Caliper Disc Brakes

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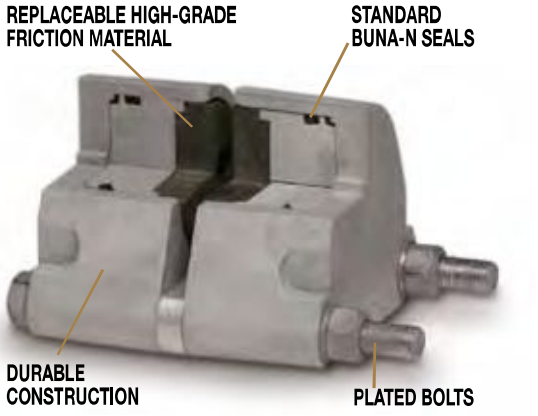
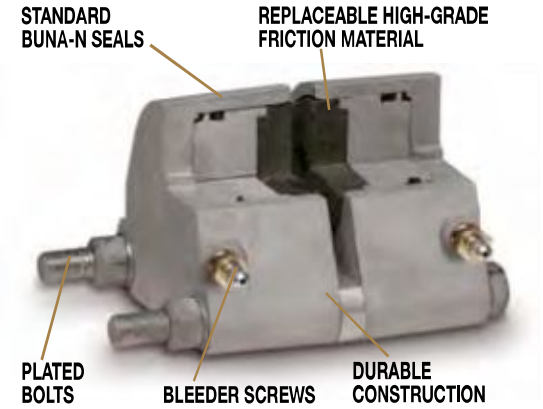
FEATURES

PNEUMATIC BRAKES



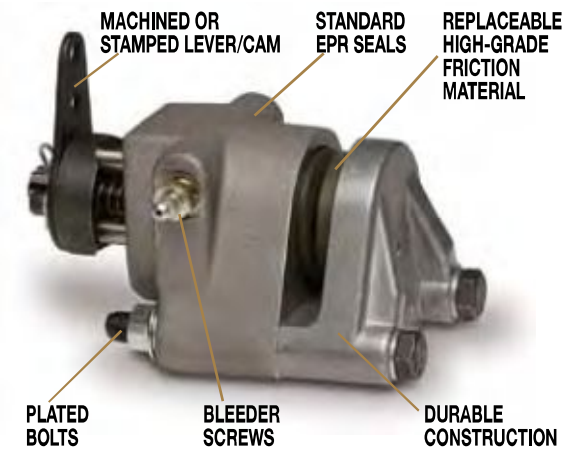
Tolomatic manufactures pneumatic brakes in three sizes: P10 Series, P20 Series and P220 Series. Available in both double acting or single acting. These brakes feature replaceable, high-grade friction material, standard Buna-N seals, aluminum construction and zinc plated bolts. Options include EPR seals,Viton® seals, retractable pistons and floating bracket. (See pages 32 to 37)

HYDRAULIC BRAKES



Tolomatic hydraulic caliper disc brakes are available in the widest range of sizes. From the H10 Series up to the H960 Series, these brakes are sure to supply the braking torque you need for your application. Available in both double acting or single acting (depending on model). These brakes feature replaceable, high-grade friction material, standard Buna-N seals, aluminum or cast iron construction (depending on model), bleeder screws and zinc plated bolts. Options include EPR seals,Viton® seals, retractable pistons and floating brackets. (See pages 38 to 49)

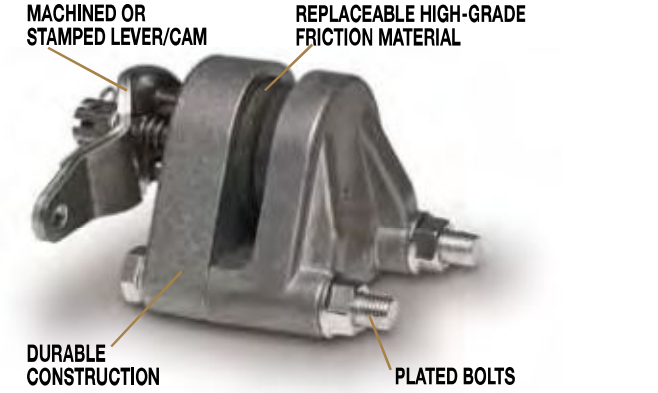
HYDRAULIC / MECHANICAL BRAKES



These Tolomatic brakes combine hydraulic and mechanical braking in one caliper. Available in the H/ME20 Series and H/ME220 Series these single acting calipers deliver high braking torque in a small package. Features include: replaceable, high-grade friction material, standard EPR seals, aluminum or cast iron construction (depending on model), bleeder screws and zinc plated bolts. Options include Buna-N seals,Viton® seals and floating brackets. (See pages 50 to 55)

