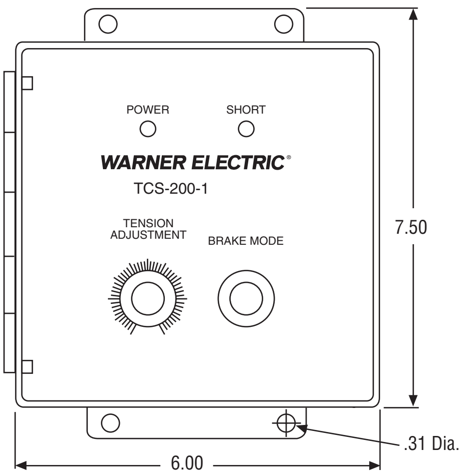


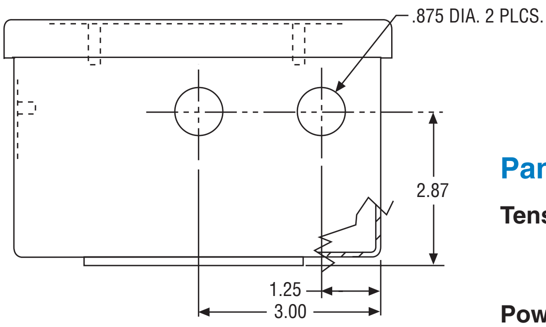
Tension Controls

Dimensions/Enclosures

Dimensions

TCS-200-1

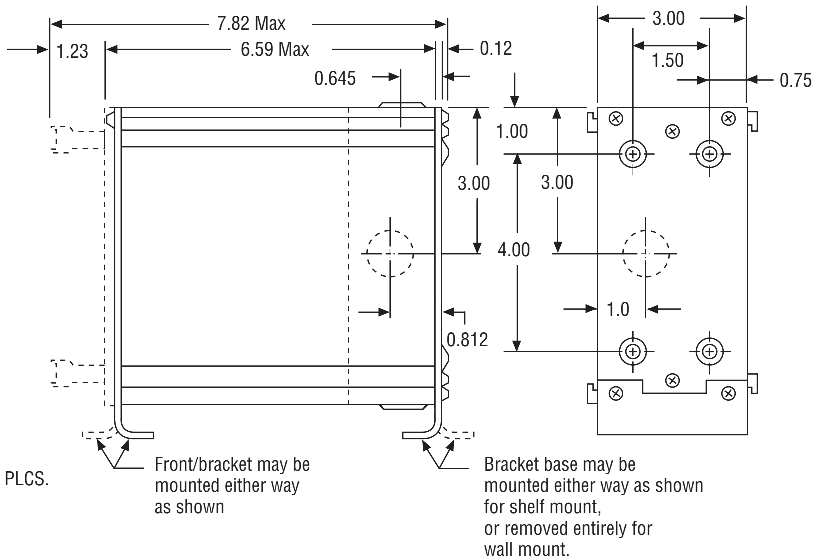




Wall/Shelf Mount

Tension Controls – For use with MCS-203, MCS-204, MCS-207 or MCS-208 order part number 6910-448-016.
For use with TCS-210 or 220, order part number 6910-448-029.

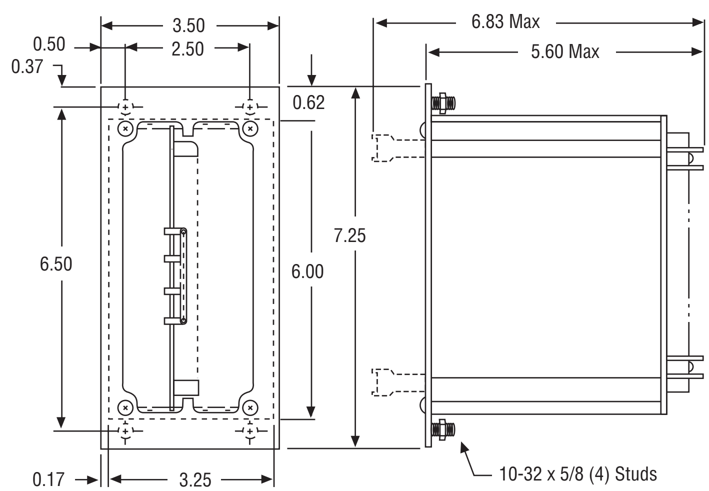
Power Supplies – For use with MCS-166, order part number 6910-448-019.



Panel Mount

Tension Controls – For use with MCS-203, MCS-204, MCS-207 or MCS-208 order part number 6910-448-015.
For use with TCS-210 or 220, order part number 6910-448-028.

Power Supplies – For use with MCS-166, order part number 6910-448-018.

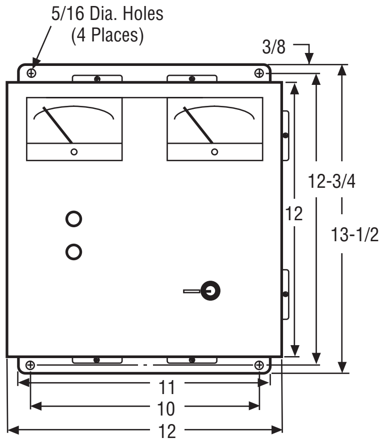


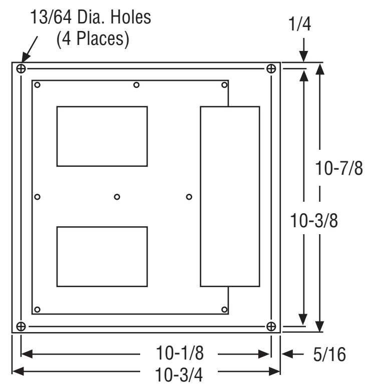
Ribbon Cable

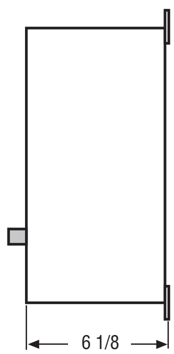
A ribbon cable has been added to the rear terminal board of the MCS-203/204/207/208 and MCS-166 enclosures to improve performance and reliability. The upgrade is fully retrofitable and enclosure part numbers have not changed.

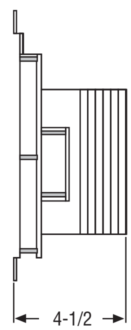
Dual Brake Controls

TCS-310, TCS-320





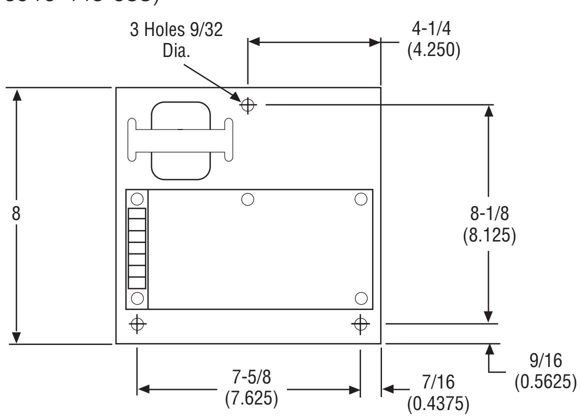


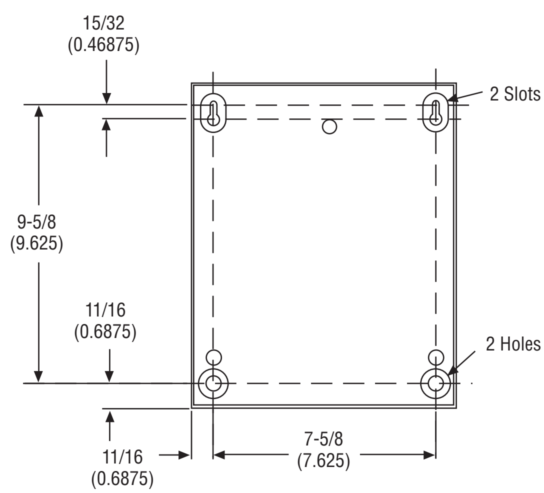


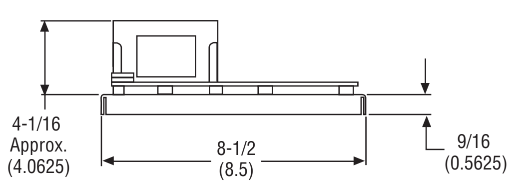
Power Supplies

TCS-167, TCS-168

(P/N 6910-448-033)







Selection Guide

Selecting the proper clutch or brake starts with collecting the appropriate data. See the data form on page 13. Once the data is collected, go through the various calculations for thermal and torque requirements. Examples are on pages 16-28. At this point, a general selection can be made from these two pages. Then go to the applicable page for further details on the unit such as mounting considerations and dimensions.

Finally, a control system must be chosen – several factors will influence this choice, such as degree of accuracy required (open vs. closed loop), physical restraints in the machine (dancer or load cell). Go to the controls section on page 44 for full specifications and details on these various controls systems.

Once control system is selected, determination of dancer, load cell, or analog system can be made. Dancer design considerations can be found on pages 33-37. Load cell design considerations and sizing can be found on pages 38-43.

You are now well on the way to specifying the best tension control system available.

	Product	Description and most suitable applications
Electric	**TB Series**  Brakes	**Basic Tension Brakes** Single disc friction electromagnetic brake. Operates with any Warner 24V or 90V control. Very economical. Excellent life when properly sized.
	ATT Series  Brakes & Clutches	**Advanced Technology Brakes & Clutches** The tension version of the popular Warner Electric Advanced Technology clutches and brakes. Economical and easy to install. The clutch has an easily adaptable pulley mounting. Operated by full family of Warner Electric tension controls, 24V and 90V.
	MTB Series  Brakes	**Modular Tension Brakes** Single or double disc electromagnetic brake uses multiple pucks for precise selection of torque range. Unique design provides up to double normal operating torque for E-stops. Works with all Warner Electric 24V tension controls.
	M Series  Brakes & Clutches	**Permanent Magnet Brakes & Clutches** These units can be used as either clutch or brakes. They operate with permanent magnets, thereby requiring no external power source. Very accurate torque control is manually adjustable.
	Magnetic Particle  Brakes & Clutches	**Magnetic Particle Brakes & Clutches** Very precise torque control in an enclosed unit that does not have friction discs, but employs magnetically charged powder that varies torque according to current. Works with all Warner Electric 24V tension controls.

Heat Transfer Capacity

Dynamic Torque Rating	Continuous Operation	On-Off Operation	Typical Applications and Comments	Page No.
0.50–256 lb.ft.	.02–1.1 HP	.03–2.12 HP	Narrow to medium width web machines such as business forms presses. Also good on wire pay-offs. A low-cost alternative in many applications.	72
7–62 lb.ft. Up to 83 lb.ft. with overcurrent	.3 to .9 HP	—	Light tension on narrow web paper or plastic film, such as bag making machines and printing presses. Clutch provides a good, economical solution on many winders.	78
0.21–592 lb.ft. Up to 1,120 lb.ft. with overcurrent	.25–2.75 HP	—	The work horse of the brake line. Wide dynamic torque range. Good for business forms presses, wire pay-offs, slitters, coaters. Excellent choice for closed loop as well as open loop systems.	86
0–65 lb.in.	3-150 watts	—	Excellent problem solver for difficult light tension applications. Particularly good for nip-roll control where diameter compensation is not required. Perfect solution for wire braiders and twisters where pay-off is spinning. No control required.	98
.17–578 lb.ft.	10-400 watts	—	Excellent solution where wear particles of friction disc units cause a problem. Very precise torque regulation. Will operate with great accuracy at lower speeds than friction disc units. Staying within thermal capacity is critical for long life.	106

Tension Brakes and Clutches

Selection Guide

	Product	Description and most suitable applications
Pneumatic	**Mistral**  Brakes	**Pneumatic Brakes** The Mistral combines high thermal capacity with a rugged, easy-to-maintain design. No guard is required. Both open and closed loop controls available. Optional cooling fan increases heat dissipation.
Pneumatic	**Magnum**  Not for New Applications. FOR INFORMATION ONLY. Brakes	**Pneumatic Brakes** High thermal capacity and easy to service this brake requires no guard. Optional fan increase thermal capacity. Easily controllable in both open and closed loop mode.
Pneumatic	**AD Series**  Not for New Applications. FOR INFORMATION ONLY. Brakes	**Pneumatic Brakes** Broad range of torque capacities accessible by selection of modular actuators. All control options are available.
Pneumatic	**MODEVO**  Brakes	**Pneumatic Brakes** Combination of high thermal capacity and broad range of torques through various selection of actuators and friction pads. Option for increase thermal capacities.

Heat Transfer Capacity (Continued)

Dynamic Torque Rating	Continuous Operation	On-Off Operation	Typical Applications and Comments	Page No.
5.2–1,328 lb.ft.	3.2–6.4 HP	3.5–7.0 HP	The brake of choice in the corrugator industry due to long life and ease of maintenance. Other converting industry applications apply equally.	130
0.16–1,180 lb.ft.	1.5–6.0 HP 4.0–22.0 HP w/forced air cooling	—	This brake is well accepted among converting equipment manufacturers worldwide. Slitters, coaters, and laminators are but a few of the many applications.	134
3.8–1,785 lb.ft.	1–3.2 HP 4–6.5 HP with optional blower	—	The multiple actuator selection possibilities make this an excellent choice for machines running a variety of materials on a wide range of tensions.	138
0.6–3,180 lb.ft.	1–17 HP 4-18 HP with optional blower	—	Compatiblities of various actuator and friction pad combinations allow for wide range of applications.	144

Electric Brakes

TB Series – Basic Tension Brakes

System Features

- Full roll to core control
- Consistent tension, even during flying splices, rapid starts and emergency stops
- Eliminates web flutter to allow better registration control
- Electronic System responds in milliseconds
- Dramatically reduces material waste, downtime and maintenance
- Total systems capability—worldwide distribution—local professional service.

Features – Basic Tension Brakes

- Ideal for light duty, light load unwind tension applications
- Cost effective
- Compact package size
- Eight models
- Small sizes, from 1.7" dia. to 15.25" dia.
- .025 to 1.09 thermal horsepower capacity

Complete Control Capability

Warner Electric offers two functionally different controls and a companion power supply for all models of TB Series 24 VDC tension brakes. All three units offer compact dimensions and modular design for easy, low cost maintenance. Both controls (MCS-203/MCS-204) and the power supply are furnished with either a panel mount or wall/shelf mount enclosure at no added cost. Controls information starts on page 44.

MCS-203
Dancer Control

MCS-204
Remote/Analog
Control

Unit Size	Energy Rate Continuous	Energy Rate Alternate[1]	Maximum RPM	Minimum[2] Torque (lb.ft.)	Maximum[3] Dynamic Torque (lb.ft.)	Amps	Ohms	Watts
TB-170	0.02 HP	0.03 HP	5000	0.000	0.500	.215	111.2	5.16
TB-260	0.04 HP	0.06 HP	5000	0.060	1.700	.400	60	9.6
TB-425	0.08 HP	0.13 HP	5000	0.120	5.200	.317	76	7.6
TB-500	0.13 HP	0.24 HP	5000	0.150	18.500	1.0	24	24
TB-825	0.27 HP	0.48 HP	3000	0.360	43.200	1.18	20	28
TB-1000	0.48 HP	0.88 HP	2400	0.790	88.000	1.22	20	29
TB-1225	0.70 HP	1.27 HP	2000	1.430	172.000	1.08	22	26
TB-1525	1.09 HP	2.12 HP	1600	2.130	256.000	1.21	20	29

Notes

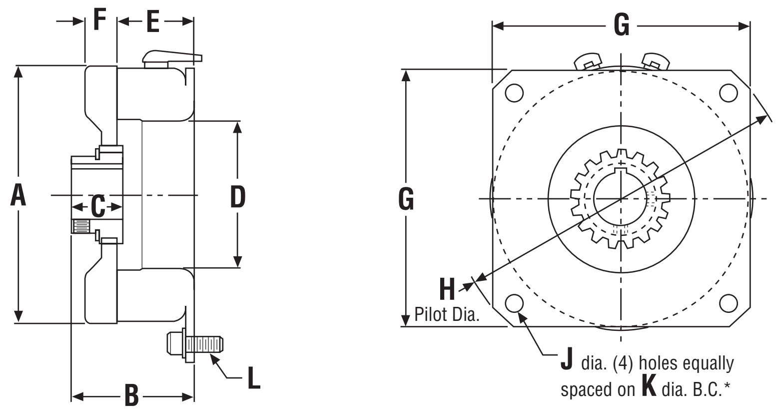
1. Alternate duty operation is defined as 30 minutes run-time with 30 minutes off-time
2. Minimum torque is with Warner Electric tension control providing anti-residual current to brake in off state. Minimum torques will be higher when controls without anti-residual current are used.
3. Dynamic torques are based on 30 RPM slip speed

Dimensions

TB-170

TB-260

TB-425



* Mounting holes are within .010" (.254) of true position relative to pilot diameter.

inches (mm)

Model	A Max.	B Max.	C	D	E	F	G Max.	H	J	K	L
TB-170	1.813 (46.05)	1.203 (30.55)	.404 (10.26)	.750 (19.05)	.812 (20.64)	.281 (7.14)	1.828 (46.43)	2.437/2.435 (61.90/61.85)	.204/.187 (5.18/4.75)	2.125 (53.98)	#8-32 UNC-3A
TB-260	2.719 (69.06)	1.906 (48.42)	.6875 (17.46)	1.375 (34.93)	1.250 (31.75)	.4688 (11.91)	2.641 (67.08)	3.500/3.498 (88.90/88.85)	.204/.187 (5.18/4.75)	3.125 (79.38)	#8-32 UNC-3A
TB-425	4.375 (111.13)	2.047 (51.99)	.875 (22.23)	2.437 (61.91)	1.250 (31.75)	.5625 (14.29)	4.266 (108.36)	5.625/5.623 (142.88/142.82)	.296/.280 (7.52/7.11)	5.000 (12.70)	#1/4-20 UNC-3A

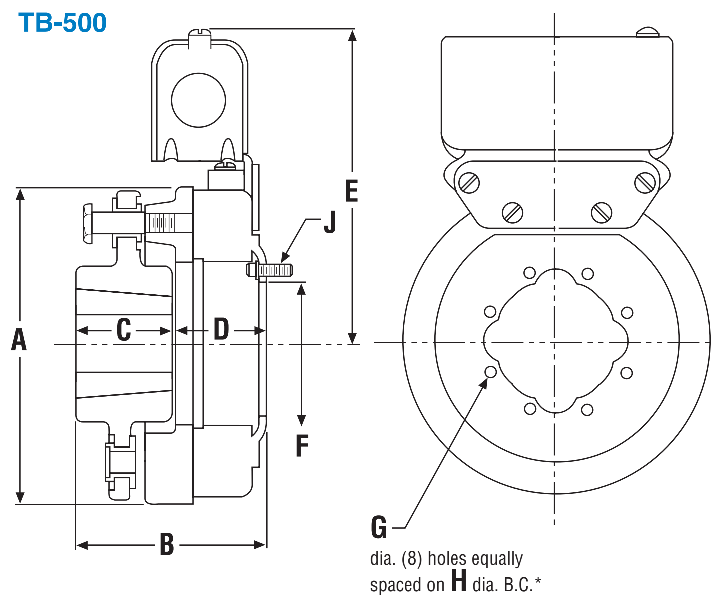
Bore and Keyway Data

Model No.	Part No.	Voltage	Bore	Keyway
TB-170	5375-1	6V	1/4"	none
	5375-4	24V	1/4"	none
	5375-2	6V	5/16"	none
	5375-5	24V	5/16"	none
	5375-3	6V	3/8"	none
	5375-6	24V	3/8"	none
TB-260	5365-2	6V	3/8"	3/32" x 3/64"
	5365-8	24V	3/8"	3/32" x 3/64"
	5365-3	6V	7/16"	1/8" x 1/16"
	5365-9	24V	7/16"	1/8" x 1/16"
	5365-4	6V	1/2"	3/16" x 3/32"
	5365-10	24V	1/2"	3/16" x 3/32"
	5365-5	6V	5/8"	3/16" x 3/32"
	5365-11	24V	5/8"	3/16" x 3/32"
	5365-6	6V	3/4"	3/16" x 3/32"
	5365-12	24V	3/4"	3/16" x 3/32"
TB-425	5367-5	6V	1/2"	1/8" x 1/16"
	5367-9	24V	1/2"	1/8" x 1/16"
	5367-6	6V	5/8"	3/16" x 3/32"
	5367-10	24V	5/8"	3/16" x 3/32"
	5367-7	6V	3/4"	3/16" x 3/32"
	5367-11	24V	3/4"	3/16" x 3/32"
	5367-8	6V	7/8"	3/16" x 3/32"
	5367-12	24V	7/8"	3/16" x 3/32"

Model No.	Part No.	Voltage	Bushing	Bore	Keyway
TB-500	5310-2 5310-24	6V 24V	Dodge 1215 (see pg 155 for for specific P/N)	1/2–9/16 5/8–7/8 15/16–1-1/4	1/8" x 1/16" 3/16" x 3/32" 1/4" x 1/8"

Dimensions

TB-500



* Mounting holes are within .010" (.254) of true position relative to pilot diameter.

inches (mm)

Model	A Max.	B Max.	C	D	E Max.	F	G	H	J
TB-500	5.125 (130.18)	3.140 (79.77)	1.500 (38.10)	1.594 (40.48)	5.062 (128.59)	2.062 (52.39)	.208/.201 (5.28/5.11)	2.375 (60.33)	#8-32 UNC-3A

For replacement parts list and exploded view drawing, see page 76.

Note: All dimensions are nominal unless otherwise noted.

Electric Brakes

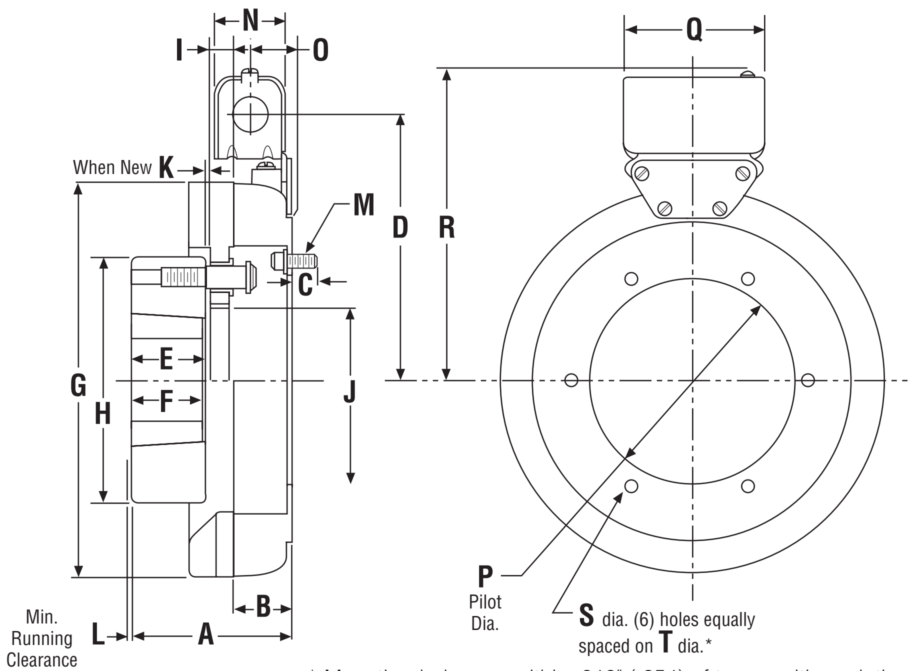
TB Series – Basic Tension Brakes

Dimensions

TB-825

TB-1000

TB-1225



* Mounting holes are within .010" (.254) of true position relative to pilot diameter.

inches (mm)

Model	A Max.	B	C Max.	D	E	F	G Max.	H Dia.	I	J Dia.
TB-825	3.671 (93.24)	1.312 (33.32)	.562 (14.27)	5.656 (143.66)	1.593 (40l.46)	1.500 (38.10)	8.468 (215.09)	4.625 (117.48)	.609 (15.47)	2.187 (55.55)
TB-1000	4.109 (104.37)	1.453 (36.91)	.562 (14.27)	6.531 (165.89)	1.906 (48.41)	1.750 (44.45)	10.187 (258.75)	6.250 (158.75)	.609 (15.47)	3.875 (94.83)
TB-1225	5.390 (136.91)	1.6740 (41.66)	.562 (14.27)	7.531 (191.29)	3.000 (76.20)	3.000 (76.20)	12.437 (315.90)	6.875 (174.63)	.609 (15.47)	4.500 (114.30)

Model	K Min.	L	M	N	O	P Max.	Q	R	S	T
TB-825	.093 (2.36)	.062 (12.57)	5/16-18 UNC-3A	1.546 (39.27)	.921 (23.39)	3.503/3.501 (88.98/88.93)	3.750 (95.25)	6.406 (162.71)	.358/.338 (9.09/8.59)	4.250 (107.95)
TB-1000	.093 (2.36)	.062 (1.57)	5/16-18 UNC-3A	1.546 (39.27)	.921 (23.39)	5.378/5.376 (136.60/136.55)	3.750 (95.25)	7.687 (195.25)	.358/.338 (9.09/8.59)	6.125 (155.58)
TB-1225	.093 (2.36)	.062 (1.57)	5/16-18 UNC-3A	1.546 (39.27)	.921 (23.39)	6.378/6.376 (162.00/161.95)	3.750 (95.25)	8.687 (220.65)	.358/.338 (9.09/8.59)	7.250 (184.15)

See page 155 for specific bushing part numbers.

Bore and Keyway Data

Model #	Part #	Voltage	Bushing	Bore	Keyway
TB-825	5311-2	6V	Dodge 1615	1/2–9/16	1/8" x 1/16"
	5311-24	24V	(see pg 159 for	5/8–7/8	3/16" x 3/32"
			for specific P/N)	15/16–1-1/4	1/4" x 1/8"
				1-5/16–1-3/8	5/16" x 5/32"
				1-7/16–1-1/2	3/8" x 3/16"
				1-9/16–1-5/8	3/8" x 3/16"
TB-1000	5312-1	6V	Dodge 2517	1/2–9/16	1/8" x 1/16"
	5312-24	24V	(see pg 159 for	5/8–7/8	3/16" x 3/32"
			for specific P/N)	15/16–1-1/4	1/4" x 1/8"
				1-5/16–1-3/8	5/16" x 5/32"
				1-7/16–1-3/4	3/8" x 3/16"
				1-13/16–2-1/4	1/2" x 1/4"
				2-5/16–2-1/2	5/8" x 5/16"

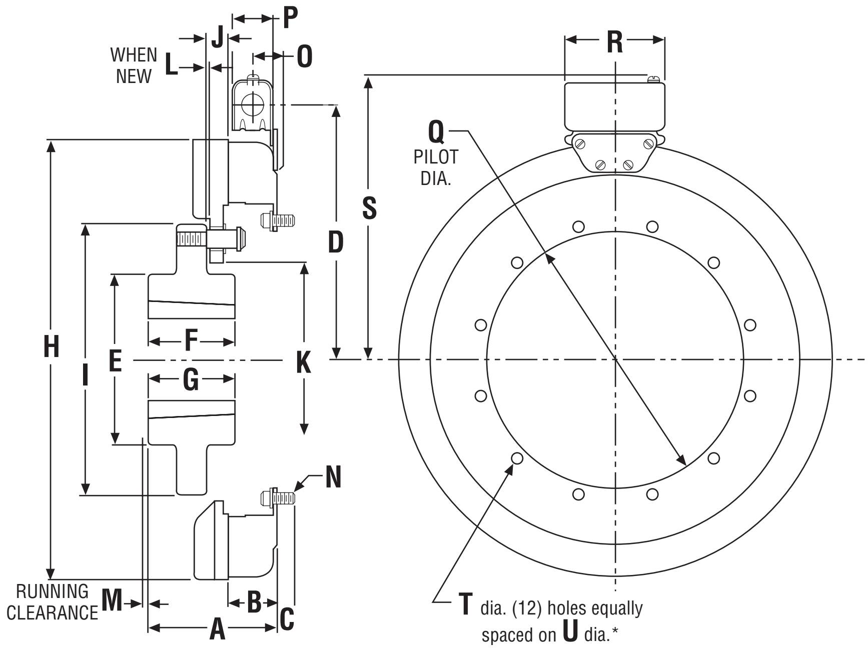
Model #	Part #	Voltage	Bushing	Bore	Keyway
TB-1225	5313-1	6V	Dodge 3030	15/16–1-1/4	1/4" x 1/8"
	5313-24	24V	(see pg 155 for	1-5/16–1-3/8	5/16" x 5/32"
			for specific P/N)	1-7/16–1-3/4	3/8" x 3/16"
				1-13/16–2-1/4	1/2" x 1/4"
				2-5/16–2-3/4	5/8" x 5/16"
				2-13/16–3	3/4" x 3/8"
TB-1525	5314-1	6V	Dodge 3030	15/16–1-1/4	1/4" x 1/8"
	5314-24	24V	(see pg 155 for	1-5/16–1-3/8	5/16" x 5/32"
			for specific P/N)	1-7/16–1-3/4	3/8" x 3/16"
				1-13/16–2-1/4	1/2" x 1/4"
				2-5/16–2-3/4	5/8" x 5/16"
				2-13/16–3	3/4" x 3/8"

For replacement parts list and exploded view drawing, see page 77.

Note: All dimensions are nominal unless otherwise noted.

Dimensions

TB-1525



* Mounting holes are within .010" (.254) of true position relative to pilot diameter.

inches (mm)

Model	A Max.	B	C Max.	D	E Dia.	F	G	H Dia.	I Dia.	J Dia.	K Dia.
TB-1525	4.531 (115.09)	1.750 (44.45)	.562 (14.27)	9.187 (233.35)	6.000 (152.40)	3.000 (76.2)	3.000 (76.2)	15.562 (395.27)	9.500 (241.30)	.609 (15.47)	7.125 (180.98)

Model	L	M Min.	N	O	P Max.	Q	R	S	T	U
TB-1525	.093 (2.36)	.062 (1.57)	5/16-18 UNC-3A	.921 (23.39)	1.546 (39.27)	9.002/9.000 (228.65/228.60)	3.750 (95.25)	10.343 (262.71)	.358/.338 (9.09/8.59)	9.750 (247.65)

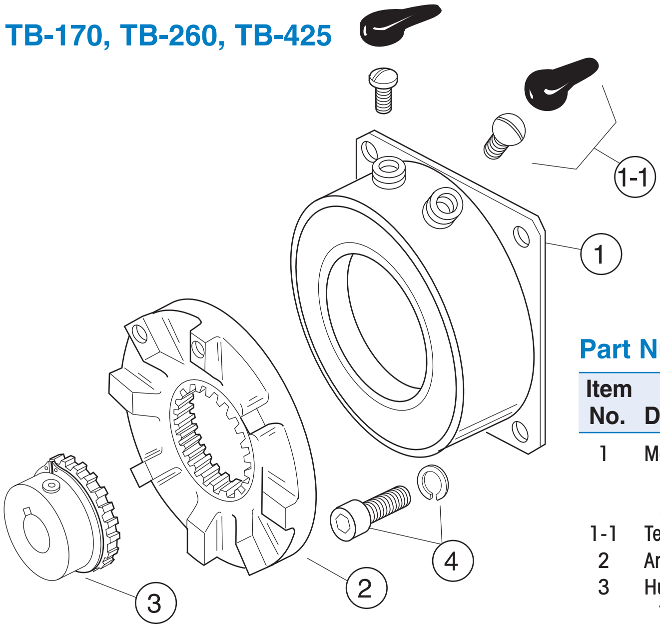
See page 155 for specific bushing part numbers.
For replacement parts list and exploded view drawing, see page 77.

Note: All dimensions are nominal unless otherwise noted.

Brake Assemblies and Part Numbers

TB Series – Basic Tension Brakes

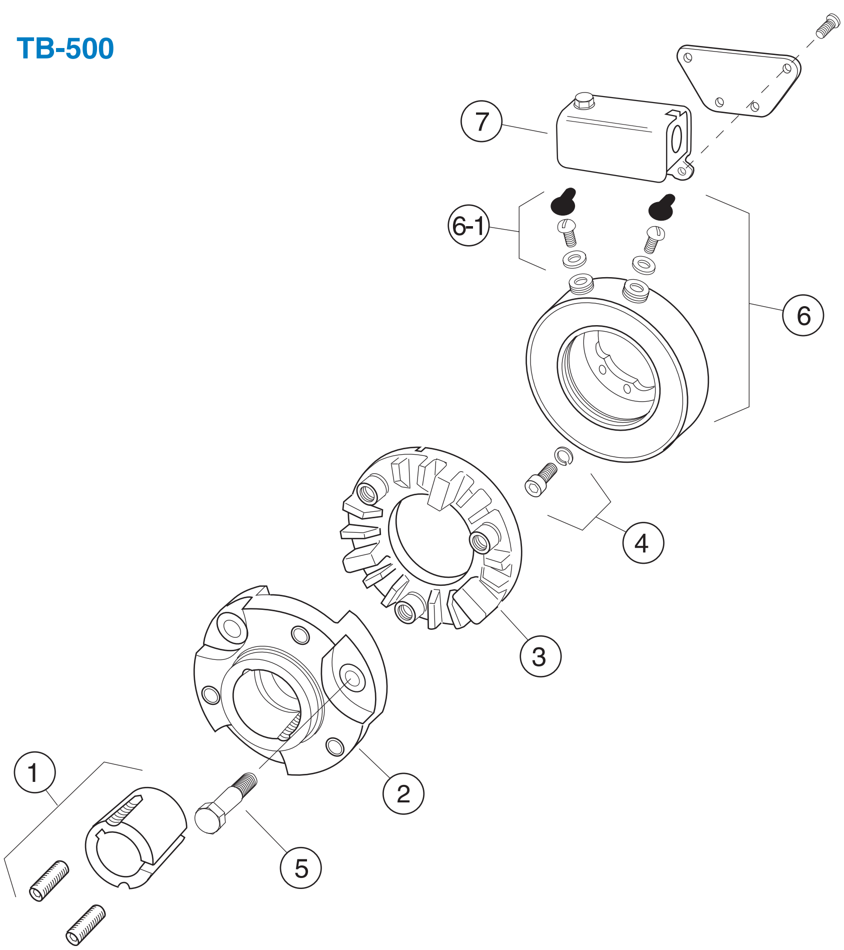
TB-170, TB-260, TB-425



Part Numbers

Item No.	Description	TB-170 Qty.	TB-170 P/N	TB-260 Qty.	TB-260 P/N	TB-425 Qty.	TB-425 P/N
1	Magnet, O.M.	1		1		1	
	6 Volt		5375-631-010		5365-631-013		5367-631-007
	24 Volt		5375-631-012		5365-631-016		5367-631-008
1-1	Terminal Accessory		—	1	5103-101-002	1	5103-101-003
2	Armature	1	110-0096	1	110-0097	1	110-0098
3	Hub Assembly	1		1		1	
	1/4" Bore		5102-541-002		—		—
	5/16" Bore		5102-541-003		—		—
	3/8" Bore		5102-541-004		5103-541-002		—
	1/2" Bore		—		5103-541-004		5104-541-002
	5/8" Bore		—		5103-541-006		5104-541-004
	3/4" Bore		—		5103-541-008		5104-541-006
	7/8" Bore		—		—		5104-541-007
4	Mounting Accessories	1	5102-101-001	1	5102-101-001	1	5104-101-002

TB-500



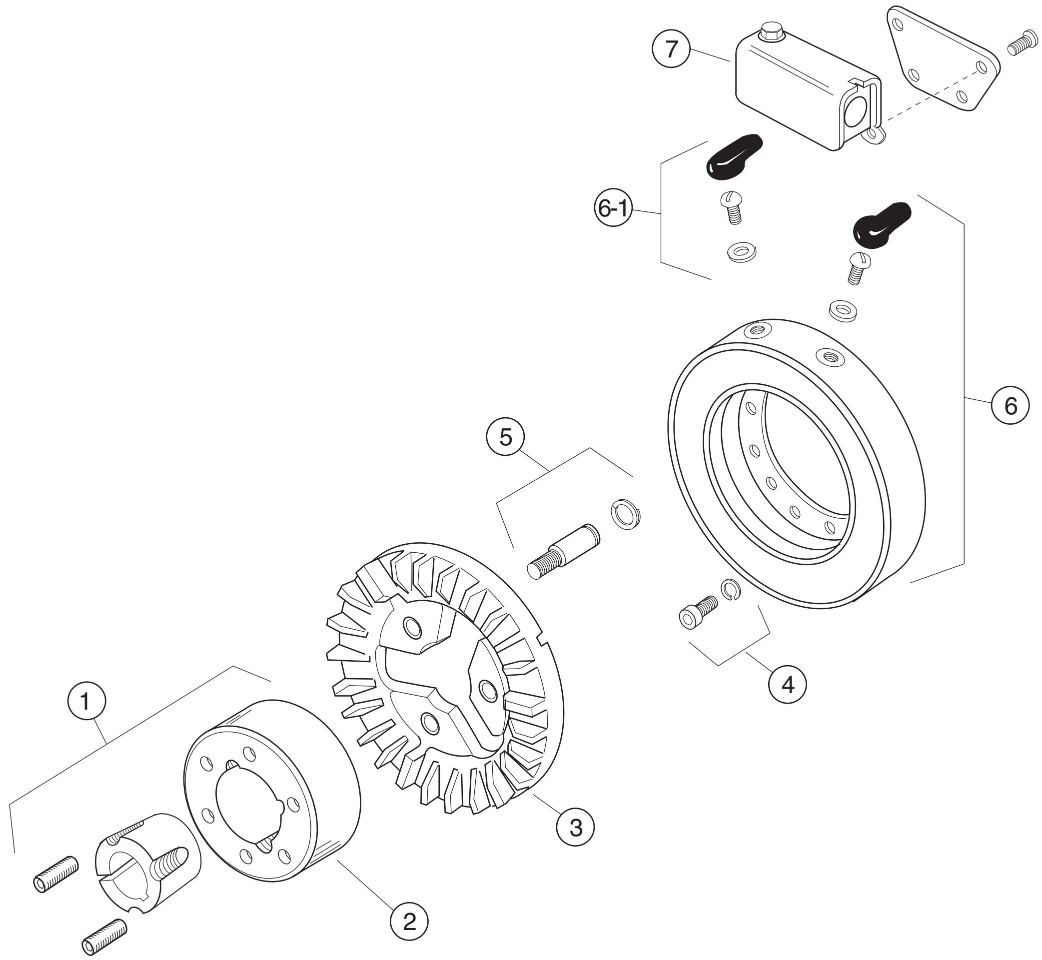
Part Numbers

Item No.	Description	TB-500 Qty.	TB-500 P/N
1	Bushing Taperlock*	1	180-0116 to 180-0128
2	Hub, Armature	1	5300-541-004
3	Armature	1	110-0047
4	Magnet Mounting Acc.		
	Inside Mounted	2	5102-101-001
	Outside Mounted	1	5300-101-008
5	Drive Pin	3	5300-101-003
6	Magnet		
	6 Volt I.M.	1	5300-631-019
	6 Volt O.M.	1	5300-631-024
	24 Volt I.M.	1	5300-631-040
	24 Volt O.M.	1	5300-631-051
6-1	Terminal Accessory	1	5311-101-001
7	Conduit Box	1	5200-101-010

* See page 155 for specific shaft sizes and bushing numbers.

Brake Assemblies and Part Numbers

TB-825, TB-1000, TB-1225, TB-1525



Part Numbers

Item No.	Description	TB-825 Qty.	TB-825 P/N	TB-1000 Qty.	TB-1000 P/N	TB-1225 Qty.	TB-1225 P/N	TB-1525 Qty.	TB-1525 P/N
1	Bushing Taperlock*	1	180-0131 to 180-0149	1	180-0185 to 180-0217	1	180-0262 to 180-0295	1	180-0262 to 180-0295
2	Hub, Armature	1	540-0394	1	540-0313	1	540-0015	1	540-0314
3	Armature	1	5301-111-019	1	5302-111-021	1	5303-111-011	1	5304-111-005
4	Magnet Mounting Acc.								
	Inside Mounting	1	5321-101-001	1	5321-101-001	1	5321-101-001	2	5321-101-001
5	Drive Pin & Retainer	3	5301-101-001	3	5301-101-001	4	5301-101-001	4	5301-101-001
6	Magnet	1		1		1		1	
	6 Volt I.M.		5311-631-024		5312-631-018		5313-631-017		5314-631-002
	24 Volt I.M.		5311-631-040		5312-631-034		5313-631-031		5314-631-022
6-1	Terminal Accessory	1	5311-101-001	1	5311-101-001	1	5311-101-001	1	5311-101-001
7	Conduit Box	1	5200-101-011	1	5200-101-011	1	5200-101-011	1	5200-101-011

* See page 155 for specific shaft sizes and bushing numbers.

These units, when used with the correct Warner Electric conduit box, meet the standards of UL-508 and are listed under the guide card #NMTR, file #59164 and are CSA Certified under file #LR11543.

Electric Brakes and Clutches

ATT Series – Advanced Technology Brakes and Clutches

Advanced Technology – A new design concept!

Warner Electric's ATT Series clutches and brakes are rugged and durable.

Besides providing the ultimate in long life and durability, the ATT units are easily repairable... and, for the first time, mounting a standard sheave, pulley or sprocket to the clutch is a snap.

AT Clutches and Brakes are completely assembled at the factory and have been specifically designed to match the torque ratings of standard motors, reducers, and other power transmission components. Easy to select and easy to install.

Features:

ATT Tension Clutches and Brakes

- Ideal for intermediate range applications
- Both brake and clutch models for winders and unwinders
- .284 to .9 thermal horsepower capacity
- Brake wear faces replaceable on the shaft for limited downtime
- Full range of control options. See pages 44-45.

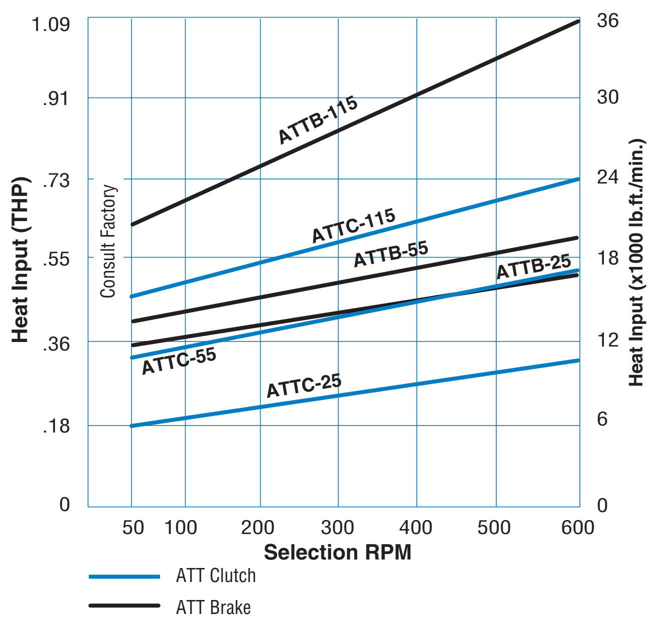
Unit Size	Maximum RPM	Continuous[1] Dynamic Torque	Overcurrent E-Stop Torque
ATT Brakes			
ATTB-25	3600	8 lb.ft.	15 lb.ft
ATTB-55	3600	15 lb.ft	21 lb.ft
ATTB-115	3600	62 lb.ft.	83 lb.ft.
ATT Clutches			
ATTC-25	3600	7 lb.ft.	*2
ATTC-55	3600	12 lb.ft.	*
ATTC-115	3600	41 lb.ft.	*

Notes

1. Dynamic torque is constant over a speed range of 0–600 RPM
2. Overcurrent is not used on clutch applications for tensioning

Continuous Operation

Thermal HP vs. Selection RPM



Special Coil Designs

High temperature coil wire improves durability in the face of high temperature environments and high cycle rates or high inertia cycling that generate large amounts of heat. High temperature Teflon leads are very resistant to accidental abrasion and cutting.

Replaceable Friction Discs

Friction disc is designed as separate assembly from clutch rotor or brake magnet, allowing for replacement of the wear surface without the expense of replacing other valuable unit components. Provides superior wear life with reduced engagement noise level.

Advanced Technology Tension Clutches and Brakes

- Ideal for intermediate range applications
- Both brake and clutch models for winders and unwinders
- .284 to .9 thermal horsepower capacity
- Wear faces replaceable on the shaft for limited downtime
- Full range of control options

Complete Control Capability

Optional Accessories

Warner Electric offers a number of optional accessories as well as rebuild kits, which may make an ATT clutch or brake easier to apply to your machine. See pages 44-45 for controls.