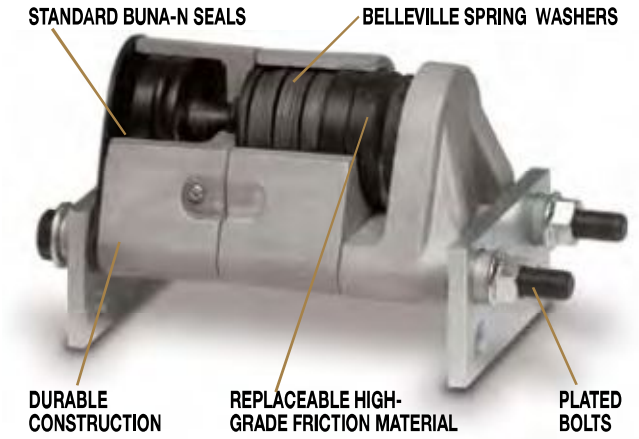
FEATURES

MECHANICAL BRAKES



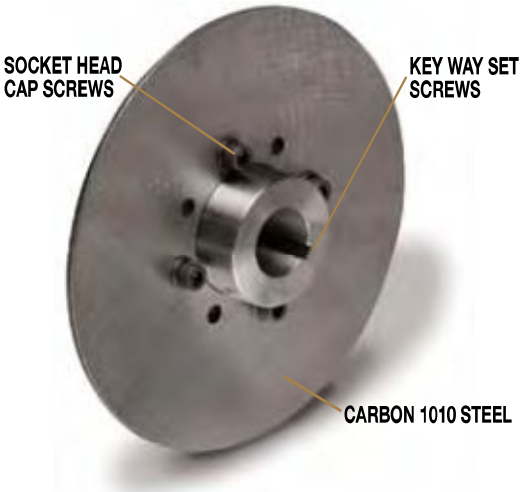
Tolomatic manufactures a broad range of mechanical brakes in these series: ME10, ME20, ME220 and MB3. Designed for use in areas that do not have access to other types of power, these single acting calipers feature replaceable, high-grade friction material, aluminum or cast iron construction (depending on model) and zinc plated bolts. (See pages 56 to 65)

SPRING APPLIED BRAKES



Tolomatic offers spring applied brakes in sizes ranging from FS20 Series to FS595 Series. These brakes require pressure (normally hydraulic) for disc release. Braking force is provided by a stack (or stacks) of Belleville spring washers. The concave washers are capable of storing enormous force. When the brake is pressurized a piston(s) moves to compress the spring washer stack(s), thus releasing the disc. These calipers feature replaceable, high-grade friction material, aluminum or cast iron construction (depending on model), Buna-N seals and zinc plated bolts. Options include EPR seals, retractable pistons and manual compensators. (See pages 66 to 79)

DISC AND HUBS



Tolomatic offers several discs and hubs to fit your application. Most are made of carbon 1010 steel, are flat within .010 inch, stress relieved and blanchard ground to an 80 (RMS) microinch finish. Discs also feature socket head cap screw fasteners and key way set screws. Standard disc diameters are 6-5/16, 8,10, 12 and 16 inches. Disc thicknesses range from 5/32" to 1/2". Available: Fixed Hub and Disc Assemblies, Fixed Hub and Disc Assemblies with Q.D. Bushings, Q.D. Bushings and Hubs, One-Piece Hub and Disc, Blank Disc, Disc with Bolt Circles and Pilot Holes, and Ventilated Disc. (See pages 80 to 87)