Unit	Model No.	Clutch Restraining Strap	Repair Kits: Friction Face Replacement	Repair Kits: Rebuild
Clutch	ATTC-25	5162-101-004	5161-101-008	5161-101-009
	ATTC-55	5162-101-004	5162-101-008	5162-101-009
	ATTC-115	5163-101-004	5163-101-008	5163-101-009
Brake	ATTB-25	—	5161-101-008	—
	ATTB-55	—	5162-101-008	—
	ATTB-115	—	5163-101-008	—

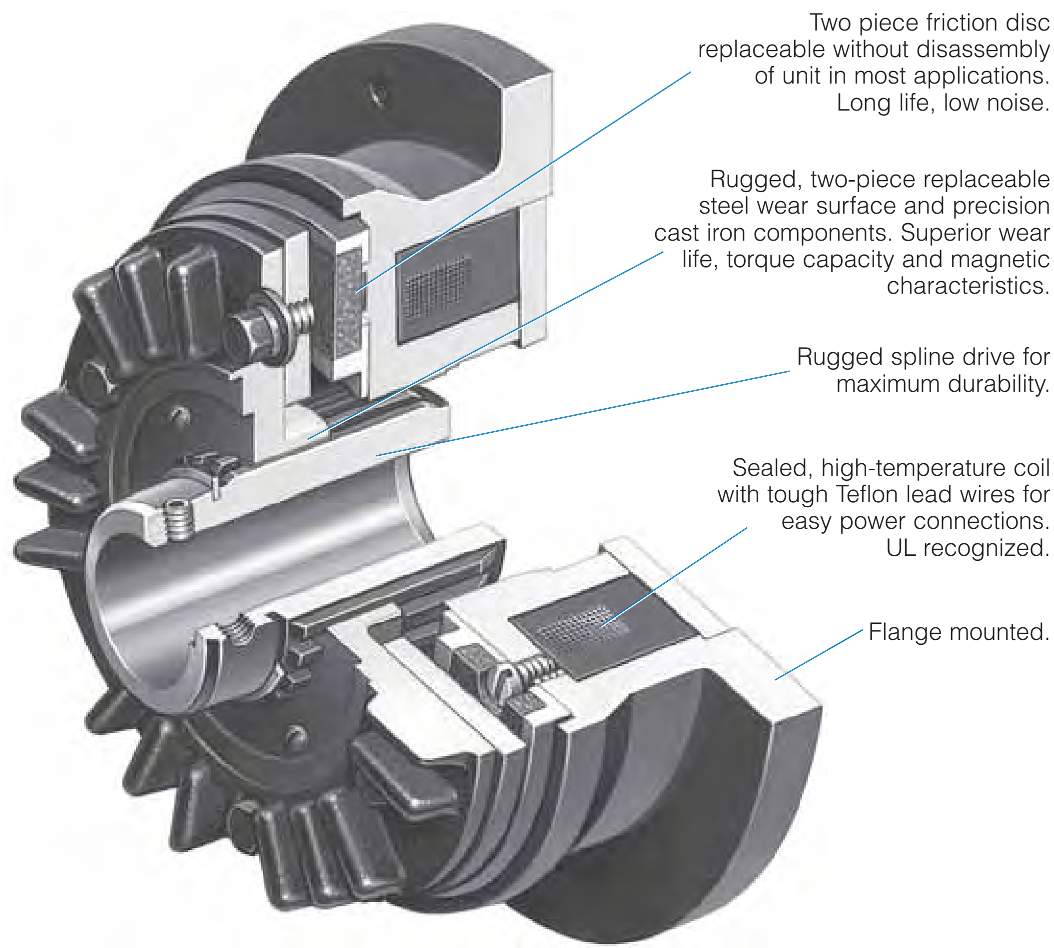
Bore Sizes/Part Numbers

Size	Bore Size (Inch)	24 VDC Clutch (ATTC)	24 VDC Brake (ATTB)	90 VDC Clutch (ATTC)	90 VDC Brake (ATTB)
ATT-25	1/2"	5161-271-021	5191-6	5161-271-025	5191-10
	5/8"	5161-271-022	5191-7	5161-271-026	5191-11
	3/4"	5161-271-023	5191-8	5161-271-027	5191-12
	7/8"	5161-271-024	5191-9	5161-271-028	5191-13
ATT-55	3/4"	5162-271-021	5192-6	5162-271-025	5192-10
	7/8"	5162-271-022	5192-7	5162-271-026	5192-11
	1"	5162-271-023	5192-8	5162-271-027	5192-12
	1-1/8"	5162-271-024	5192-9	5162-271-028	5192-13
ATT-115	1-1/8"	5163-271-021	5193-6	5163-271-025	5193-10
	1-1/4"	5163-271-022	5193-7	5163-271-026	5193-11
	1-3/8"	5163-271-023	5193-8	5163-271-027	5193-12
	1-1/2"	5163-271-024	5193-9	5163-271-028	5193-13

Electric Brakes and Clutches

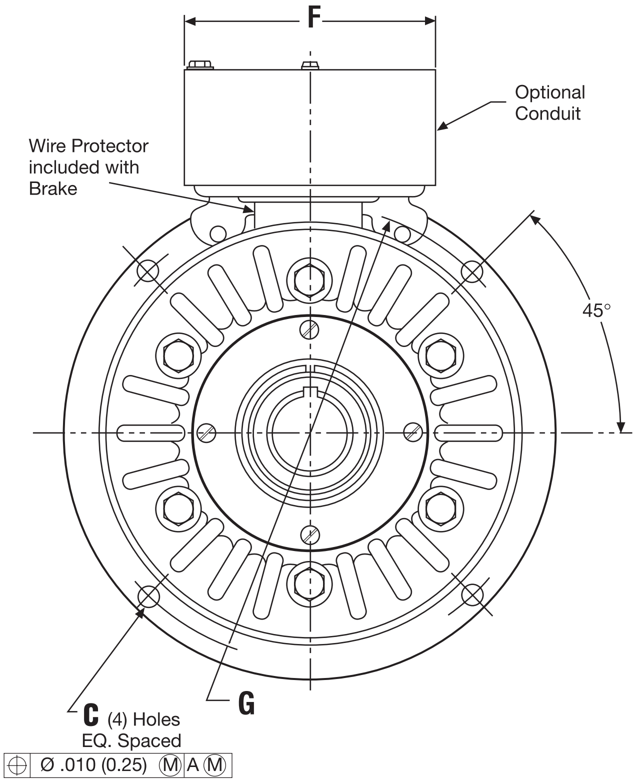
ATT Series – Advanced Technology Brakes and Clutches

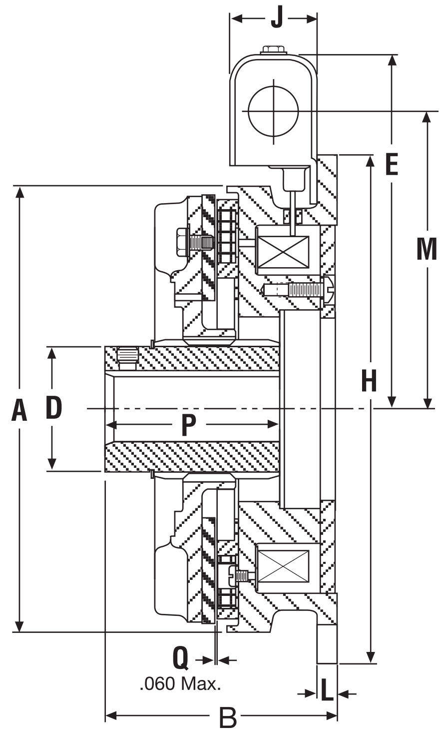
ATTB Brake



Specifications

		Mechanical Data			Electrical Data		
					24 VDC		
Unit	Model No.	Total Weight (lbs.)	Max Speed (RPM)	Inertia WR² (lb.ft.²)	Resistance (ohms)	Current (amperes)	Power (watts)
	ATTB-25	7	3600	0.038	20.6	1.16	28.0
Brake	ATTB-55	15	3600	0.126	19.6	1.22	29.4
	ATTB-115	24	3600	0.383	16.5	1.46	34.9





Customer shall maintain:

1. Squareness of brake mounting face with armature hub shaft within .006 T.I.R.
2. Concentricity of brake mounting pilot diameter with armature hub shaft within .010 T.I.R.

Shaft Bore and Keyway Dimensions

Model	Unit Bore		Key
ATTB-25	.5025 / .5005	12.76 / 12.71	1/8 Sq.
ATTB-25	.6275 / .6255	15.94 / 15.89	3/16 Sq.
ATTB-25 / ATTB-55	.7525 / .7505	19.11 / 19.06	3/16 Sq.
ATTB-25 / ATTB-55	.8775 / .8755	22.29 / 22.24	3/16 Sq.
ATTB-55	1.0025 / 1.0005	25.46 / 25.41	1/4 Sq.
ATTB-55 / ATTB-115	1.1275 / 1.1255	28.64 / 28.59	1/4 Sq.
ATTB-115	1.2525 / 1.2505	31.81 / 31.76	1/4 Sq.
ATTB-115	1.7775 / 1.3755	34.99 / 34.94	5/16 Sq.
ATTB-115	1.5025 / 1.5005	38.16 / 38.11	3/8 Sq.

inches (mm)

Model	A Max. Dia.	B Max.	C Min. Dia.
ATTB-25	4.822 (122.48)	2.730 (69.34)	.264 (6.70)
ATTB-55	6.271 (159.28)	3.010 (77.97)	.330 (8.38)
ATTB-115	7.906 (200.81)	3.625 (12.07)	.330 (8.38)

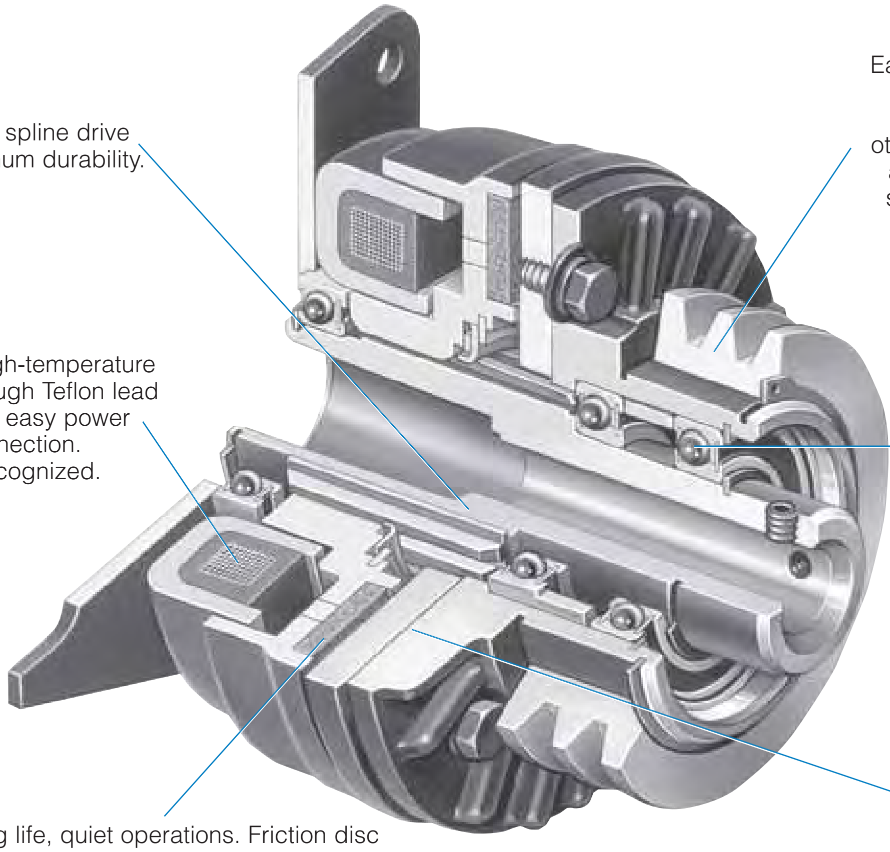
inches (mm)

Model	D Max.	E Nom.	F Max.	G Dia.	H Pilot Dia.	J Nom.	L Max.	M Nom.	P Max.
ATTB-25	1.345 (34.16)	4.748 (120.60)	3.767 (95.68)	5.250 (133.35)	5.625/5.623 (142.87/142.82)	1.544 (39.22)	.225 (5.71)	3.586 (91.08)	2.080 (52.83)
ATTB-55	1.765 (44.83)	5.37 (136.40)	3.767 (95.68)	6.875 (174.62)	7.315/7.313 (187.33/181.21)	1.544 (39.22)	.491 (12.47)	4.208 (106.88)	1.960 (49.87)
ATTB-115	2.150 (54.61)	6.278 (159.46)	3.767 (95.68)	8.500 (215.90)	9.000/8.998 (228.60/228.55)	1.544 (39.22)	.463 (11.76)	5.116 (129.95)	3.105 (78.87)

For replacement parts list and exploded view drawing, see page 84.

Note: All dimensions are nominal unless otherwise noted.

ATTC Clutch



Specifications

Model No.	Mechanical Data			Electrical Data 24 VDC		
	Total Weight (lbs.)	Max Speed (RPM)	Inertia WR^2 (lb.ft.^{2})	Resistance (ohms)	Current (amperes)	Power (watts)
ATTC-25	8	3600	0.048	20.6	1.16	28.0
ATTC-55	18	3600	0.173	19.6	1.22	29.4
ATTC-115	28	3600	0.483	16.5	1.46	34.9

Dimensions

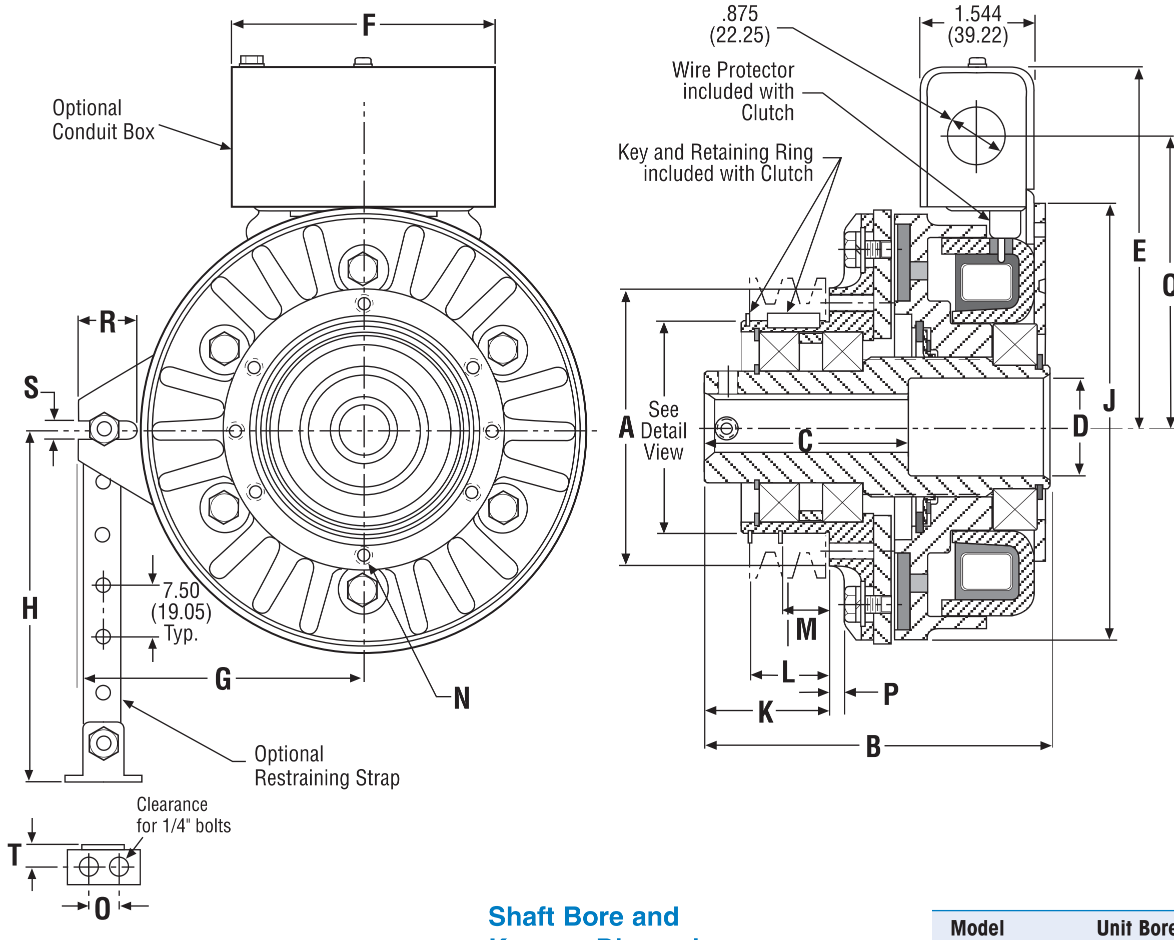
inches (mm)

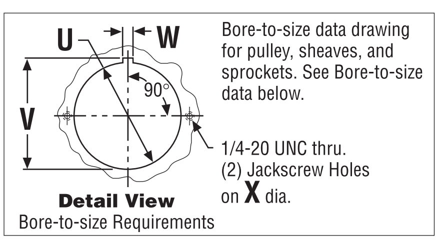
Model	A Max. Dia.	B Max.	C Nom.	D Nom. Dia.	E Max.	F Max.	G Max.	H Max.	J Max Dia.	K Max.	L Max.	M Max.	T Nom.
ATTC-25	3.60 (91.44)	4.39 (111.51)	2.375 (60.33)	1.080 (27.43)	4.748 (120.60)	3.767 (95.68)	3.282 (83.36)	5.11 (129.79)	4.822 (122.49)	1.68 (42.67)	1.003/.991 (25.48/25.17)	.715/.703 (18.16/17.86)	.375 (9.53)
ATTC-55	3.95 (100.33)	4.935 (125.35)	2.925 (74.30)	1.40 (35.56)	5.182 (131.62)	3.767 (95.68)	4.032 (102.41)	5.11 (129.79)	6.275 (159.39)	1.817 (46.15)	1.113/1.101 (28.27/27.97)	—	.375 (9.53)
ATTC-115	5.254 (133.45)	5.977 (151.82)	3.102 (78.79)	1.86 (47.24)	6.089 (154.66)	3.767 (95.68)	4.246 (107.85)	10.11 (256.79)	7.906 (200.81)	2.467 (62.66)	1.539/1.523 (39.09/38.68)	—	.375 (9.53)

For replacement parts list and exploded view drawing, see page 85.

Note: All dimensions are nominal unless otherwise noted.

Dimensions





Shaft Bore and Keyway Dimensions

Model	Unit Bore		Key
ATTC-25	.5025/.5005	(12.76/12.71)	1/8 Sq.
ATTC-25	.6275/.6255	(15.94/15.89)	3/16 Sq.
ATTC-25 ATTC–55	.7525/.7505	(19.11/19.06)	3/16 Sq.
ATTC-25 ATTC-55	.8775/.8755	(22.29/22.24)	3/16 Sq.

Model	Unit Bore		Key
ATTC-55	1.0025/1.0005	(25.46/25.41)	1/4 Sq.
ATTC-55 ATTC-115	1.1275/1.1255	(28.64/28.59)	1/4 Sq.
ATTC-115	1.2525/1.2505	(31.71/31.76)	1/4 Sq.
ACCT-115	1.3775/1.3755	(34.99/34.94)	5/16 Sq.
ATTC-115	1.5025/1.5005	(38.16/38.11)	3/8 Sq.

inches (mm)

Model	N No. of Holes	N Thread Size	N Max. Depth	N Bolt Circle	O Nom.	Q Nom.	R Min.	S Min.
ATTC-25	3	1/4-20	.500	3.00	.500 (12.7)	3.586 (91.08)	.752 (19.08)	.279 (7.09)
ATTC-55	4	1/4-20	.635	3.50	.500 (12.7)	4.156 (105.56)	.722 (18.34)	.265 (6.73)
ATTC-115	4	5/16-18	.830	4.75	.500 (12.7)	4.927 (125.15)	.504 (12.80)	.265 (6.73)

Bore-to-Size Data

U Bore Dia.	V Keyway Height	W Keyway Width	X Bolt Circle
2.502/2.500 (63.55/63.50)	2.601/2.591 (66.06/65.81)	.1905/.1885 (4.84/4.79)	3.00 (76.20)
3.002/3.000 (76.25/76.20)	3.099/3.089 (78.71/78.46)	.1905/.1885 (4.84/4.79)	3.50 (88.90)
4.002/4.000 (101.65/101.60)	4.127/4.117 (104.83/104.57)	.378/.376 (9.60/9.55)	4.50 (114.30)

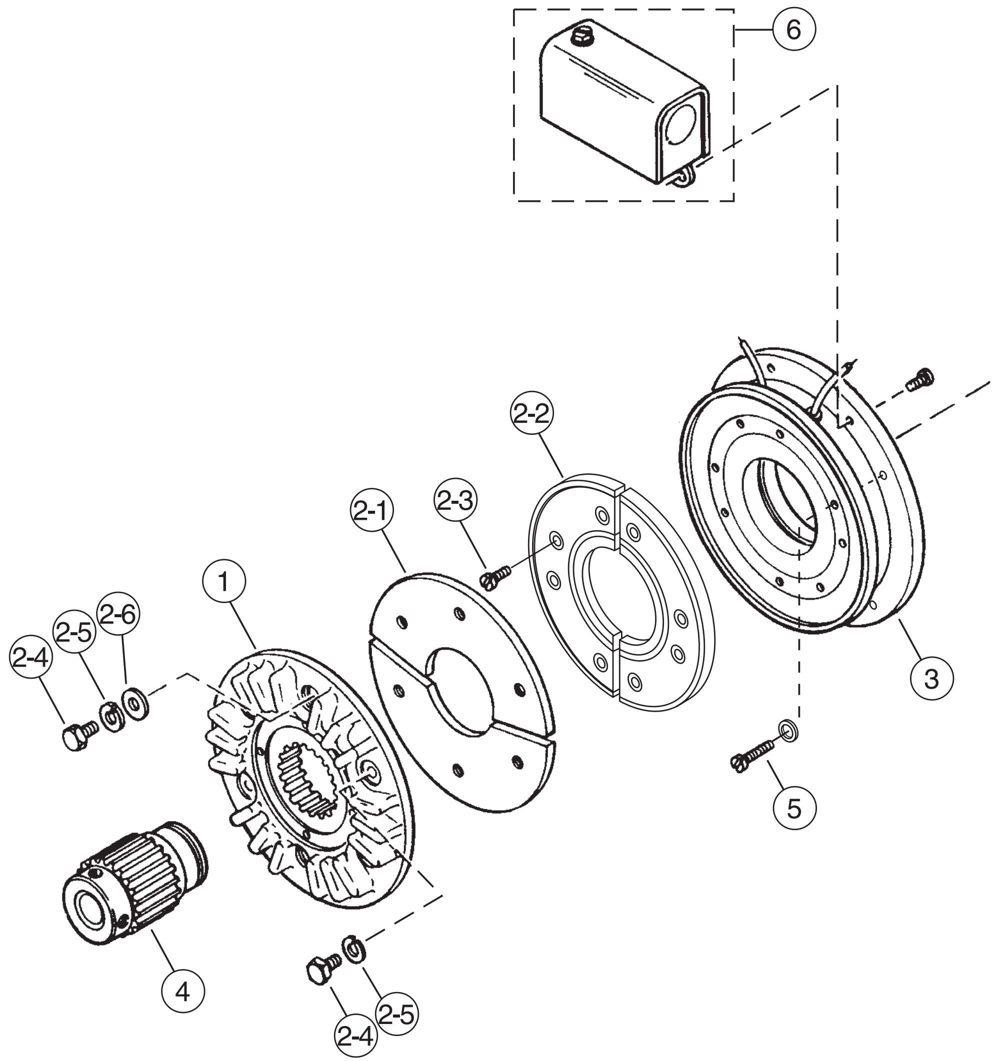
For replacement parts list and exploded view drawing, see page 85.

Note: All dimensions are nominal unless otherwise noted.

Brake Assemblies and Part Numbers

ATT Series – Advanced Technology Brakes

ATTB-25, ATTB-55, ATTB-115



Brake Assemblies

Unit Size	Voltage	Part No.
ATTB-25-1/2	24	5191-6
ATTB-25-1/2	90	5191-10
ATTB-25-5/8	24	5191-7
ATTB-25-5/8	90	5191-11
ATTB-25-3/4	24	5191-8
ATTB-25-3/4	90	5191-12
ATTB-25-7/8	24	5191-9
ATTB-25-7/8	90	5191-13
ATTB-55-3/4	24	5192-6
ATTB-55-3/4	90	5192-10
ATTB-55-7/8	24	5192-7
ATTB-55-7/8	90	5192-11
ATTB-55-1	24	5192-8
ATTB-55-1	90	5192-12
ATTB-55-1-1/8	24	5192-9
ATTB-55-1-1/8	90	5192-13
ATTB-115-1-1/8	24	5193-6
ATTB-115-1-1/8	90	5193-10
ATTB-115-1-1/4	24	5193-7
ATTB-115-1-1/4	90	5193-11
ATTB-115-1-3/8	24	5193-8
ATTB-115-1-3/8	90	5193-12
ATTB-115-1-1/2	24	5193-9
ATTB-115-1-1/2	90	5193-13

Part Numbers

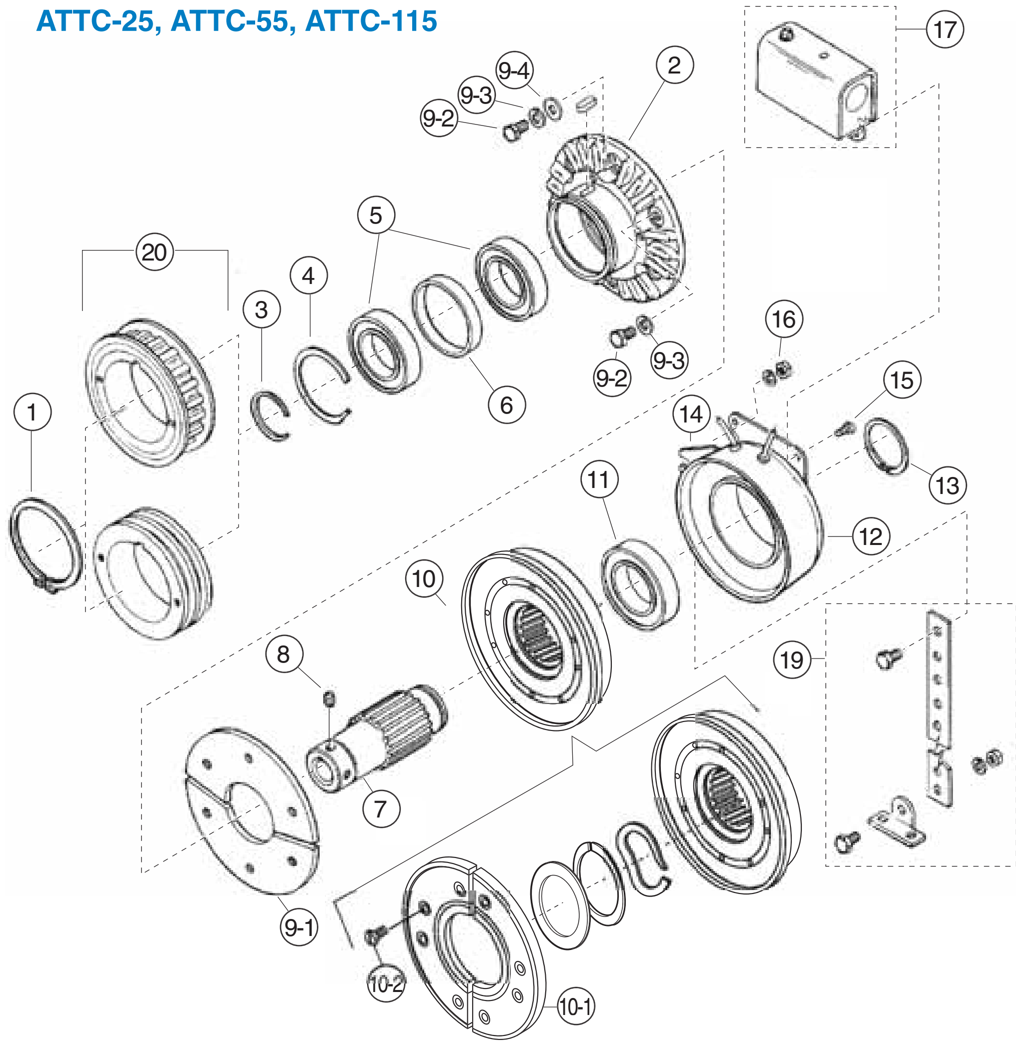
Item		ATTB-25		ATTB-55		ATTB-115	
No.	Description	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.
1	Armature Hub	1	540-0908	1	540-0851	1	540-0864
2-1	Armature	1	110-0220	1	110-0218	1	110-0223
2-2	Facing Assem.	1	5191-445-003	1	5192-445-003	1	5193-445-003
2-3	Screw	6	797-1389	8	797-1389	8	797-1389
2-4	Screw	4	797-1020	6	797-1387	6	797-1174
2-5	Lockwasher	–	–	6	950-0355	6	950-0355
2-6	Flatwasher	–	–	2	950-0023	2	950-0023
3	Magnet Assem.	1	–	1	–	1	–
	24 Volts D.C.	–	5191-631-007	–	5192-631-007	–	5193-631-014
	90 Volts D.C.	–	5191-631-008	–	5192-631-008	–	5193-631-015
4	Splined Hub	1	–	1	–	1	–
	1/2" Bore	–	5191-541-002	–	–	–	–
	5/8" Bore	–	5191-541-003	–	–	–	–
	3/4" Bore	–	5191-541-004	–	5192-541-002	–	–

Item		ATTB-25		ATTB-55		ATTB-115	
No.	Description	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.
	7/8" Bore	–	5191-541-005	–	5192-541-003	–	–
	1" Bore	–	–	–	5192-541-004	–	–
	1-1/8" Bore	–	–	–	5192-541-005	–	5193-541-002
	1-1/4" Bore	–	–	–	–	–	5193-541-003
	1-3/8" Bore	–	–	–		–	5193-541-004
	1-1/2" Bore	–	–	–	–	–	5193-541-005
5	Mtg. Acc'y.	1	5191-101-007	1	5192-101-007	1	5192-101-007
Optional Accessory Items							
6	Conduit Box	1	5162-101-002	1	5162-101-002	1	5162-101-002
Kit Items							
7	Friction Face Replacement Kit (includes items 2-1, 2-2, 2-3, 2-4, 2-5, 2-6)	1	5161-101-008	1	5162-101-008	1	5163-101-008

Brake Assemblies and Part Numbers

ATT Series – Advanced Technology Clutches

ATTC-25, ATTC-55, ATTC-115



Clutch Assemblies

Unit Size	Voltage	Part No.
ATTC-25-1/2	24	5161-271-021
ATTC-25-1/2	90	5161-271-025
ATTC-25-5/8	24	5161-271-022
ATTC-25-5/8	90	5161-271-026
ATTC-25-3/4	24	5161-271-023
ATTC-25-3/4	90	5161-271-027
ATTC-25-7/8	24	5161-271-024
ATTC-25-7/8	90	5161-271-028
ATTC-55-3/4	24	5162-271-021
ATTC-55-3/4	90	5162-271-025
ATTC-55-7/8	24	5162-271-022
ATTC-55-7/8	90	5162-271-026
ATTC-55-1	24	5162-271-023
ATTC-55-1	90	5162-271-027
ATTC-55-1-1/8	24	5162-271-024
ATTC-55-1-1/8	90	6162-271-028
ATTC-115-1-1/8	24	5163-271-021
ATTC-115-1-1/8	90	5163-271-025
ATTC-115-1-1/4	24	5163-271-022
ATTC-115-1-1/4	90	5163-271-026
ATTC-115-1-3/8	24	5163-271-023
ATTC-115-1-3/8	90	5163-271-027
ATTC-115-1-1/2	24	5163-271-024
ATTC-115-1-1/2	90	5163-271-028

Part Numbers

Item		ATTC-25		ATTC-55		ATTC-115	
No.	Description	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.
1	Retaining Ring	1	748-0734	1	748-0725	1	748-0738
2	Armature Hub	1	540-0907	1	540-0852	1	540-0863
3	Retaining Ring	1	748-0732	1	748-0726	1	748-0737
4	Retaining Ring	1	748-0731	1	748-0728	1	748-0736
5	Bearing	2	166-0278	2	166-0277	2	166-0279
6	Spacer	1	807-0119	1	807-1061	1	807-1063
7	Splined Hub	1	–	1	–	1	–
	1/2" Bore		540-0910	–	–	–	–
	5/8" Bore		540-0911	–	–	–	–
	3/4" Bore		540-0912		540-1501	–	–
	7/8" Bore		540-0913		540-1502	–	–
	1" Bore	–	–		540-1503	–	–
	1-1/8" Bore	–	–		540-1504		540-0857
	1-1/4" Bore	–	–	–	–		540-0858
	1-3/8" Bore	–	–	–	–		540-0859
	1-1/2" Bore	–	–	–	–		540-0860
8	Setscrew	2	797-1393	2	797-1386	2	797-1395
*†9-1	Armature	1	110-0220	1	110-0218	1	110-0223
*†9-2	Screw	4	797-1519	6	797-1462	6	797-1463
*†9-3	Lockwasher	–	–	6	950-0355	6	950-0355
*9-4	Flatwasher	–	–	2	950-0023	2	950-0023
*10	Rotor	1	5161-751-002	1	5162-751-002	1	5163-751-002

Item		ATTC-25		ATTC-55		ATTC-115	
No.	Description	Qty.	Part No.	Qty.	Part No.	Qty.	Part No.
*†10-1		1	5191-445-003	1	5192-445-003	1	5193-445-003
*†10-2		6	797-1389	8	797-1389	8	797-1389
*11	Bearing	1	166-0283	1	166-0284	1	166-0279
12	Field Assembly						
	90 Volts D.C.	1	5161-451-003	1	5162-451-003	1	5163-451-003
	24 Volts D.C.	1	5161-451-004	1	5162-451-004	1	5163-451-004
*13	Retaining Ring	1	748-0018	1	748-0727	1	748-0737
14	Adapter	–	–	–	–	2	104-0300
15	Screw	–	–	–	–	4	797-1396
16	Lockwasher	–	–	–	–	4	950-0102
Optional Accessory Items							
17	Conduit Box	1	5162-101-002	1	5162-101-002	1	5162-101-002
19	Restraining Arm Assembly	1	5162-101-004	1	5162-101-004	1	5162-101-004
20	Timing Belt and V Belt Pulleys: Consult Factory.						
Kit Items							
*	Clutch Rebuild Kit (includes items 9-1, 9-2, 9-3, 9-4, 10, 11, 13)	1	5161-101-012	1	5162-101-012	1	5163-101-012
†	Friction Service Kit	1	5161-101-008	1	5162-101-008	1	5163-101-008

Note: In some versions of this product, item 10 consists of a rotor and a replaceable face.

Electric Brakes

MTB Series – Modular Tension Brakes

One of the keys to the Warner Electric tensioning system is the Electro Disc tension brake. Electro Disc brake systems are capable of continuous slip from full roll to core diameter while providing outstandingly consistent and accurate control of unwind tension throughout the process. Electro Disc brakes operate smoothly and quietly. They respond instantly for emergency stops. Wear life is remarkable. Electronic control systems are easily interfaced with Warner Electric controls. Selection of the right brake for virtually any web processing application, from film to boxboard, is made possible through a building-block modular design.

Simple Maintenance

Rugged design eliminates most moving parts. No diaphragms to break down. Asbestos-free brake pads are quickly and easily replaced. Brake wear does not affect torque as with some other types of brakes.

Easy Installation

Electro Disc tension brakes fit within tight space restrictions. Bushings adapt to most standard and metric shafts. Electrical installation replaces complex pneumatic plumbing, valves and compressors.

Long Life, High Heat Dissipation

A replaceable face armature disc provides extremely long life and maximum heat dissipation. Standard armature discs can be mounted singly or in tandem as shown here to increase the heat dissipation and torque capability.

Accurate, Consistent Control

The responsiveness of electric brakes coupled with specially designed controls provides accurate tensioning from beginning to end of roll, even during emergency stops and flying splices.

Brake Modularity

With one to sixteen magnets and single or double armature discs, Electro Disc tension brakes offer torque control and continuous slip capacity to meet a broad spectrum of requirements for virtually any web processing application.

Four armature sizes

Patented Design

The patented Electro Disc design is a proven concept, featuring a simple, yet powerful tension brake … easy-to-control, smooth, quiet and accurate. The speed of response and controllability, especially near zero tension, far exceeds that of other braking technologies.

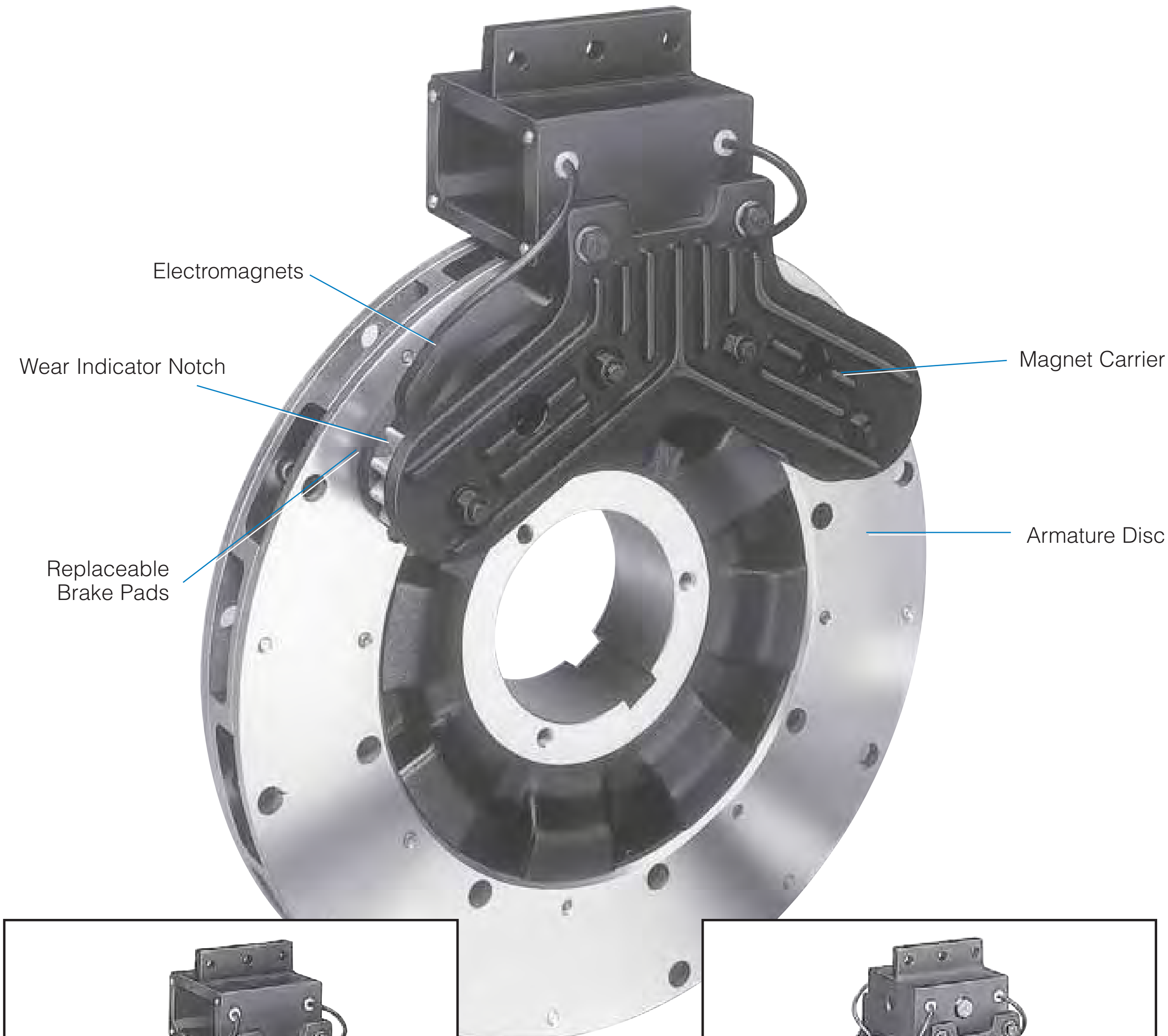
Simple. Powerful. Controllable.

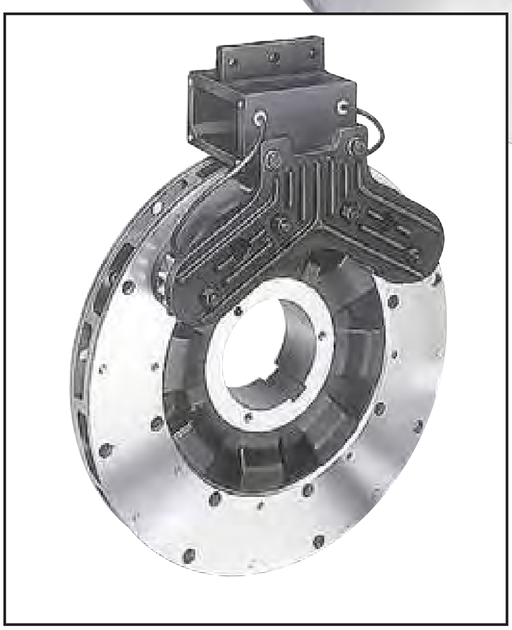
The electromagnetic principle, as applied to the Electro Disc tension brake, results in a brake design that features outstanding control from zero torque to the maximum limits of the brake. Complex moving parts are eliminated.

Smooth Operation with Minimal Maintenance

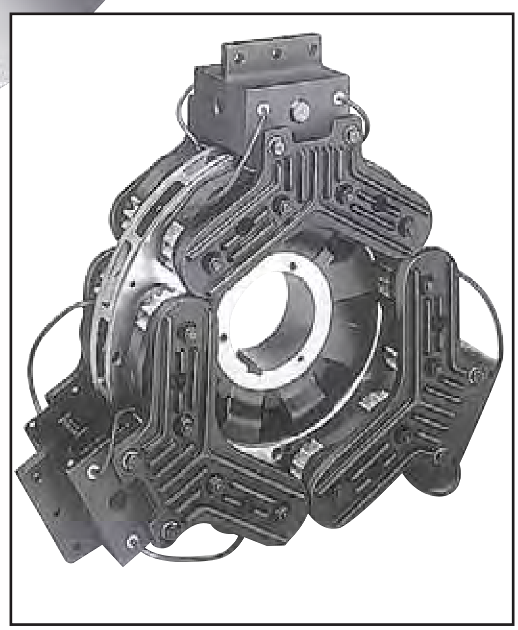
The friction pads are made of a unique composite of asbestos-free friction materials specially designed to produce smooth, powerful, yet quiet engagement between the magnet and armature discs. Since the replaceable friction pads and armature disc are the only parts which receive regular wear, the electromagnets can be reused indefinitely. An indicator notch on the friction pad, as well as an optional electric wear indicator, makes routine checking for remaining wear life quick and easy.

MTB-II ... the second generation





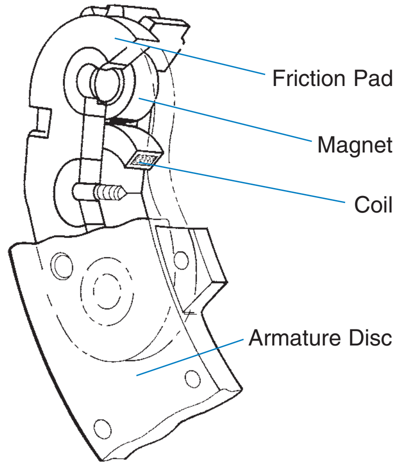
Single disc, 2 magnets



Dual disc, 12 magnets

Electric Brakes

MTB Series – Modular Tension Brakes



Principle of Operation

Warner Electric tension brakes operate on the electromagnetic principle. The brake's two basic parts, an electromagnet and an armature disc, pull into contact as power is applied. At the center of the Warner Electric tension brake magnet is the electric coil, consisting of numerous layers of tightly wound wire, which gives Warner Electric brakes their torque capability. By simply increasing or decreasing the current to the electric coil, proportionately more or less braking torque will be generated.

MTB-II...The Second Generation

The ED magnet has been redesigned following years of engineering tests and evaluation. The result is a unique, patent pending design providing more than double the life of the previous Electro Disc brakes … without any loss in smoothness or controllability.

New armature design

New aluminum armature carriers for 10", 13" and 15" systems provide inertial reduction up to 40%, allowing improved tension control as high speed machines accelerate to core. The radial blower design improves air flow and cooling. Systems run cooler and last longer.

New friction system

The friction system features three important benefits:

- A new, long wearing friction pad material.
- A new, improved balance between the wear rate of the magnetic poles and the friction material.
- A replaceable face friction pad for fast, easy maintenance.

New pole geometry

The geometry of the magnetic poles has been redesigned (Patent Pending) to minimize the "leading edge wear" common to all pin mounted friction brakes. Magnet mounting holes do not extend through the face for freer, axial movement.

New electronic wear indicator option

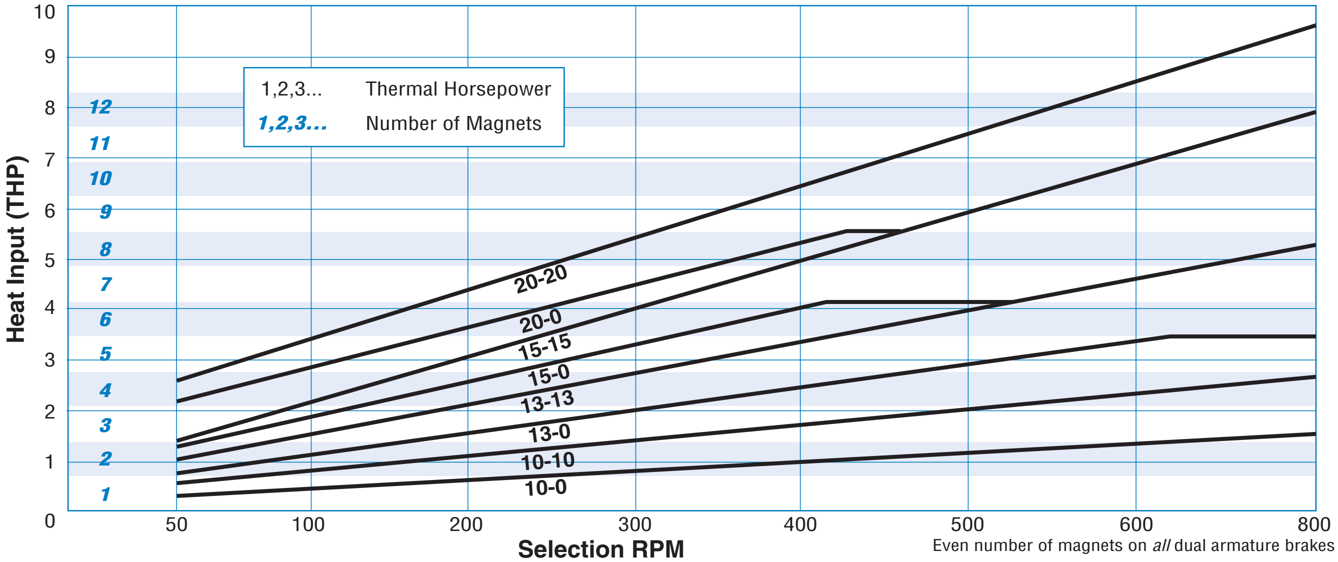
An optional, electronic wear indicator is imbedded into the magnets to aid in planning maintenance requirements. An indicator on the Warner Electric control illuminates at the point where 15% of brake life still remains.

Electric Brakes

MTB Series – Modular Tension Brakes

Thermal HP vs. Selection RPM

Heat Dissipation Curves

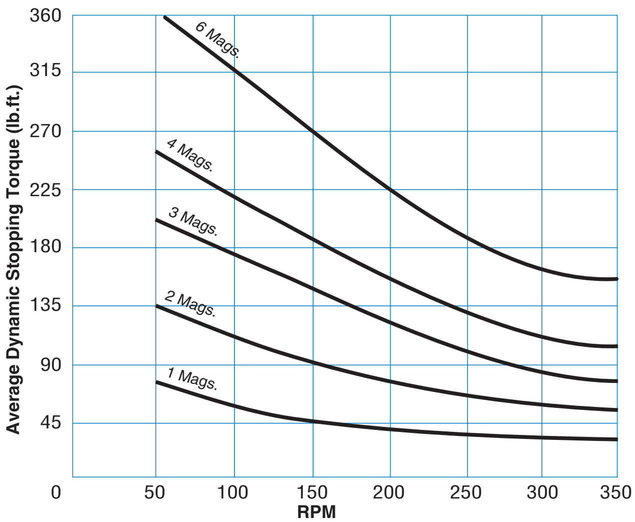


Even number of magnets on *all* dual armature brakes

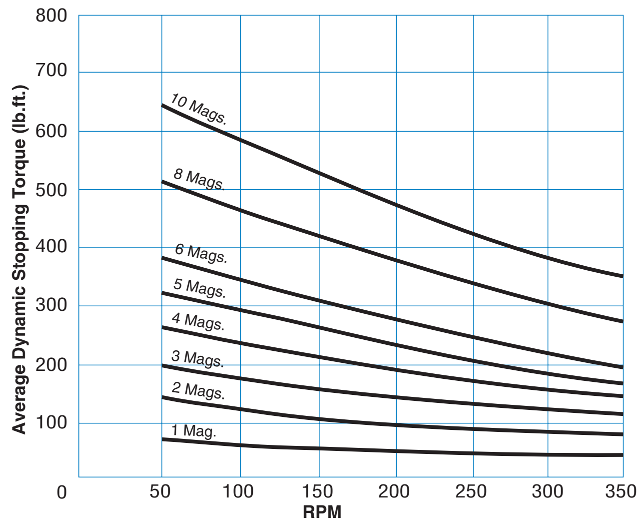
Emergency Stop Torque Curves

Note: The following curves are for emergency stop torques. For normal running dynamic torque, multiply the emergency stop torque value by .54.

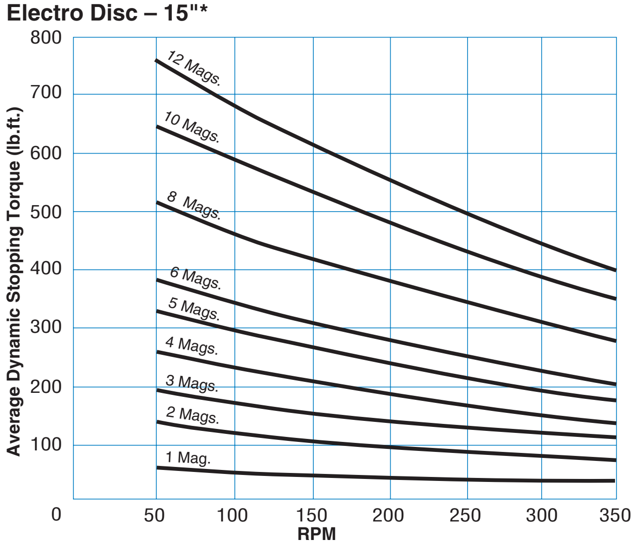
Electro Disc – 10"*



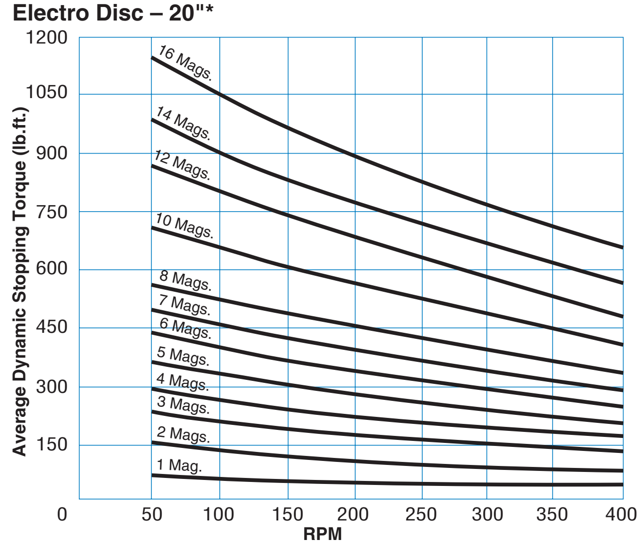
Electro Disc – 13"*



Electro Disc – 15"*



Electro Disc – 20"*



* MTB II Dynamic Torques at 500 mA per magnet, available from TCS series controls during emergency stop.

Electric Brakes

MTB Series – Modular Tension Brakes

Model number designation

Single Disc, 2 Magnets

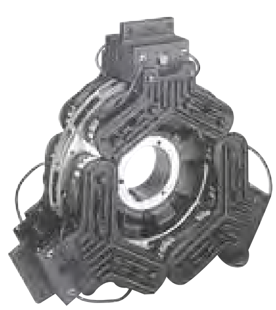
Model 15 — 0 — 2

- Dia. of Armature → 15
- Designates (1) Disc → 0
- Number of Magnets → 2

Dual Discs, 4 Magnets

Model 15 — 15 — 4

- Dia. of Armature → 15
- Designates (2) Discs → 15
- Number of Magnets → 4



Dual Discs, 12 Magnets

Model 15 — 15 — 12

- Dia. of Armature → 15
- Designates (2) Discs → 15
- Number of Magnets → 12

Specifications

Model	No. of Discs	No. of Magnets	Resistance @20°C Ohms[1]	Current Amps	Watts[1]	Max. Allowable Disc Speed RPM
10-0-1	1	1	69.10	0.35	8.33	3600
10-0-2	1	2	34.55	0.69	16.67	3600
10-0-3	1	3	23.03	1.04	25.01	3600
10-10-2	2	2	34.55	0.69	16.67	3600
10-10-4	2	4	17.28	1.39	33.33	3600
10-10-6	2	6	11.52	2.08	50.0	3600
13-0-1	1	1	69.10	0.35	8.33	2500
13-0-2	1	2	34.55	0.69	16.67	2500
13-0-3	1	3	23.03	1.04	25.01	2500
13-0-4	1	4	17.28	1.39	33.33	2500
13-0-5	1	5	13.82	1.74	41.68	2500
13-13-2	2	2	34.55	0.69	16.67	2500
13-13-4	2	4	17.28	1.39	33.33	2500
13-13-6	2	6	11.52	2.08	50.0	2500
13-13-8	2	8	8.64	2.78	66.67	2500
13-13-10	2	10	6.91	3.47	83.36	2500
15-0-1	1	1	69.10	0.35	8.33	2500
15-0-2	1	2	34.55	0.69	16.67	2500
15-0-3	1	3	23.03	1.04	25.01	2500
15-0-4	1	4	17.28	1.39	33.33	2500
15-0-5	1	5	13.82	1.74	41.68	2500
15-0-6	1	6	11.52	2.08	50.0	2500
15-15-2	2	2	34.55	0.69	16.67	2500
15-15-4	2	4	17.28	1.39	33.33	2500
15-15-6	2	6	11.52	2.08	50.0	2500
15-15-8	2	8	8.64	2.78	66.67	2500
15-15-10	2	10	6.91	3.47	83.36	2500
15-15-12	2	12	5.76	4.17	100.0	2500
20-0-1	1	1	69.10	0.35	8.33	1600
20-0-2	1	2	34.55	0.69	16.67	1600
20-0-3	1	3	23.03	1.04	25.01	1600
20-0-4	1	4	17.28	1.39	33.33	1600
20-0-5	1	5	13.82	1.74	41.68	1600
20-0-6	1	6	11.52	2.08	50.0	1600
20-0-7	1	7	9.87	2.43	58.36	1600
20-0-8	1	8	8.64	2.78	66.67	1600
20-20-2	2	2	34.55	0.69	16.67	1600
20-20-4	2	4	17.28	1.39	33.3	1600
20-20-6	2	6	11.52	2.08	50.0	1600
20-20-8	2	8	8.64	2.78	66.67	1600
20-20-10	2	10	6.91	3.47	83.36	1600
20-20-12	2	12	5.76	4.17	100.0	1600
20-20-14	2	14	4.94	4.86	116.60	1600
20-20-16	2	16	4.32	5.56	133.33	1600

Notes: 1. Electrical data based on magnets connected in parallel.

Armature Data

Brake Size	No. of Armatures	Total Brake Inertia (lb.ft.^{2})	Armature and Hub* Total Weight (lbs.)
10"	1	0.9	9.4
	2	1.4	14.6
13"	1	2.9	16.6
	2	4.6	25.0
15"	1	4.6	22.3
	2	7.5	32.5
20"	1	20.0	70.0
	2	36.0	105.0

*Armature, hub and bushing rotate

Torque Ratings per Magnet

Brake Size	Dynamic Torque* (lb.ft.)	Drag Torque (lb.ft.)	E-Stop** (lb.ft.)
10"	28.5	.21	62
13"	30	.32	64
15"	33	.37	65
20"	37	.51	70

* Per magnet @ 50 rpm; 270 ma coil current

** Per magnet @ 50 rpm; 500 ma coil current

Modular Design … tailored to meet your requirements

To select the proper size Electro Disc tension brake, it is important to understand that the brakes are fully modular. This feature enables matching requirements for heat dissipation and emergency stopping torque to the tension brake configuration that optimizes these features.

Selection

The easy-to-use selection charts on page 89 specifies a particular modular combination as listed in the accompanying chart. (See page 90 for selection of basic tension brakes.)

Determining two factors are all that's required.

1. Diameter
   Basically heat dissipation capacity is directly proportional to the diameter of the disc.
2. Number of magnets
   Torque capacity is proportional to the number of magnets. See page 89 for torque and heat dissipation sizing to meet the specific requirements of your application.

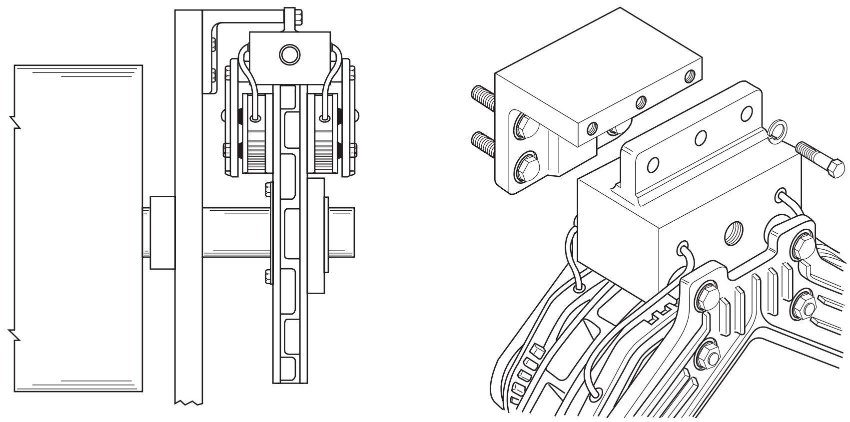
Mounting Configurations

Flexible Mounting

Thrust bearings, side loading, and special supports are a thing of the past!

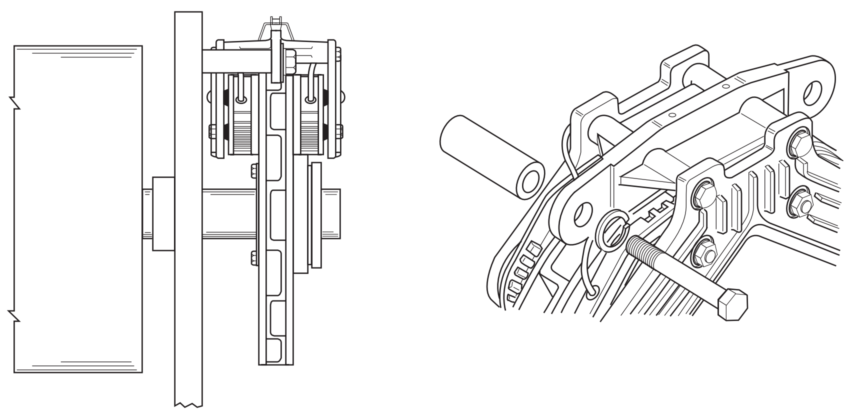
Universal Mounting Bracket

With addition of a simple "L" shaped bracket (Customer supplied), the universal mount provides a perfectly easy retrofit on older machines.



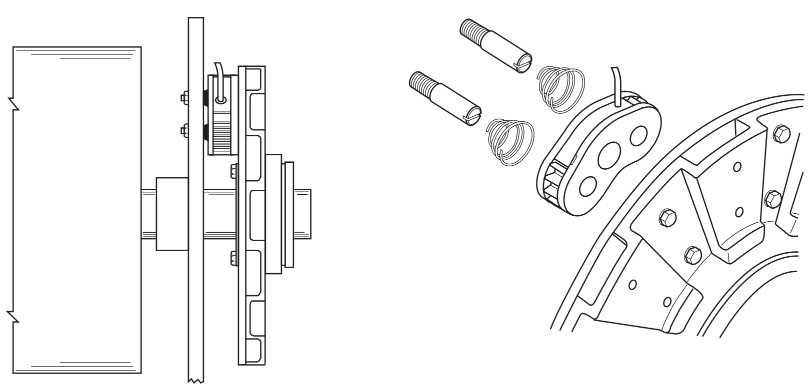
Bulk Head Mounting Bracket

Use of the bulkhead mount reduces the overall diameter to allow mounting in more constricted or enclosed locations.



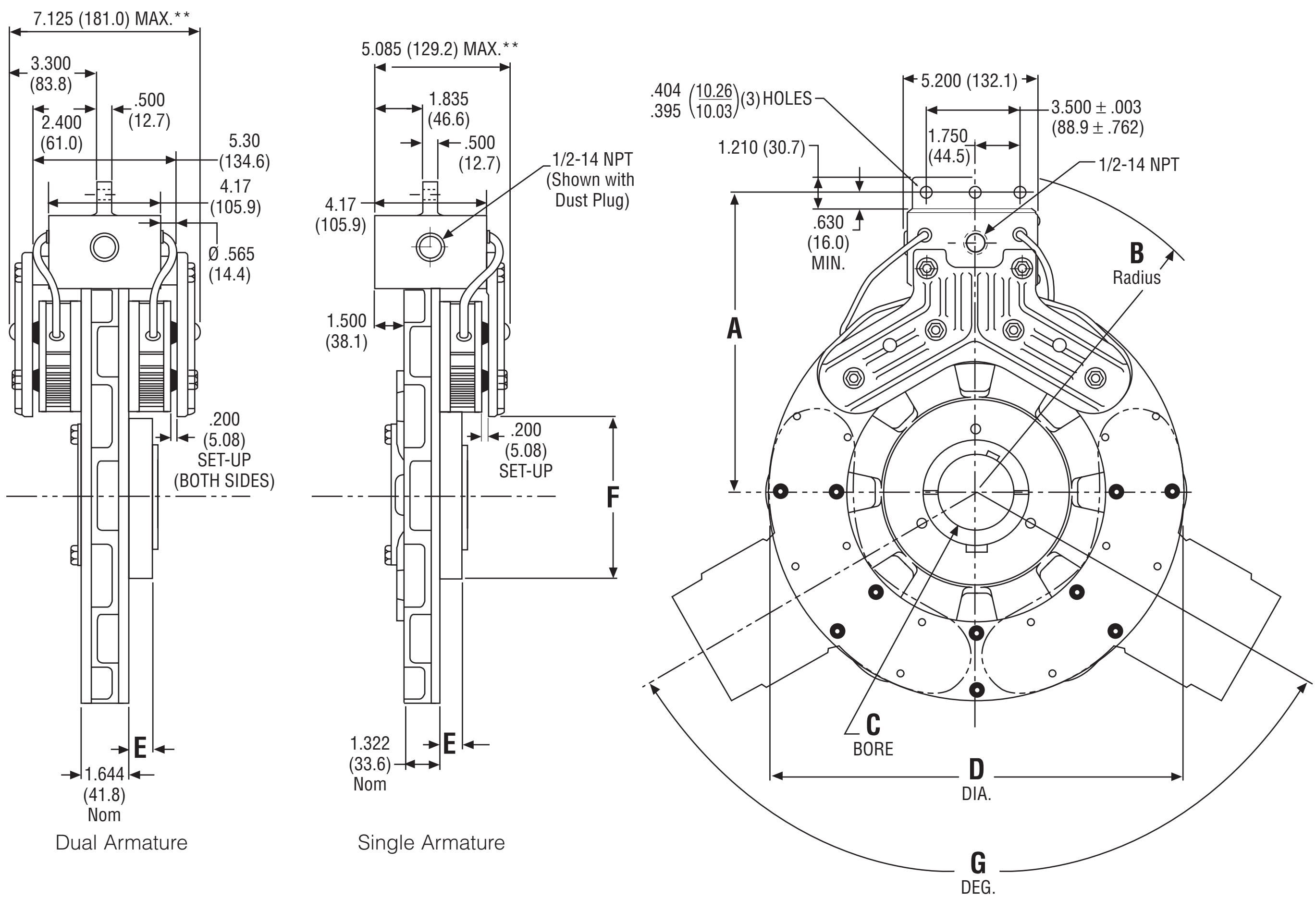
Direct (Free) Mounting

For the Machine Builder or retrofitter, the free mount provides the simplest, least expensive option with low profile and diameter advantages. Mounting directly to the side frame of the machine offers all support necessary for performance requirements.



MTB-II Dimensions

. . . with Universal Mounting Brackets



inches (mm)

Armature Size	A	B Max.	C BORE Stock*	C BORE Bushing	C BORE Browning	D Max.	E Max.	F Max.	G Degree
10"	8.625 ± .020 (219.0 ± 0.5)	9.500 (241.3)	1.750 (44.45)	.500–1.750 (14.0–42.0)	P-1	10.020 (254.5)	.479 (12.2)	3.550 (88.9)	180
13"	10.187 ± .020 (258.7 ± 0.5)	11.000 (279.4)	3.375 (85.73)	1.125–3.750 (28.0–95.0)	R-1	13.520 (343.4)	1.219 (31.0)	5.687 (144.4)	108 & 144
15"	11.125 ± .020 (282.6 ± 0.5)	12.000 (304.8)	3.375 (85.73)	1.125–3.750 (28.0–95.0)	R-1	15.325 (389.3)	1.219 (31.0)	6.875 (174.6)	120
20"	13.470 ± .020 (340.4 ± 0.5)	14.250 (362.0)	— —	2.375–5.500 —	U-0	20.020 (508.5)	2.720 (69.1)	4.380 (111.3)	—

* Stock bore is straight bore for use with Trantorque bushing.

For replacement parts list and exploded view drawing, see page 96.

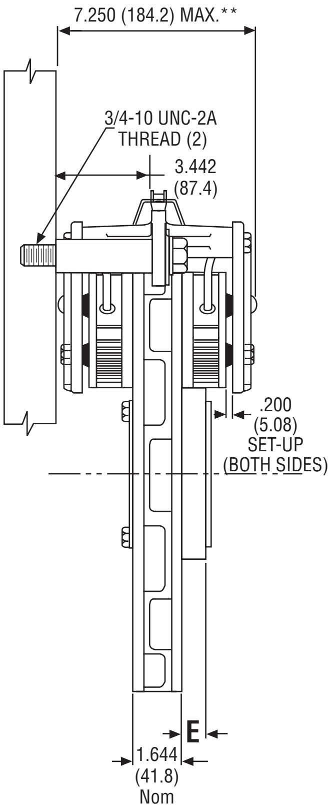
** Width dimension is the same for single or dual magnet carriers. (Dual magnet carrier shown.)

Consult factory for dimensional information on MTB-I.

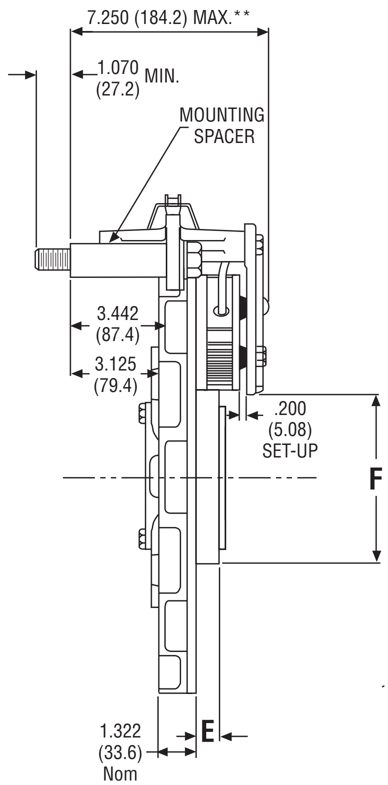
Note: All dimensions are nominal unless otherwise noted.

MTB-II Dimensions

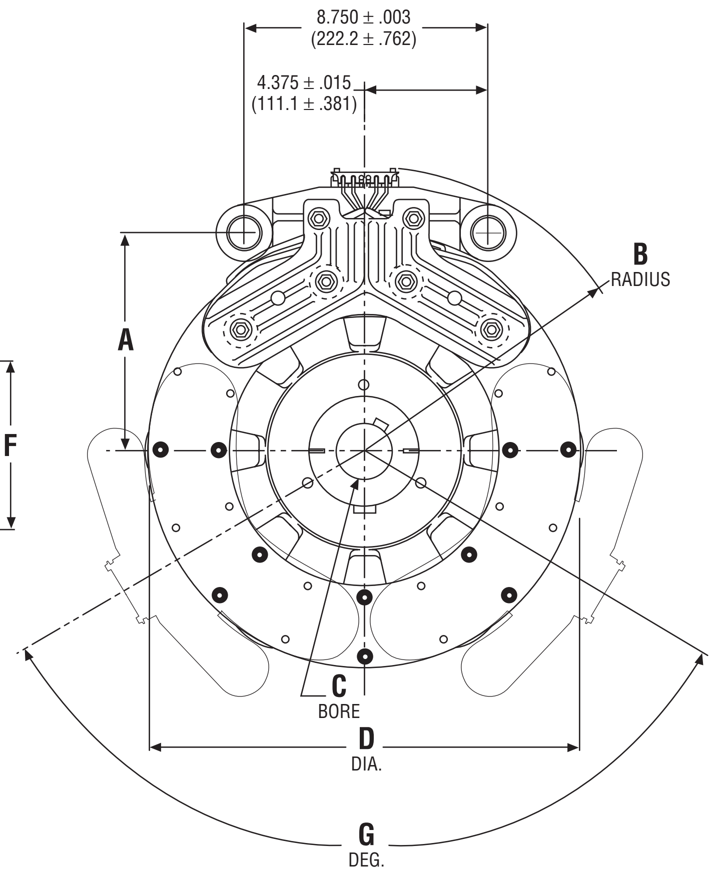
. . . with Bulk Head Mounting Brackets



Dual Armature



Single Armature



inches (mm)

Armature Size	A	B Max.	C BORE Stock*	C BORE Bushing	C BORE Browning	D Max.	E Max.	F Max.	G Degree
10"	5.260 ± .020 (133.6 ± 0.5)	7.750 (196.9)	1.750 (44.45)	.500–1.750 (14.0–42.0)	P-1	10.020 (254.5)	.479 (12.2)	3.55 (88.9)	180
13"	6.822 ± .020 (173.3 ± 0.5)	9.300 (236.2)	3.375 (85.73)	1.125–3.750 (28.0–95.0)	R-1	13.520 (343.4)	1.219 (31.0)	5.687 (144.4)	108 & 144
15"	7.760 ± .020 (197.1 ± 0.5)	10.230 (259.9)	3.375 (85.73)	1.125–3.750 (28.0–95.0)	R-1	15.325 (389.3)	1.219 (31.0)	6.875 (174.6)	120
20"	10.250 ± .020 (260.4 ± 0.5)	12.500 (317.5)	— —	2.375–5.500 —	U-0	20.020 (508.5)	2.720 (69.1)	4.380 (111.3)	—

* Stock bore is straight bore for use with Trantorque bushing.

For replacement parts list and exploded view drawing, see page 96.

** Width dimension is the same for single or dual magnet carriers. (Dual magnet carrier shown.)

Consult factory for dimensional information on MTB-I.

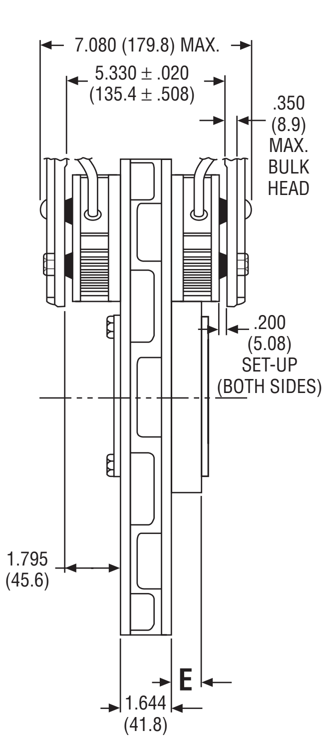
Note: All dimensions are nominal unless otherwise noted.

Electric Brakes

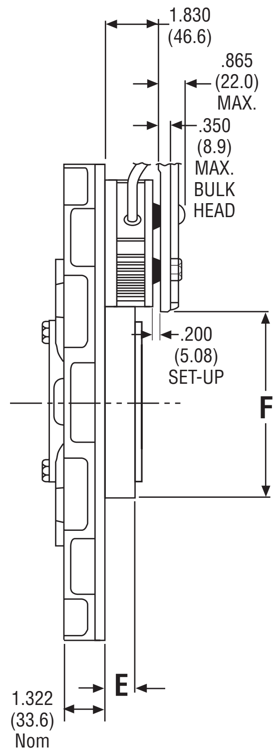
MTB Series – Modular Tension Brakes

MTB-II Dimensions

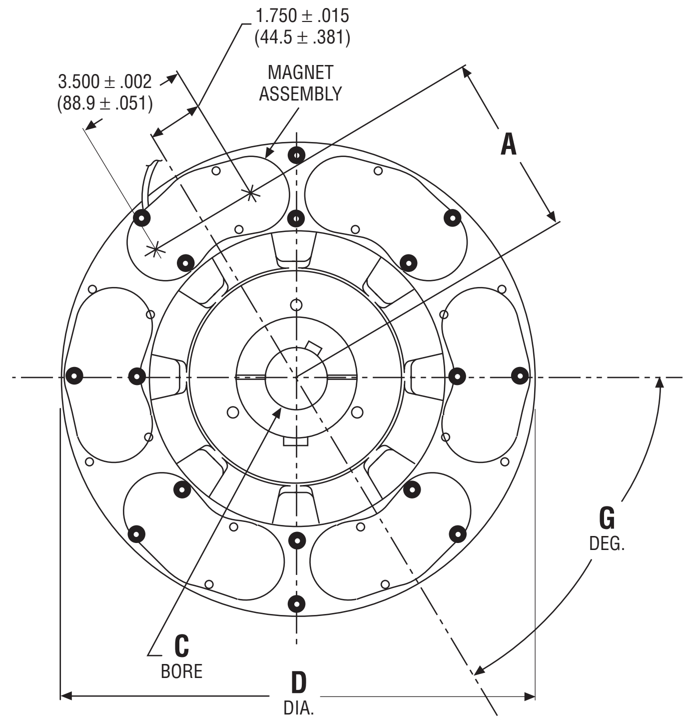
. . . with Direct Mounting



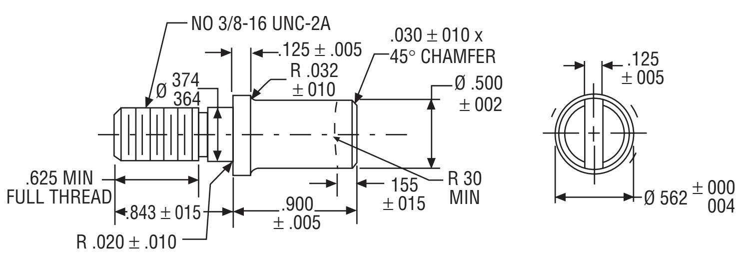
Dual Armature



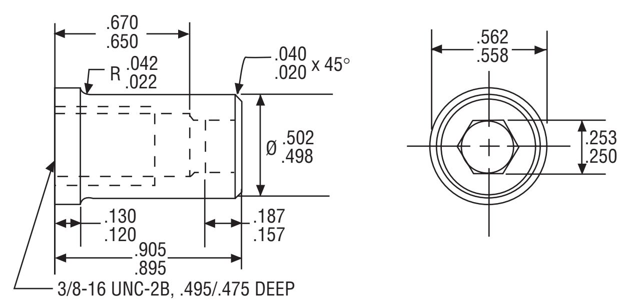
Single Armature



Male Pins



Female Pins



inches (mm)

Armature Size	A	C BORE Stock*	C BORE Bushing	C BORE Browning	D Max.	E Max.	F Max.	G Degree
10"	3.350 ± .020 (85.1 ± 0.5)	1.750 (44.45)	.500–1.750 (14.0–42.0)	P-1	10.020 (254.5)	.479 (12.2)	3.550 (88.9)	120
13"	5.215 ± .020 (132.5 ± 0.5)	3.375 (85.73)	1.125–3.750 (28.0–95.0)	R-1	13.520 (343.4)	1.219 (31.0)	5.687 (144.4)	72
15"	5.850 ± .020 (148.6 ± 0.5)	3.375 (85.73)	1.125–3.750 (28.0–95.0)	R-1	15.325 (389.3)	1.219 (31.0)	6.875 (174.6)	60
20"	8.125 ± .040 (206.4 ± 1.0)	— —	2.375–5.500 —	U-0	20.020 (508.5)	2.720 (69.1)	— —	—

* Stock bore is straight bore for use with Trantorque bushing.
For replacement parts list and exploded view drawing, see page 96.

Consult factory for dimensional information on MTB-I.

Note: All dimensions are nominal unless otherwise noted.

Retrofit/Upgrade of MTB to MTB-II

New MTB-II magnets and armature carriers are designed to easily retrofit and upgrade existing MTB applications.

MTB Magnet Weight
3 lb. 4.5 oz. each Magnet

1. Magnets only – Existing applications can extend the life of the friction system by installing MTB-II components.

If presently using… MTB MAGNETS			Upgrade with… MTB-II MAGNETS		
Magnet		5216-631-004	**Standard Magnet**		5216-631-010
			or		
			Magnet with electronic wear indicator		5216-631-009
that should go with…			*that should go with…*		
Magnet Carriers					
Dual	10"	5216-295-002	**Dual**	10"	5216-295-005
	13"	None		13"	5216-295-006
	15" & 20"	5216-295-001		15" & 20"	5216-295-007
Single	All	5216-295-003	**Single**	All	5216-295-004
OR (if Free Mounting)…			*OR (if Free Mounting)…*		
Free Mount Pins		5216-101-010	**Free Mount**		5216-101-029
		5216-101-008	**Pins**		5216-101-030

Note: a) The same number of magnets should be used unless additional considerations exist (consult factory).
b) MTB-II Free Mount Pins (5216-101-029) may replace the pins in the MTB carriers to convert them into MTB-II carriers.

2. **Aluminum Armature Carriers –** Existing applications may be upgraded to aluminum armature carriers with the benefit of reducing armature inertia. This may be done with or without upgrading the magnets.

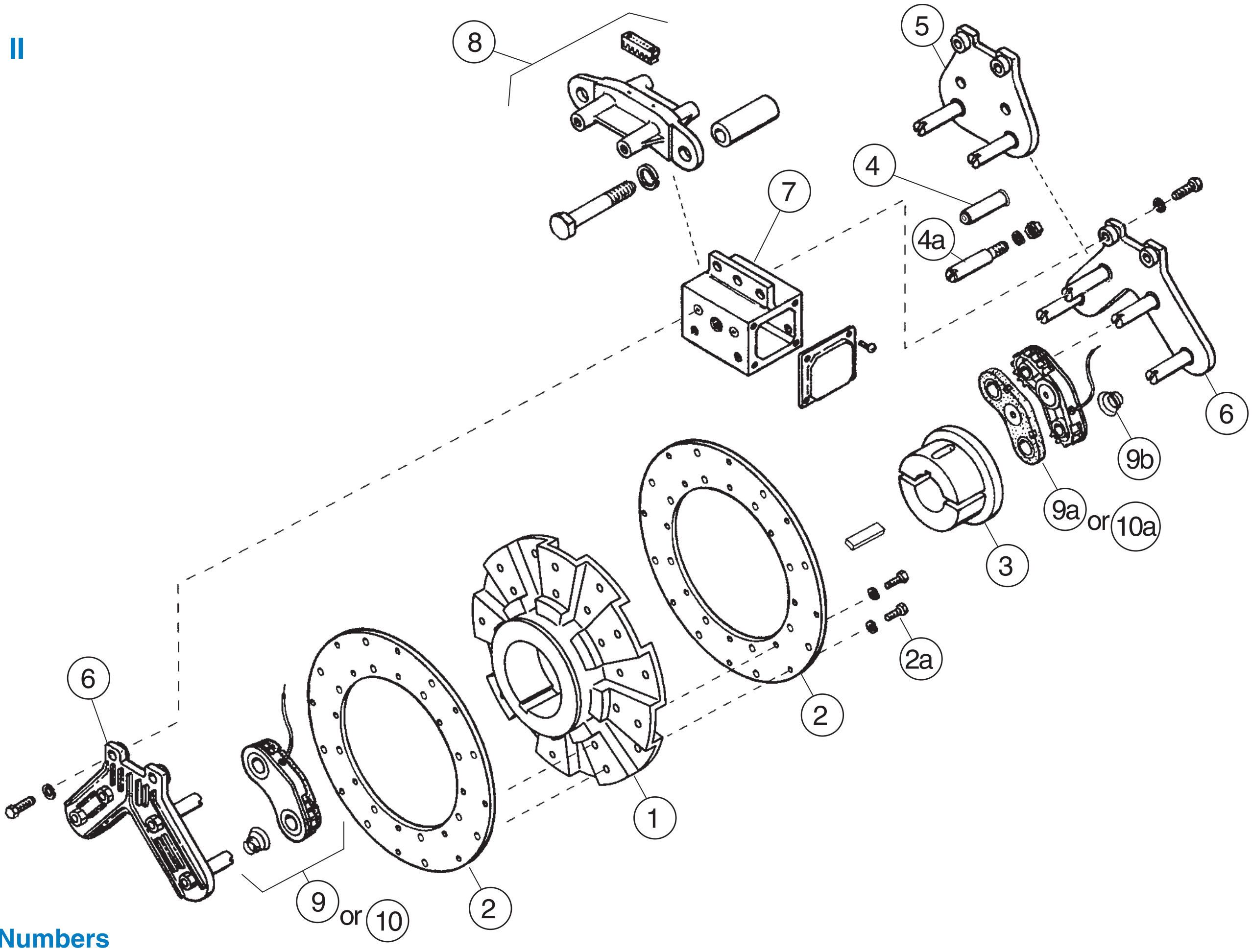
If presently using… MTB ARMATURE & HUB		Upgrade with… MTB-II ARMATURE & CARRIER	
10" Armature	5216-111-001	**10" Armature**	5216-101-025
that should go with…		*that should go with…*	
10" Hub	540-0842	**Tapered Bore Carrier**	295-0021
		OR	
		Straight Bore Carrier	295-0026
15" Armature	5216-111-003	**15" Armature**	5216-101-024
that should go with…		*that should go with…*	
15" Hub	540-1382	**Tapered Bore Carrier**	295-0019
		OR	
		Straight Bore Carrier	295-0028

Note: Due to the orientation of the tapered bore in the integral hub of the MTB-II armature carrier, some existing MTB applications may not readily retrofit to the new assembly (consult factory).

Brake Assemblies and Part Numbers

MTB Series – Modular Tension Brakes

MTB II



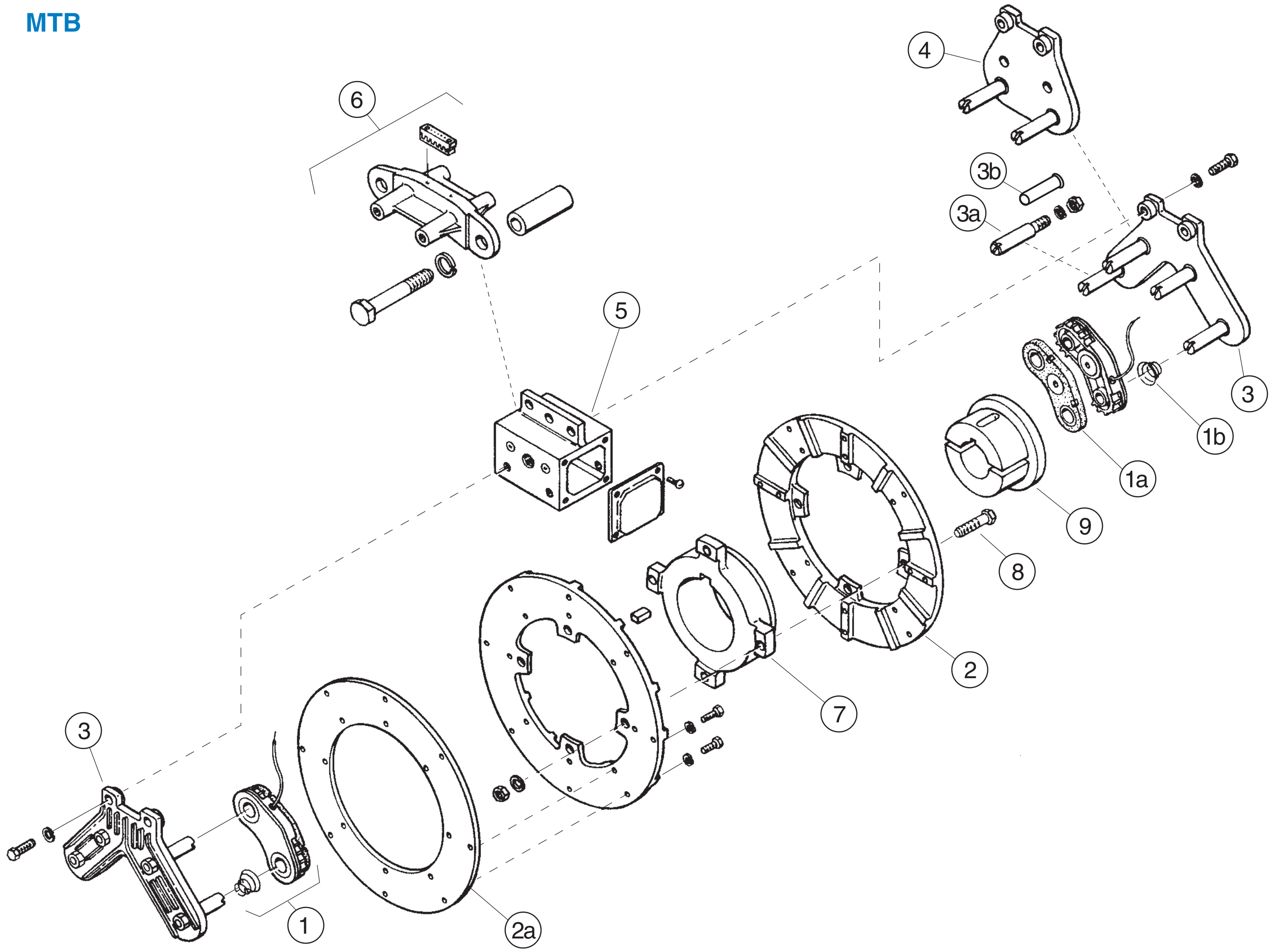
Part Numbers

Item	Description	10" Armature	13" Armature	15" Armature	20" Armature*
Armatures					
1	Armature Carrier (Bushing Enters from Flush Side of Carrier as Shown)	295-0021	295-0023	295-0019	—
	Armature Carrier Reverse Taper (Bushing Enters from Extended Side of Carrier)	295-0031	295-0030	295-0029	—
	Armature Carrier (Straight Bore)	295-0026	295-0027	295-0028	—
2	Armature (Replaceable Face)	5216-101-025	5216-101-026	5216-101-024	—
2a	Armature Mounting Accessory (Included with Armature)	5216-101-023	5216-101-023	5216-101-023	—
3	Bushing (Customer Supplied) Taper Bore	Browning P1	Browning R1	Browning R1	—
	Straight Bore	Use Trantorque. Consult Warner Electric			—
4	Female Pin Kit (Includes 2 Pins)	5216-101-030	5216-101-030	5216-101-030	5216-101-030
4a	Male Pin Kit (Includes 2 Pins with Nuts and Lockwashers)	5216-101-029	5216-101-029	5216-101-029	5216-101-029
Magnet Carriers					
5	Single Magnet Carrier Assembly	5216-295-004	5216-295-004	5216-295-004	5216-295-004
6	Dual Magnet Carrier Assembly	5216-295-005	5216-295-006	5216-295-007	5216-295-007
Carrier Brackets					
7	Universal Mounting Bracket, Series 10-0, 13-0, & 20-0 (2)	5216-101-020	5216-101-020	5216-101-020	5216-101-020
	Universal Mounting Bracket, Series 10-10, 13-13, & 20-20 (2)	5216-101-021	5216-101-021	5216-101-021	5216-101-021
8	Bulk Head Mounting Bracket (3)	5216-101-022	5216-101-022	5216-101-022	5216-101-022
Magnets					
9	Magnet Assembly, Standard	5216-631-010	5216-631-010	5216-631-010	5216-631-010
	Magnetic Assembly, HICO	5216-631-013	5216-631-013	5216-631-013	5216-631-013
9a	Friction Pad, Standard (Replacement Part Only)	5216-101-028	5216-101-028	5216-101-028	5216-101-028
	Friction Pad, HICO (4)	5216-101-031	5216-101-031	5216-101-031	5216-101-031
9b	Preload Spring (1) (Included with Magnets)	808-0008	808-0008	808-0008	808-0008
10	Magnet Assembly with Wear Indicator	5216-631-009	5216-631-009	5216-631-009	5216-631-009
10a	Friction Pad with Wear Indicator (Replacement Part Only)	5216-101-027	5216-101-027	5216-101-027	5216-101-027

(1) Two of each required for each brake magnet.
(2) Includes magnet carrier (4 & 5) mounting hardware.
(3) Includes magnet mounting hardware, bracket mounting bolts and spacers.
(4) HICO friction pads can be identified by orange paint mark near wear notch.

* 20" armature components – see page 97.
Browning is a registered trademark of Emerson Electric Co.
Trantorque is a registered trademark of Trantorque Corporation.

MTB



Part Numbers

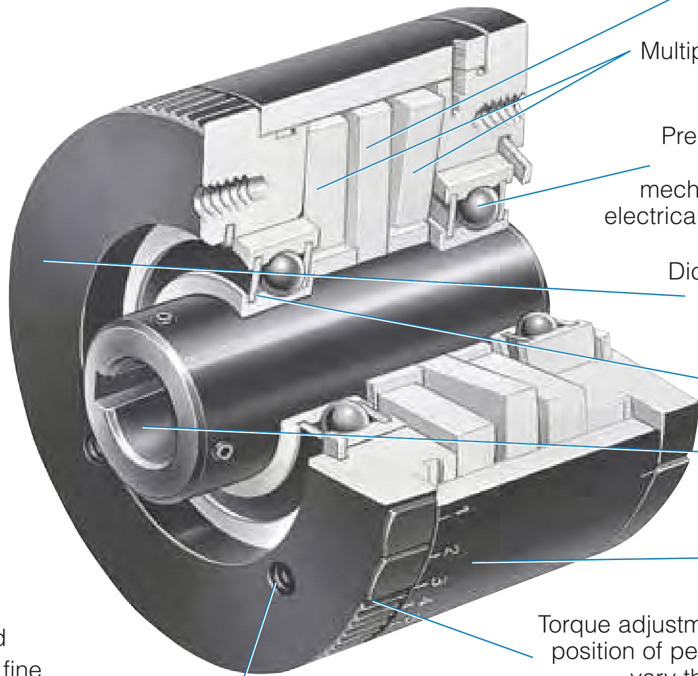
Item	Description	10" Armature	15" Armature	20" Armature
1	Magnet Assembly	5216-631-004	5216-631-004	5216-6310-004
1a	Friction Pad (Replacement Part Only)	5216-101-003	5216-101-003	5216-101-003
1b	Preload Spring1	808-0008	808-0008	808-0008
2	Armature (Replaceable Face & Carrier)	5216-111-001	5216-111-003	5216-111-004
2a	Steel Replacement Face	5216-101-012	5216-101-011	5216-101-013
3	Dual Magnet Carrier Assembly	5216-295-002	5216-295-001	5216-295-001
3a	Male Pin Only (Includes Nut & Lockwasher)	5216-101-010	5216-101-010	5216-101-010
3b	Female Pin Kit	5216-101-008	5216-101-008	5216-101-008
4	Single Magnet Carrier Assembly	5216-295-003	5216-295-003	5216-295-003
5	Series 10-0, 15-0, & 20-0 Universal Mounting Bracket (2)	5216-101-020	5216-101-020	5216-101-020
	Series 10-10, 15-15, & 20-20 Universal Mounting Bracket (2)	5216-101-021	5216-101-021	5216-101-021
6	Bulk Head Mounting Bracket (3)	5216-101-022	5216-101-022	5216-101-022
7	Hub	540-0842	540-1382	540-1399
8	Series 10-0, 15-0, & 20-0 Armature Mounting Accessory	5216-101-004	5216-101-004	5216-101-018
	Series 10-10, 15-15, & 20-20 Armature Mounting Accessory	5216-101-005	5216-101-005	5216-101-019
9	Bushing (Customer Supplies)	Browning Type P-1	Browning Type R-1	Browning Type U-0

(1) Two of each required for each brake magnet.
(2) Includes magnet carrier (3 & 4) mounting hardware.
(3) Includes magnet mounting hardware, bracket mounting bolts and spacers.
Browning is a registered trademark of Emerson Electric Co.