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Caliper Disc Brakes

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P10 SERIES - ALUMINUM

AVAILABLE STYLES

Double Acting

FIXED MOUNT - FIXED DISC

PICTURED: 0701-0000

Single Acting

FIXED MOUNT - FLOATING DISC

PICTURED: 0705-0000

Single Acting with Floating Bracket

FLOATING MOUNT - FIXED DISC

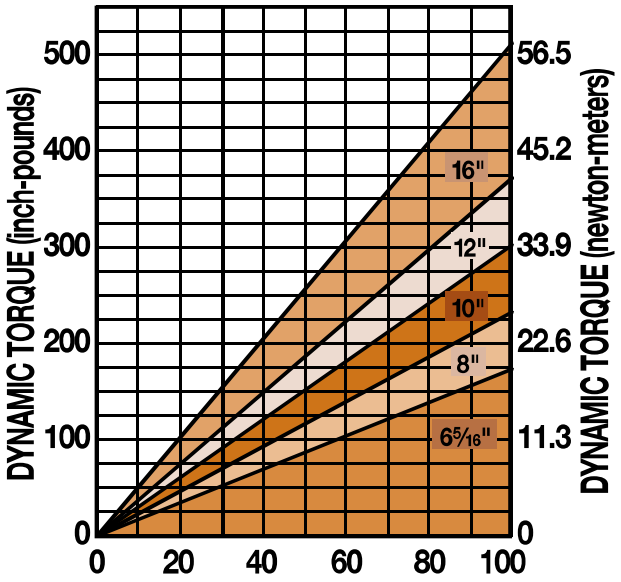
PICTURED: 0705-0001

P10 SPECIFICATIONS

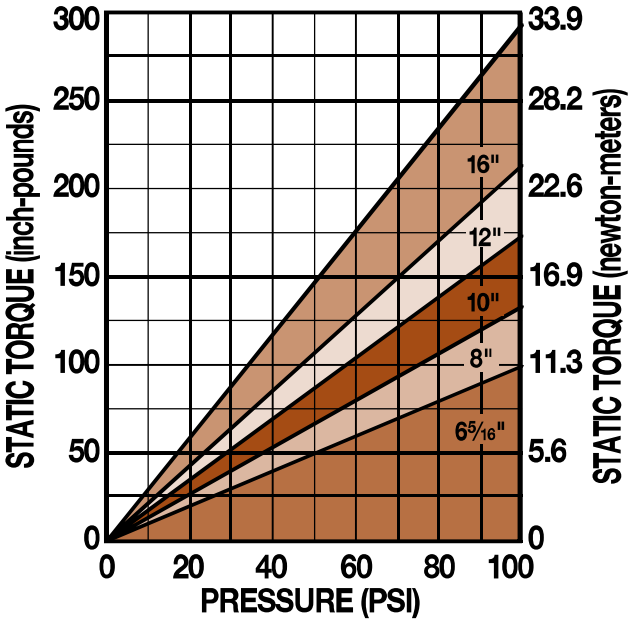
Maximum Pressure Rating:	100 PSI
Accommodates Tolomatic disc diameters:	6-5/16", 8", 10", 12", 16"
Maximum disc diameter:	none
Housing Material:	Extruded aluminum
Bolts:	Zinc plated grade 5
Seals:	Buna-N Standard
Wearable friction material:	0.47 in^3
Wearable friction material/retractable models:	0.13 in^3
Friction material:	Replaceable, high-grade
Total lining area:	1.84 in^2
Total lining area/retractable models:	1.64 in^2
Piston diameter:	1.125 in.
Fluid displacement, non-retractable:	Single acting = 0.029 in^3 Double acting = 0.029 in^3
OPTIONS	
Seals:	EPR seals
Pistons:	Retractable piston(s)
Floating bracket:	Stamped steel construction

PERFORMANCE DATA

Dynamic Torque vs Pressure



Static Torque vs Pressure



DISC SIZING EQUATIONS

DYNAMIC TORQUE (IN.-LBS.) = 0.70 x BRAKING RADIUS (IN.) x PRESSURE (PSI)
STATIC (PARKING) TORQUE (IN.-LBS.) = 0.40 x BRAKING RADIUS (IN.) x PRESSURE (PSI)
BRAKING RADIUS (IN.) = [DISC DIAMETER ÷ 2] - 0.624

Caliper Disc Brakes ORDER ONLINE

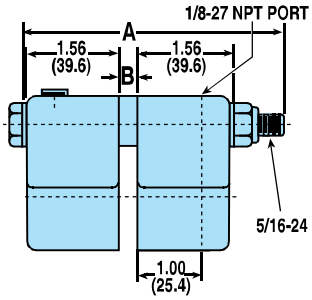
P10 SERIES - ALUMINUM

DOUBLE ACTING

FIXED MOUNT - FIXED DISC

Accommodates disc thickness: 5/32" 1/4" 3/8" 1/2"

Weight 1.0 lbs. .45 kgs.



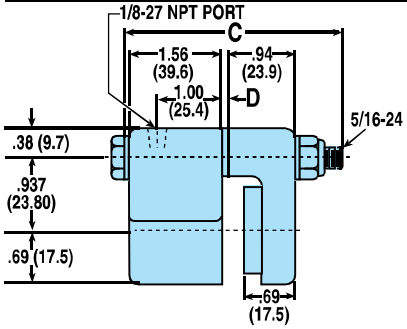
MODEL CODE	DISC THK.	A	B	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
P10DA	5/32"	3.50"	.281"	Double Acting	0701-0000
P10DAR	5/32"	3.50"	.281"	Double Acting, Retractable Pistons	0708-0000
P10DB	1/4"	3.50"	.375"	Double Acting	0702-0000
P10DBR	1/4"	3.50"	.375"	Double Acting, Retractable Pistons	0709-0000
P10DER	1/2"	4.00"	.625"	Double Acting, Retractable Pistons	0709-0003
P10DL	3/8"	4.00"	.500"	Double Acting	0702-0002
P10DLR	3/8"	4.00"	.500"	Double Acting, Retractable Pistons	0709-0002

SINGLE ACTING

FIXED MOUNT - FLOATING DISC

Accommodates disc thickness: 5/32" 1/4"

Weight .75 lbs. .34 kgs.