Magnetic Brakes and Clutches

M Series – Permanent Magnet

Fast, precise torque adjustment!



Precision Tork™ clutches and brakes

Precision Tork units provide constant torque independent of slip speed. They offer excellent overload and jam protection for all drive train components and also provide soft starts with zero slip when a preset torque is reached. Precision Tork permanent magnet clutches and brakes do not require maintenance and provide extremely long life. Since they operate from permanent magnets, no outside control or power source is required.

Features and Benefits

Fast, precise torque adjustment
- Torque is set with a large knurled adjustment ring.
- Infinite adjustability between minimum and maximum settings. This allows units to be fine tuned to your unique requirement.
- Easy to read graduations.

Torque is constant with respect to speed
- Torque is extremely consistent and smooth at low, as well as high, speeds.
- By using the Precision Tork unit, you can solve almost any torque control problem.

No external control or power source
- Simple to install
- Nothing to monitor
- Unaffected by power interruption or power fluctuation
- Safe to use

Dependable performance
- Smallest possible transition from static to dynamic torque. Virtually eliminates the “stick-slip” phenomenon associated with friction devices.
- Long life. The only wearing parts are the ball bearings.
- Extremely accurate. Precision Tork units out-perform all other devices at low RPM.

Versatile mounting: Easy to retrofit
- Clutches are available with hollow bores for mounting on motor shafts or jack shafts.
- Bolt circles allow for fixed mounting, adding a pulley, or stub shaft adapter.
- Brakes are available with solid shaft outputs.

Distributor item
- Off the shelf availability.
- Interchangeable with competitors’ products.

Special Applications

Specials are our business. . .

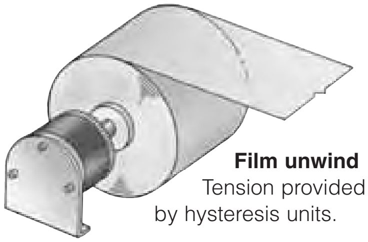
- Special shaft bores and keyways
- Shaft extensions
- System retrofits
- Metric bores and keyways
- Stainless steel construction
- Fixed torque units

Magnetic Brakes and Clutches

M Series – Permanent Magnet

Unwind tension control

Brake mounted on shaft of unwind spool or bobbin.



Film unwind
Tension provided by hysteresis units.

Information required:

Full roll diameter (in.) = 6 in.
Core diameter (in.) = 4 in.
Average tension (lbs.) = 4 lbs.
Velocity (feet per min.) = 100 fpm

How to size:

Average radius (in.) =

$$\frac{\text{Full roll dia. (in.)} + \text{Core dia. (in)}}{4}$$

$$= \frac{6 + 4}{4} = 2.5 \text{ in.}$$

Torque (lb.in.) =

Avg. tension (lbs.) x Avg. radius (in.)
= 4 x 2.5 = 10 lb.in.

Check tension range:

Max. tension = Torque (lb.in.) x

$$\frac{2}{\text{Core dia. (in.)}} = 10 \times \frac{2}{4} = 5 \text{ lbs.}$$

Min. tension = Torque (lb.in.) x

$$\frac{2}{\text{Full roll dia. (in.)}} = 10 \times \frac{2}{6} = 3.3 \text{ lbs.}$$

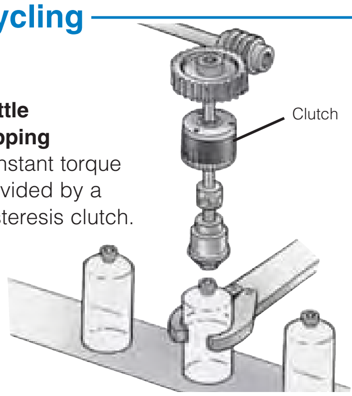
Slip watts =

$$\frac{\text{Max. tension (lbs.)} \times \text{velocity (fpm)}}{44.2}$$

= 11.3 watts

Select Model MC4

Cycling



Bottle capping
Constant torque provided by a hysteresis clutch.

Information required:

Slip RPM = 500 RPM
Torque = 8 lb.in.
% slip time of total cycle time = 25%

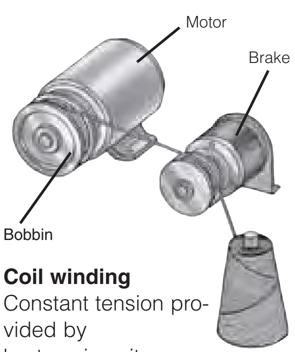
How to size:

*Watts = .0118 x torque (lb.in.) x slip RPM x % slip time = .0118 x 8 x 500 x .25 = 11.8 watts

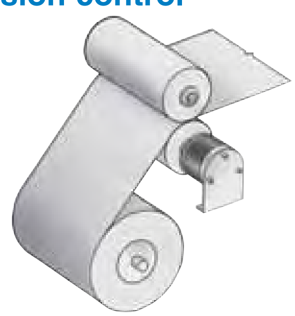
Select an MC4 from the specification chart.

*Note: Consult factory if peak slip watts are extremely high or if duration of slip period is in excess of 1 minute.

Nip roll or pulley tension control



Coil winding
Constant tension provided by hysteresis unit.



Film tensioning
Constant tensioning supplied by hysteresis unit.

Information required:

Pulley or nip roll diameter = 4 in. Tension = 6 lbs. Velocity = 100 fpm

How to size:

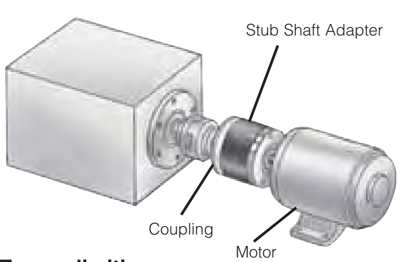
$$\text{Torque (lb.in.)} = \text{Tension (lbs.)} \times \frac{\text{Dia. (in.)}}{2} = 6 \times \frac{4}{2} = 12 \text{ lb.in.}$$

$$\text{Slip watts} = \frac{\text{Tension (lbs.)} \times \text{velocity (fpm)}}{44.2} = \frac{6 \times 100}{44.2} = 13.5 \text{ watts}$$

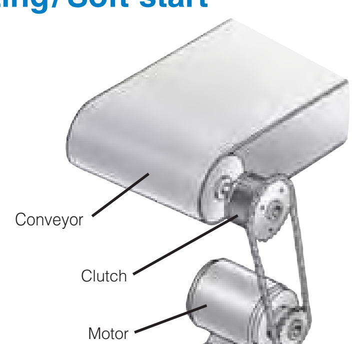
Select Model MC5

Overload protection/Torque limiting/Soft start

Motor horsepower method



Torque limiting
Hysteresis clutch provides overload protection.



Material handling
Hysteresis clutch can provide overload protection and soft start.

Information required:

Motor HP = 1/2 HP
Motor RPM = 1750 RPM

How to size:

$$\text{Torque (lb.in.)} = \frac{\text{HP} \times 63000}{\text{RPM}} =$$

$$\frac{1/2 \times 63000}{1750} = 18 \text{ lb.in.}$$

Select an MC5 from the specification chart.

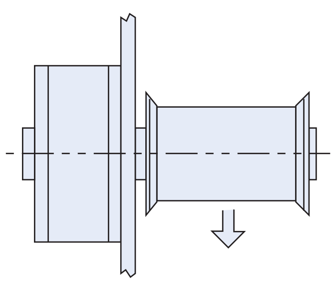
Magnetic Brakes and Clutches

M Series – Permanent Magnet

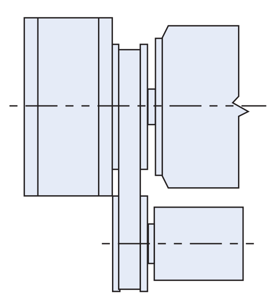
Specifications

Model Size	Torque	Heat Dissipation (watts)	Inertia (oz.in./sec.^{2})	Bending Moment (lb.in.)	Max. RPM	Weight (lbs.)	Bore Range/Shaft Dia. (in.)
Clutches							
MC1.5	1–10 oz.in.	10	0.7×10^{-3}	5	3600	11 oz.	1/4
MC2	1–22 oz.in.	10	0.7×10^{-3}	5	3600	11 oz.	1/4
MC3	0.3–6.0 lb.in.	18	6.5×10^{-3}	10	1800	2	3/8
MC4	0.5–11 lb.in.	22	13.3×10^{-3}	10	1800	2.5	3/8, 1/2, 5/8
MC5	1–30 lb.in.	72	77×10^{-3}	25	1800	9	3/8, 1/2, 5/8, 3/4, 7/8, 1
MC5.5	1–50 lb.in.	110	120×10^{-3}	25	1800	11	5/8, 3/4, 7/8, 1
MC6	2–70 lb.in.	150	196×10^{-3}	25	1800	12	5/8, 3/4, 7/8, 1
MC9	15–300 lb.in.	345	600×10^{-3}	50	1200	45	5/8, 3/4, 7/8, 1, 1-1/8, 1-1/4
Brakes							
MB1	0-1.1 oz.in.	3	3.5×10^{-5}	1	3600	2 oz.	3/16
MB1.5	1-10 oz.in.	10	0.9×10^{-3}	5	3600	11 oz.	1/4
MB2	1–22 oz.in.	10	0.9×10^{-3}	5	3600	11 oz.	1/4
MB3	0.3–6.0 lb.in.	18	6.9×10^{-3}	10	1800	2	3/8
MB4	0.5–11 lb.in.	22	13.7×10^{-3}	10	1800	2.5	5/8
MB5	1–30 lb.in.	72	82×10^{-3}	25	1800	9	1
MB5.5	1–50 lb.in.	110	125×10^{-3}	25	1800	11	1
MB6	2–70 lb.in.	150	201×10^{-3}	25	1800	12	1
MB9	15–300 lb.in.	345	600×10^{-3}	50	1200	45	1

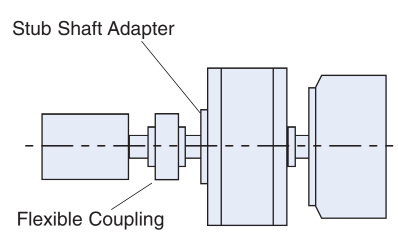
Typical Mounting Arrangements



Brake:
Typical setup for tensioning wire, film and fibers.



Clutch:
Typical setup for material handling, soft starts and torque limiting.

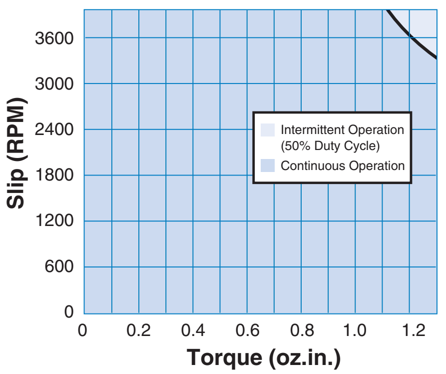


Clutch Coupling:
Typical setup for torque limiting protection used for labeling, capping and printing applications.

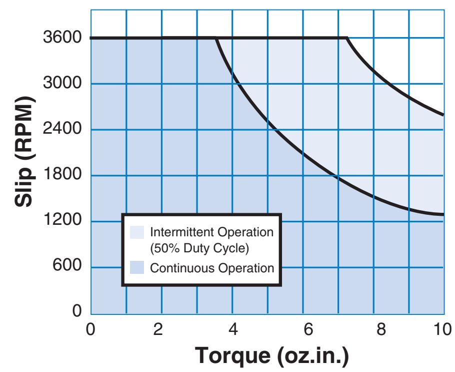
Heat Dissipation Charts

Clutches/Brakes

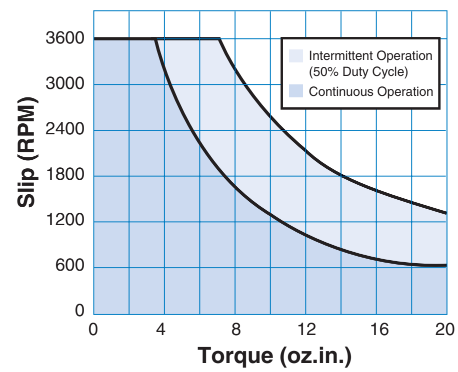
MB1



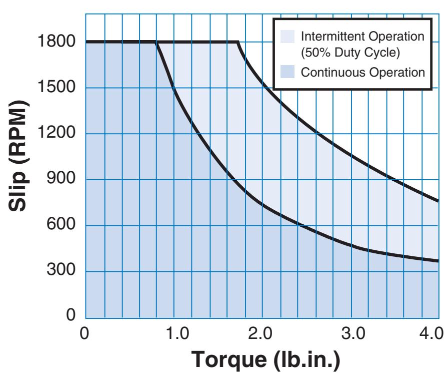
MC1.5/MB1.5



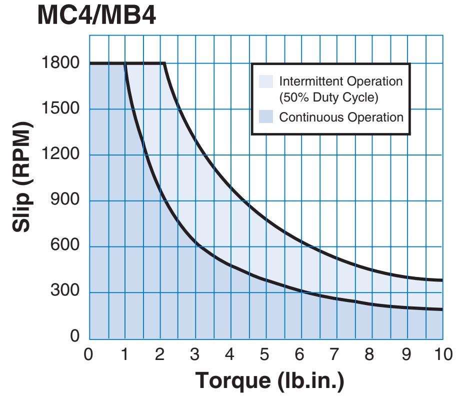
MC2/MB2



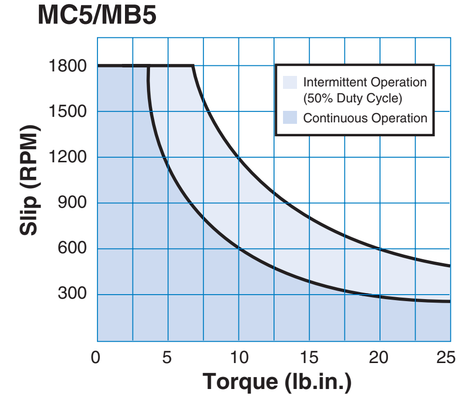
MC3/MB3



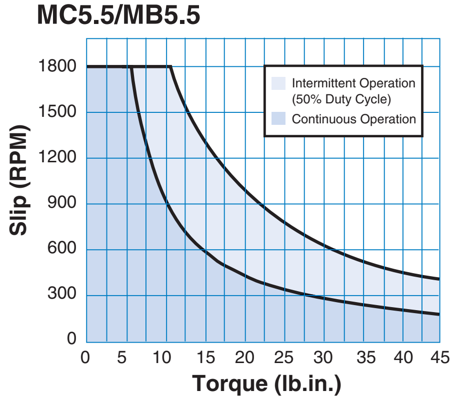
MC4/MB4



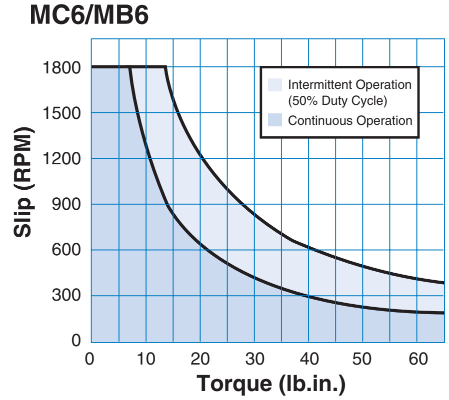
MC5/MB5



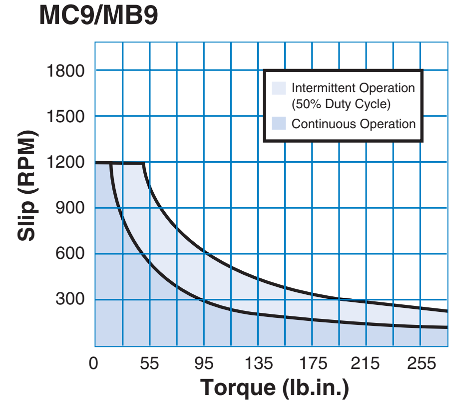
MC5.5/MB5.5



MC6/MB6



MC9/MB9



Note: Torque output at a given setting will vary up to 3% from unit to unit. Matched units are available upon request.

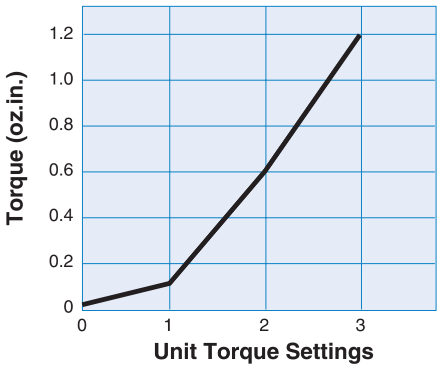
Magnetic Brakes and Clutches

M Series – Permanent Magnet

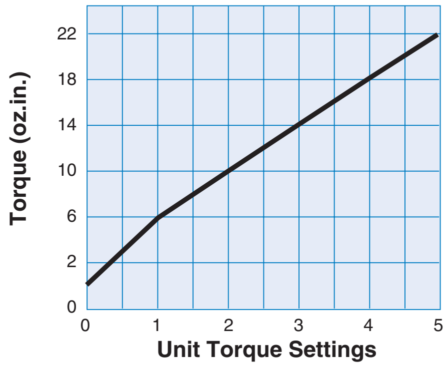
Torque Setting Charts

Clutches/Brakes

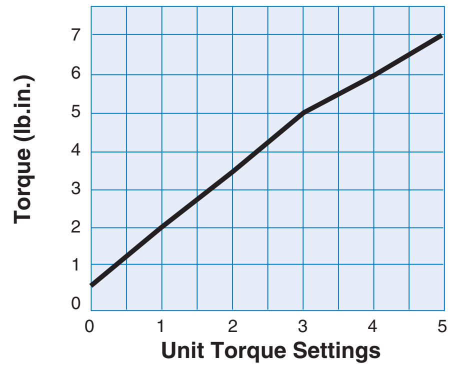
MB1



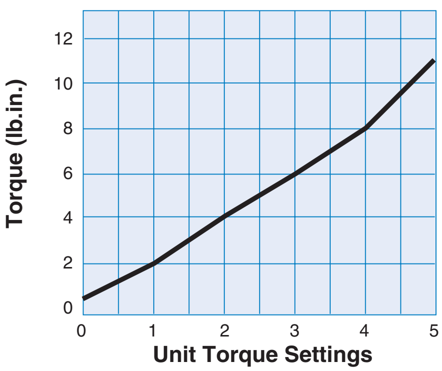
MC2/MB2



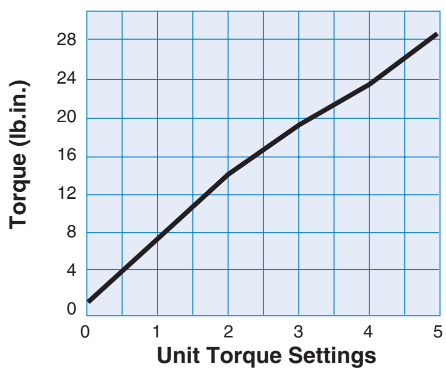
MC3/MB3



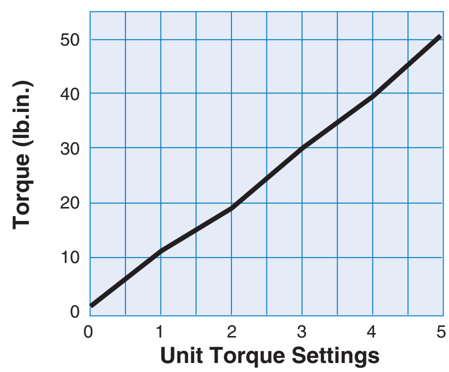
MC4/MB4



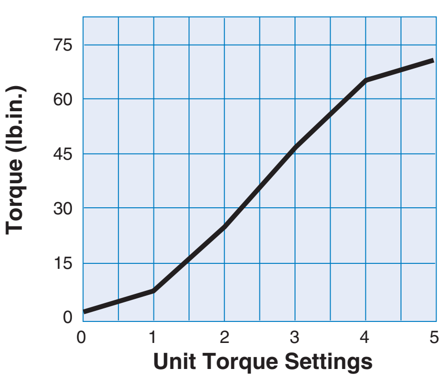
MC5/MB5



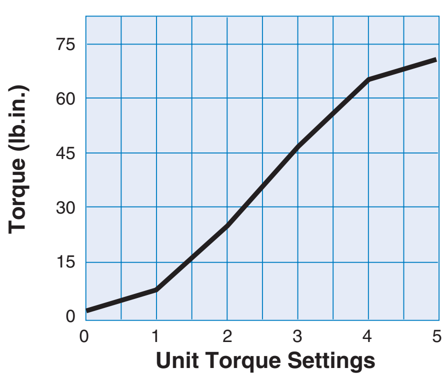
MC5.5/MB5.5



MC6/MB6

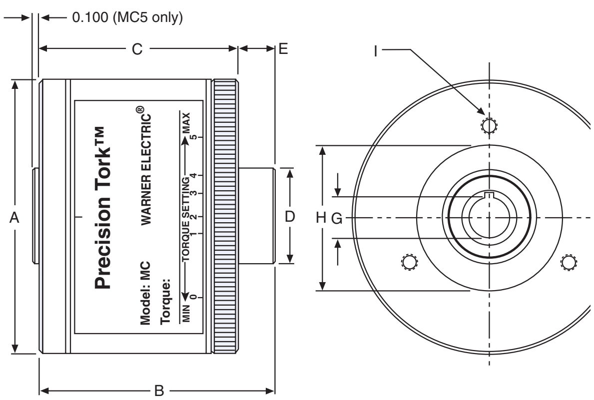


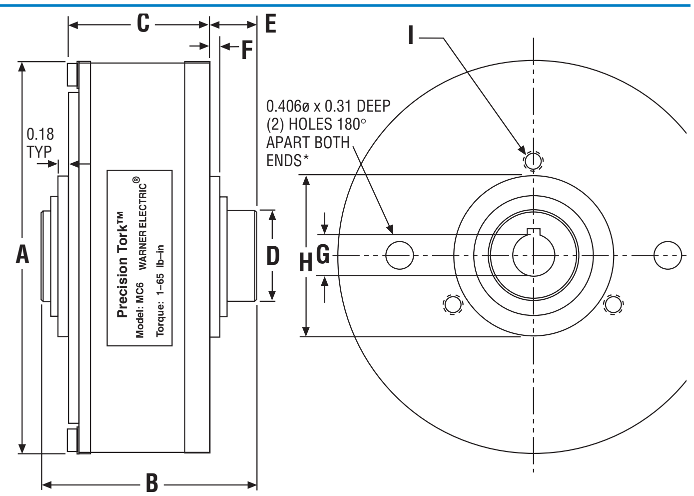
MC9/MB9



Note: Torque output at a given setting will vary up to 3% from unit to unit. Matched units are available upon request.

MC – Magnetic Clutches





Drawing A

Drawing B

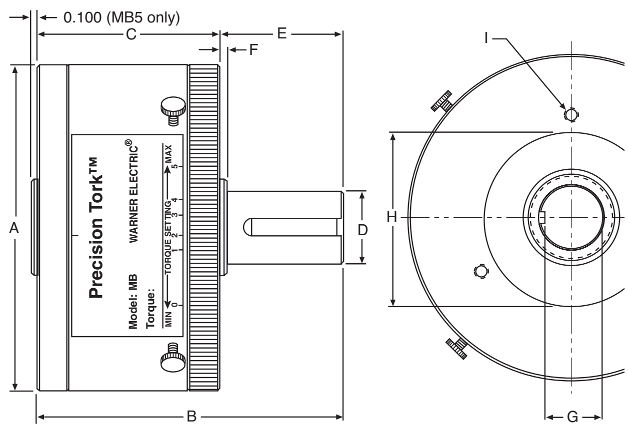
Model	Drawing	A	B	C	D	E	F
MC1.5*	A	1.85	1.61	1.35	0.375	0.26	–
MC2*	A	1.85	1.61	1.35	0.375	0.26	–
MC3*	A	2.75	2.24	2.00	0.590	0.24	–
MC4*	A	3.23	2.26	2.00	0.984	0.26	–
MC5*	A	4.65	3.18	2.65	1.378	0.42	–
MC5.5*	A	5.29	3.25	2.65	1.378	0.60	–
MC6**	B	6.10	3.18	2.04	1.378	0.73	0.18
MC9**	B	9.4	4.17	3.49	1.77	0.55	0.13

* Set screw adjustment
** Spanner wrench required for adjustment. Spanner wrench P/N YZ00-0007

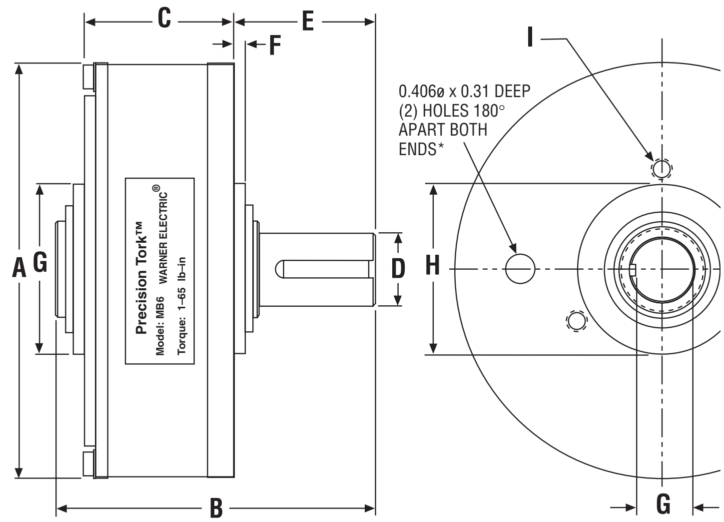
Bore & Keyseat Sizes

Model	Keyseat	Lockdown Method	G (Bore)	H (Pilot-Both Ends)	I (Both Ends)
MC1.5	None	3/32 Roll Pin	1/4	0.875/0.874 x 0.08 dp	3) 6-32 x 5/16 dp 1.25 B.C.
MC2	None	3/32 Roll Pin	1/4	0.875/0.874 x 0.08 dp	3) 6-32 x 5/16 dp 1.25 B.C.
MC3	None	2) Set Screws	3/8	1.383/1.381 x .120 dp	3) 10-32 x 7/16 dp 1.875 B.C.
MC4	None 1/8 Key 3/16 Key	3/32 Roll Pin 2) Set Screws 2) Set Screws	3/8 1/2 5/8	1.850x1.849 x 0.08 dp	3) 10-32 x 7/16 dp 2.375 B.C.
MC5	None 1/8 Key 3/16 Key 3/16 Key 3/16 Key 1/4 Shallow	2) Set Screws 2) Set Screws 2) Set Screws 2) Set Screws 2) Set Screws 2) Set Screws	3/8 1/2 5/8 3/4 7/8 1	2.441/2.440 x .100 dp	3) 10-32 x 1/2 dp 3.00 B.C.
MC5.5	3/16 Key 3/16 Key 3/16 Key 1/4 Shallow	2) Set Screws 2) Set Screws 2) Set Screws 2) Set Screws	5/8 3/4 7/8 1	2.441/2.440 x .100 dp	3) 10-32 x 1/2 dp 3.00 B.C.
MC6	3/16 Key 3/16 Key 3/16 Key 1/4 Shallow	2) Set Screws 2) Set Screws 2) Set Screws 2) Set Screws	5/8 3/4 7/8 1	2.441/2.440	3) 1/4-20 x 5/16 dp 2.875 B.C.
MC9	3/16 Key 3/16 Key 3/16 Key 1/4 Key 1/4 Key 1/4 Key	2) Set Screws 2) Set Screws 2) Set Screws 2) Set Screws 2) Set Screws 2) Set Screws	5/8 3/4 7/8 1 1-1/8 1-1/4	3.250/3.248	4) 5/16-18 x 1/2 dp 5.875 B.C.

MB – Magnetic Brakes



Drawing C



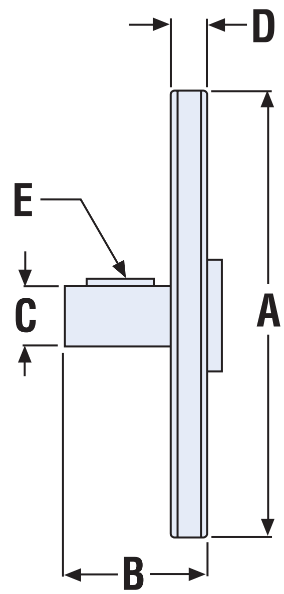
Drawing D

Optional Mounting brackets, see page 127

Model	Drawing	A	B	C	D (Shaft)	E	F	G	H (Pilot-Both Ends)	I (Both Ends)
MB1*	C	1.00	1.39	0.85	3/16	0.58	–	0.170 Flat	0.301/0.302 x 0.100 dp	3) 4-40 x 1/4 dp 0.610 B.C.
MB1.5*	C	1.85	2.35	1.35	1/4	1.00	–	0.230 Flat	0.875/0.874 x 0.08 dp	3) 6-32 x 5/16 dp 1.250 B.C.
MB2*	C	1.85	2.35	1.35	1/4	1.00	–	0.230 Flat	0.875/0.874 x 0.08 dp	3) 6-32 x 5/16 dp 1.250 B.C.
MB3*	C	2.75	3.02	2.00	3/8	1.03	0.03	0.350 Flat	1.383/1.381 x 0.12 dp	3) 10-32 x 7/16 dp 1.875 B.C.
MB4*	C	3.23	2.97	2.00	5/8	0.97	0.09	0.518/0.503	1.850/1.849 x 0.08dp	3) 10-32 x 7/16 dp 2.375 B.C.
MB5*	C	4.65	4.40	2.65	1	1.75	0.11	0.859/0.844	2.441/2.440 x 0.100 dp	3) 10-32 x 1/2 dp 3.000 B.C.
MB5.5*	C	5.29	4.53	2.65	1	1.88	0.25	0.859/0.844	2.441/2.440 x 0.100 dp	3) 10-32 x 1/2 dp 3.000 B.C.
MB6**	D	6.10	4.50	2.04	1	2.22	0.18	0.859/0.844	2.441/2.440	3) 1/4-20 x 5/16 dp 2.875 B.C.
MB9**	D	9.40	5.41	3.49	1	1.80	0.13	0.859/0.844	3.250/3.248	3) 5/16-18 x 1/2 dp 5.875 B.C.

* Thumb screw adjustment
** Spanner wrench required for adjustment. Spanner wrench P/N YZ00-0007

Stub Shaft Adapter



- Utilized when "clutch coupling" configuration is desired.
- Comes complete with attachment hardware and drive key.
- Stub shaft adapters should be used in conjunction with a flexible coupling.

Model Size	Clutch Model	A	B	C	D	E
A2-14	MC2	1.60	0.78	1/4	0.15	Flat
A3-38	MC3	2.36	1.19	3/8	0.19	Flat
A4-38	MC4	2.86	1.19	3/8	0.19	Flat
A4-58	MC4	2.86	1.19	5/8	0.19	3/16" Key
A5-1	MC5, MC5.5	3.45	1.72	1	0.27	1/4" Key
A5-12	MC5, MC5.5	3.45	1.47	1/2	0.27	1/8" Key
A6-34	MC6	3.40	1.70	3/4	0.35	3/16" Key

Magnetic Particle Brakes and Clutches

Accurate torque control with instantaneous engagement!

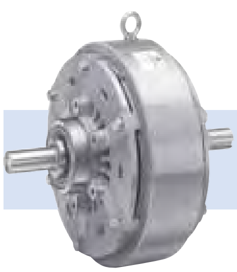
Available in a wide range of models and sizes

Warner Electric's magnetic particle brakes and clutches are quiet and clean and provide outstanding performance in slipping and torque control applications. They are ideal for unwind, rewind, and intermittent (point to point) tension applications. They are also ideal for controlled starting or stopping, torque limiting and cycling applications.

These units use high quality materials and unique designs to provide precision performance, superior heat dissipation and extremely long life. The magnetic powder, made from a patented alloy, provides extreme resistance to heat and wear, and, therefore, promotes long life and high thermal ratings. Also, one of the brake models, the PTB, incorporates a patented heat pipe that further extends its thermal capability. PTB units have thermal ratings three times higher than brakes with natural cooling and equivalent to water-cooled brakes.

Brakes

Six different brake models are available: four with male shafts and two with hollow bores. The units with hollow bores can be shaft-mounted, if desired. Final selection is determined by torque and thermal requirements. The product selection section provides more specific information on these models.



Clutches

Three different clutch models, each with several sizes, are available to handle a variety of applications. The face-mounted models can be used in parallel or inline applications. The shaft-mounted units offer a second option for parallel shaft applications and are ideal for tension rewind applications. Please see the product selection section for more specific information.

Features and Benefits

Precise Control

- Spherical particles provide smooth torque independent of speed. Low speed chatter is also eliminated.
- The magnetic circuit is designed to produce torque proportional to current.
- Unique design requires only one powder seal, thus reducing drag torque and allowing for a wider operating range.

Extremely Long Life

- Spherical particles made from a patented alloy provide outstanding resistance to corrosion and mechanical breakdown.

High Heat Dissipation

- One of the models, the PTB, uses a patented heat pipe that provides heat dissipation levels equal to water-cooled units and several times greater than natural cooling.
- The shaft mounted clutches provide self-cooling through the use of an integral fan that rotates with the input.

Clean Operation

- All models are completely enclosed. Ideal for applications where clean operation is desired.

Easy to Mount

- Precision pilots are provided to position units for easy installation.
- Clutches and brakes with hollow bores are offered for applications where shaft mounting is desired.

Smooth Engagement

- Torque characteristics provide for smooth and controllable acceleration or deceleration of the load.

Fast Response

- Fine particles respond quickly to field for millisecond engagement, if required.

No Maintenance

- Adjustment or lubrication is not required.

Quiet Operation

- Engagement is smooth and quiet.

Low Current Draw

- Efficient magnetic circuit design allows for minimal current draw.

Torque independent of slip speed

Torque is transmitted through magnetic particle chains that 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.

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 electric power consumption.

Versatile mounting

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

Distributor Item

Off the shelf availability. Interchangeable with industry standard sizes.

Specials Designs

- ***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.

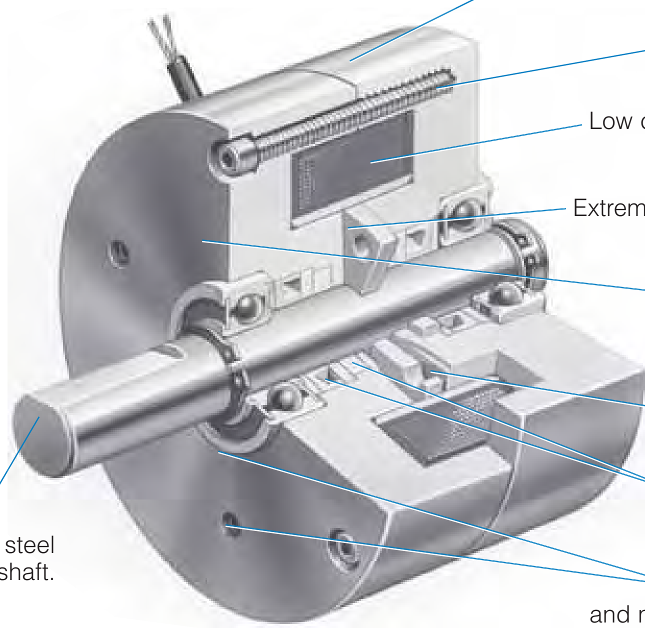
- ***Metric units***

Magnetic Particle Brakes and Clutches

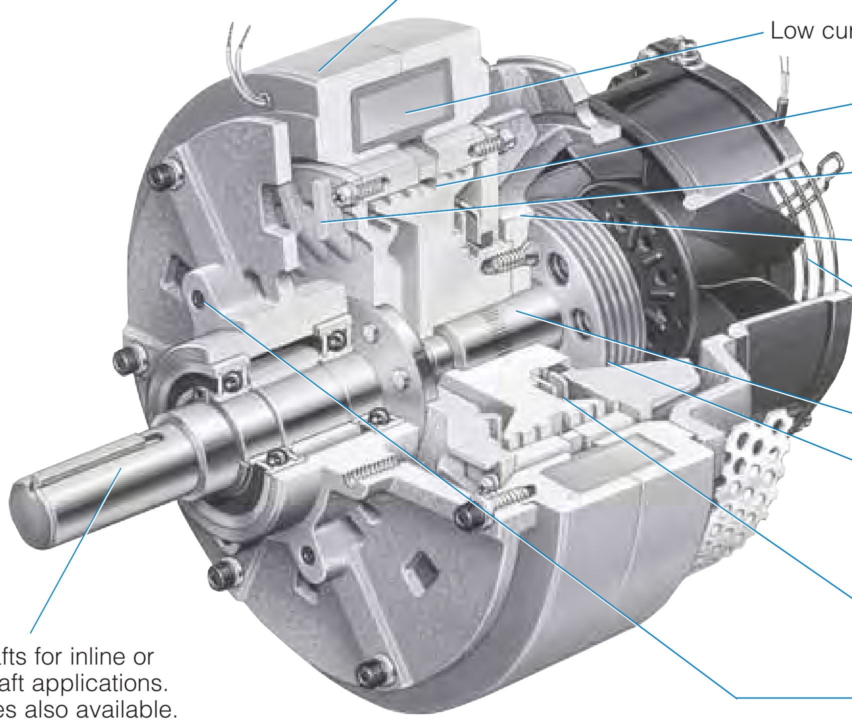
Design and Operation

Warner Electric 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. Controls information starts on page 44.

MPB Products

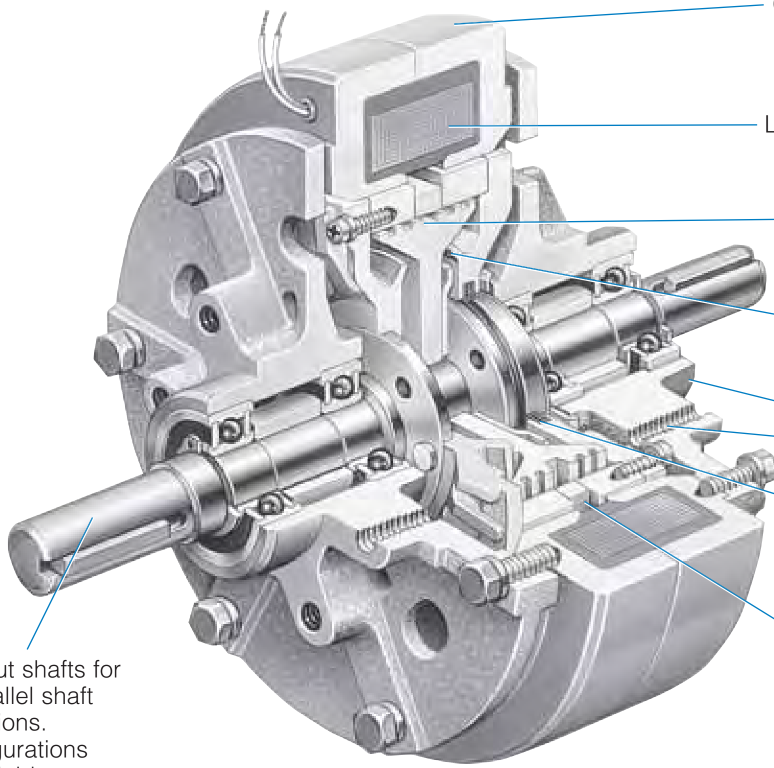


PTB Brake



Magnetic Particle Brakes and Clutches

POC Clutch



Principle of Operation

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

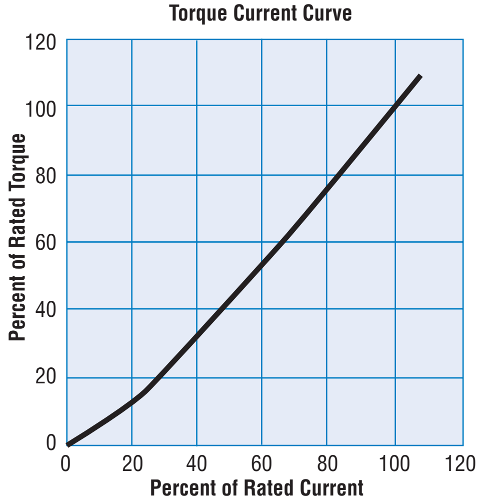
When DC current is applied to the magnetic particle unit, a magnetic flux (chain) is formed, linking the shaft/disc to the housing. As the current is increased, the magnetic flux becomes stronger, increasing the torque. The magnetic flux creates extremely smooth torque and virtually no "stick-slip".

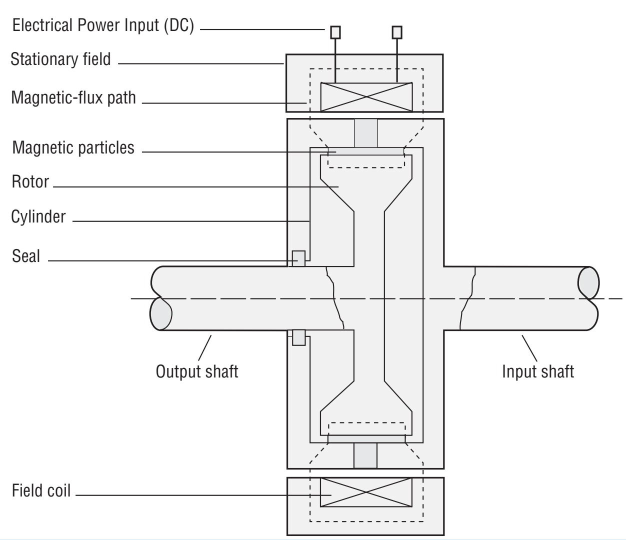
Disengagement

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

Cycling

A cycling effect is achieved by turning the current to the coil on and off.





Magnetic Particle Brakes and Clutches

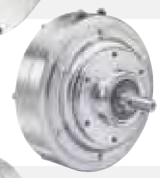
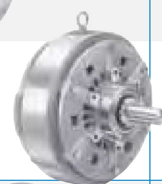
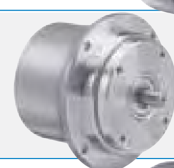
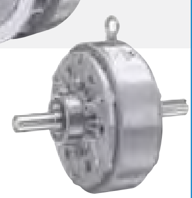
Selection

Unit torque ratings go from as low as 2.0 lb.in. to as high as 578 lb.ft. Also, many models are available to handle specific mounting requirements. The clutch family has three options. The MPC and POC have shaft inputs and outputs and is ideal for inline applications. The PHC models have a hollow bore and can be shaft-mounted for parallel shaft applications. The PMC clutch covers the lower end of the torque range and has a flanged input hub. Also, this unit is often mounted as a brake.

The brake family includes seven models. The MPB covers the low torque ranges and comes with shaft inputs or hollow bores. The POB is a shaft input brake that covers the medium and high torque extremes of the torque range. The PRB series covers the mid range. With four models that have different input and housing options. The PTB model uses a patented heat pipe cooling method that has a cooling capacity equivalent to water-cooled units, but without the hassles of water cooling.

Selection Requirements

To properly size a magnetic particle brake or clutch, torque transmitted and heat generated must be considered. If you know these values, refer to the specifications and thermal curves to select a unit. For sizing and selection calculation see pages 16 through 28. To select a control for your application refer to the control section on page 44.

Product	Model	Torque Ratings (lb.ft.)	Heat Dissipation Ratings Ratings Watts [HP_T]
Brake	**MPB** 	0.17 lb.ft.–20 lb.ft.	10–200 [0.013 to 0.27]
	POB 	2.1 to 578	60 to 4,000 [0.080 to 5.36]
	PRB-H 	8.6 to 144	95 to 575 [0.13 to 0.77]
	PTB-BL$_3$ 	18 to 144	500 to 4,100 [0.67 to 5.50
Brake or Clutch	**PMC-A$_3$** 	0.72 to 2.8 (8.6 to 34 lb. in.)	30 to 66 [0.040 to 0.088]
Clutch	**MPC** 	0.17 lb.ft. to 10.0 lb.ft.	10 to 140 [0.13 to 0.188]
	PHC-R 	4.3 to 144	70 to 1,150 [0.094 to 1.54]
	POC 	2.1 to 578	60 to 4,000 [0.080 to 5.36]

Magnetic Particle Brakes and Clutches

Description	Cooling Method	Applications	Dimension Drawings (page no.)
Low and high torque units. Light duty thermal. All brakes have output shafts and pilots for mounting. Optional brackets available.	Natural	Tension unwind, light duty unwind	116
Low and high torque units are offered in this model. All units have male input shafts and pilots for mounting, except for the size 80, which is foot-mounted.	Natural	Tension unwind	118-119
This is the basic PRB model. It is offered with a hollow bore and a pilot for mounting.	Natural	Tension unwind	120
The PTB-BL_3 offers superior heat dissipation capability. Units are pilot-mounted and a male input shaft is provided for connecting to the load.	Heat Pipe with 115VAC blower	Tension unwind, load for testing. Ideal for applications requiring high heat dissipation	117
These units offer precise control in the small tension ranges. They have flanged input hubs and double-ended output shafts for maximum mounting flexibility. They can be easily mounted as clutches or brakes.	Natural	Tension unwind or rewind, soft start or stop, torque limiting	121-122
Low and medium torque units for light duty rewind applications. Shaft in–shaft out with pilots, allow for sample mounting. Optional brackets available.	Natural	Tension rewind, light duty rewind	123
This model has a hollow bore, making it ideal for applications where shaft mounting is preferred. It has a piloted input flange for pulley or sprocket attachment.	Self-cooling with integral fan	Tension rewind, soft start	124
This model is preferred in many applications. It is offered with male input and output shafts and all units are pilot mounted, except for the size 80. This largest unit, the size 80, is footmounted.	Natural	Tension rewind	125–126

Magnetic Particle Brakes and Clutches

Mechanical and Electrical Data (24 VDC)

Model	Size	Torque lb.ft. (lb.in.)	Drag Torque lb.ft. (lb.in.)	Max. Speed RPM	Inertia lb.ft.^{2} (lb.in.^{2})	Resistance Ohms 75°F	Amperes 75°F	Max. Heat Diss. Watts @ Max. RPM	Weight lbs.
MPB	2	(2)	(.40)	1800	(1.31×10^{-3})	303	0.079	10	1
	15	(15)	(.40)	1000	(1.39×10^{-2})	80	0.302	20	3
	70	(70)	(1)	1000	(8.03×10^{-2})	35	0.677	100	7
	120	(120)	(2)	1000	(3.75×10^{-1})	33	0.742	140	12
	240	(240)	(4)	1000	(1.35)	14	1.693	200	20
POB	0.3	2.1	.065	1800	.0128	35.6	.674	105	5.5
	0.6	4.3	.13	1800	.0173	21.1	1.14	80	7.9
	1.2	8.6	.26	1800	.0304	20.6	1.16	145	12
	2.5	18	.54	1800	.0973	15.8	1.52	195	22
	5	36	1.1	1800	.249	8.8	2.74	290	38
	10	72	2.2	1800	1.04	9.0	2.68	460	77
	20	144	4.3	1800	2.23	7.2	3.34	790	128
	40	289	8.7	1800	5.93	5.1	4.66	1990	220
	80	578	17	1800	23.5	4.3	5.57	3900	551
PRB-H	1.2	8.6	.26	1800	.104	31.6	.760	95	11
	2.5	18	.54	1800	.161	25.6	.937	118	15
	5	36	1.1	1800	.453	19.3	1.24	170	29
	10	72	2.2	1800	1.51	14.8	1.62	355	57
	20	144	4.3	1800	4.46	12.5	1.93	570	101
PTB	2.5	18	.54	1800	.0973	15.8	1.52	880	24
	5	36	1.1	1800	.249	8.8	2.74	1850	38
	10	72	2.2	1800	1.04	9.0	2.68	3050	76
	20	144	4.3	1800	2.23	7.20	3.34	4400	114
PMC-A_3	10	(8.6)	(.25)	1800	.239	35.1	.684	30	2
	20	(17)	(.51)	1800	.413	31.6	.760	40	2.9
	40	(34)	(1)	1800	1.14	26.3	.912	68	5.5
MPC	2	(2)	(.40)	1800	(1.33×10^{-3})	303	0.079	10	1
	15	(15)	(.40)	1000	(1.48×10^{-2})	80	0.302	20	6
	70	(70)	(1)	1000	(8.89×10^{-2})	35	0.677	100	17
	120	(120)	(2)	1000	($3.62 \text{ X } 10^{-1}$)	33	0.742	140	22
PHC-R	0.6	4.3	.13	1800	.0223	21.1	1.14	105	9.3
	1.2	8.6	.26	1800	.0392	20.6	1.16	200	13
	2.5	18	.54	1800	.126	15.8	1.52	395	22
	5	36	1.1	1800	.323	8.8	2.74	620	38
	10	72	2.2	1500	1.42	9.0	2.68	940	95
	20	144	4.3	1500	3.01	7.20	3.34	1350	154
POC	0.3	2.1	.065	1800	.0128	35.6	.674	105	5.5
	0.6	4.3	.13	1800	.0173	21.1	1.14	80	7.9
	1.2	8.6	.26	1800	.0304	20.6	1.16	145	12
	2.5	18	.54	1800	.0973	15.8	1.52	195	22
	5	36	1.1	1800	.249	8.8	2.74	290	38
	10	72	2.2	1800	1.04	9.0	2.68	460	77
	20	144	4.3	1800	2.23	7.2	3.34	790	128
	40	289	8.7	1800	5.93	5.1	4.66	1990	220
	80	578	17	1800	23.5	4.3	5.57	3900	551

Selection Requirements

Torque

The torque required is calculated differently for different applications. For tension applications, torque is a function of roll radius and tension. For controlled starting and stopping, torque is a function of inertia, speed, and desired time to start or stop the load. For torque limiting applications, allowable drive through torque is used to select a unit. Please follow the selection example that applies to your application to determine the torque required in units of pound-feet.

Heat

When a brake or clutch is slipping, heat is generated. This is the result of mechanical energy being converted to thermal energy. Tension applications are considered continuous slip applications. Heat generated is a function of tension and linear material speed and is generally described in terms of "thermal horsepower" (HPt). For starting and stopping applications, heat is generated when the unit slips during the stopping and starting of the load. Here heat is a function of speed, inertia, and cycle rate, and is described in terms "energy rate" (ft. lbs./min.). The selection example that fits your application will determine heat in the appropriate units.

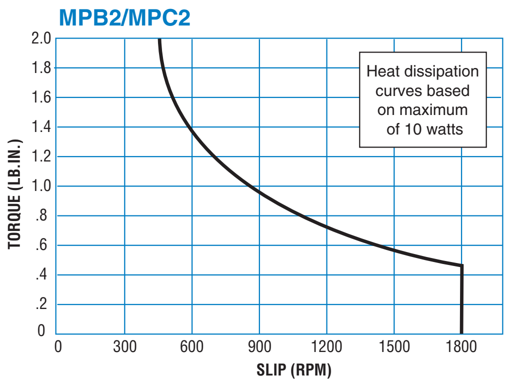
The amount of energy the application produces must be less than the capabilities of the clutch or brake to dissipate. If the energy generated by the application is greater, then the controlling device will be destroyed from excessive heat buildup.

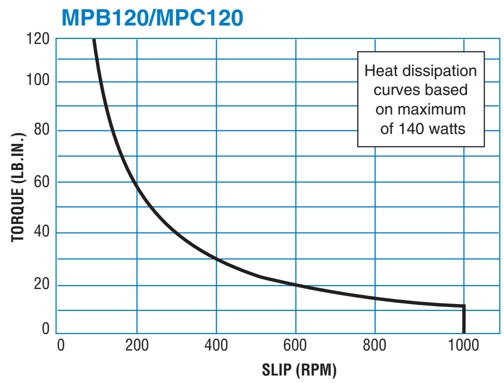
Environmental considerations such as –25°F to +140°F (–31.7°C to +60°C) high ambient temperature can reduce the unit's ability to dissipate heat. For applications with high ambient temperatures or where heat dissipation is marginal, fans or blowers may be used to improve dissipation.

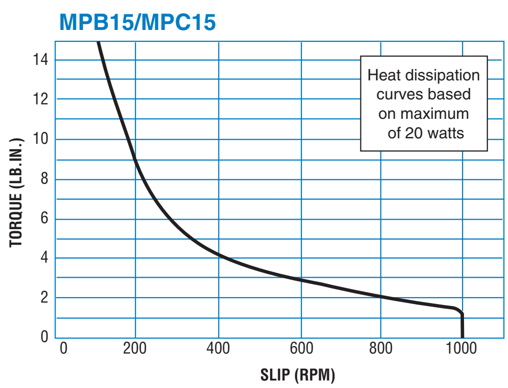
Heat Dissipation Curves

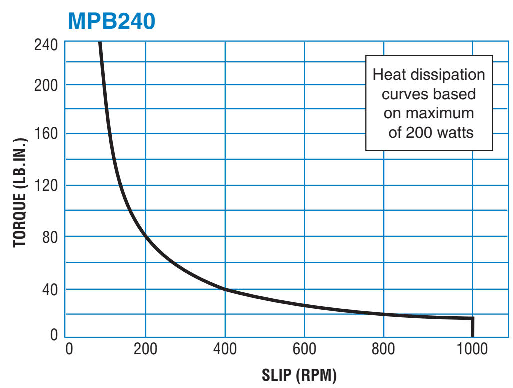
Determine your slip RPM requirements and torque requirements. Where the two points intersect must be under the curve for the unit selected. Remember to check at both minimum and maximum torque-speed conditions.

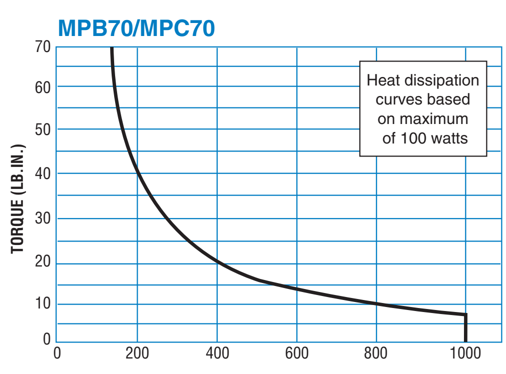
MPC/MPB Clutches/Brakes











Magnetic Particle Brakes and Clutches

Heat Dissipation Curves

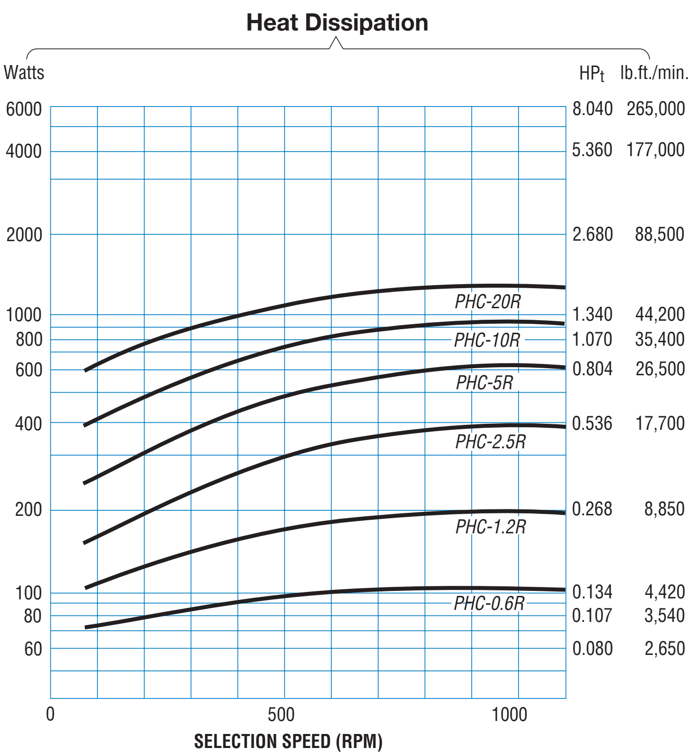
Operating Temperature

The surface temperature of the unit must be less than the temperature indicated in the following chart.

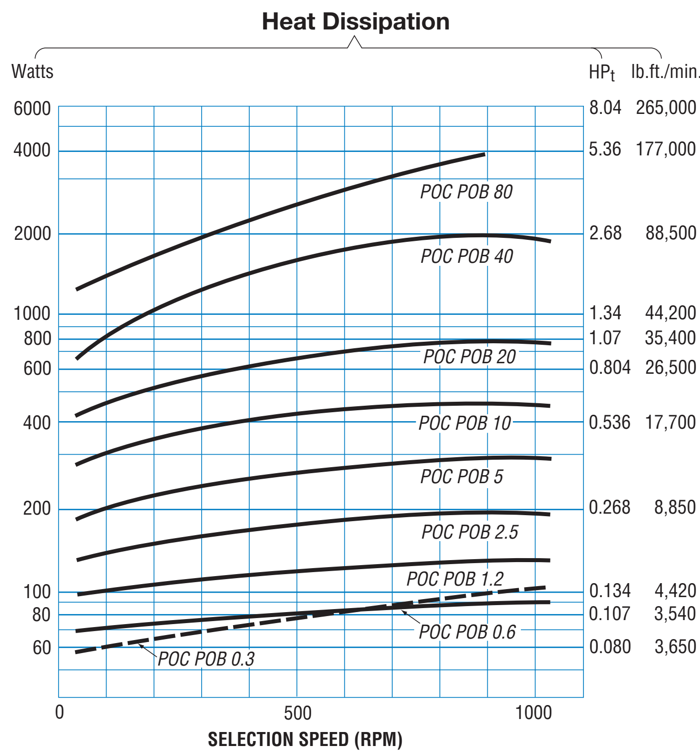
Maximum Surface Temperature

Model	Temp (°F)
PMC-A_3	167
POC/PHC-R/POB	176
PRB/PTB-BL_3	194

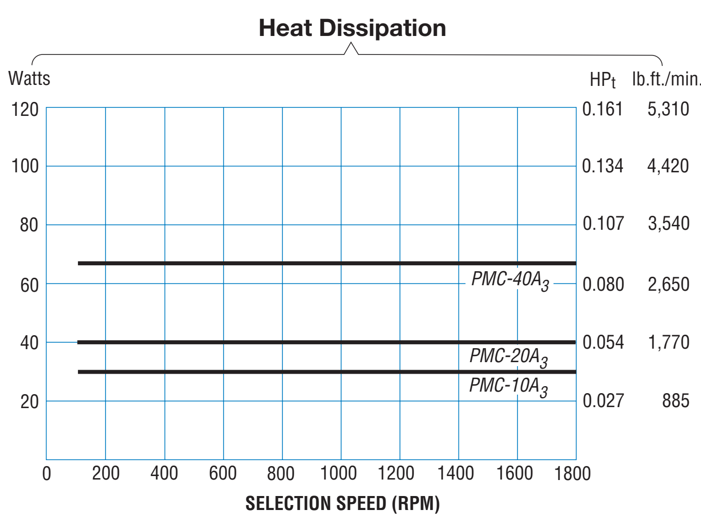
PHC-R Clutches



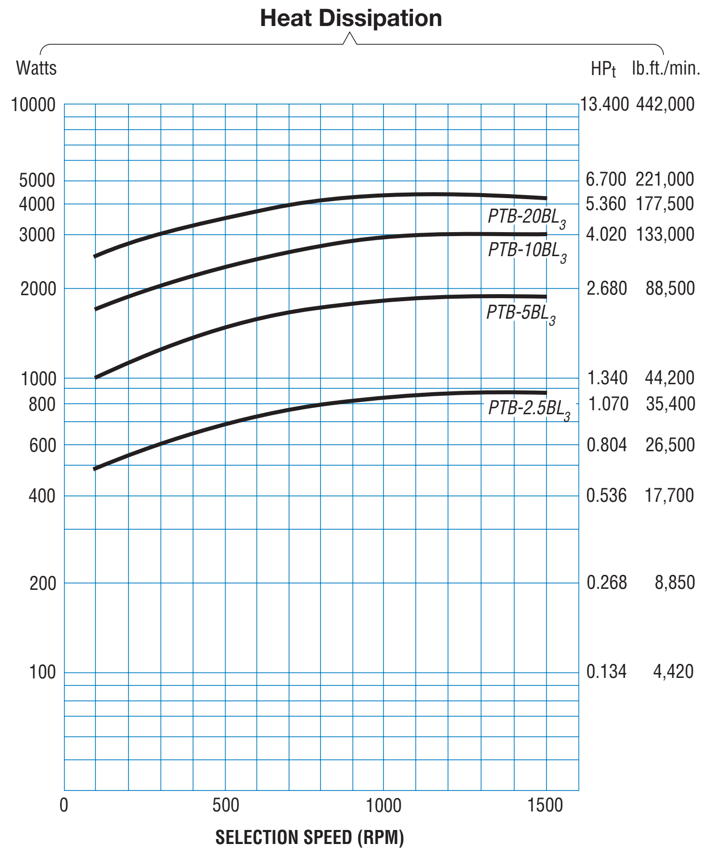
POC/POB Clutches/Brakes



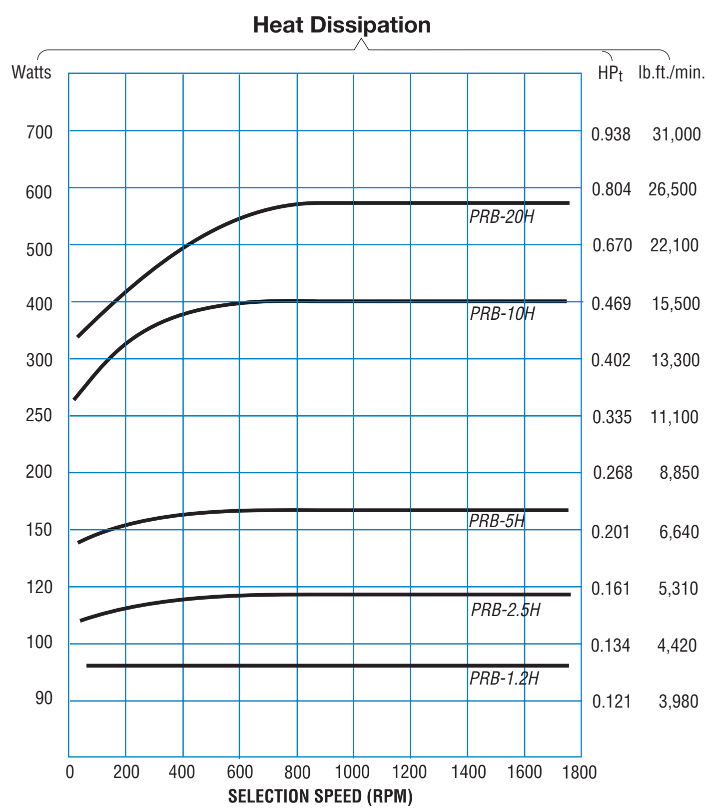
PMC-A_3 Clutches or Brakes



PTB-BL$_3$ Brakes

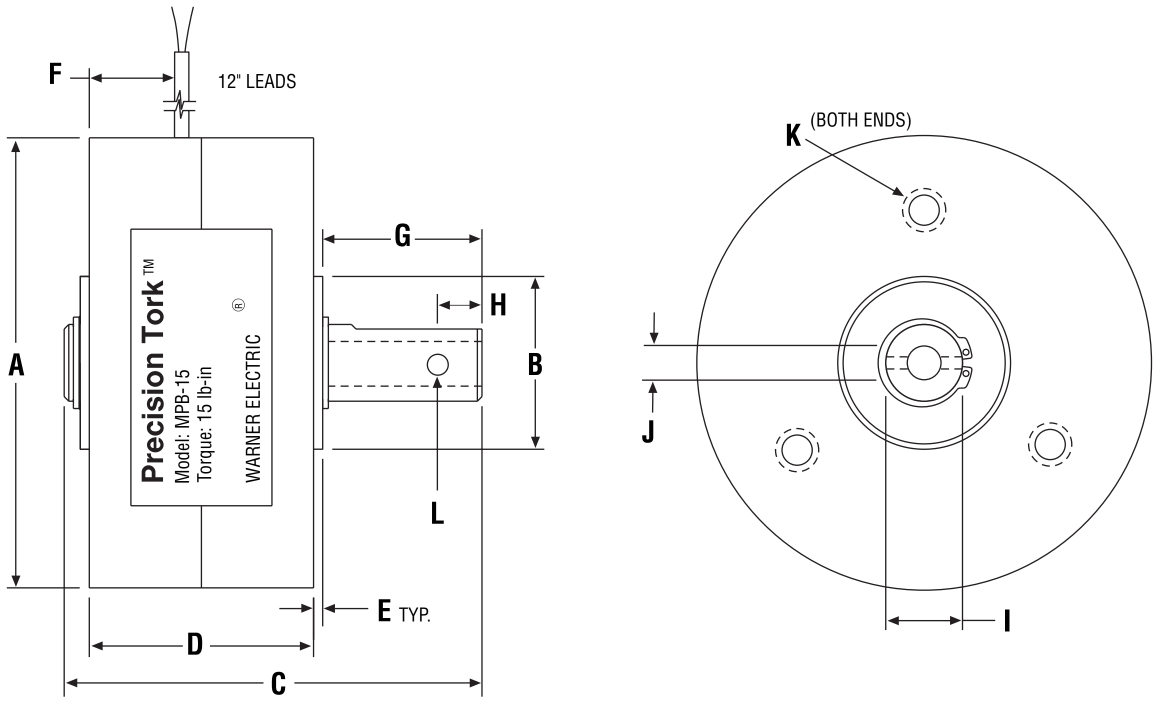


PRB-1.2H, 2.5H, 5H, 10H and 20H



MPB Series Brakes

Low and high torque units. Light duty thermal. All brakes have output shafts and pilots for mounting. Optional brackets available.



Optional mounting bracket, see page 127.

Dimensions inches

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

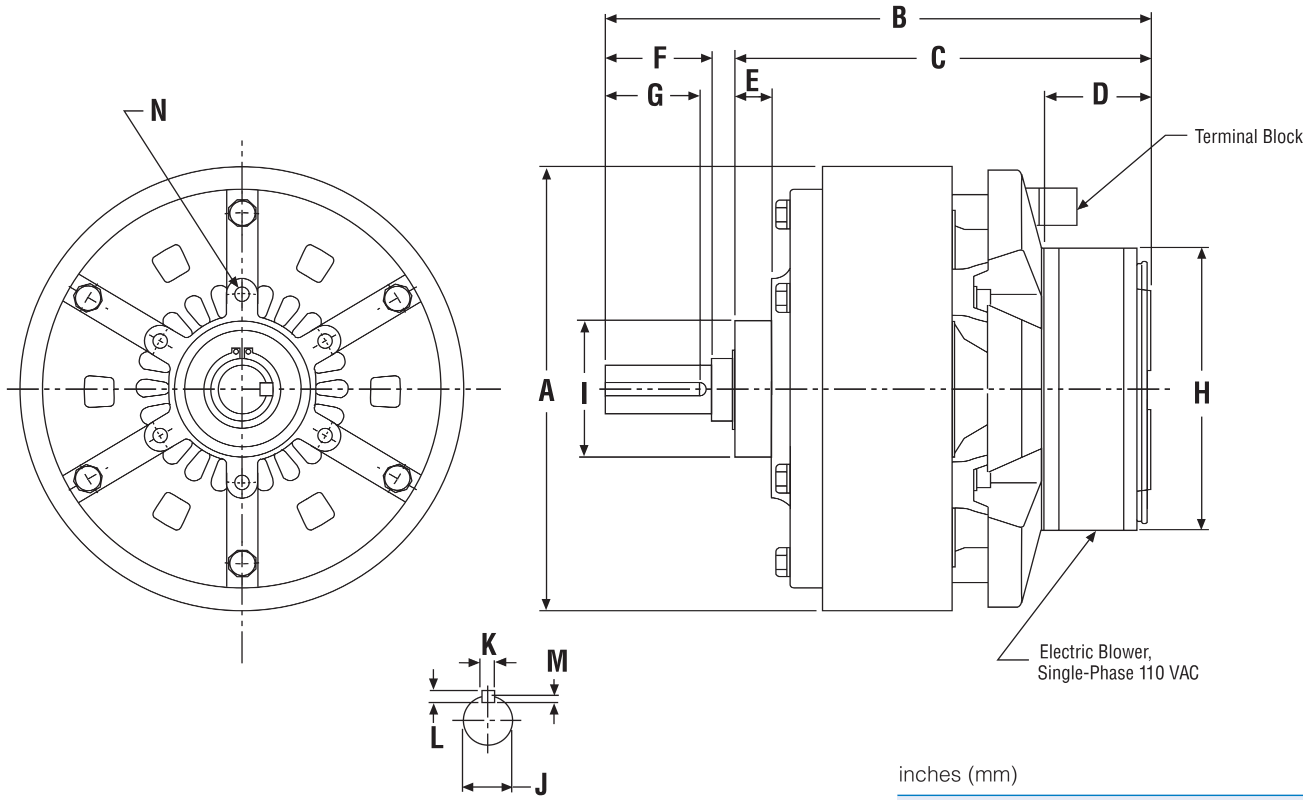
Model Number	Max. Drag Torque 0 Excit. (lb.in.)	Rated Torque (lb.in.)	Rated Voltage	Resistance (Ohms)	Rated Current (Amps)	Build Up Time W/out OEX (Millisec)	Build Up Time With OEX (Millisecs)	Inertia of Output Shaft (lb.in.^{2})	Max. Heat Dissipation (watts)	Max. Speed Recom. (RPM)	Weight
MPB2	0.40 0.40	2 2	24 90	92 1,552	0.261 0.058	8 8	4 4	1.31×10^{-3} 1.31×10^{-3}	10 10	1,800 1,800	1 1
MPB15	0.40 0.40	15 15	24 90	80 1,501	0.302 0.060	25 25	9 9	1.39×10^{-2} 1.39×10^{-2}	20 20	1,000 1,000	3 3
MPB70	1.00 1.00	70 70	24 90	35 613	0.677 0.147	70 70	17 17	8.03×10^{-2} 8.03×10^{-2}	100 100	1,000 1,000	7 7
MPB120	2.00 2.00	120 120	24 90	33 475	0.742 0.190	90 90	25 25	3.75×10^{-1} 3.75×10^{-1}	140 140	1,000 1,000	12 12
MPB240	4.00 4.00	240 240	24 90	19 246	1.286 0.366	150 150	45 45	1.35 1.35	200 200	1,000 1,000	20 20

Note: All dimensions are nominal unless otherwise noted.

PTB-BL_3 Brakes

The PTB-BL_3 offers superior heat dissipation capability. Units are pilot mounted and a male input shaft is provided for connecting to the load.

Dimensions



inches (mm)

Shaft Dimensions				
Size	**J**	**K**	**L**	**M**
2.5	0.7874/0.7866 (20.000/19.979)	0.1978/0.1973 (5.024/5.012)	0.20 (5)	0.12 (3)
5	0.9843/0.9834 (25.000/24.979)	0.2768/0.2762 (7.030/7.015)	0.28 (7)	0.16 (4)
10	1.1811/1.1803 (30.000/29.979)	0.2768/0.2762 (7.030/7.015)	0.28 (7)	0.16 (4)
20	1.3780/1.3770 (35.000/34.975)	0.3949/0.3943 (10.030/10.015)	0.31 (8)	0.18 (4.5)

Specifications

Model	Nominal Part Number	Torque (lb. ft.)	E-Stop Torque (lb. ft.)	Nominal Drag Torque (lb. ft.)	Maximum Speed (rpm)	Inertia Input (lb. ft.^{2})	Max. Heat Diss. Watts @ Max. RPM	Weight (lbs.)
2.5	5401-169-141	18	23	.54	1,800	.0973	880	24
5	5401-169-151	36	47	1.1	1,800	.249	1,850	38
10	5401-169-161	72	88	2.2	1,800	1.04	3,050	76
20	5401-169-171	144	180	4.3	1,800	2.23	4,400	114

inches (mm)

										N			
Size	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H***	**I**	**Thread Size**	**Depth**	**Num. of Holes**	**Bolt Circle**
2.5	7.17 (182)	8.72 (221.5)	6.67 (169.5)	1.69 (43)	0.59 (15)	1.69 (43)	1.50 (38)	□ 4.72 □ (120)	2.1654/2.1642 (55.000/54.970)	M6	0.51 (13)	6	3.071 (78)
5	8.62 (219)	10.81 (274.5)	8.19 (208)	2.42 (61.5)	0.91 (23)	2.24 (57)	1.85 (47)	○ 5.91 ○ (150)	2.9134/2.9122 (74.000/73.970)	M6	0.51 (13)	6	3.937 (100)
10	11.42 (290)	13.19 (335)	10.12 (257)	2.42 (61.5)	0.98 (25)	2.64 (67)	2.20 (56)	○ 5.91 ○ (150)	3.9370/3.9356 (100.000/99.965)	M10	0.71 (18)	6	5.512 (140)
20	13.19 (335)	13.88 (352.5)	10.61 (269.5)	2.42 (61.5)	0.98 (25)	2.80 (71)	2.36 (60)	○ 5.91 ○ (150)	4.3307/4.3293 (110.000/109.965)	M10	0.71 (18)	6	5.906 (150)

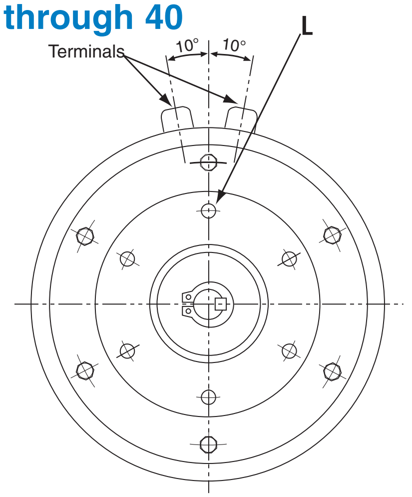
*Adjacent symbol denotes shape of blower.

Note: All dimensions are nominal unless otherwise noted.

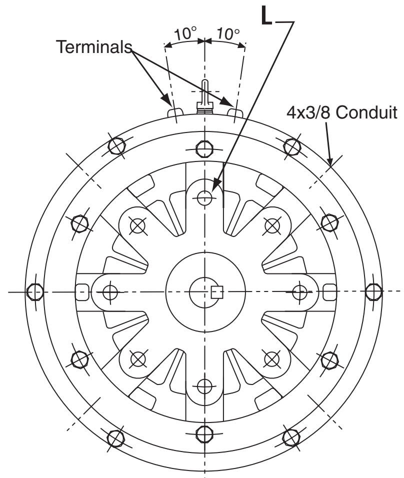
POB Series Brakes

Low and high torque units are offered in this model. All units have male input shafts and pilots for mounting, except for the size 80, which is foot-mounted.

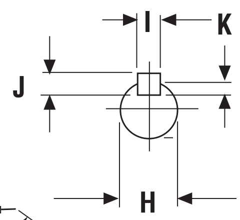
Dimensions
Sizes 0.3 through 40

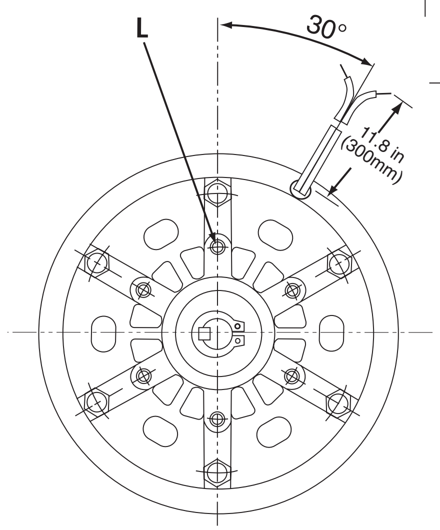


End View (POB-0.3)

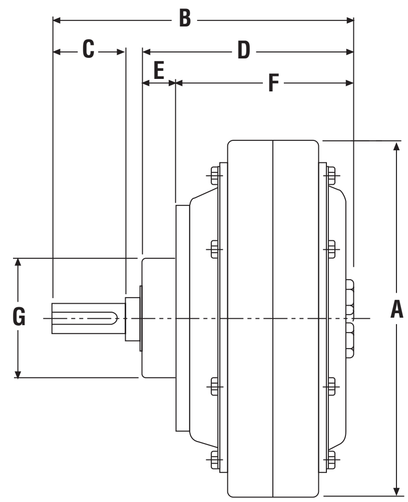


End View (POB-40)





End View (POB-0.6, 1.2, 2.5, 5.0, 10 and 20)

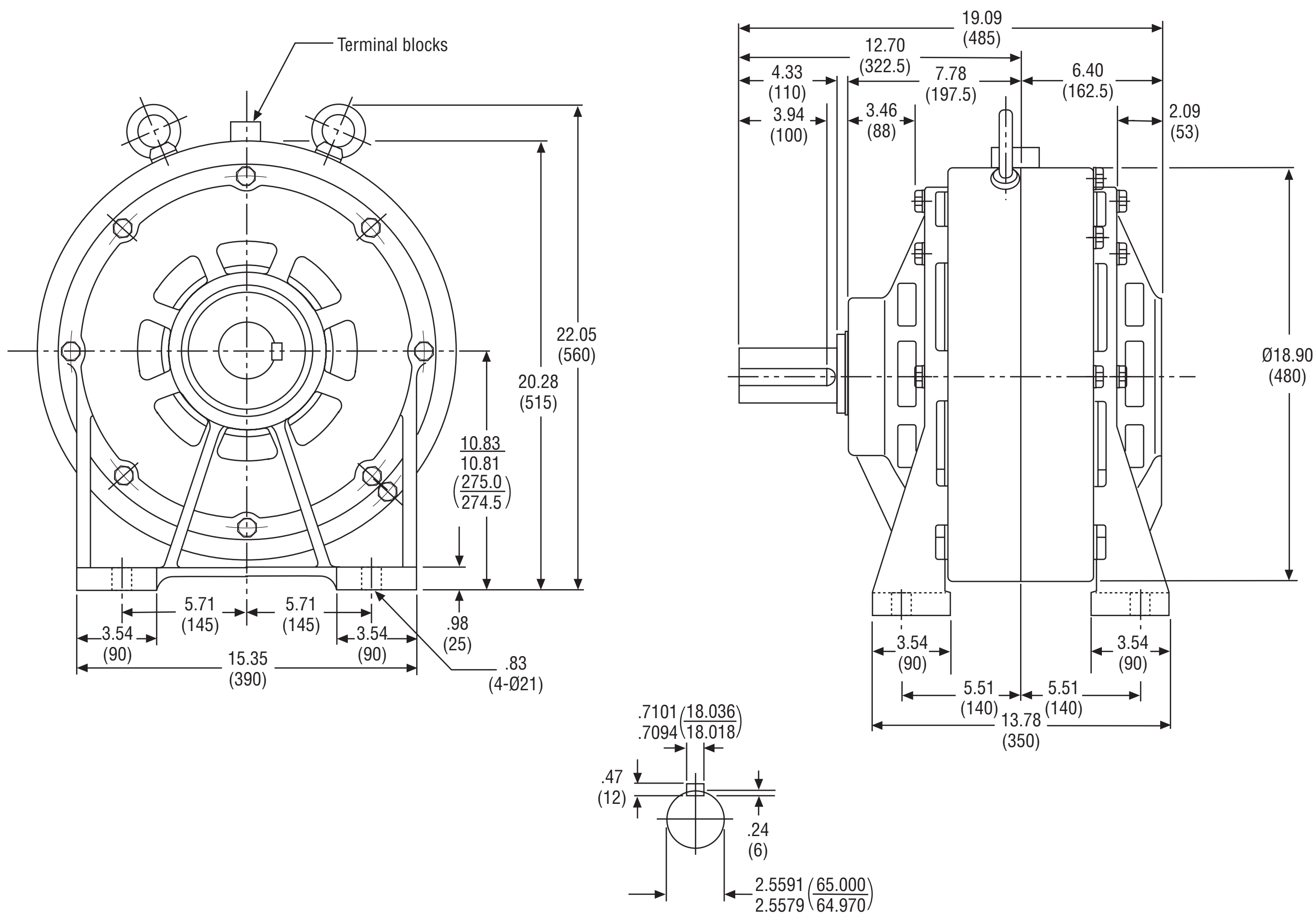


inches (mm)

							Shaft Dimensions					L			
Model	A	B	C	D	E	F	G	H	I	J	K	Thread Size	Depth	No. of Holes	Bolt Circle
POB-0.3	4.72 (120)	4.13 (105)	0.91 (23)	2.95 (75)	0.43 (11)	2.52 (64)	1.6535/1.6526 (42.000/41.975)	0.3937/0.3931 (10.000/9.985)	0.1584/0.1580 (4.024/4.012)	0.16 (4)	0.10 (2.5)	M5	0.39 (10)	6	2.520 (64)
POB-0.6	5.28 (134)	4.29 (109)	1.02 (26)	3.01 (76.5)	0.39 (10)	2.62 (66.5)	1.6535/1.6526 (42.000/41.975)	0.4724/0.4717 (12.000/11.982)	0.1584/0.1580 (4.024/4.012)	0.16 (4)	0.10 (2.5)	M5	0.43 (11)	6	2.520 (64)
POB 1.2	5.98 (152)	5.14 (130.5)	1.36 (34.5)	3.52 (89.5)	0.51 (13)	3.01 (76.5)	1.6535/1.6526 (42.000/41.975)	0.5906/0.5898 (15.000/14.982)	0.1978/0.1973 (5.024/5.012)	0.20 (5)	0.12 (3.0)	M6	0.51 (13)	6	2.520 (64)
POB 2.5	7.17 (182)	6.10 (155)	1.69 (43)	4.06 (103)	0.59 (15)	3.46 (88)	2.1654/2.1642 (55.000/54.970)	0.7874/0.7866 (20.000/19.979)	0.1978/0.1973 (5.024/5.012)	0.20 (5)	0.12 (3.0)	M6	0.51 (13)	6	3.071 (78)
POB 5.0	8.62 (219)	7.44 (189)	2.24 (57)	4.82 (122.5)	0.91 (23)	3.92 (99.5)	2.9134/2.9122 (74.000/73.970)	0.9843/0.9834 (25.000/24.979)	0.2768/0.2762 (7.030/7.015)	0.28 (7)	0.16 (4.0)	M6	0.51 (13)	6	3.937 (100)
POB 10	11.42 (290)	9.19 (233.5)	2.64 (67)	6.12 (155.5)	0.98 (25)	5.14 (130.5)	3.9370/3.9356 (100.000/99.965)	1.1811/1.1803 (30.000/29.979)	0.2768/0.2762 (7.030/7.015)	0.28 (7)	0.16 (4.0)	M10	0.71 (18)	6	5.512 (140)
POB 20	13.19 (335)	10.37 (263.5)	2.80 (71)	7.11 (180.5)	0.98 (25)	6.12 (155.5)	4.3307/4.3293 (110.000/109.965)	1.3780/1.3770 (35.000/34.975)	0.3949/0.3943 (10.030/10.015)	0.31 (8)	0.18 (4.5)	M10	0.71 (18)	6	5.906 (150)
POB-40	15.55 (395)	12.99 (330)	3.62 (92)	8.82 (224)	1.30 (33)	7.52 (191)	5.1181/5.1165 (130.000/129.960)	1.7717/1.7707 (45.000/44.975)	0.4739/0.4731 (12.036/12.018)	0.31 (8)	0.18 (4.5)	M12	0.79 (20)	8	2.520 (200)

Note: All dimensions are nominal unless otherwise noted.

Size 80



Specifications

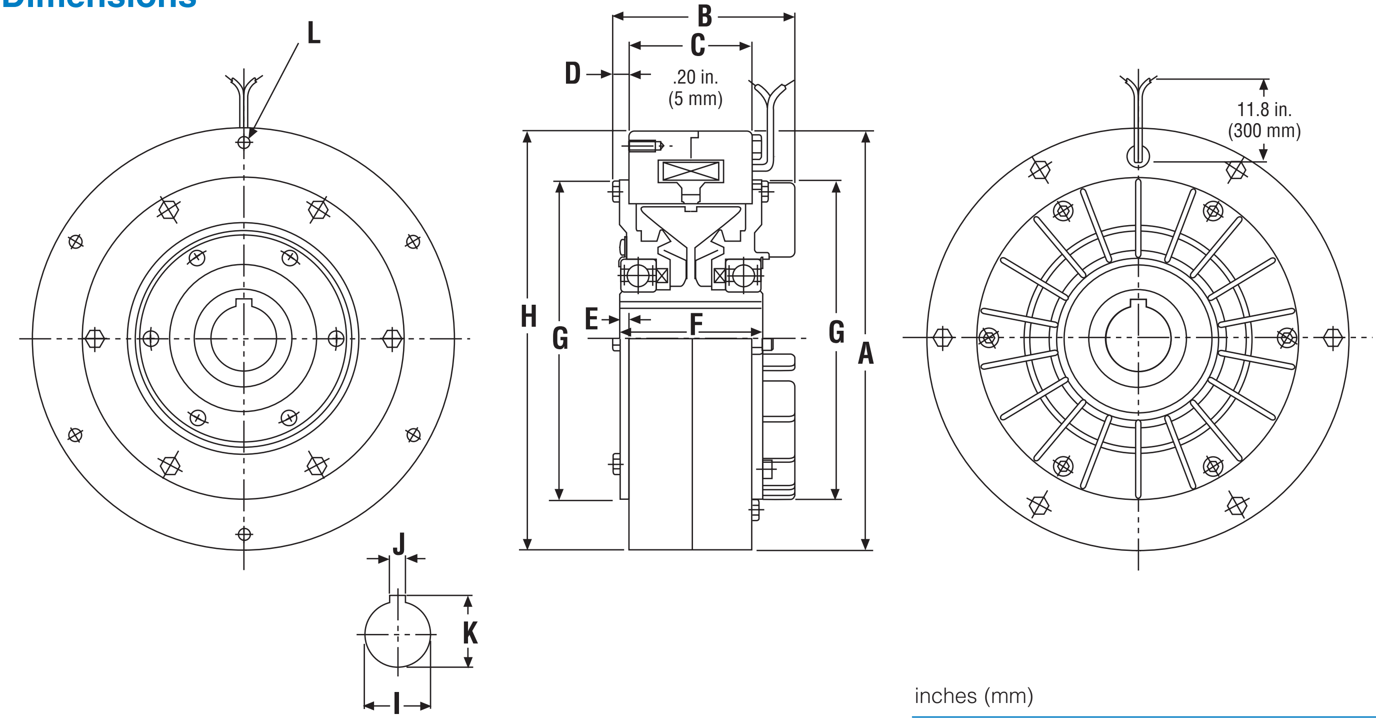
Size	Part Number	Rated Torque (lb. ft.)	E-Stop Torque (lb. ft.)	Drag Torque (lb. ft.)	Maximum Speed (rpm)	Inertia Input (lb. ft.^{2})	Max. Heat Diss. Watts @ Max. RPM	Weight (lbs.)
0.3	5401-169-211	2.1	3.0	.065	1,800	.0128	105	5.3
0.6	5401-169-221	4.3	5.9	.13	1,800	.0173	80	7.5
1.2	5401-169-231	8.6	12.0	.26	1,800	.0304	145	11.5
2.5	5401-169-241	18	23.0	.54	1,800	.0973	195	24.3
5.0	5401-169-251	36	43.0	1.1	1,800	.0249	290	35.3
10	5401-169-261	72	101.0	2.2	1,800	1.04	460	72.8
20	5401-169-271	144	180.0	4.3	1,800	2.23	790	106
40	5401-169-281	289	361	8.7	1,800	5.93	1,990	176
80	5401-169-291	578	723	17	1,500	23.5	3,900	573

Note: All dimensions are nominal unless otherwise noted.

PRB-H Series Brakes

This is the basic PRB model. It is offered with a hollow bore and a pilot for mounting.

Dimensions



inches (mm)

Bore Sizes

Size	I	J	K
1.2	0.5913/0.5906 (15.018/15.000*)	0.1980/0.1972 (5.028/5.010)	0.6791/0.6693 (17.250/17.000)
2.5	0.7882/0.7874 (20.021/20.000*)	0.1980/0.1972 (5.028/5.010)	0.8760/0.8661 (22.250/22.000)
5	1.1819/1.1811 (30.021/30.000*)	0.2770/0.2761 (7.035/7.013)	1.3091/1.2992 (33.250/33.000)
10	1.1819/1.1811 (30.021/30.000)	0.2770/0.2761 (7.035/7.013)	1.3091/1.2992 (33.250/33.000)
20	1.5758/1.5748 (40.025/40.000)	0.3951/0.3942 (10.035/10.013)	1.7224/1.7126 (43.750/43.500)

* For availability of inch series bores, contact your Warner Electric representative.

Specifications

Size	Part Number	Torque (lb. ft.)	E-Stop Torque (lb. ft.)	Drag Torque (lb. ft.)	Maximum Speed (rpm)	Inertia Input (lb. ft.^{2})	Max. Heat Diss. Watts @ Max. RPM	Weight (lbs.)
1.2	5401-169-331	8.6	12	.26	1,800	.104	95	11
2.5	5401-169-341	18	23	.54	1,800	.161	118	15
5	5401-169-351	36	43	1.1	1,800	.453	170	29
10	5401-169-361	72	101	2.2	1,800	1.51	355	57
20	5401-169-371	144	180	4.3	1,800	4.46	570	101

inches (mm)

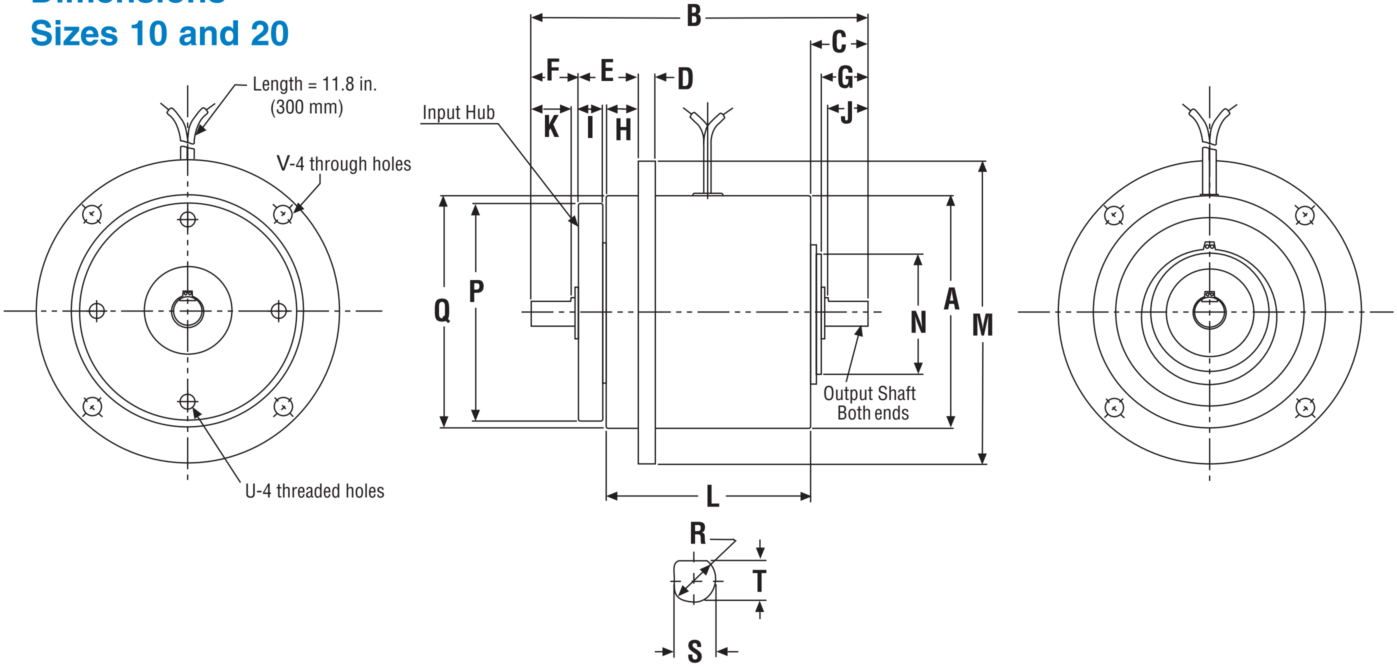
Size	A	B	C	D	E	F	G	H	L Thread Size	L No. of Depth	L Bolt Holes	L Circle
1.2	5.35 (136)	2.48 (63)	1.65 (42)	0.28 (7)	0.22 (5.5)	2.09 (53)	4.29 (109)	5.3543/5.3528 (136.000/135.960)	M5	0.39 (10)	6	4.92 (125)
2.5	6.30 (160)	2.87 (73)	1.85 (47)	0.30 (6.5)	0.26 (6.5)	2.36 (60)	4.88 (124)	6.2992/6.2976 (160.000/159.960)	M5	0.39 (10)	6	5.83 (148)
5	7.68 (195)	3.33 (84.5)	2.24 (57)	0.31 (8)	0.20 (5)	2.64 (67)	5.87 (149)	7.6772/7.6754 (195.000/194.954)	M6	0.47 (12)	6	7.13 (181)
10	9.84 (250)	4.09 (104)	2.68 (68)	0.33 (8.5)	0.20 (5)	3.07 (78)	7.40 (188)	9.8425/9.8407 (250.000/249.954)	M6	0.47 (12)	8	9.17 (233)
20	12.01 (305)	5.06 (128.5)	3.15 (80)	0.47 (12)	0.30 (7.5)	3.74 (95)	9.21 (234)	12.0079/12.0058 (305.000/304.948)	M8	0.47 (12)	8	11.10 (282)

Note: All dimensions are nominal unless otherwise noted.

These units offer precise control in the small tension ranges. They have flanged input hubs and double-ended output shafts for maximum mounting flexability. They can be easily mounted as clutches or brakes.

PMC Series Clutches/Brakes

Dimensions
Sizes 10 and 20



Specifications

Size	Part Number	Torque (lb. in.)	E-Stop Torque (lb. in.)	Drag Torque (lb. in.)	Maximum Speed (rpm)	Inertia Input (lb. in.^{2})	Output (lb. in.^{2})	Max. Heat Diss. Watts @ Max. RPM	Weight (lbs.)
10	5401-270-111	8.6	11.5	.25	1,800	.239	.0291	30	2.0
20	5401-270-121	17	20.4	.51	1,800	.413	.0752	40	2.9

inches (mm)

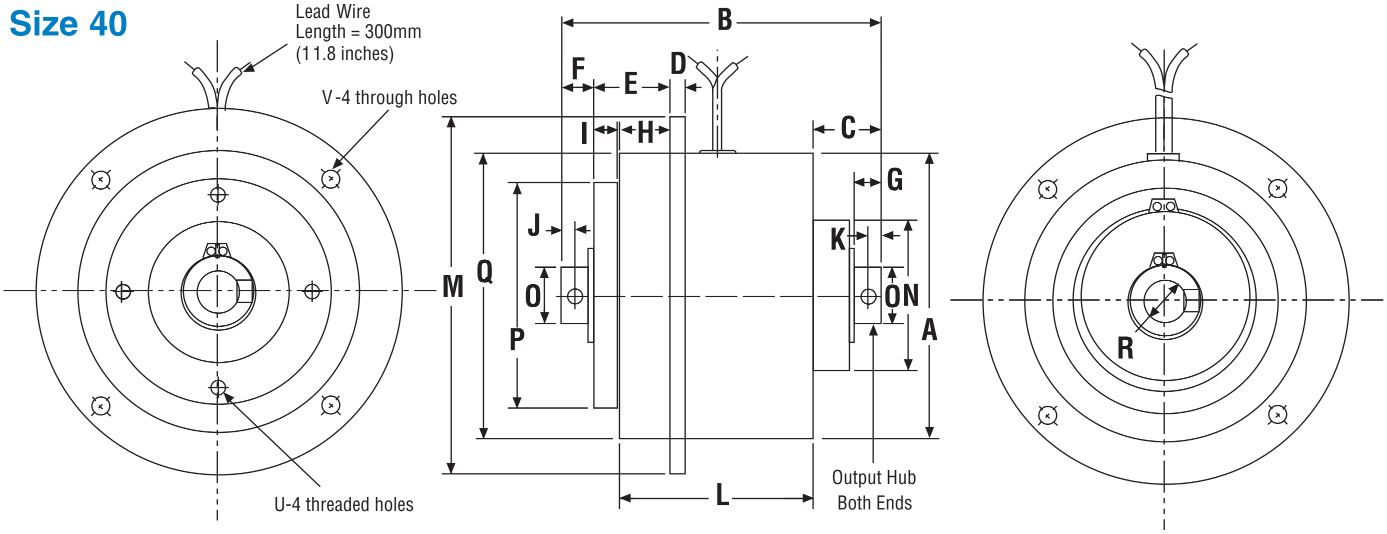
Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N
10	2.28 (58)	3.03 (77)	0.55 (14)	0.16 (4)	0.59 (15)	0.47 (12)	0.47 (12)	0.31 (8)	0.24 (6)	0.39 (10)	0.39 (10)	2.01 (51)	2.99 (76)	1.18 (30)
20	2.72 (69)	4.57 (116)	1.30 (33)	0.16 (4)	0.87 (22)	0.98 (25)	0.94 (24)	0.59 (15)	0.24 (6)	0.79 (20)	0.79 (20)	2.01 (51)	3.62 (92)	1.38 (35)

			Shaft Dimensions			U			V	
Size	P	Q	R	S	T	Thread Size	Depth	Bolt Circle	Hole Size	Bolt Circle
10	2.1260/2.1248 (54.000/53.970)	2.2835/2.2823 (58.000/57.970)	0.2756/0.2750 (7.000/6.985)	0.24 (6)	— —	M4	0.24 (6)	1.81 (46)	0.18 (4.5)	2.68 (68)
20	2.1260/2.1248 (54.000/53.970)	2.7165/2.7154 (69.000/68.970)	0.4724/0.4720 (12.000/11.988)	0.45 (11.5)	0.45 (11.5)	M4	0.24 (6)	1.81 (46)	0.18 (4.5)	3.23 (82)

Note: All dimensions are nominal unless otherwise noted.

PMC Series Clutches/Brakes

Dimensions
Size 40



Specifications

Size	Part Number	Torque (lb. in.)	E-Stop Torque (lb. in.)	Drag Torque (lb. in.)	Maximum Speed (rpm)	Inertia Input (lb. in.^{2})	Output (lb. in.^{2})	Max. Heat Diss. Watts @ Max. RPM	Weight (lbs.)
40	5401-270-131	34	42.5	1.0	1,800	1.14	.372	68	5.5

inches (mm)

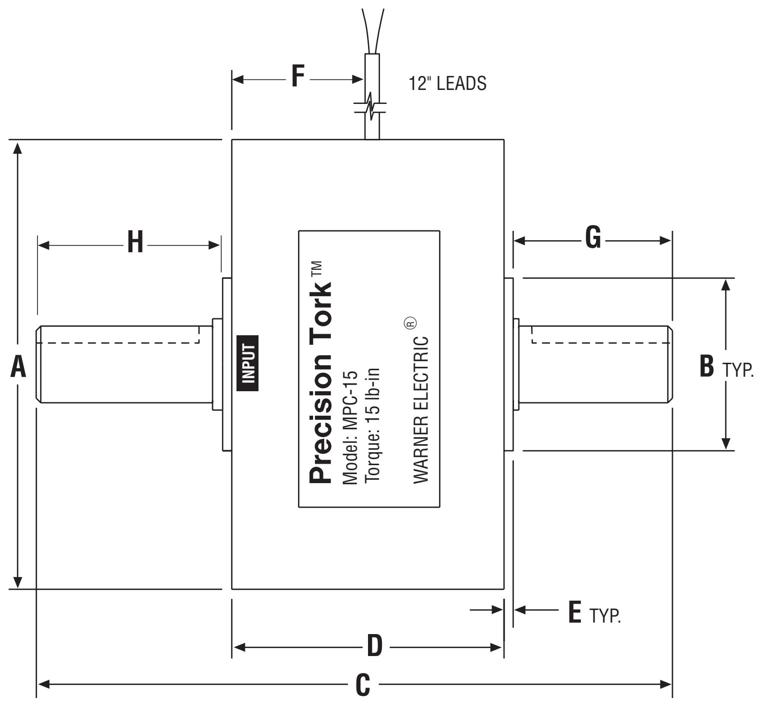
Size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
40	3.39 (86)	3.82 (97)	0.83 (21)	0.16 (4)	0.87 (22)	0.39 (10)	0.34 (8.7)	0.59 (15)	0.24 (6)	0.16 (4)	0.16 (4)	2.32 (59)	4.41 (112)	1.97 (50)	0.79 (20)

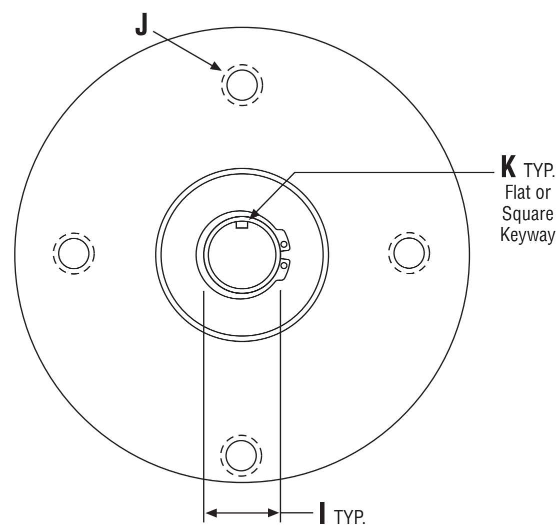
			Bore	U			V	
Size	P	Q	R	Thread Size	Depth	Bolt Circle	Hole Size	Bolt Circle
40	2.7559/2.7547 (70.000/69.970)	3.3858/3.3844 (86.000/85.965)	0.4731/0.4724 (12.018/12.000)	M4	0.24 (6)	2.36 (60)	0.18 (4.5)	3.94 (100)

Note: All dimensions are nominal unless otherwise noted.

MPC Series Clutches

Low and medium torque units for light duty rewind applications. Shaft in-shaft out with pilots, allow for sample mounting. Optional brackets available.





Optional mounting bracket, see page 127.

Dimensions inches

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

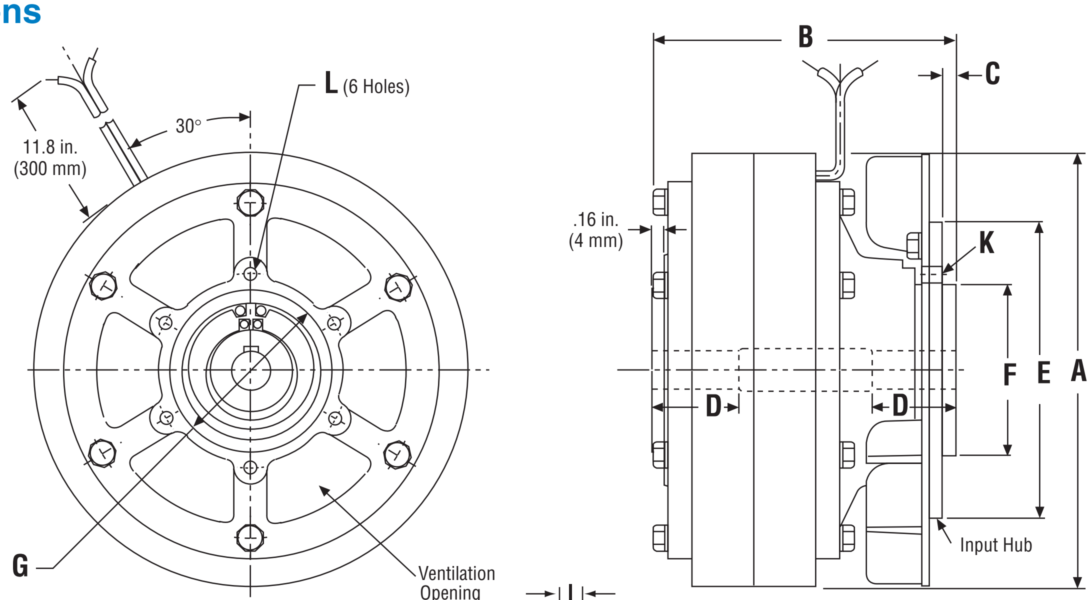
Model Number	Max. Drag Torque 0 Excit. (lb.in.)	Rated Torque (lb.in.)	Rated Voltage	Resistance (Ohms)	Rated Current (Amps)	Build Up Time W/out OEX (Millisec)	Build Up Time With OEX (Millisecs)	Inertia of Output Shaft (lb.in.²)	Max. Heat Dissipation (watts)	Max. Speed Recom. (RPM)	Weight
MPC2	0.40	2	24	92	0.261	8	4	1.33×10^{-3}	10	1,800	1
	0.40	2	90	1552	0.058	8	4	1.33×10^{-3}	10	1,800	1
MPC15	0.40	15	24	80	0.302	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

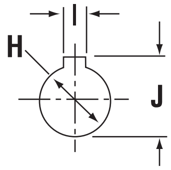
Note: All dimensions are nominal unless otherwise noted.

PHC-R Series Clutches

This model has a hollow bore, making it ideal for applications where shaft mounting is preferred. It has a piloted input flange for pulley or sprocket attachment.

Dimensions





inches (mm)

Bore Dimensions			
Size	**H**	**I**	**J**
0.6	0.4731/0.4724 (12.018/12.000)	0.1586/0.1579 (4.028/4.010)	0.5413/0.5315 (13.75/13.50)
1.2	0.5913/0.5906 (15.018/15.000)	0.1980/0.1972 (5.028/5.010)	0.6791/0.6693 (17.25/17.00)
2.5	0.9851/0.9843 (25.021/25.000)	0.2770/0.2761 (7.035/7.013)	1.1122/1.1024 (28.25/28.00)
5	1.3789/1.3780 (35.025/35.000)	0.3951/0.3942 (10.035/10.013)	1.5256/1.5157 (38.75/38.50)
10	1.7726/1.7717 (45.025/45.000)	0.4741/0.4731 (12.043/12.016)	1.9193/1.9094 (48.75/48.50)
20	2.1665/2.1654 (55.030/55.000)	0.5922/0.5912 (15.043/15.016)	2.3720/2.3622 (60.25/60.00)

Specifications

Size	Part Number	Nominal Torque (lb. ft.)	Nominal Drag Torque (lb. ft.)	Maximum Speed (rpm)	Inertia Input (lb. ft.^{2})	Output (lb. ft.^{2})	Max. Heat Diss. Watts @ Max. RPM	Weight (lbs.)
0.6	5401-270-321	4.3	.13	1,800	.0223	.00712	105	9.3
1.2	5401-270-331	8.6	.26	1,800	.0392	.0171	200	13
2.5	5401-270-341	18	.54	1,800	.126	.0494	395	22
5	5401-270-351	36	1.1	1,800	.323	.138	620	38
10	5401-270-361	72	2.2	1,500	1.42	.617	940	95
20	5401-270-371	144	4.3	1,500	3.01	1.30	1,350	154

inches (mm)

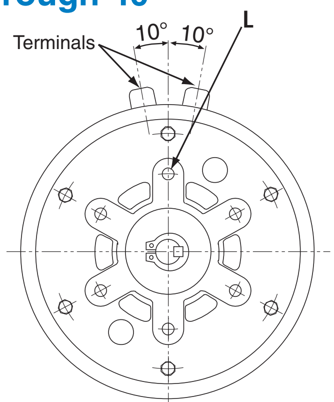
								K				L			
Size	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**Thread Size**	**Depth**	**Num.of Holes**	**Bolt Circle**	**Thread Size**	**Depth**	**Num. of Holes**	**Bolt Circle**
0.6	5.28 (134)	3.62 (92)	0.16 (4)	1.00 (25.5)	3.50 (89)	1.9685/1.9675 (50.000/49.975)	1.9685/1.9675 (50.000/49.975)	M4	0.24 (6)	6	2.362 (60)	M4	0.24 (6)	6	2.362 (60)
1.2	5.98 (152)	3.78 (96)	0.16 (4)	0.98 (25)	3.50 (89)	1.7717/1.7707 (45.000/44.975)	2.7559/2.7547 (70.000/69.970)	M5	0.24 (6)	6	2.165 (55)	M4	0.31 (8)	6	3.150 (80)
2.5	7.17 (182)	5.20 (132)	0.20 (5)	1.77 (45)	5.51 (140)	2.7559/2.7547 (70.000/69.970)	2.7559/2.7429 (70.000/69.670)	M6	0.39 (10)	6	3.150 (80)	M6	0.35 (9)	6	3.150 (80)
5	8.62 (219)	5.83 (148)	0.16 (4)	1.57 (40)	6.50 (165)	3.4252/3.4238 (87.000/86.965)	3.4252/3.4238 (87.000/86.965)	M8	0.39 (10)	6	4.016 (102)	M8	0.39 (10)	6	4.016 (102)
10	11.42 (290)	7.22 (183.5)	0.24 (6)	2.36 (60)	7.48 (190)	4.1339/4.1325 (105.000/104.965)	4.3307/4.3293 (110.000/109.965)	M10	0.51 (13)	6	4.724 (120)	M8	0.39 (10)	6	4.724 (120)
20	13.19 (335)	8.74 (222)	0.35 (9)	2.95 (75)	8.66 (220)	5.1181/5.1165 (130.000/129.960)	5.1181/5.1165 (130.000/129.960)	M10	0.59 (15)	6	5.906 (150)	M10	0.53 (13.5)	6	5.906 (150)

Note: This is a stationary field clutch. The tapped holes “L” in the field are for securing the housing to prevent it from rotating. This can be done with capscrews or with a restraining strap. Do not block ventilation openings when mounting.

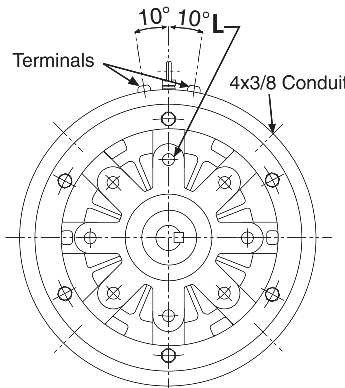
Note: All dimensions are nominal unless otherwise noted.

This model is preferred in many applications. It is offered with male input and output shafts and all units are pilot mounted, except for the size 80. This largest unit, the size 80, is foot mounted.

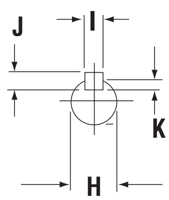
Dimensions
Sizes 0.3 through 40

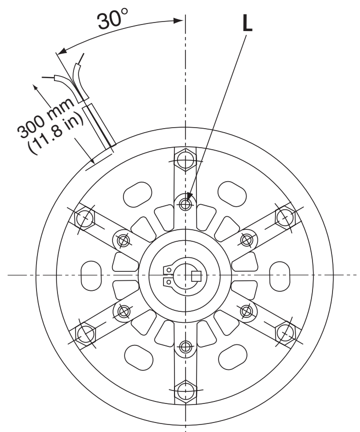


End View (POC-0.3)

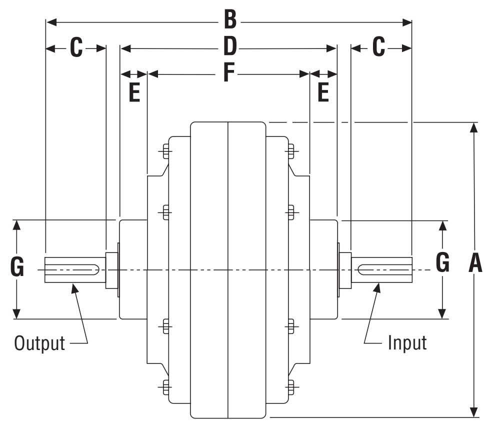


End View (POC-40)





End View (Size 20 and smaller)



All dimensions are nominal unless otherwise noted.

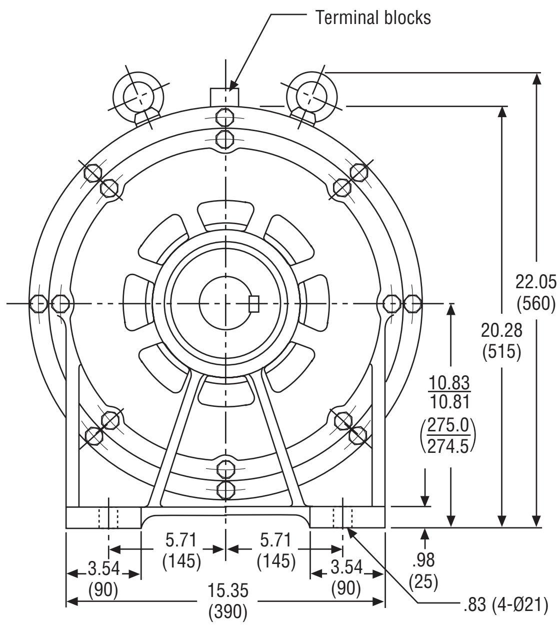
inches (mm)

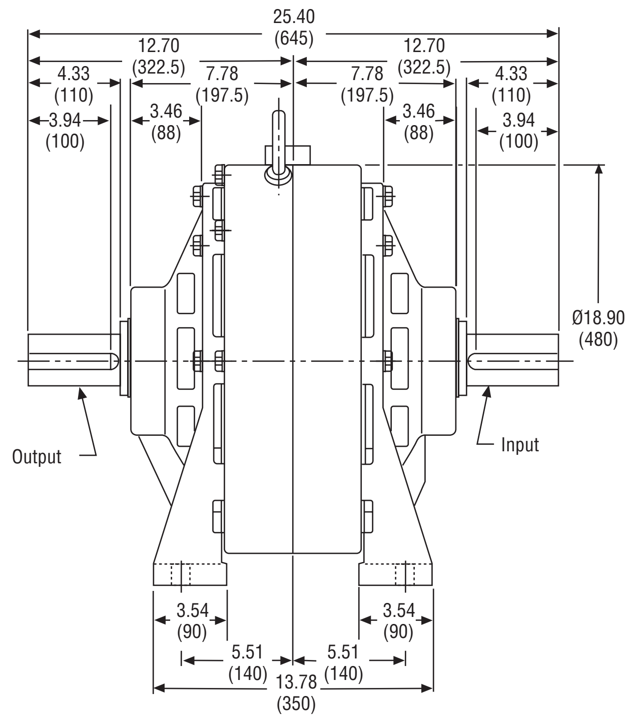
Model	A	B	C	D	E	F	Shaft Dimensions G	H	I	J	K	L Thread Size	Depth	No. of Holes	Bolt Circle
POC-0.3	4.72 (120)	5.79 (147)	0.91 (23)	3.43 (87)	0.43 (11)	2.56 (65)	1.6535/1.6526 (42.000/41.975)	0.3937/0.3931 (10.000/9.985)	0.1584/0.1580 (4.024/4.012)	0.16 (4)	0.10 (2.5)	M5	0.39 (10)	6 x 2	2.520 (64)
POC-0.6	5.28 (134)	6.10 (155)	1.02 (26)	3.54 (90)	0.39 (10)	2.76 (70)	1.6535/1.6526 (42.000/41.975)	0.4724/.4717 (12.000/11.9820)	0.1584/0.1580 (4.024/4.012)	0.16 (4)	0.10 (2.5)	M5	0.43 (11)	6 x 2	2.520 (64)
POC-1.2	5.98 (152)	7.40 (188)	1.36 (34.5)	4.17 (106)	0.51 (13)	3.15 (80)	1.6535/1.6526 (42.000/41.975)	0.5906/0.5898 (15.000/14.982)	0.1978/0.1973 (5.024/5.012)	0.20 (5)	0.12 (3)	M6	0.51 (13)	6 x 2	2.520 (64)
POC-2.5	7.17 (182)	8.96 (227.5)	1.69 (43)	4.86 (123.5)	0.59 (15)	3.68 (93.5)	2.1654/2.1642 (55.000/54.970)	0.7874/0.7866 (20.000/19.979)	0.1978/0.1973 (5.024/5.012)	0.20 (5)	0.12 (3)	M6	0.51 (13)	6 x 2	3.071 (78)
POC-5	8.62 (219)	11.18 (284)	2.24 (57)	5.94 (151)	0.91 (23)	4.13 (105)	2.9134/2.9122 (74.000/73.970)	0.9843/0.9834 (25.000/24.979)	0.2768/0.2762 (7.030/7.015)	0.28 (7)	0.16 (4)	M6	0.51 (13)	6 x 2	3.937 (100)
POC-10	11.42 (290)	13.70 (348)	2.64 (67)	7.56 (192)	0.98 (25)	5.59 (142)	3.9370/3.9356 (100.000/99.965)	1.1811/1.1803 (30.000/29.979)	0.2768/0.2762 (7.030/7.015)	0.28 (7)	0.16 (4)	M10	0.71 (18)	6 x 2	5.512 (140)
POC-20	13.19 (335)	15.04 (382)	2.80 (71)	8.50 (216)	0.98 (25)	6.54 (166)	4.3307/4.3293 (110.000/109.965)	1.3780/1.3770 (35.000/34.975)	0.3949/0.3943 (10.030/10.015)	0.31 (8)	0.18 (4.5)	M10	0.71 (18)	6 x 2	5.906 (150)
POC-40	15.55 (395)	19.29 (490)	3.62 (92)	10.94 (278)	1.30 (33)	8.35 (212)	5.1181/5.1165 (130.000/129.960)	1.7717/1.7707 (45.000/44.975)	0.4739/0.4731 (12.036/12.018)	0.31 (8)	0.18 (4.5)	M12	0.79 (20)	8 x 2	7.874 (200)

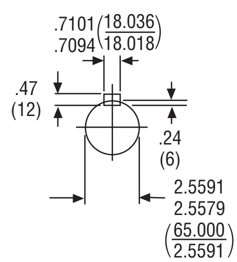
* Air inlet for optional forced air cooling. Consult factory.

Note: All dimensions are nominal unless otherwise noted.

Dimensions
Size 80





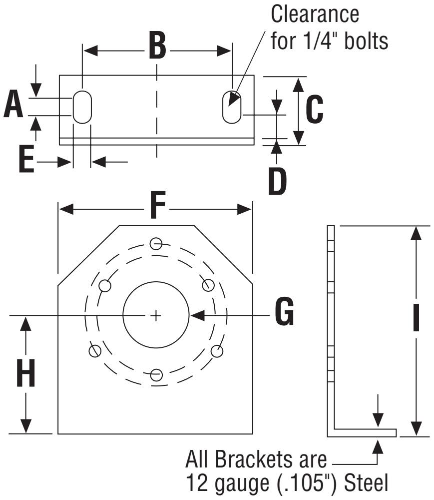


Specifications inches

Size	Part Number	Torque (lb. ft.)	Drag Torque (lb. ft.)	Maximum Speed (rpm)	Inertia Input (lb. ft.^{2})	Output (lb. ft.^{2})	Max. Heat Diss. Watts @ Max. RPM	Weight (lbs.)
0.3	5401-270-211	2.1	.065	1,800	.0128	.00477	105	5.5
0.6	5401-270-221	4.3	.13	1,800	.0173	.00570	80	7.9
1.2	5401-270-231	8.6	.26	1,800	.0304	.0104	145	12
2.5	5401-270-241	18	.54	1,800	.0973	.0387	195	22
5	5401-270-251	36	1.1	1,800	.249	.114	290	38
10	5401-270-261	72	2.2	1,800	1.04	.437	460	77
20	5401-270-271	144	4.3	1,800	2.23	1.19	790	128
40	5401-270-281	289	8.7	1,800	5.93	3.08	1,990	220
80	5401-270-291	578	17	1,500	23.5	15.2	3,900	551

Optional Accessories

Optional Mounting Bracket (for mounting MPB Brakes and MPC Clutches)

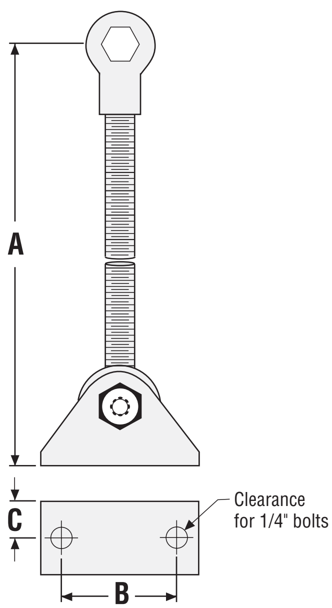


inches (mm)

Model	Fits Size (See Note)	A	B	C	D	E	F	G	H	I
MPB-2B	MB2/MC2	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	MB3/MC3, MB4/MC4	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	MB5/MC5	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	MB5.5/MC5.5	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	MB6/MC6	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)

Note: All dimensions are nominal unless otherwise noted.
All MPC Series clutches require 2 mounting brackets.
MPB Series brakes require 1 mounting bracket.

Optional Torque Arm (for shaft mounting PRB-H and PRB-HF Brakes)



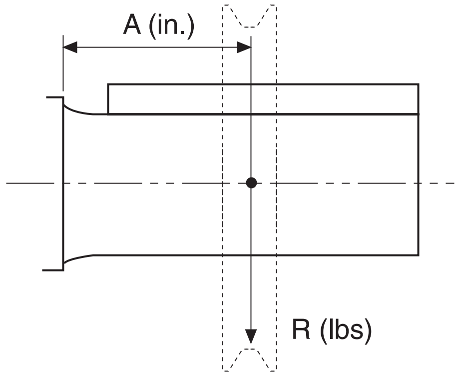
inches (mm)

Model	Part Number	A inches (mm)	B inches (mm)	C inches (mm)
PRB-1.2H	5401-101-001	9.03 (229.4)	1.50 (38.1)	0.31 (7.9)
PRB-2.5H	5401-101-001	9.03 (229.4)	1.50 (38.1)	0.31 (7.9)
PRB-5H	5401-101-002	11.19 (284.2)	1.50 (38.1)	0.38 (9.5)
PRB-10H	5401-101-002	11.19 (284.2)	1.50 (38.1)	0.38 (9.5)
PRB-20H	5401-101-003	19.31 (490.5)	2.38 (60.3)	0.38 (9.5)

Note: All dimensions are nominal unless otherwise noted.

Overhung Load

When an overhung load (side load) is applied to the shaft, verify that this load does not exceed the maximum allowable. Operating speed and where the load is applied to the shaft (see Dimension A, below) must be known. For speed, determine the speed coefficient from the coefficient table. Also, determine the allowable overhung load from the chart based on Dimension A. Multiply the load from the chart times the speed coefficient to determine the allowable load for the application.



Overhung Load

Note: Shaft extensions are not recommended.

Pulley or Sprocket Load

For most applications, the overhung load is caused by pulleys or sprockets. The smaller the pitch diameter (PD) of the pulley or sprocket, the higher the belt or chain tension, and, therefore, the greater the overhung load. To determine the minimum pulley diameter for the application, use the following equation:

$$\text{Minimum PD (in.)} = \frac{24\ TK}{CR}$$

T = Torque (lb.ft.) This is the torque actually being transmitted, not necessarily the maximum torque capacity of the brake.

K = Safety factor for the tension in type of drive. Use 1.2 to 1.5 for sprockets, 2 to 4 for belts.

C = Speed coefficient from table.

R = Radial load allowable at 1,000 RPM. (The allowable radial loads for various locations on the shaft are given in the Allowable Load chart.)

Example: Determine the minimum sprocket diameter that can be used on a PRS-5S. Dimension A is 1.1 inches, the torque requirement is 20 lb.ft. and the speed is 600 RPM.

$$\text{Minimum PD (in.)} = \frac{24 \times 20 \times 1.5}{1.2 \times 214}$$
$$= 2.8 \text{ inch minimum PD}$$

Allowable Overhung Load

Type	A (in.)	R (lbs.)	A (in.)	R (lbs.)	A (in.)	R (lbs.)
MPB2/MPC2	.40	5	.50	4	.80	2.5
MPB15/MPC15	.40	25	.50	20	1	10
MPB70/MPC70	.40	37.5	.50	30	1.25	12
MPB120/MPC120	.50	30	1	15	1.5	10
MPB240	.50	50	1	25	1.5	16
POC/POB-0.3	.40	30	.50	28	.90	22
POC/POB-0.6	.40	45	.50	42	1.0	29
POC/POB-1.2	.40	52	.70	43	1.4	31
POC/POB-2.5	.40	88	.90	67	1.7	48
PTB-2.5BL3	.40	125	.90	104	1.7	82
POC/POB-5	.40	204	1.1	136	2.2	93
PTB-5BL3	.40	204	1.1	136	2.2	93
POC/POB-10	.40	313	1.3	235	2.6	159
PTB-10BL3	.40	433	1.3	368	2.6	282
POC/POB-20	.40	379	1.4	265	2.8	198
PTB-20BL3	.40	379	1.4	265	2.8	198
POC/POB-40	.40	581	1.8	432	3.6	324
POC/POB-80	.40	860	2.2	648	4.3	498

Note: This table is based on 1,000 rpm and a bearing life of 6,000 hours. Also, this table assumes that no thrust load is applied.

Speed Coefficient

Speed (rpm)	Speed Coefficient
50	2.74
100	2.18
200	1.72
400	1.37
600	1.20
800	1.09

Speed (rpm)	Speed Coefficient
1,000	1.00
1,200	0.95
1,400	0.89
1,600	0.86
1,800	0.82
2,000	0.80

Pneumatic Brakes

Mistral Brakes

Modular design permits variable tensioning capacities!

Wichita Clutch's Mistral pneumatic tension brakes are ideally suited to the needs of the corrugating market for which it was originally designed. It is also a versatile product which is finding favor in additional tensioning applications. Wichita Clutch designers and engineers consulted extensively with mill roll stand manufacturers and users to offer a tension brake ideally suited to the needs of this particular market. The result is a compact, high performance, versatile brake capable of handling the tensioning needs of the latest machine designs, as well as existing equipment. The Mistral paves the way for increasing line speeds by 5.4 feet/sec. from 810 feet/min. (or slower) to 1,140 feet/min.

Varying number of actuators provide optimum tension control

Each brake may be specified with a varying number of pneumatic actuators, allowing precise selection of brake torque capacity for optimum tension control.

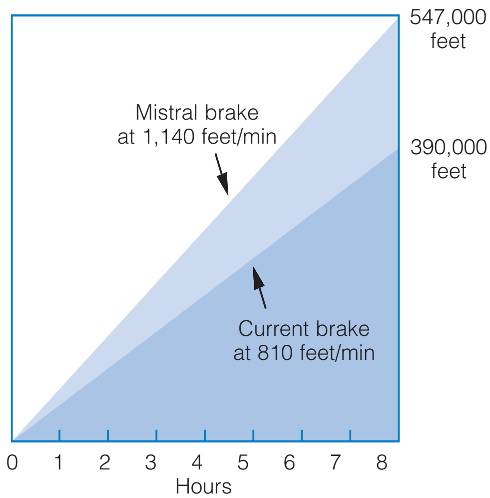
Compact Design

Mistral brakes are compact at only 11.6" or 16.1" in diameter. Their size facilitates the pickup of small, part reels used in short batch runs. For automatic reel loading machines, Mistral offers optional infrared and speed sensor installation within the brake. And their modern, industrial styling enhances the appearance of any machine on which they are used.

Easy Access with Removable Cover Panel

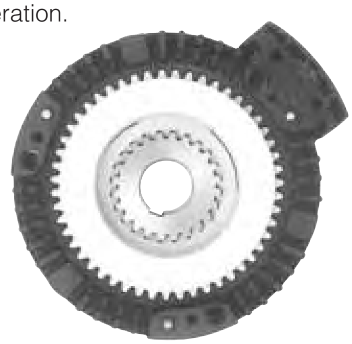
By removing just three cap screws, the Mistral's front cover can be detached for easy and fast access to internal parts. Cover removal automatically disconnects both air and electricity.

Performance Curve



Mounting Ease

Three bolts mount the brake to the arm of the mill roll stand or machine frame and an optional pilot location makes fitting to both new and existing machines a simple operation.



Wear Indicator

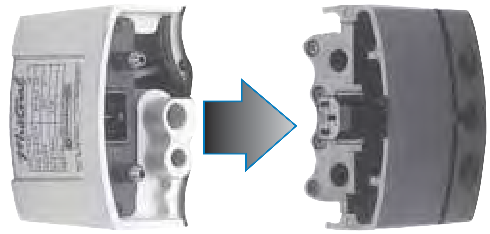
A brake wear indicator, which is conveniently located for easy visual inspection, means no down time to check remaining friction material life.

Easy Connection

Air and electrical connections are easily accessible for fast, simple installation and maintenance.

Safety

Mistral's integral guarding eliminates the cost and effort of installing external guards. Operator safety is further enhanced by automatic air and electric disconnects when the front cover is removed.

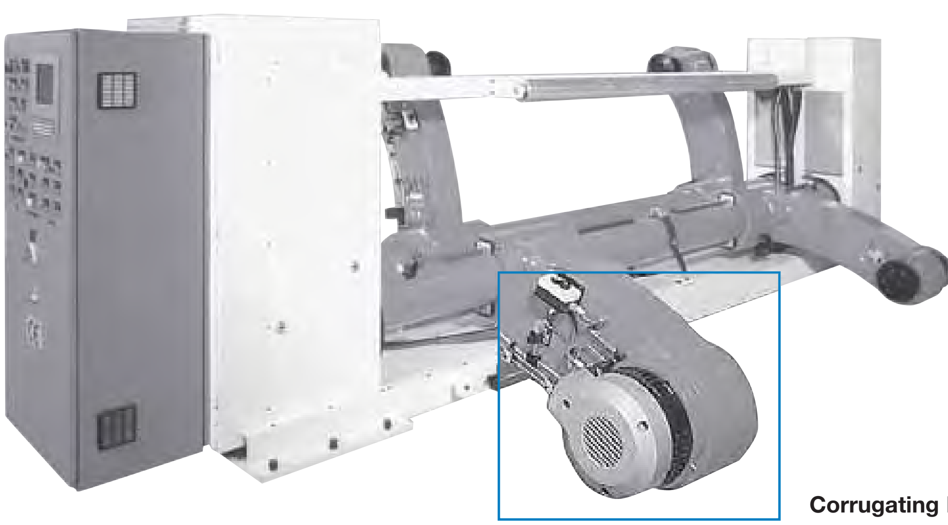


Integral Cooling

A rugged, high performance, low energy usage fan is housed within the brake for high heat dissipation — a must for increased productivity through controlled tension at many roll speeds.

Fan and Connection Data

Model	Fan Voltages	Fan Power	Electric	Pneum.
200	220VAC 50/60 Hz 110VAC 50/60 Hz 24VDC	20W	M16 PG9 3/8 NPT	1/8 BSP 1/8 BSP 1/8 NPT
280	220VAC 50/60 Hz 110VAC 50/60 Hz 24VDC	25W	M16 PG9 3/8 NPT	1/8 BSP 1/8 BSP 1/8 NPT



Corrugating Press Installation

Pneumatic Brakes

Mistral Brakes

Specifications

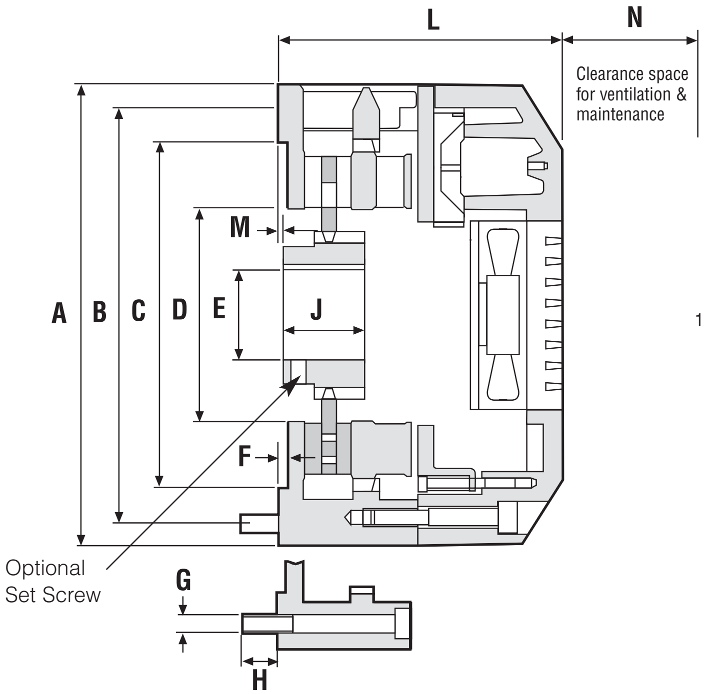
Model	Dynamic Slipping Torque Capacity				Heat Transfer Capacity with fan				Maximum Speed	Inertia of Rotating Parts		Weight				Fan Power Rating
	Air Pressure (lb.in.)		(Nm)		Continuous Operation		:30 On/:30 Off Operation			Wr²	J=mr²	Total Brake		Rotating Parts		
Mistral	min.* 3 psi	max. 80 psi	min.* 0.2 BAR	max. 5.5 BAR	(hp)	(kW)	(hp)	(kW)	(rev./min.)	(lb.ft.²)	(kgm²)	(lb.)	(kg)	(lb.)	(kg)	(W)
200/2/LC	62	1770	7	200	3.2	2.4	3.5	2.6	2860	0.40	0.017	77	35	9.92	4.5	20
200/2	97	2655	11	300	3.2	2.4	3.5	2.6	2860	0.40	0.017	77	35	9.92	4.5	20
200/4/LC	124	3540	14	400	3.2	2.4	3.5	2.6	2860	0.40	0.017	77	35	9.92	4.5	20
200/4	195	5310	22	600	3.2	2.4	3.5	2.6	2860	0.40	0.017	77	35	9.92	4.5	20
200/6/LC	195	5310	22	600	3.2	2.4	3.5	2.6	2860	0.40	0.017	77	35	9.92	4.5	20
200/6	292	7965	33	900	3.2	2.4	3.5	2.6	2860	0.40	0.017	77	35	9.92	4.5	20
280/3/LC	133	3540	14	400	6.4	4.8	7	5.2	2090	1.80	0.076	110	50	20.72	9.4	25
280/3	199	5310	21	600	6.4	4.8	7	5.2	2090	1.80	0.076	110	50	20.72	9.4	25
280/6/LC	265	7080	28	800	6.4	4.8	7	5.2	2090	1.80	0.076	110	50	20.72	9.4	25
280/6	399	10620	42	1200	6.4	4.8	7	5.2	2090	1.80	0.076	110	50	20.72	9.4	25
280/9/LC	399	10620	42	1200	6.4	4.8	7	5.2	2090	1.80	0.076	110	50	20.72	9.4	25
280/9	597	15930	63	1800	6.4	4.8	7	5.2	2090	1.80	0.076	110	50	20.72	9.4	25

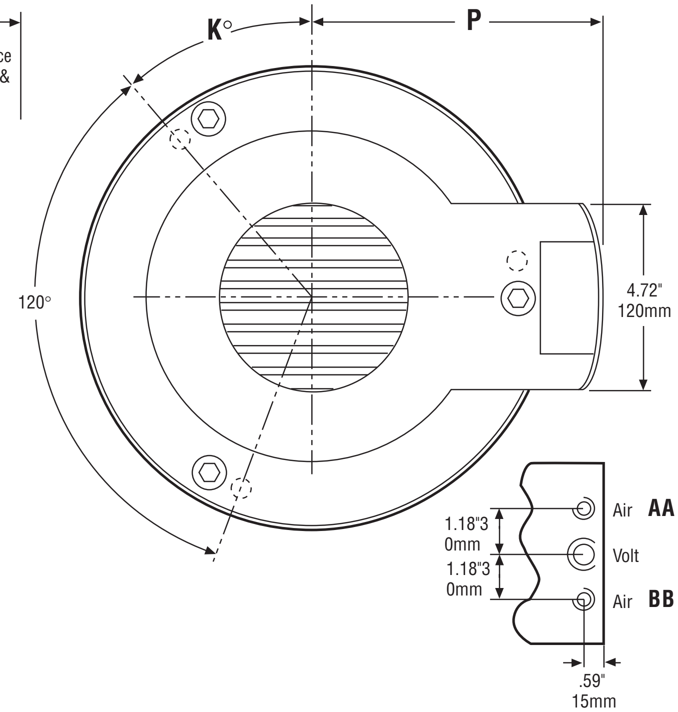
* Lower minimum torques possible with appropriate control.

Pneumatic Brakes

Mistral Brakes

Dimensions





Bore and Keyway Dimension "E" inches (mm)

Model	Minimum Bore (No Keyway)	Maximum Bore with Keyway	
200	1.00 (25)	2 3/8 (60)	5/8 x 7/32 (18 x 4.4)
280	1.00 (25)	2 5/8 (65)	3/4 x 1/4 (18 x 4.4)

inches (mm)

Model	A	B (H.C.)	F	G	H	J	K (DEG)	L	M	N	P
200	11.61 (295)	10.236 (260)	.24 (6)	1/2 (M12)	.98 (25)	1.97 (50)	40° (40°)	7.01 (178)	N/A (N/A)	2.76 (70)	7.19 (182.5)
280	16.14 (410)	13.976 (355)	0 0	5/8 (M16)	1.18 (30)	2.36 (60)	20° (20°)	7.56 (192)	0.37 (9.5)	3.15 (80)	9.47 (240.5)

Model	Mounting Pilot	Mounting Bolts Qty. and Size
200	**Dim. "C"** 8.661 +.003 / –.000 (220 +.08 / –.00)	3 @ 1/2–13 UNC (3 @ M12 x 1-3/4)
280	**Dim. "D"** 6.890 +.003 / –.000 (175 +.08 / –.00)	3 @ 5/8–11 UNC (3 @ M16 x 2)

Actuator/Inlet

Model	No. of Actuators	No. of Air Inlets	No. of Actuators Per Air Inlets AA	BB
200/2	2	2	2	0
200/4	4	2	2	2
200/6	6	2	2	4
280/3	3	2	3	0
280/6	6	2	3	3
280/9	9	2	3	6

Pneumatic Brakes

Magnum Brakes

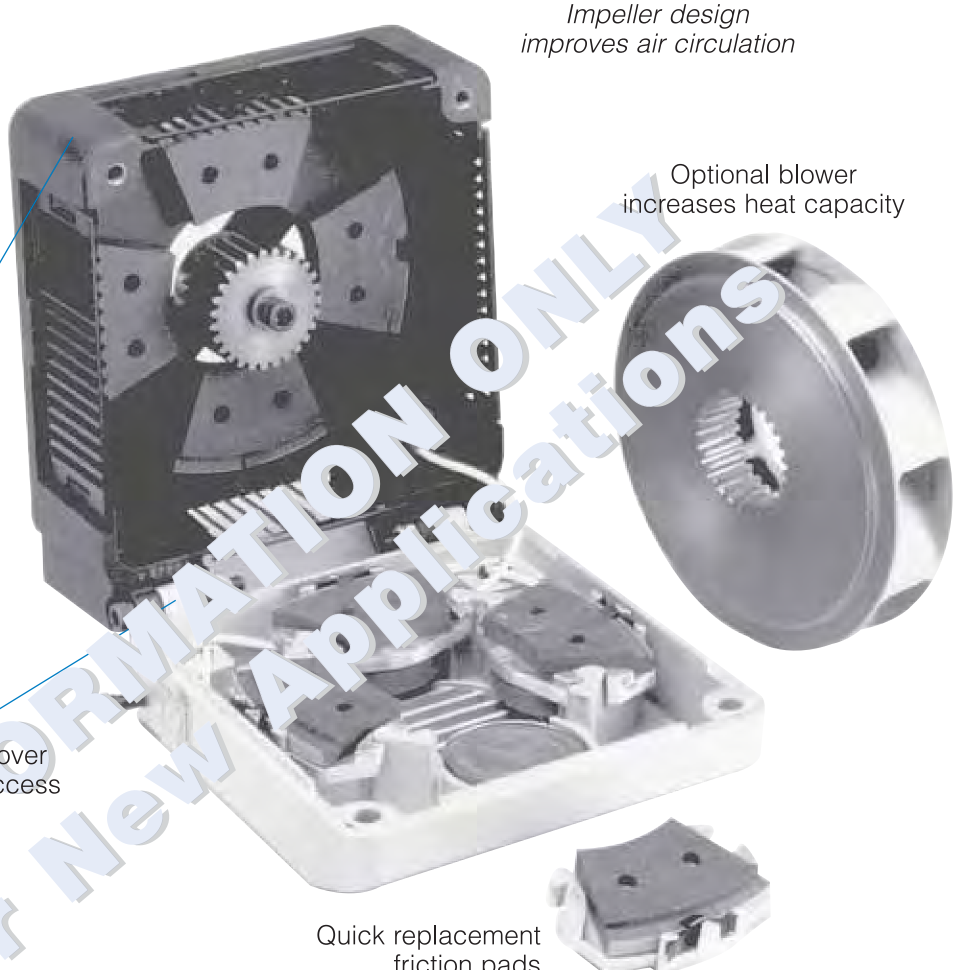
Totally Enclosed with a Wide Range of Torque Capacities

Magnum series unwind tension brakes offer high performance in a compact, easy to install package. Air vents and an impeller-type disk are tuned to achieve highly efficient air flow. Heat dissipation is further enhanced by the use of an integral fan (optional). Four sizes are available with torque capacities from 17 lb.in. through 14,160 lb.in.

Impeller design improves air circulation

Optional blower increases heat capacity

Totally enclosed. No guard required.



Hinged cover for easy access

Quick replacement friction pads

Pneumatic Brakes

Magnum Brakes

Specifications

Model No.	Dynamic Slipping Torque Cap. lb.in.[1] *Min 3 PSI	Max 80 PSI	Brake	Heat Transfer Capacity for Continuous Operation HP[2] HP Heat Transfer Cap. Forced Cooled at 50 rpm	100 rpm	200 rpm	500 rpm	Maximum Speed (rpm) Medium Speed brake disc (rpm)	High Speed brake disc (rpm)	Inertia of brake disc + hub (lb.ft.²)	Weight Total Brake (lb.)	Brake disc + Hub (lb.)
260/1LC	17	440										
260/1	26	660										
260/2LC	43	880	Mag.	1.3	1.5	1.9	2.9					
260/2	60	1320										
260/3LC	60	1320						2530	4427	.74	31	13.7
260/3	85	1980	Mag. Plus	1.7 Fan	2.1 Fan	2.8 Fan	4.0 Fan					
260/4LC	85	1760										
260/4	113	2640										
340/1LC	35	687	Mag.	2.3	2.7	3.3	4.7					
340/1	43	1030										
340/2LC	70	1373	Mag. Thin	1.1	1.3	1.6	2.6					
340/2	86	2060										
340/3LC	95	2060										
340/3	129	3090	Mag. Thin	2.4 Fan	2.5 Fan	2.7 Fan	3.1 Fan					
340/4LC	129	2748										
340/4	172	4120	Mag. B	3.6 Fan	4.0 Fan	4.8 Fan	5.6 Fan	2040	3570	2.4	45	23
340/5LC	163	3435										
340/5	215	5150										
340/6LC	198	4120	Mag. Plus	3.9 Fan	4.3 Fan	5 Fan	5.7 Fan					
340/6	258	6180										
400/2LC	86	1774										
400/2	113	2660	Mag.	3.5	4.0	5.2	8.8					
400/3LC	129	2660										
400/3	172	3990										
400/4LC	172	3548	Mag.B	4.9 Fan	5.7 Fan	7.1 Fan	8.8 Fan					
400/4	225	5320										
400/5LC	215	4435										
400/5	286	6650	Mag. Plus	6.0 Fan	7.0 Fan	8.4 Fan	9.4 Fan					
400/6LC	252	5322						1712	2996	5.7	71	41
400/6	238	7980										
400/7LC	285	6210										
400/7	400	9310										
400/8LC	338	7096										
400/8	451	10640	Mag.	4.7	6.0	8.7	14.7					
500/2LC	113	2360										
500/2	146	3540	Mag.B	10.0 Fan	11.4 Fan	12.6 Fan	14.7 Fan					
500/3LC	172	3540										
500/3	225	5310										
500/4LC	225	4720										
500/4	304	7080	Mag. Plus	10.7 Fan	12.0 Fan	13.4 Fan	16.8 Fan					
500/5LC	286	5900										
500/5	382	8850										
500/6LC	338	7080						1308	2289	17	127	60
500/6	451	10620										
500/7LC	400	8260										
500/7	530	12390										
500/8LC	451	9440										
500/8	608	14160										

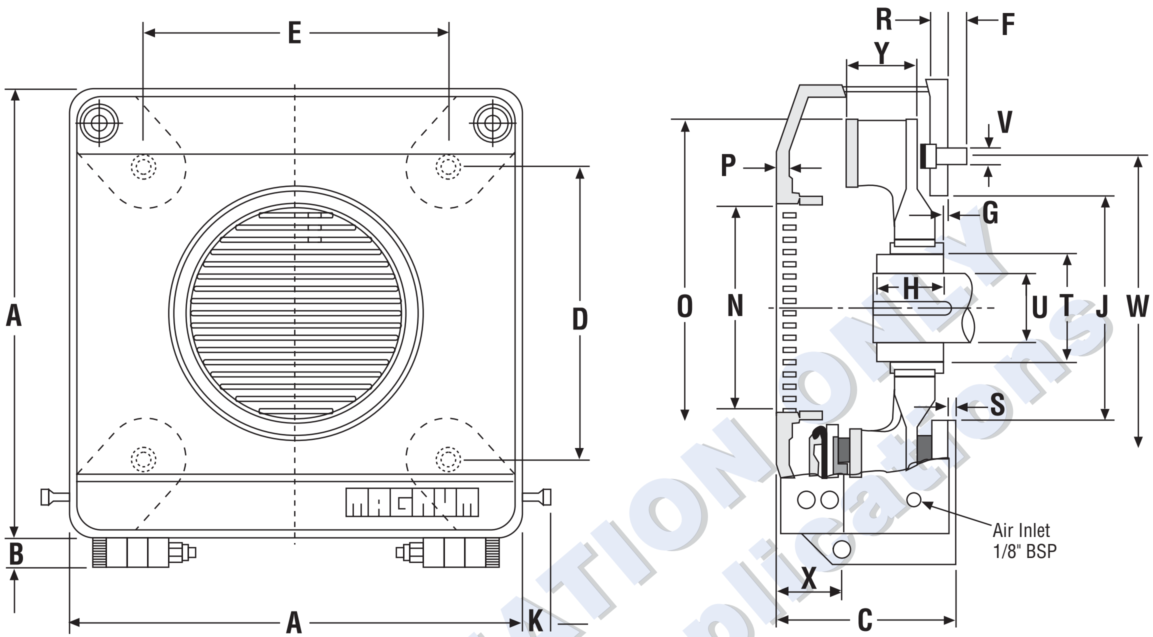
Notes

1. The dynamic slipping torque range for a given brake model can be changed by switching the actuators in or out by means of the hand slide valves provided e.g. a 340/3 to a 340/2 or a 340/1.
2. The heat transfer ratings in the above chart assume a forward rotation of the brake disc. For reverse rotation, the heat ratings of models Magnum 260 and Magnum 340 should be reduced by 15%. If in doubt, please contact your Wichita Clutch engineer.

* Lower minimum torques possible with appropriate control.

Dimensions

Magnum



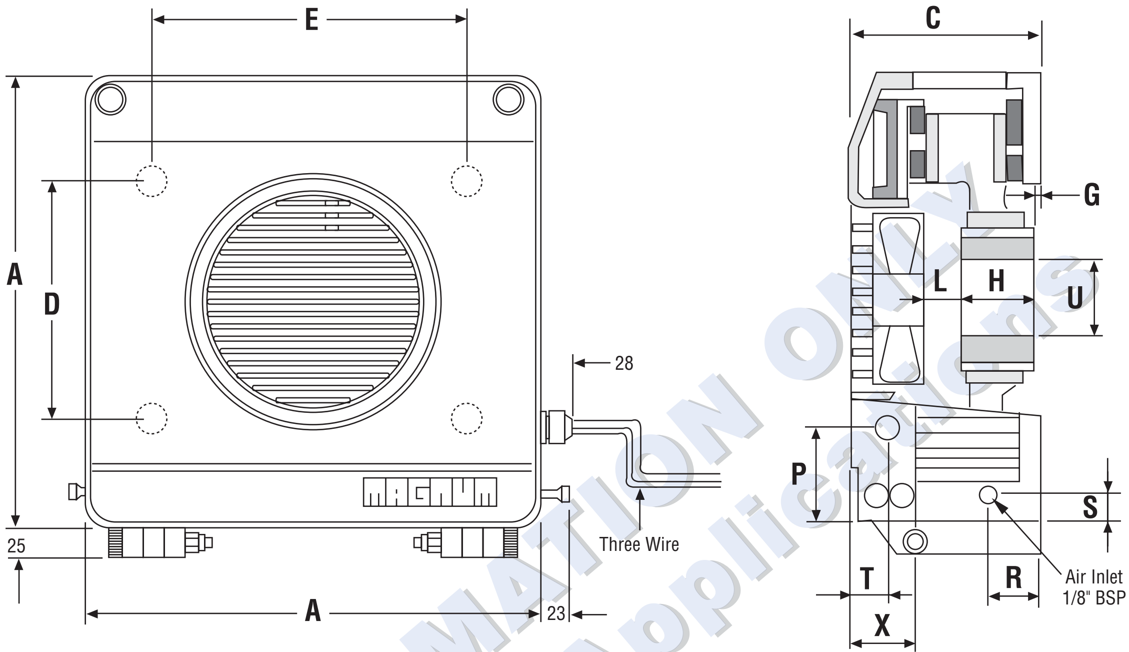
inches (mm)

Model No.	A	A1	B	B1	C	C1	D	E	F	G	H	J	K
260	10.4 (264)	10.6 (270)	1.0 (25)	0.8 (20)	5.7 (145)	7.7 (195)	7.0 (176.8)	7.0 (176.8)	0.8 (20)	0.2 (5)	2.2 (55)	3.9 (100)	0.9 (23)
340	13.6 (346)	13.8 (350)	1.0 (25)	0.8 (20)	5.7 (145)	8.0 (205)	5.5 (140.0)	9.5 (242.5)	0.9 (22)	0.2 (5)	2.2 (55)	6.9 (175)	0.9 (23)
340 Thin	13.6 (346)	13.8 (350)	1.0 (25)	0.8 (20)	5.12 (130)	8.0 (205)	5.5 (140.0)	9.5 (242.5)	0.9 (22)	0.2 (5)	2.2 (55)	6.9 (175)	0.9 (23)
400	16 (406)	16.1 (410)	1.0 (25)	0.8 (20)	5.7 (145)	7.7 (195)	10.4 (265.2)	10.4 (265.2)	1.1 (27)	0.2 (5)	2.4 (60)	7.9 (200)	0.9 (23)
500	19.9 (506)	2.0 (510)	1.1 (28)	0.8 (20)	5.7 (150)	8.0 (205)	13.3 (339.4)	13.3 (339.4)	1.2 (30)	0.2 (5)	2.4 (60)	12.6 (320)	0.9 (23)

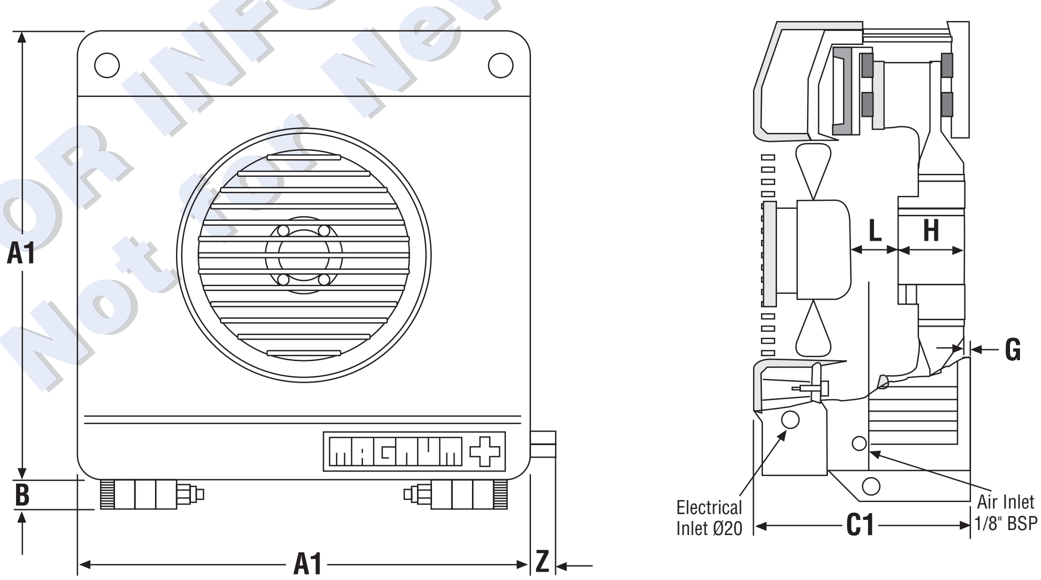
Model No.	L	N	O	P	R	S	T	U Min	U Max	V	W PCD	X	Y	Z
260	2.0 (50)	3.7 (95)	9.0 (230)	.24 (6)	.59 (15)	.20 (5)	2.44 (62)	.59 (15)	1.77 (45)	4 off-M12 X 35	9.84 (250)	1.969 (50)	2.36 (60)	.47 (12)
340	2.0 (50)	5.5 (14)	11.0 (280)	.24 (6)	.51 (13)	.28 (7)	3.62 (92)	.98 (25)	2.24 (57)	4 off-M12 x 30	11.02 (280)	1.969 (50)	2.32 (59)	.47 (12)
340 Thin	2.0 (50)	5.5 (14)	11.0 (280)	.24 (6)	.51 (13)	.28 (7)	3.62 (92)	.98 (25)	2.24 (57)	4 off-M12 x 30	11.02 (280)	1.969 (50)	2.32 (59)	.47 (12)
400	1.0 (25)	7.9 (200)	13.4 (340)	.31 (8)	.51 (13)	.12 (3)	4.69 (119)	1.38 (35)	2.56 (65)	4 off-M16 x 40	14.76 (375)	2.047 (52)	2.36 (60)	.47 (12)
500	1.0 (25)	11.1 (283)	17.5 (445)	.44 (11)	.59 (15)	.08 (2)	5.6 (140)	1.38 (35)	4.08 (102)	4 off-M20 x 45	18.1 (480)	2.2 (55)	2.32 (59)	.47 (12)

Certified prints showing exact dimensions are sent with every order acknowledgement, and these should always be obtained before finalizing any design detail.

Magnum B



Magnum Plus



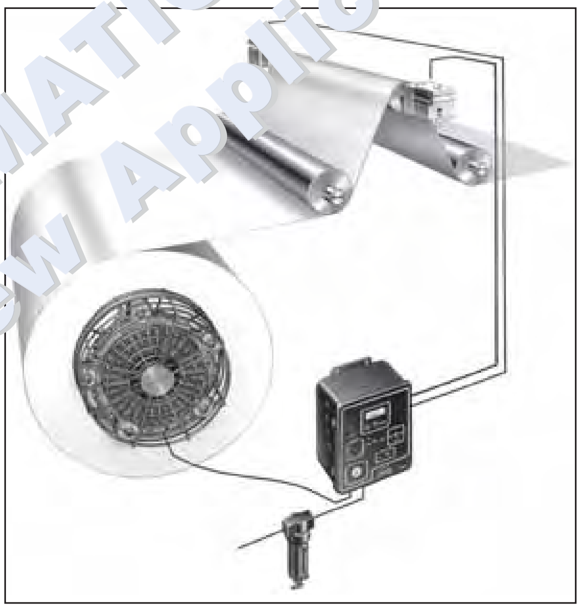
Pneumatic Brakes

AD Series – Air Disc® Brakes

The Wichita Clutch Air Disc is a pneumatic unwind brake for those heavy-duty applications where high thermal capacity and/or high tension requirements exceed the range of electrically actuated products.

The Wichita Clutch Air Disc pneumatic brake offers effective web control under heavy working conditions through innovative engineering features such as low inertia and high thermal conductivity rotor discs, which allow high work loads and still afford control as the roll reaches core.

Unique actuators float freely to compensate for run-out and less than ideal roll conditions. Simple pad replacement makes maintenance a breeze – especially when factoring in the long life of the components.



Load Cell
Control System

Typical Applications

Dancer
Tension Control System

Analog
Tension Control System

Selection

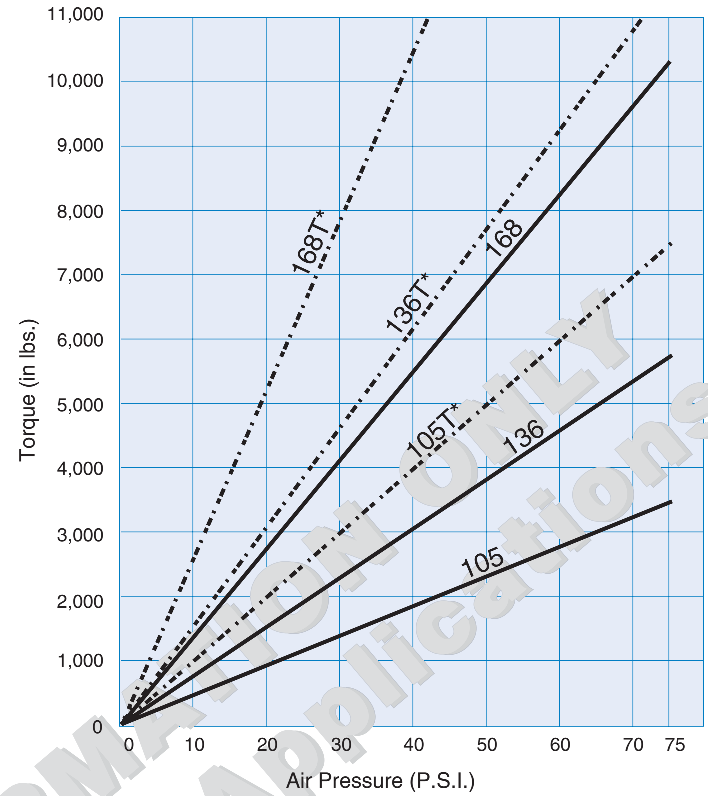
Selecting any tension braking device requires consideration of many interrelated factors. By using the data sheet on pages 16-28, the correct sizing information can be organized. Provisions for selection calculations are also made on this form.

If you need assistance, please copy this form and forward it to Wichita Clutch. Your local Wichita Clutch market representative or your local Wichita Clutch Authorized Distributor can also provide selection assistance.

Torque Characteristics

Torque produced by the Air Disc is proportional to the air pressure applied. Refer to the chart at the right to see the relationship of air pressure to torque.

Torque Characteristics



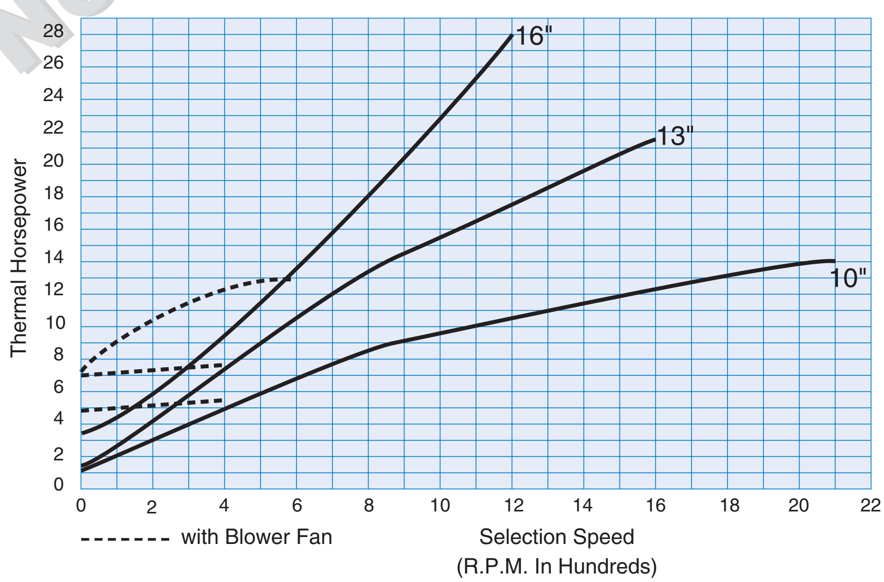
NOTE: Torque is proportional to air pressure as shown above.

Rotor Inertia and Weights

Brake Size	Rotor and Hub* Total Weight (Lbs)	Total Brake Inertia (lb.ft.^{2})
10"	28.3	2.6
13"	53.2	6.5
16"	81.0	23.7

*Both Rotor and Hub Rotate

Table 2. Thermal Horsepower



Pneumatic Brakes

AD Series – Air Disc® Brakes

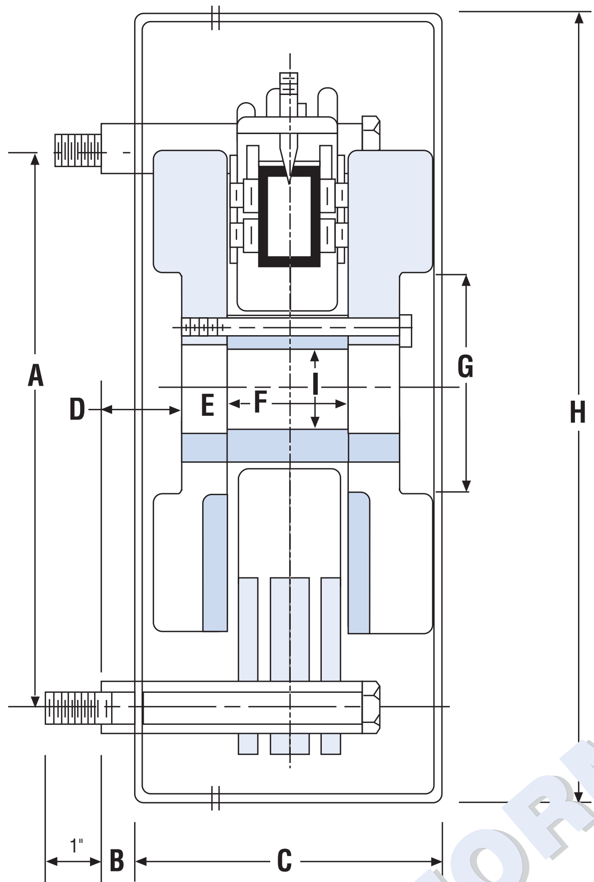
Table 3. Capacities

Model No.	Dia. of Friction Plates	No. of Actuators	Approx. Total Weight (lbs.)	Max Speed* (RPM)	Rated Torque At 75 P.S.I. Air Pressure (lb.in./lb.ft.)
101 101T	10" 10"	1 1	50 50	2,100	700/58 1,470/120
102 102T	10" 10"	2 2	53 53	2,100	1,400/117 2,940/245
103 103T	10" 10"	3 3	56 56	2,100	2,100/175 4,410/365
104 104T	10" 10"	4 4	59 59	2,100	2,800/233 5,880/490
105 105T	10" 10"	5 5	62 62	2,100	3,500/292 7,350/610
131 131T	13" 13"	1 1	78 78	1,600	950/79 1,995/165
132 132T	13" 13"	2 2	81 81	1,600	1,900/158 3,990/330
133 133T	13" 13"	3 3	84 84	1,600	2,850/238 5,985/495
134 134T	13" 13"	4 4	87 87	1,600	3,800/317 7,980/665
135 135T	13" 13"	5 5	90 90	1,600	4,750/396 9,975/830
136 136T	13" 13"	6 6	93 93	1,600	5,700/475 11,970/995
161 161T	16" 16"	1 1	111 111	1,300	1,275/106 2,675/220
162 162T	16" 16"	2 2	114 114	1,300	2,550/213 5,355/445
163 163T	16" 16"	3 3	117 117	1,300	3,825/319 8,030/665
164 164T	16" 16"	4 4	120 120	1,300	5,100/425 10,710/890
165 165T	16" 16"	5 5	123 123	1,300	6,375/531 13,385/1,115
166 166T	16" 16"	6 6	126 126	1,300	7,650/638 16,065/1,335
167 167T	16" 16"	7 7	129 129	1,300	8,926/744 18,745/1,560
168 168T	16" 16"	8 8	132 132	1,300	10,200/850 21,420/1,785

"T" Designates high coefficient friction material. Available as an option upon request.

* Max Speed is with standard friction plate. A high speed friction plate capable of 50% higher speed is available. Thermal capacity is reduced with high speed friction plate to 60% of values shown on thermal curves.

Dimensions



Model No.	A	B	C	D	E	F	G
101-105	13.00	.75	6.25	1.59	.88	2.72	6.00
131-136	14.75	.75	6.25	1.59	.88	2.72	8.00
161-168	17.50	1.25	6.25	2.09	.88	2.72	10.50

H	Max. Bore Rect. Key I		J	K
	Max.	Min.		
16.60	1.875	1.0	5/8"-11	5
18.00	3.000	1.0	5/8"-11	6
21.50	4.500	1.0	5/8"-11	8

J = Size of Mounting Bolts
K = Number of Mounting Bolts

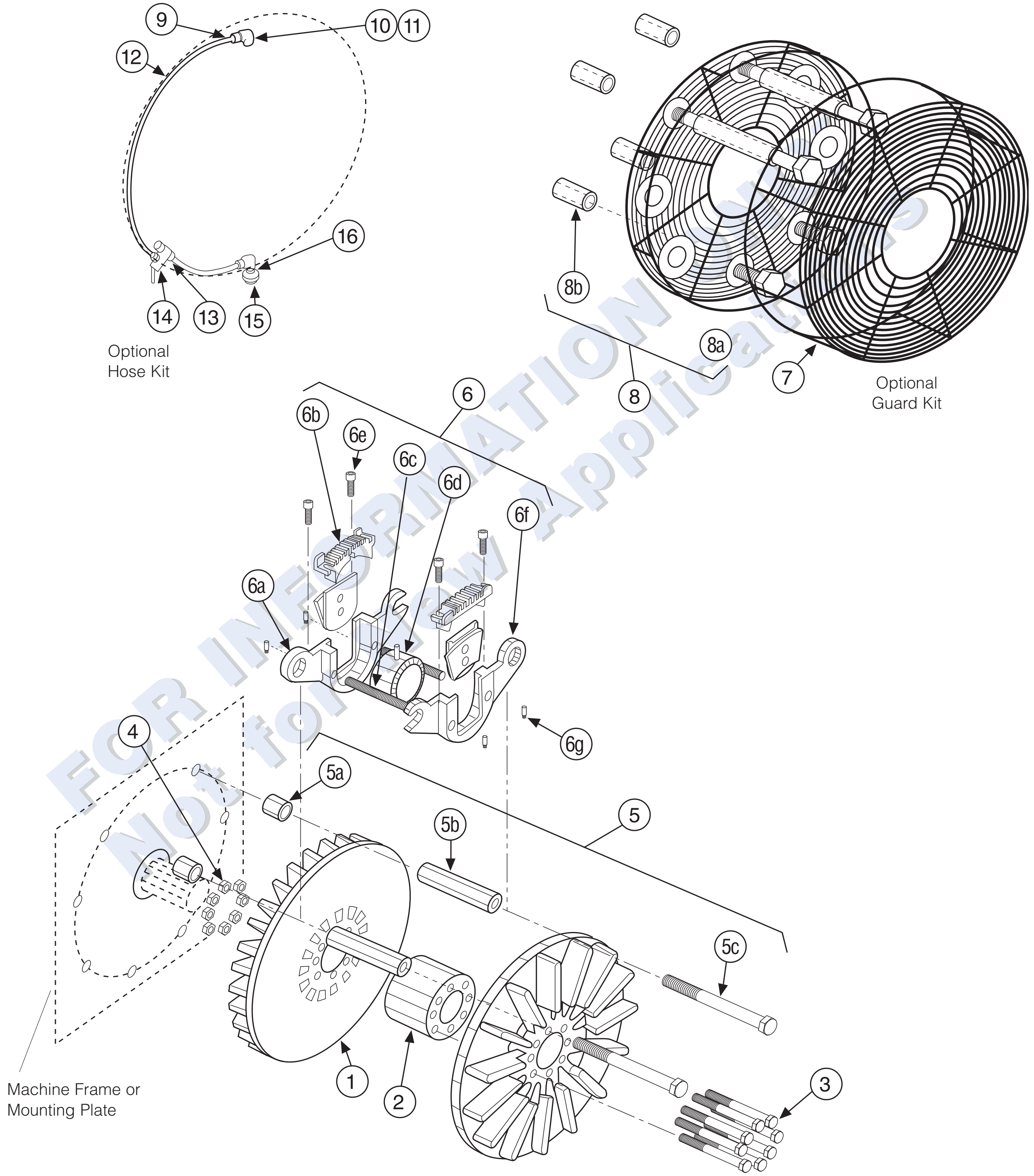
Guard and Hose Kit

Size	Basic Unit	Guard Kit	Hose Kit
101	7-810-100-100-5	4-610-021-009-3	8-610-070-007-1
102	7-810-200-100-5	4-610-021-009-3	8-610-070-007-2
103	7-810-300-100-5	4-610-021-009-3	8-610-070-007-3
104	7-810-400-100-5	4-610-021-009-3	8-610-070-007-4
105	7-810-500-100-5	4-610-021-009-3	8-610-070-007-5
131	7-813-100-100-5	4-613-021-010-3	8-613-070-007-1
132	7-813-200-100-5	4-613-021-010-3	8-613-070-007-2
133	7-813-300-100-5	4-613-021-010-3	8-613-070-007-3
134	7-813-400-100-5	4-613-021-010-3	8-613-070-007-4
135	7-813-500-100-5	4-613-021-010-3	8-613-070-007-5
136	7-813-600-100-5	4-613-021-010-3	8-613-070-007-6
161	7-816-100-100-5	4-616-021-007-3	8-616-070-007-1
162	7-816-200-100-5	4-616-021-007-3	8-616-070-007-2
163	7-816-300-100-5	4-616-021-007-3	8-616-070-007-3
164	7-816-400-100-5	4-616-021-007-3	8-616-070-007-4
165	7-816-500-100-5	4-616-021-007-3	8-616-070-007-5
166	7-816-600-100-5	4-616-021-007-3	8-616-070-007-6
167	7-816-700-100-5	4-616-021-007-3	8-616-070-007-7
168	7-816-800-100-5	4-616-021-007-3	8-616-070-007-8

Notes:

1. Wichita Clutch does not recommend using a hose kit without a guard kit.
2. The guard kit uses the bolt spacer kit that comes with the basic unit kits for mounting. Using the 10" guard with a unit with fewer than 3 actuators requires one guard bolt spacer kit. 13" & 16" guard kits require two guard bolt spacer kits when utilizing fewer than 4 and 6 actuators, respectively. With 4 and 6 actuators, only one guard bolt spacer kit is required. No guard bolt spacer kit is required with 5 or 7 actuators.

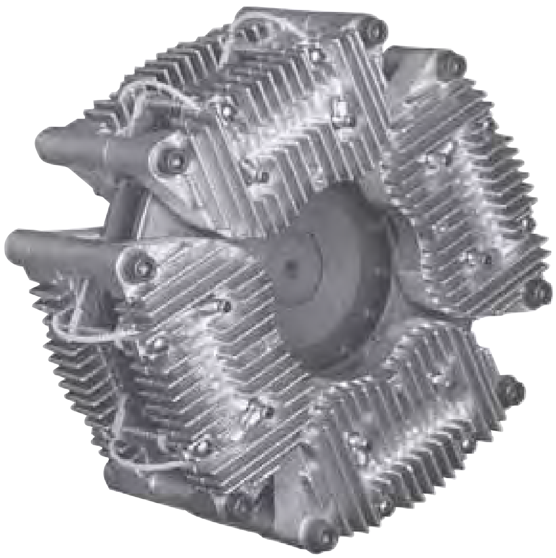
Component Parts

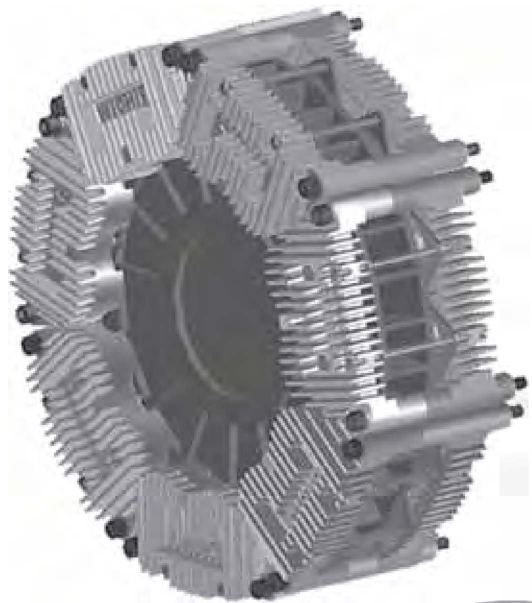


Parts List

Item Description			10" Rotor	13" Rotor	16" Rotor
Basic Brake	1.	Friction Plate	4-610-001-001-1	4-613-001-001-1	4-616-001-001-1
	2.	Hub	4-610-001-002-3	4-613-001-000-3	4-616-001-000-3
	3.	HHCS 3/8 x 5"	2-173-037-050-0	2-173-037-050-0	2-173-037-050-0
	4.	Nut 3/8	2-112-037-012-0	2-112-037-012-0	2-112-037-012-0
	5.	Bolt/Spacer Kit	8-610-010-001-0	8-610-010-001-0	8-610-010-001-0
	5.a	Short Spacer	4-616-015-000-3	4-616-015-000-3	4-616-015-000-3
	5.b	Spacer	4-613-015-002-3	4-613-015-002-3	4-613-015-002-3
	5.c	HHCS 5/8 x 7"	2-173-062-070-0	2-173-062-070-0	2-173-062-070-0
	6.	Airtube Carrier Assembly	8-610-002-001-5	8-613-002-003-5	8-616-002-001-5
	6.a	Airtube Carrier	4-610-002-001-5	4-613-002-003-5	4-616-002-001-5
	6.b	Airtube Carrier Cap	4-613-002-004-5	4-613-002-004-5	4-613-002-004-5
	6.c	Spring	4-613-033-000-4	4-613-033-000-4	4-613-033-000-4
	6.d	Airtube Assembly	8-613-020-008-0	8-613-020-008-0	8-613-020-008-0
	6.e	SHCS 1/4 x 3/4"	2-177-025-006-0	2-177-025-006-0	2-177-025-006-0
	6.f	Friction Puck Assembly, STD	8-613-007-000-0	8-613-007-000-0	8-613-007-000-0
		Friction Pad Assembly, HICO	8-613-507-000-0	—	—
	6.g	Spring Pin	4-613-033-001-4	4-613-033-001-4	4-613-033-001-4
Guard Kit	7.	Guard	4-610-021-009-3	4-613-021-010-3	4-616-021-007-3
	8.	Guard Bolt/Spacer Kit	8-610-010-002-0	8-610-010-002-0	8-610-010-002-0
	8.a	HHCS 5/8 x 2 1/4	2-173-062-022-0	2-173-062-022-0	2-173-062-022-0
	8.b	Short Spacer	4-616-015-000-3	4-616-015-000-3	4-616-015-000-3
Hose Kit	9.	Coupling 1/8 x 1/8	4-613-072-006-0	4-613-072-006-0	4-613-072-006-0
	10.	Elbow 1/8 x 10-32	4-613-072-007-0	4-613-072-007-0	4-613-072-007-0
	11.	Tee 10-32 x 10-32 x 1/8	4-613-072-008-0	4-613-072-008-0	4-613-072-008-0
	12.	Teflon Tubing	4-610-074-001-0	4-610-074-001-0	4-610-074-001-0
	13.	10-32 Hex Plug	4-613-072-004-0	4-613-072-004-0	4-613-072-004-0
	14.	3-Way Switch	4-613-071-002-0	4-613-071-002-0	4-613-071-002-0
	15.	10-32 Straight Fitting	4-613-072-002-0	4-613-072-002-0	4-613-072-002-0
	16.	Washer	4-137-050-111-0	4-137-050-111-0	4-137-050-111-0
	17.	Extension 1/8	2-308-001-001-0	2-308-001-001-0	2-308-001-001-0

ModEvo Tension Brakes





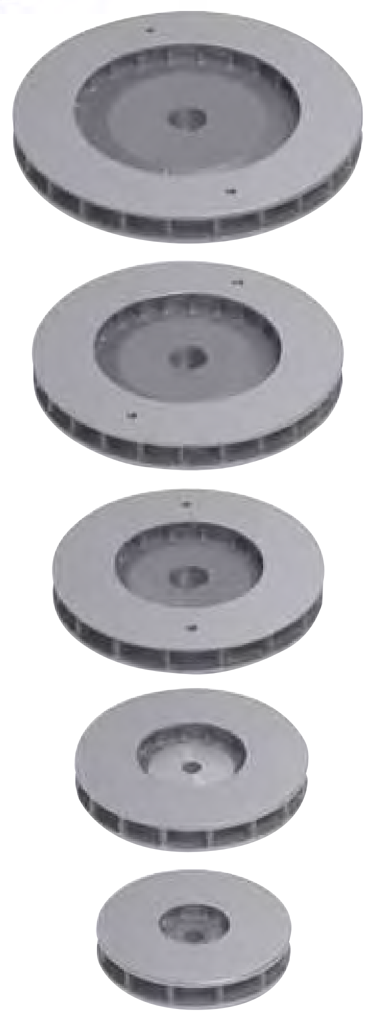
Brake Discs and Cooling

The ModEvo brake disc was developed at the Bedford, UK factory using Finite Element Analysis techniques to ensure maximum strength with minimum weight. The design is optimized to make best use of the cooling air available at slow speeds, and being bidirectional, it achieves high heat dissipation capacity in either rotational direction, unlike some other brakes. An optional electric cooling fan is available where space is limited or more extreme heat handling is required.

Available in five sizes: 250 mm, 300 mm, 350 mm, 400 mm and 450 mm diameters, all discs are the same thickness and use the same brake modules and actuators. Each disc can be specified with a minimum of a single module, up to the maximum number of modules that can be fitted around the disc. This allows torque-handling capabilities ranging from a maximum of 659 lb.ft. for the 250 mm disc, up to 3181 lb.ft. for the 450 mm disc.

NOTE: If using a high speed ductile iron disc the catalog heat rating should be reduced by 10% as the thermal conductivity of the ductile iron is less than grey cast iron.

Maximum Rotational Speed		
Disc Diameter mm	Standard Speed rev./min.	High Speed rev./min.
250	2,250	3,375
300	1,900	2,850
350	1,650	2,475
400	1,450	2,175
450	1,250	1,875



Actuator Options

Newly developed rolling diaphragm actuators are used in ModEvo, producing more force than previous designs to allow higher torque ratings. However, the sensitivity for which rolling diaphragms are favored is not compromised. Three actuator options are available, offering clamping forces of 100%, 60% or 25%.

The finned, die cast aluminum brake module is common to all brake disc diameters. Each module houses two pairs of actuators, and allows friction pads to be changed quickly without dismantling the module.

100%

60%

25%

Friction Pad Options

To provide maximum flexibility when selecting the required torque/tension range for an application, two pad options are available, with different coefficients of frictions: Low (μ=0.20), color-coded yellow; Standard (μ=0.35), color-coded red. Pad types may be mixed within a single brake assembly to provide an exact match to the machine requirements.

Optional Guard

The optional guard has a plastic front with 'ModEvo' molded in and a metal ventilated perimeter.

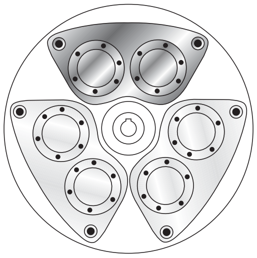
Mounting is by four brackets on customer's machine frame.

The center of the guard is designed such that it may be cut-out by customer to suit the diameter of the shaft in through-shaft installations.

ModEvo 300/8 with Fan

Brake Size (fan Diameter)	24v DC	115v AC	230v AC
250 (150 mm)	Yes	Yes	Yes
300 (150 mm)	Yes	Yes	Yes
350 (150 mm)	Yes	Yes	Yes
400 (150 mm)	Yes	Yes	Yes
(200 mm)	not available	Yes	Yes
450 (150 mm)	Yes	Yes	Yes
(200 mm)	not available	Yes	Yes
(250 mm)	not available	Yes	Yes

ModEvo Model 250



<table>
<tr><th rowspan="3">Model</th><th colspan="6">Minimum Torques
Minimum (3 PSI) (0.2 Bars)[1]
lb.ft.(Nm)</th></tr>
<tr><th>LC[2]</th><th>Std[3]</th><th>LC[2]</th><th>Std[3]</th><th>LC[2]</th><th>Std[3]</th></tr>
<tr><th colspan="2">25% Actuators</th><th colspan="2">60% Actuators</th><th colspan="2">100 % Actuators</th></tr>
<tr><td>250/1</td><td>0.6
(0.8)</td><td>0.93
(1.3)</td><td>1.3
(1.8)</td><td>2.2
(3)</td><td>2.2
(3)</td><td>3.7
(5)</td></tr>
<tr><td>250/2*</td><td>1.1
(1.5)</td><td>1.9
(2.5)</td><td>2.6
(3.6)</td><td>4.4
(6)</td><td>4.4
(6)</td><td>7.4
(10)</td></tr>
<tr><td>250/4*</td><td>2.2
(3)</td><td>3.7
(5)</td><td>5.3
(7.2)</td><td>8.8
(12)</td><td>8.8
(12)</td><td>14.7
(20)</td></tr>
<tr><td>250/6*</td><td>3.3
(4.5)</td><td>5.5
(7.5)</td><td>7.9
(10.8)</td><td>13.2
(18)</td><td>13.2
(18)</td><td>22
(30)</td></tr>
<tr><th colspan="7">Maximum Torques
Maximum (87 PSI) (6 Bars)
lb.ft.(Nm)</th></tr>
<tr><td>250/1</td><td>15.8
(21.3)</td><td>27.5
(37.3)</td><td>37.8
(51)</td><td>66
(89.4)</td><td>63
(85)</td><td>110
(149)</td></tr>
<tr><td>250/2*</td><td>31.3
(42.5)</td><td>53.25
(72.3)</td><td>75
(102)</td><td>127.8
(173.4)</td><td>125
(170)</td><td>213
(289)</td></tr>
<tr><td>250/4*</td><td>62.8
(85)</td><td>110
(149)</td><td>150.6
(204)</td><td>264
(357.6)</td><td>251
(340)</td><td>440
(596)</td></tr>
<tr><td>250/6*</td><td>94
(127.5)</td><td>164.8
(223.5)</td><td>225.6
(306)</td><td>395.4
(536.4)</td><td>376
(510)</td><td>659
(894)</td></tr>
</table>

* For single actuator operation torques for 250/1 are applicable.

<table>
<tr><th>Model[6]</th><th>Speed[4]
Max.</th><th colspan="7">Heat Capacity for Effective
Cooling Speeds</th><th>Inertia
Rotating
Parts</th><th colspan="2">Weight</th></tr>
<tr><th></th><th></th><th colspan="7">HP(kW)[5]</th><th>lb.ft.^{2}
(kbm^2)</th><th colspan="2">lbs.(kg)</th></tr>
<tr><th></th><th>RPM</th><th>50
RPM</th><th>100
RPM</th><th>200
RPM</th><th>300
RPM</th><th>400
RPM</th><th>500
RPM</th><th>600
RPM</th><th></th><th>Total</th><th>Rotating</th></tr>
<tr><td>250/1</td><td>2250</td><td colspan="7">Without Fan</td><td rowspan="5">1.424
(0.060)</td><td>27.337
(12.4)</td><td rowspan="5">19.180
(8.7)</td></tr>
<tr><td>250/2</td><td>2250</td><td>1.61
(1.2)</td><td>1.88
(1.4)</td><td>2.55
(1.9)</td><td>3.22
(2.4)</td><td>3.62
(2.7)</td><td>4.02
(3.0)</td><td>4.29
(3.2)</td><td>29.101
(13.2)</td></tr>
<tr><td>250/4</td><td>2250</td><td colspan="7">With Electric Cooling Fan</td><td>38.801
(17.6)</td></tr>
<tr><td>250/6</td><td>2250</td><td>4.56
(3.4)</td><td>4.69
(3.5)</td><td>5.10
(3.8)</td><td>5.36
(4.0)</td><td>5.36
(4.0)</td><td>5.36
(4.0)</td><td>5.36
(4.0)</td><td>48.772
(22.1)</td></tr>
</table>

[1] Minimum torques were calculated using a multiplier of 0.6 for LC times Standard.

[2] LC - Low Coefficient based on 0.2 Coefficient of friction.

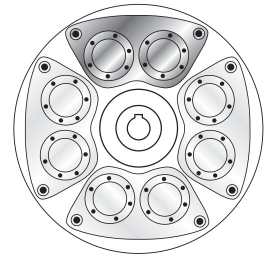
[3] Standard based on 0.35 Coefficient of friction.

[4] Max. speed is with standard brake disc. A high speed brake disc capable of 50% higher speed is also available. Heat Capacity reduced by 10% when high speed disc is used.

[5] Limit LC to 70% of heat capacity.

[6] When selecting number of actuators, use a limit of 3.35 HP per actuator pair (2.5 kW per Actuator pair) for duty w/o fan and 3.75 HP per Actuator pair (2.8 kW per Actuator pair) when fan cooled.

ModEvo Model 300



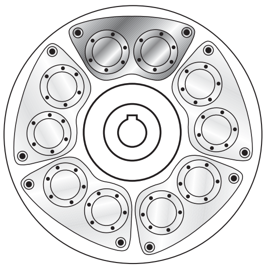
Model	Minimum Torques					
	Minimum (3 PSI) (0.2 Bars)[1] lb.ft.(Nm)					
	LC[2]	Std[3]	LC[2]	Std[3]	LC[2]	Std[3]
	25% Actuators		60% Actuators		100 % Actuators	
300/1	0.7 (0.9)	1.1 (1.5)	1.6 (2.2)	2.6 (3.6)	2.6 (3.6)	5.2 (7)
300/2*	1.6 (2.1)	2.6 (3.5)	3.7 (5)	6.2 (8.4)	6.2 (8.4)	10.3 (14)
300/4*	3.1 (4.2)	5.2 (7)	7.4 (10.1)	12.4 (16.8)	12.4 (16.8)	20.6 (28)
300/6*	4.5 (6.3)	7.7 (10.5)	11.1 (15.1)	18.5 (25.2)	18.5 (25.2)	30.9 (42)
300/8*	6.2 (8.4)	10.3 (14)	14.9 (20.2)	24.8 (33.6)	24.8 (33.6)	41.3 (56)
	Maximum Torques Maximum (87 PSI) (6 Bars) lb.ft.(Nm)					
300/1	19.8 (27)	34.9 (47.3)	47.4 (64.8)	83.6 (113.4)	79 (108)	139.4 (189)
300/2*	39.8 (54)	69.7 (94.5)	95.4 (129.6)	167.3 (226.8)	159 (216)	278.8 (378)
300/4*	79.5 (108)	139.4 (189)	190.8 (259.2)	334.6 (453.6)	318 (432)	557.6 (756)
300/6*	119.3 (162)	209.1 (283.5)	286.2 (388.8)	501.8 (680.4)	477 (648)	836.4 (1,134)
300/8*	159.3 (216)	278.8 (378)	382.2 (518.4)	669 (907.2)	637 (864)	1,115 (1,512)

* For single actuator operation torques for 300/1 are applicable.

Model[6]	Speed[4] Max.	Heat Capacity for Effective Cooling Speeds							Inertia Rotating Parts	Weight	
		HP(kW)[5]							lb.ft.^{2} (kbm^2)	lbs.(kg)	
	RPM	50 RPM	100 RPM	200 RPM	300 RPM	400 RPM	500 RPM	600 RPM		Total	Rotating
300/1	1900				**Without Fan**					38.140 (17.3)	
300/2	1900	2.82 (2.1)	3.22 (2.4)	4.02 (3.0)	4.69 (3.5)	5.36 (4.0)	6.04 (4.5)	6.71 (5.0)		39.904 (18.1)	
300/4	1900				**With Electric Cooling Fan**				2.966 (0.125)	49.604 (22.5)	29.883 (13.6)
300/6	1900	6.71 (5.0)	6.71 (5.0)	6.71 (5.0)	6.71 (5.0)	7.38 (5.5)	8.05 (6.0)	8.05 (6.0)		59.525 (27.0)	
300/8	1900									69.446 (31.5)	

1 Minimum torques were calculated using a multiplier of 0.6 for LC times Standard.
2 LC - Low Coefficient based on 0.2 Coefficient of friction.
3 Standard based on 0.35 Coefficient of friction.
4 Max. speed is with standard brake disc. A high speed brake disc capable of 50% higher speed is also available. Heat Capacity reduced by 10% when high speed disc is used.
5 Limit LC to 70% of heat capacity.
6 When selecting number of actuators, use a limit of 3.35 HP per actuator pair (2.5 kW per Actuator pair) for duty w/o fan and 3.75 HP per Actuator pair (2.8 kW per Actuator pair) when fan cooled.

ModEvo Model 350



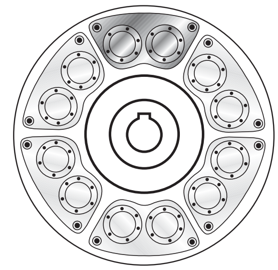
Model	Minimum Torques Minimum (3 PSI) (0.2 Bars)[1] lb.ft.(Nm)					
	LC[2]	Std[3]	LC[2]	Std[3]	LC[2]	Std[3]
	25% Actuators		60% Actuators		100 % Actuators	
350/1	0.9 (1.2)	1.5 (2)	2.1 (2.9)	3.5 (4.8)	3.5 (4.8)	5.9 (8)
350/2*	1.8 (2.4)	3.0 (4)	4.3 (5.8)	7.1 (9.6)	7.1 (9.6)	11.8 (16)
350/4*	3.6 (4.8)	5.9 (8)	8.5 (11.5)	14.2 (19.2)	14.2 (19.2)	23.6 (32)
350/6*	5.3 (7.2)	8.9 (12)	12.7 (17.3)	21.2 (28.8)	21.2 (28.8)	35.4 (48)
350/8*	7.1 (9.6)	11.8 (16)	17 (9.6)	28.3 (38.4)	28.3 (38.4)	47.2 (64)
350/10*	8.9 (12)	14.8 (20)	21.2 (28.8)	35.4 (48)	35.4 (48)	59.0 (80)
	Maximum Torques Maximum (87 PSI) (6 Bars) lb.ft.(Nm)					
350/1	24 (32.5)	42 (57)	57.55 (78)	101 (137)	95.9 (130)	168 (228)
350/2*	48 (65)	84.1 (114)	115.1 (156)	201.8 (273.6)	191.8 (260)	336.4 (456)
350/4*	95.9 (130)	168.2 (228)	230.2 (312)	403.6 (547.2)	383.6 (520)	672.7 (912)
350/6*	143.8 (195)	252.3 (342)	345.2 (468)	605.4 (820.8)	575.3 (780)	1009 (1,368)
350/8*	190.5 (260)	336.4 (456)	457.3 (624)	807.2 (1,094.4)	762.1 (1,040)	1,345.4 (1,824)
350/10*	239.7 (325)	420.4 (570)	575.3 (780)	1,009 (1,368)	9,58.9 (1,300)	1,681.7 (2,280)

* For single actuator operation torques for 350/1 are applicable.

Model[6]	Speed[4] Max.	Heat Capacity for Effective Cooling Speeds HP(kW)[5]							Inertia Rotating Parts $lb.ft.^2$ (kbm^2)	Weight lbs.(kg)	
	RPM	50 RPM	100 RPM	200 RPM	300 RPM	400 RPM	500 RPM	600 RPM		Total	Rotating
350/2	1650	**Without Fan**							5.458 (0.230)	57.982 (24.8)	46.958 (20.3)
350/4	1650	3.75 (2.8)	4.16 (3.1)	5.63 (4.2)	6.44 (4.8)	7.38 (5.5)	8.85 (6.6)	9.66 (7.2)		69.005 (29.2)	
350/6	1650	**With Electric Cooling Fan**								80.248 (33.7)	
350/8	1650	7.8 (5.8)	8.45 (6.3)	8.72 (6.5)	8.72 (6.5)	8.72 (6.5)	8.72 (6.5)	8.72 (6.5)		91.271 (38.2)	
350/10	1650									102.294 (42.7)	

1 Minimum torques were calculated using a multiplier of 0.6 for LC times Standard.
2 LC - Low Coefficient based on 0.2 Coefficient of friction.
3 Standard based on 0.35 Coefficient of friction.
4 Max. speed is with standard brake disc. A high speed brake disc capable of 50% higher speed is also available. Heat Capacity reduced by 10% when high speed disc is used.
5 Limit LC to 70% of heat capacity.
6 When selecting number of actuators, use a limit of 3.35 HP per actuator pair (2.5 kW per Actuator pair) for duty w/o fan and 3.75 HP per Actuator pair (2.8 kW per Actuator pair) when fan cooled.

ModEvo Model 400



Model	Minimum Torques					
	Minimum (3 PSI) (0.2 Bars)[1] lb.ft.(Nm)					
	LC[2]	Std[3]	LC[2]	Std[3]	LC[2]	Std[3]
	25% Actuators		60% Actuators		100 % Actuators	
400/1	1.1 (1.5)	1.9 (2.5)	2.6 (3.6)	4.4 (6)	4.4 (6)	7.4 (10)
400/2*	2.2 (3)	3.7 (5)	5.3 (7.2)	8.9 (12)	8.9 (12)	14.8 (20)
400/4*	4.4 (6)	7.4 (10)	10.6 (14.4)	17.7 (24)	17.7 (24)	29.5 (40)
400/6*	6.7 (9)	11.1 (15)	16 (21.6)	26.6 (36)	26.6 (36)	44.3 (60)
400/8*	8.9 (12)	14.8 (20)	21.2 (28.8)	35.4 (48)	35.4 (48)	59.0 (80)
400/10*	11.1 (15)	18.5 (25)	26.6 (36)	44.3 (60)	44.3 (60)	73.8 (100)
400/12*	13.3 (18)	22.1 (30)	31.9 (43.2)	53.1 (72)	53.1 (72)	88.5 (120)
	Maximum Torques Maximum (87 PSI) (6 Bars) lb.ft.(Nm)					
400/1	28.15 (38.15)	49.2 (66.7)	67.5 (91.5)	118 (160)	112.5 (152.5)	196.9 (267)
400/2*	56.3 (76.3)	98.3 (133.5)	135 (183)	236 (320.4)	225 (305)	393.9 (534)
400/4*	112.5 (152.5)	197 (267)	270 (366)	472.7 (640.8)	450 (610)	787.8 (1,068)
400/6*	168.7 (228.8)	295.4 (400.5)	404.9 (549)	708.9 (961.2)	674.9 (915)	1,181.9 (1,602)
400/8*	225 (305)	393.9 (534)	539.9 (732)	945.3 (1,281.6)	899.9 (1,220)	1,575.5 (2,136)
400/10*	281.2 (381.3)	492.4 (667.5)	674.9 (915)	1,181.6 (1,602)	1,124.8 (1,525)	1,969.4 (2,670)
400/12*	337.5 (457.5)	590.8 (801)	809.9 (1,098)	1,417.9 (1,922.4)	1,349.8 (1,830)	2,363.3 (3,204)

* For single actuator operation torques for 400/1 are applicable.

<table>
<tr><th>Model[6]</th><th>Speed[4] Max.</th><th colspan="7">Heat Capacity for Effective Cooling Speeds</th><th>Inertia Rotating Parts</th><th colspan="2">Weight</th></tr>
<tr><td></td><td></td><td colspan="7">HP(kW)[5]</td><td>lb.ft.^{2} (kbm^2)</td><td colspan="2">lbs.(kg)</td></tr>
<tr><td></td><td>RPM</td><td>50 RPM</td><td>100 RPM</td><td>200 RPM</td><td>300 RPM</td><td>400 RPM</td><td>500 RPM</td><td>600 RPM</td><td></td><td>Total</td><td>Rotating</td></tr>
<tr><td>400/2</td><td>1450</td><td colspan="7">Without Fan</td><td rowspan="6">9.492
(0.400)</td><td>69.005
(31.3)</td><td rowspan="6">61.509
(26.8)</td></tr>
<tr><td>400/4</td><td>1450</td><td rowspan="2">4.29
(3.2)</td><td rowspan="2">5.10
(3.8)</td><td rowspan="2">7.24
(5.4)</td><td rowspan="2">8.05
(6.0)</td><td rowspan="2">9.12
(6.8)</td><td rowspan="2">10.46
(7.8)</td><td rowspan="2">11.31
(8.4)</td><td>78.705
(35.7)</td></tr>
<tr><td>400/6</td><td>1450</td><td>88.626
(40.2)</td></tr>
<tr><td>400/8</td><td>1450</td><td colspan="7">With Electric Cooling Fan</td><td>98.547
(44.7)</td></tr>
<tr><td>400/10</td><td>1450</td><td rowspan="2">10.06
(7.5)</td><td rowspan="2">11.13
(8.3)</td><td rowspan="2">11.67
(8.7)</td><td rowspan="2">12.47
(9.3)</td><td rowspan="2">13.41
(10.0)</td><td rowspan="2">13.41
(10.0)</td><td rowspan="2">13.41
(10.0)</td><td>108.467
(49.2)</td></tr>
<tr><td>400/12</td><td>1450</td><td>118.168
(53.6)</td></tr>
</table>

[1] Minimum torques were calculated using a multiplier of 0.6 for LC times Standard.

[2] LC - Low Coefficient based on 0.2 Coefficient of friction.

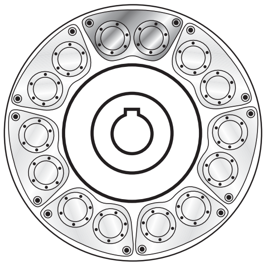
[3] Standard based on 0.35 Coefficient of friction.

[4] Max. speed is with standard brake disc. A high speed brake disc capable of 50% higher speed is also available. Heat Capacity reduced by 10% when high speed disc is used.

[5] Limit LC to 70% of heat capacity.

[6] When selecting number of actuators, use a limit of 3.35 HP per actuator pair (2.5 kW per Actuator pair) for duty w/o fan and 3.75 HP per Actuator pair (2.8 kW per Actuator pair) when fan cooled.

ModEvo Model 450



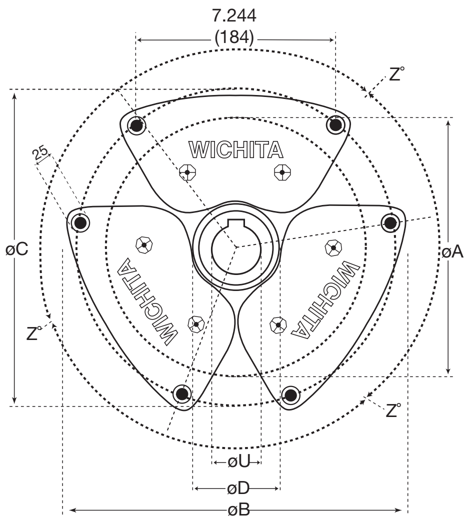
Model	Minimum Torques Minimum (3 PSI) (0.2 Bars)[1] lb.ft.(Nm)					
	LC[2]	Std[3]	LC[2]	Std[3]	LC[2]	Std[3]
	25% Actuators		60% Actuators		100 % Actuators	
450/1	1.2 (1.7)	2.0 (2.8)	2.9 (4.0)	4.9 (6.6)	4.9 (6.6)	8.1 (11)
450/2*	2.3 (3.2)	3.9 (5.3)	5.6 (7.6)	9.3 (12.6)	9.3 (12.6)	15.5 (21)
450/4*	4.7 (6.3)	7.8 (10.5)	11.2 (15.1)	18.6 (25.2)	18.6 (25.2)	31.0 (42)
450/6*	7 (9.5)	11.6 (37.8)	16.7 (22.7)	27.9 (37.8)	27.9 (37.8)	46.5 (63)
450/8*	9.3 (12.6)	15.7 (15.5)	22.3 (30.2)	37.7 (50.4)	37.2 (50.4)	62.0 (84)
450/10*	11.6 (15.8)	19.4 (26.3)	27.9 (37.8)	46.5 (63)	46.5 (63)	77.5 (105)
450/12*	13.9 (18.9)	23.2 (31.5)	33.4 (45.4)	55.7 (75.6)	55.7 (75.6)	92.9 (126)
450/14*	13.6 (22.1)	27.1 (27.1)	39 (52.9)	65 (88.2)	65 (88.2)	108.4 (147)
	Maximum Torques Maximum (87 PSI) (6 Bars) lb.ft.(Nm)					
450/1	32.45 (44)	56.7 (77)	77.9 (105.6)	136.3 (189.8)	129.8 (176)	227.2 (308)
450/2*	64.9 (88)	113.6 (154)	155.8 (211.2)	272.6 (369.6)	259.6 (352)	454.4 (616)
450/4*	129.8 (176)	227.2 (308)	311.6 (422.4)	545.2 (739.2)	519.3 (704)	908.7 (1,232)
450/6*	194.7 (264)	340.8 (462)	467.3 (633.6)	817.9 (1,108.8)	778.9 (1,056)	1,363.1 (1,848)
450/8*	259.6 (352)	454.4 (616)	623.1 (844.8)	1,090.4 (1,478.4)	1,038.5 (1,408)	1,817.4 (2,464)
450/10*	324.6 (440)	568 (770)	778.9 (1,056)	1,363.1 (1,848)	1,298.2 (1,760)	2,271.8 (3,080)
450/12*	389.5 (528)	681.6 (924)	934.7 (1,267.2)	1,635.7 (2,217.6)	1,557.8 (2,112)	2,726.2 (3,696)
450/14*	454.4 (616)	795.1 (1,078)	1,090.4 (1,478.4)	1,908.3 (2,587.2)	1,817.4 (2,464)	3,180.5 (4,312)

* For single actuator operation torques for 450/1 are applicable.

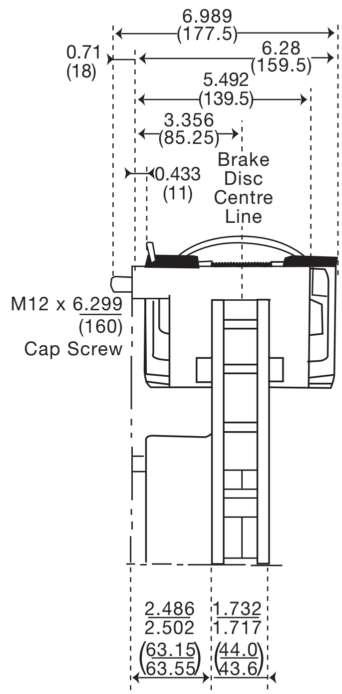
<table>
<tr><th>Model[6]</th><th>Speed[4] Max.</th><th colspan="7">Heat Capacity for Effective Cooling Speeds</th><th>Inertia Rotating Parts</th><th colspan="2">Weight</th></tr>
<tr><td></td><td></td><td colspan="7">HP(kW)[5]</td><td>lb.ft.² (kbm²)</td><td colspan="2">lbs.(kg)</td></tr>
<tr><td></td><td>RPM</td><td>50 RPM</td><td>100 RPM</td><td>200 RPM</td><td>300 RPM</td><td>400 RPM</td><td>500 RPM</td><td>600 RPM</td><td></td><td>Total</td><td>Rotating</td></tr>
<tr><td>450/2</td><td>1250</td><td colspan="7" rowspan="7">Without Fan
4.56 (3.4) | 5.77 (4.3) | 8.18 (6.1) | 9.39 (7.0) | 10.46 (7.8) | 12.34 (9.2) | 13.41 (10.0)
With Electric Cooling Fan
11.40 (8.5) | 12.74 (9.5) | 13.41 (10.0) | 14.48 (10.8) | 15.56 (11.6) | 16.76 (12.5) | 17.84 (13.3)</td><td rowspan="7">14.475 (0.610)</td><td>82.673 (37.5)</td><td rowspan="7">72.752 (33.0)</td></tr>
<tr><td>450/4</td><td>1250</td><td>92.374 (41.9)</td></tr>
<tr><td>450/6</td><td>1250</td><td>102.294 (46.4)</td></tr>
<tr><td>450/8</td><td>1250</td><td>112.215 (50.9)</td></tr>
<tr><td>450/10</td><td>1250</td><td>122.136 (55.4)</td></tr>
<tr><td>450/12</td><td>1250</td><td>131.836 (59.8)</td></tr>
<tr><td>450/14</td><td>1250</td><td>141.757 (64.3)</td></tr>
</table>

[1] Minimum torques were calculated using a multiplier of 0.6 for LC times Standard.
[2] LC - Low Coefficient based on 0.2 Coefficient of friction.
[3] Standard based on 0.35 Coefficient of friction.
[4] Max. speed is with standard brake disc. A high speed brake disc capable of 50% higher speed is also available. Heat Capacity reduced by 10% when high speed disc is used.
[5] Limit LC to 70% of heat capacity.
[6] When selecting number of actuators, use a limit of 3.35 HP per actuator pair (2.5 kW per Actuator pair) for duty w/o fan and 3.75 HP per Actuator pair (2.8 kW per Actuator pair) when fan cooled.

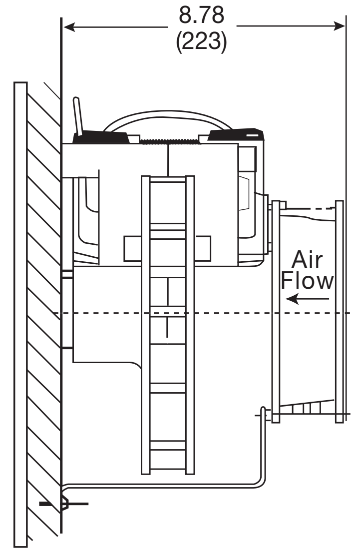
ModEvo Dimensions



Front View



Side View



Side View With Fan

Dimensions: inches (mm)

Size	250	300	350	400	450
ØA - Disc Size	9.843 (250)	11.811 (300)	13.78 (350)	15.748 (400)	17.717 (450)
ØB - Overall	12.756 (324)	14.528 (369)	16.339 (415)	18.149 (461)	20.000 (508)
ØC - Bolt P.C.D	11.752 (298.5)	13.524 (343.5)	15.315 (389)	17.146 (435.5)	18.996 (482.5)
ØD - Clearance Diameter	3.543 (90)	5.512 (140)	7.480 (190)	9.449 (240)	11.417 (290)
U - As Cast Bore	0.984 (25)	0.984 (25)	0.984 (25)	0.984 (25)	0.984 (25)
Maximum Bore	2.165 (55)	3.110 (79)	4.606 (117)	5.354 (136)	6.063 (154)
Z" - Angular Position	120°	90°	72°	60°	51.4°
Maximum Number of Brake Modules	3	4	5	6	7
Wichita Generic Drawing Number	73125-000	73130-000	73141-000	73141-000	73145-000
Hose Length/Module 15667-020 W4 6977	39.37 (1,000)	47.25 (1,200)	55.12 (1,400)	63.00 (1,600)	70.87 (1,800)

Sensors

Ultrasonic Sensors

Introduction

Ultrasonic signals are like audible sound waves, except the frequencies are much higher.

Ultrasonic transducers have piezoelectric crystals which resonate to a desired frequency and convert electric energy into acoustic energy and vice versa.

Diagram A shows how sound waves transmitted in the shape of a cone are reflected back to the transducer. At this stage, an output signal is produced to perform some kind of indicating or control function.

A minimum distance from the sensor is required to provide a time delay so that the “echoes” can be interpreted. Variables which can affect the operation of an ultrasonic sensor include: target surface angle, reflective surface roughness, change in temperature or humidity. The targets can have any kind of reflective form and even round objects are an acceptable target.

Advantages of Ultrasonic Sensors

- Discrete distances to moving objects can be detected and measured
- Less affected by target materials and surfaces
- Not affected by color
- Solid state – virtually unlimited maintenance-free life
- Small objects can be detected over longer distances
- Resistance to external disturbances such as vibration, infrared radiation, ambient noise, and EMI radiation

Applications for Ultrasonic Sensors

- Loop control
- Roll diameter, tension control, winding and unwind
- Web break detection
- Level detection/control
- Presence detection

UT30 Series

The Warner Electric UT30 Series Ultrasonic Sensors feature three types of sensors:

- Range measurement with analog output
- Proximity detection with range and hysteresis control
- Long range measurement with analog output
- CE Approved

Range Measurement with Analog Output

This type of sensor is capable of both 4–20mA and/or 0–10V output signals, with an added feature of inverting these signals to 20–4mA and for 10–0V by means of simply wiring the units in the instructed way. Long range sensors come with current (mA) output signals only.

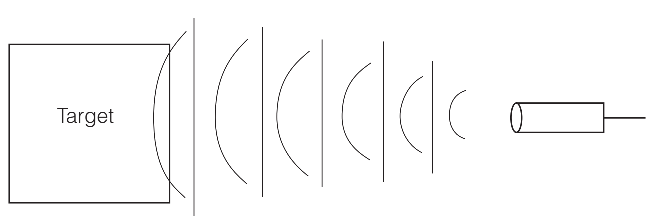


Diagram A

A range measurement sensor works in a very precise, easily controllable way. Precise distance of an object moving to and from the transducer is measured via time intervals between transmitted and reflected bursts of ultrasonic sound. The internal circuit reads this time and then proportionately provides an output in either MAs or volts to that distance.

General Installation Information

Target Angle

This term refers to the “tilt response” limitations of a given sensor. Since ultrasonic sound waves reflect off the target/object, target angles indicate acceptable amounts of tilt for a given sensor. If an application requires a target angle beyond the capabilities of a single sensor, two sensors can be teamed to provide even a broader angle of tilt.

Beam Spread

This term is defined as the area in which a round wand will be sensed if passed through the target area. This is the maximum spreading of the ultrasonic sound as it leaves the transducer.

Analog Output

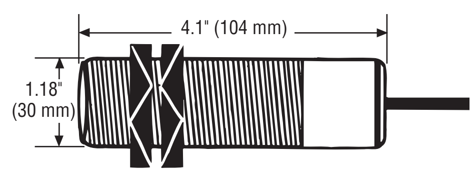
- 4–20mA and 0–10V
- Wire selectable inverted or non-inverted outputs

Threaded plastic barrel
M 30 x 1.5

Specifications

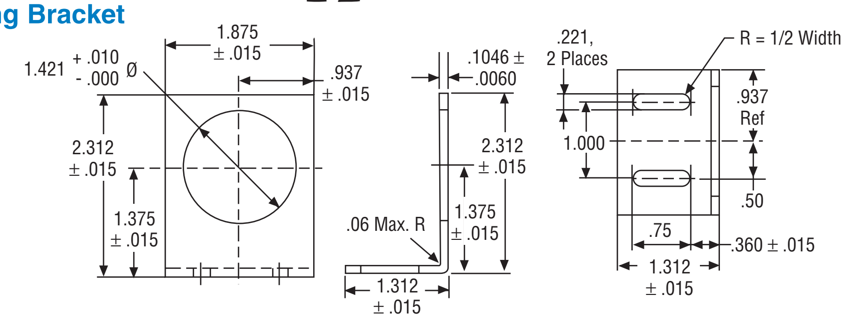
Sensing Range	4–40" (101..1016mm)	8–80" (203..2032mm)
Ordering Information		
Model Description	UT30UP-DCA4-1016-CSI	UT30UP-DCA4-2032-CSI
Part Number	7600-448-001	7600-448-002
Electrical Data		
Voltage Range (min./max.)	20–30 VDC reverse polarity protected	20–30 VDC reverse polarity protected
Input Current	50mA	50mA
Transducer Frequency	212 KHz	150 KHz
Short Circuit Protected	Yes	Yes
LED – (strength indicator)	Yes – green to red; Page 152	Yes – green to red; Page 152
Response Time	30 mSec	50 mSec
Range Control	Zero and span (2 potentiometers)	Zero and span (2 potentiometers)
Mechanical Data		
Temperature Range (min./max.)	–25°F to +140°F (–31.7°C to +60°C)	–25°F to +140°F (–31.7°C to +60°C)
Degree of Protection	IP65/NEMA12	IP65/NEMA12
Body Material	Valox plastic	Valox plastic
Termination Cable 6 ft. (2m)	PVC 4 x 22 gauge	PVC 4 x 22 gauge
Plug/socket	Versions available to order	Versions available to order
Accessories	1) Brackets	1) Brackets
Humidity	0–95% non-condensing	0–95% non-condensing

Dimensions



Mounting Bracket

M 30 ST



Accessories

Brackets for M 30 x 1.5

Ordering Information

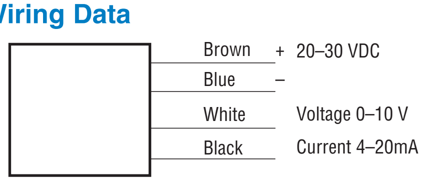
Plastic – BK5-D34PA
Part Number: 596-0223-041

Metal – M 30 ST
Part Number: 7430-448-003

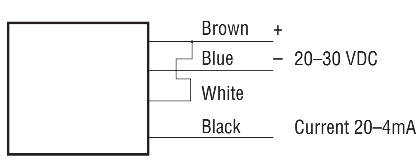
***Power Supply** - NG24 110/220 VAC Input
24 VDC @ 300mA Output
Part Number: 7500-448-020

Note: Provides output to appropriate analog input control. (Ex. TCS-200-1)

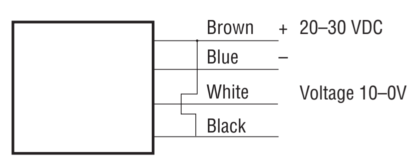
Wiring Data



Non-Inverted Output



Current Output Inverted



Voltage Output Inverted

***Note:** Some controls do not have 24 VDC outputs for the ultrasonic sensor power. These controls require the use of the NG 24 power supply

Operation and Setup

Minimum Analog Ranging

Minimum analog ranging is when you desire to have the full 4–20 mA or 0–10V output over the minimum 5-inch sensing span. Five inches of minimum sensing span can be adjusted anywhere in the sending range. For example 10”–15” or 25”–30”. To make this adjustment, place the target at the minimum sensing range and adjust P1 to 4mA. Then move the target to the maximum sensing range and adjust P2 to 20mA. Recheck the ratings and make appropriate adjustments, if necessary. See Diagram A.

Maximum Analog Ranging

Analog sensing in the maximum range means utilizing the entire 36” span (4”–40”) and 72” span (8”–80”). To adjust, set the target at the minimum range, either 4” or 8”, and adjust P1 to 4mA. Move the target to the maximum range and adjust P2 to 20mA. Recheck readings and make appropriate adjustments, if necessary. See Diagram B.

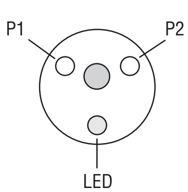
Inverted Analog Outputs

Inverted outputs means that the 4–20mA or 0–10V output signal will decrease proportionally with distance. To adjust, place the target at the minimum sensing distance and adjust P1 to 20mA. Place the target at the maximum sensing distance and adjust P2 to 4mA. Re-check readings and make appropriate adjustments, if necessary. See Diagram C.

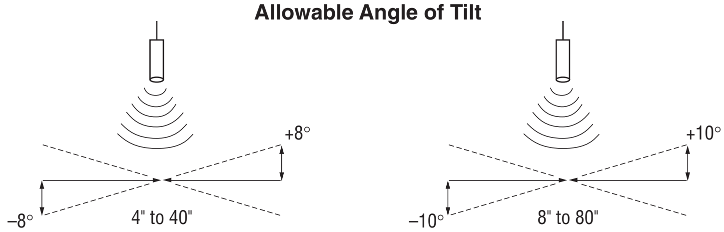
LED Operation (Note D)

The LED is green when the unit is powered. It will fade to red as a target is detected with increased intensity as more signal is being reflected from the target. **Note:** Any color other than green equals a workable signal level.

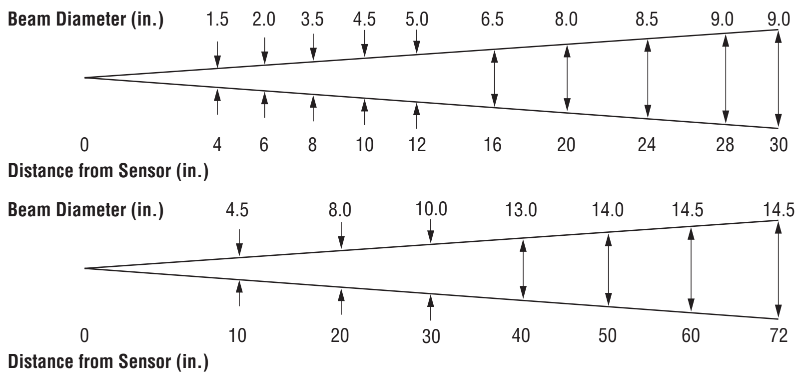
Adjustment Pots
Zero and Span Control



Allowable Angle of Tilt



Beam Spread vs. Target Distance



Minimum Analog Ranging

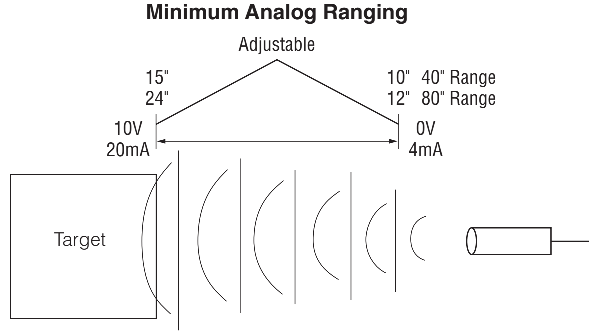


Diagram A

Maximum Analog Ranging

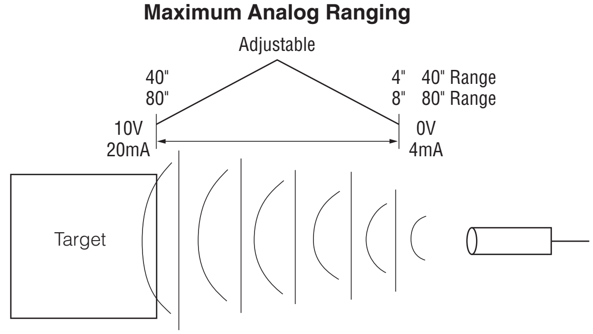


Diagram B

Inverted Analog Ranging

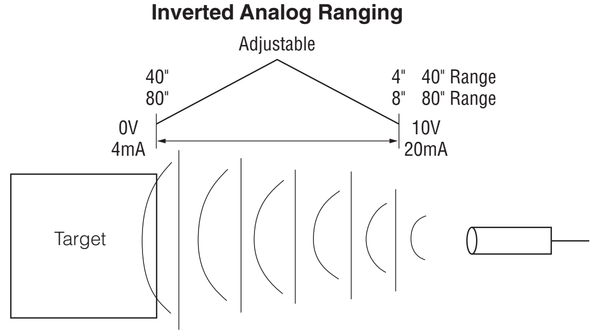


Diagram C

Shaft Size	Keyway Size	Bushing Number Warner Electric	Bushing Number Dodge
1/2	1/8 x 1/16	180-0116	
9/16	1/8 x 1/16	180-0117	
5/8	3/16 x 3/32	180-0118	
11/16	3/16 x 3/32	180-0119	
3/4	3/16 x 3/32	180-0120	
13/16	3/16 x 3/32	180-0121	1215
7/8	3/16 x 3/32	180-0122	
15/16	1/4 x 1/8	180-0123	
1	1/4 x 1/8	180-0124	
1-1/16	1/4 x 1/8	180-0125	
1-1/8	1/4 x 1/8	180-0126	
1-3/16	1/4 x 1/8	180-0127	
1-1/4	1/4 x 1/8	180-0128	
1/2	1/8 x 1/16	180-0131	
9/16	1/8 x 1/16	180-0132	
5/8	3/16 x 3/32	180-0133	
11/16	3/16 x 3/32	180-0134	
3/4	3/16 x 3/32	180-0135	
13/16	3/16 x 3/32	180-0136	
7/8	3/16 x 3/32	180-0137	
15/16	1/4 x 1/8	180-0138	
1	1/4 x 1/8	180-0139	
1-1/16	1/4 x 1/8	180-0140	1615
1-1/8	1/4 x 1/8	180-0141	
1-3/16	1/4 x 1/8	180-0142	
1-1/4	1/4 x 1/8	180-0143	
1-5/16	5/16 x 5/32	180-0144	
1-3/8	5/16 x 5/32	180-0145	
1-7/16	3/8 x 3/16	180-0146	
1-1/2	3/8 x 3/16	180-0147	
1-9/16	3/8 x 3/16	180-0148	
1-5/8	3/8 x 3/16	180-0149	
1/2	1/8 x 1/16	180-0185	
9/16	1/8 x 1/16	180-0186	
5/8	3/16 x 3/32	180-0187	
11/16	3/16 x 3/32	180-0188	
3/4	3/16 x 3/32	180-0189	
13/16	3/16 x 3/32	180-0190	
7/8	3/16 x 3/32	180-0191	
15/16	1/4 x 1/8	180-0192	
1	1/4 x 1/8	180-0193	
1-1/16	1/4 x 1/8	180-0194	2517
1-1/8	1/4 x 1/8	180-0195	
1-3/16	1/4 x 1/8	180-0196	
1-1/4	1/4 x 1/8	180-0197	
1-5/16	5/16 x 5/32	180-0198	
1-3/8	5/16 x 5/32	180-0199	
1-7/16	3/8 x 3/16	180-0200	
1-1/2	3/8 x 3/16	180-0201	
1-9/16	3/8 x 3/16	180-0202	

Shaft Size	Keyway Size	Bushing Number Warner Electric	Bushing Number Dodge
1-5/8	3/8 x 3/16	180-0203	
1-11/16	3/8 x 3/16	180-0204	
1-3/4	3/8 x 3/16	180-0205	
1-13/16	1/2 x 1/4	180-0206	
1-7/8	1/2 x 1/4	180-0207	
1-15/16	1/2 x 1/4	180-0208	
2	1/2 x 1/4	180-0209	
2-1/16	1/2 x 1/4	180-0210	2517
2-1/8	1/2 x 1/4	180-0211	
2-3/16	1/2 x 1/4	180-0212	
2-1/4	1/2 x 1/4	180-0213	
2-5/16	5/8 x 5/16	180-0214	
2-3/8	5/8 x 5/16	180-0215	
2-7/16	5/8 x 5/16	180-0216	
2-1/2	5/8 x 5/16	180-0217	
15/16	1/4 x 1/8	180-0262	
1	1/4 x 1/8	180-0263	
1-1/16	1/4 x 1/8	180-0264	
1-1/8	1/4 x 1/8	180-0265	
1-3/16	1/4 x 1/8	180-0266	
1-1/4	1/4 x 1/8	180-0267	
1-5/16	5/16 x 5/32	180-0268	
1-3/8	5/16 x 5/32	180-0269	
1-7/16	3/8 x 3/16	180-0270	
1-1/2	3/8 x 3/16	180-0271	
1-9/16	3/8 x 3/16	180-0272	
1-5/8	3/8 x 3/16	180-0273	
1-11/16	3/8 x 3/16	180-0274	
1-3/4	3/8 x 3/16	180-0275	
1-13/16	1/2 x 1/4	180-0276	
1-7/8	1/2 x 1/4	180-0277	
1-15/16	1/2 x 1/4	180-0278	3030
2	1/2 x 1/4	180-0279	
2-1/16	1/2 x 1/4	180-0280	
2-1/8	1/2 x 1/4	180-0281	
2-3/16	1/2 x 1/4	180-0282	
2-1/4	1/2 x 1/4	180-0283	
2-15/16	5/8 x 5/16	180-0284	
2-3/8	5/8 x 5/16	180-0285	
2-7/16	5/8 x 5/16	180-0286	
2-1/2	5/8 x 5/16	180-0287	
2-9/16	5/8 x 5/16	180-0288	
2-5/8	5/8 x 5/16	180-0289	
2-11/16	5/8 x 5/16	180-0290	
2-3/4	5/8 x 5/16	180-0291	
2-13/16	3/4 x 3/8	180-0292	
2-7/8	3/4 x 3/8	180-0293	
2-15/16	3/4 x 3/8	180-0294	
3	3/4 x 3/8	180-0295	

Dodge is a registered trademark of Reliance Electric Company

Glossary

Analog (as in analog signal)
A signal that varies in amplitude or voltage over a given range.

Analog Follower Control
A control that accepts a voltage or current of varying amplitude and produces an identical, but stronger, signal at the output, suitable for driving a brake.

Butt Splice
A splice in which two webs are placed end to end without overlapping, and adhered together by a piece of adhesive placed over both. Most common with paperboard.

Controlled Stop
Stopping of the roll and web while maintaining tension at the prescribed level.

Core
The hollow center (usually made of heavy paperboard) on which the roll of material is wound.

Core Diameter
The smallest diameter of an unwind roll.

Cutter/Creaser
A machine used in the production of folding cartons. It uses sharp knives to cut through the board and dull knives to crease the board along a fold line.

Dancer
A movable, often pivoted, roll placed in a loop of the web, which is weighted or loaded to add tautness or tension to the web. Often used as part of a feedback loop to control brake operation.

Die Cutter
A machine which cuts or stamps paper or board to a specified size or shape with a steel die. The die is part of an impression cylinder in a rotary die cutter.

Duplex
Paper or paperboard that has a different color, texture or finish on either side. Also sometimes applied to any multi-ply paperboard.

Electro-Pneumatic Modulator
A device that modulates, or controls, an air brake in response to a set of control parameters.

Emergency Stop (E-Stop)
General term to describe immediate stop of a converting or printing machine due to a malfunction or unsafe condition. Normally done in fastest time possible.

Equipment Sizing or Sized
A method of tensioning a web at the in-feed that is sometimes used in printing operations. An equipment sized in-feed roller is slightly smaller than the printing impression cylinder. This creates a back tension in the web since each rotation of the printing impression cylinder pulls more web than is being fed by each rotation of the in-feed roller. Not as common as a variable sized in-feed since it requires changing the in-feed roller along with the impression cylinder.

Festoon
A reserve area consisting of several loops of stored web. This reserve is drawn down to feed the converting process while roll feed is interrupted for splicing.

Force Transducer
A device that senses the magnitude of a load upon it (such as a tension load) and sends a corresponding signal out. Also called a load cell.

Grabbiness
"Stick-slip," or lack of smoothness during slip operation of a braking system.

Heat Dissipation (in a brake)
The ability of a brake to release heat generated by friction. Dissipation usually increases with RPM. Dissipation can also be increased by forced cooling, e.g., by a fan.

Inertia Stop
An emergency stop where the prime objective is to get the unwind roll and machine to a rapid stop, disregarding any control of the web condition. The inertia of the roll is the largest factor in determining speed of stop, for a given machine braking system.

Lap Splice
A splice in which the ends of two webs are overlapped and adhered together by a piece of adhesive placed on the contact side of one.

Load Cell
See Force Transducer.

Nip Rolls
A pair of driven, rotating rollers which act to pull the web into or through the converting process.

Pivot Point
The central point of rotation, as in a dancer arm.

Pivot Point Sensor
A sensor mounted at the pivot point of the dancer arm, which determines which direction the dancer is moving, and where it is in its arc of travel.

Register
The exact, corresponding placement of successively printed images on the web of material.

Sheeter
A machine that cuts a web of material into individual sheets.

Slip
The relative motion, or sliding, between the two members of a braking system. In tensioning, the smoothness of slip is critical to maintaining tension.

Slitter-Rewinder
A machine that unwinds the wide rolls of material, slits them to narrow widths, and rewinds them into narrow rolls.

Splice
The joining of the ends of two webs to make one continuous web.

Splicer

A machine with two (or more) unwind rolls of material. As one roll expires, the other is "spliced" to the end of the first, to provide a continuous web of material to the process. Splicers are referred to as "zero-speed" if the splice occurs when the new roll is stopped, with paper feeding from a festoon storage system. A 'flying splicer" is one where the new roll is accelerated to line speed before splicing the roll, and roll feed is continuous.

Taper Tension

Constantly decreasing tension on winders to help eliminate telescoping and core crushing.

Tensile Strength

The force, parallel to the plane of the specimen, required to break a given length and width of material.

Tension

The tautness in a web of paper or material. The press or process produces a "pull-through" effect, which is countered by the unwind brake. Each material has an optimum tautness, or tension, and it is the job of the tension system to maintain this tension.

Torque

The braking force which holds the unwind roll from unwinding. Usually referred to in pound-feet or pound-inches of torque produced by the brake.

Transducer

A device that changes one type of signal into another. In tensioning, the most common types are electric-to-pneumatic transducers, and force transducers. See Force Transducer.

Web

A continuous strand of material coming from the roll in its full width. It remains in web form until 'terminated" by a sheeter, die-cutter or other device.

Web Break Detectors

Sensing devices that monitor the web and signal a shutdown or E-stop if a web break occurs. This is a good photoelectric application.

Web Draw

Tension or tautness induced in the web by the pulling action of the printing press or process, resulting in web movement in that direction.

Wrap Angle

Refers to the wrap of the web around a roller, especially a dancer roller. Expressed as "degrees of contact" with the roller.

Conversion Factors

Millimeters x 0.03937 = inches
Inches x 25.4 = millimeters

Centimeters x 0.3937 = inches
Inches x 2.54 = centimeters

Meters/minute x 3.280 = feet/minute
Feet/minute x 0.3048 = meters/minute

Kilograms x 2.205 = pounds
Pounds x 0.4536 = kilograms

Newtons x 0.22482 = pounds
Pounds x 4.448 = Newtons

Watts x 0.001341 = horsepower
Horsepower x 746 = watts

Kilogram-meter^2 x 23.753 = pound-feet^2
Pound-feet^2 x 0.0421 = kilogram-meter^2

Newton-meter x 0.722 = pound-feet
Pound-feet x 1.385 = Newton-meter

Grams/meter^2 x 0.613495 = pounds (basis weight)
Pounds (basis weight) x 1.630 = grams/meter^2

$$\text{Lineal feet} = \frac{36{,}000 \times \text{roll weight}}{\text{roll width} \times \text{basis weight}}$$

$$\text{Approximate roll unwind time} = \frac{\text{lineal feet}}{\text{linear speed}}$$

Effective cylinder force at a given air pressure

$$F_{\text{CYL (lbs.)}} = P_{\text{PSI}} \times \frac{(\text{cylinder piston diameter})\text{ in (in)}^2 \times \pi}{4}$$

Example: PSI = 30
CYL dia. = 2 in.
$F = 30 \times \left(\frac{2^2 \times \pi}{4}\right) = 94.2$ lbs.

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Warner Electric
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815-389-3771 • Fax: 815-389-2582
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