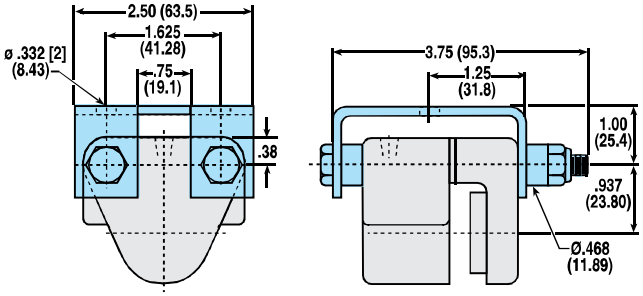
MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
P10SA	5/32"	3.00"	–	Single Acting	0705-0000
P10SB	1/4"	3.00"	.094"	Single Acting	0703-0000

SINGLE ACTING WITH FLOATING BRACKET

FLOATING MOUNT - FIXED DISC

Accommodates disc thickness: 5/32" 1/4"

Weight 1.5 lbs. .68 kgs.

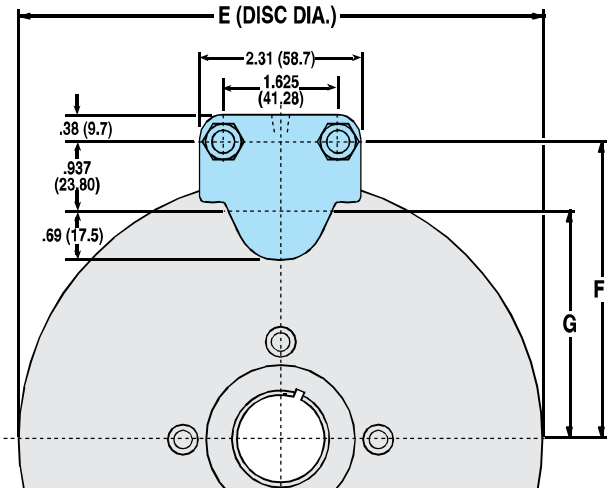


See SINGLE ACTING dimensional drawing for additional measurements

MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
P10SAF	5/32"	3.00"	–	Single Acting, Floating Bracket	0705-0001
P10SBF	1/4"	3.00"	.094"	Single Acting, Floating Bracket	0703-0001

MOUNTING DIMENSIONS

Disc Diameter	E	6.313"	8"	10"	12"	16"
	F	3.469"	4.313"	5.313"	6.313"	8.313"
Braking Radius	G	2.532"	3.376"	4.376"	5.376"	7.376"



BRAKE MODEL LETTER CODES

A 5/32" Thick Disc	**E** 1/2" Thick Disc	**P** Pneumatic Brake
B 1/4" Thick Disc	**F** Floating Bracket Mount	**R** Retractable Piston(s)
D Double Acting	**L** 3/8" Thick Disc	**S** Single Acting

Caliper Disc Brakes

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P20 SERIES - ALUMINUM

AVAILABLE STYLES

Double Acting

FIXED MOUNT - FIXED DISC

PICTURED: 0720-0000

Single Acting

FIXED MOUNT - FLOATING DISC

PICTURED: 0724-0000

Single Acting with Floating Bracket

FLOATING MOUNT - FIXED DISC

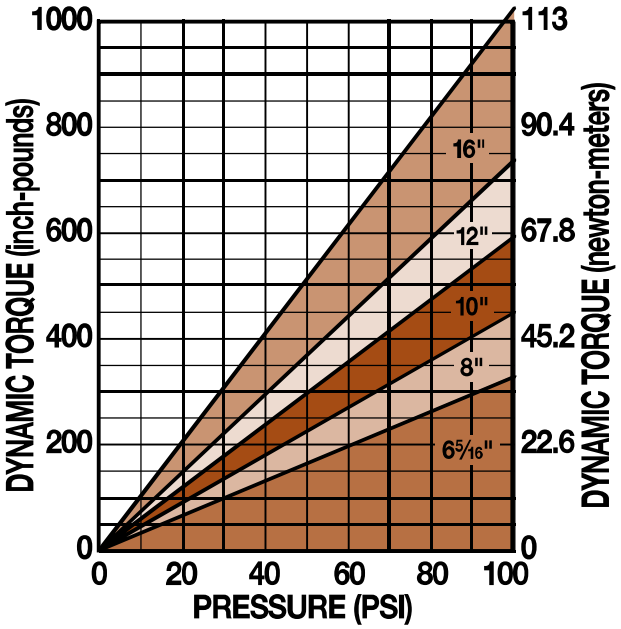
PICTURED: 0724-0001

P20 SPECIFICATIONS

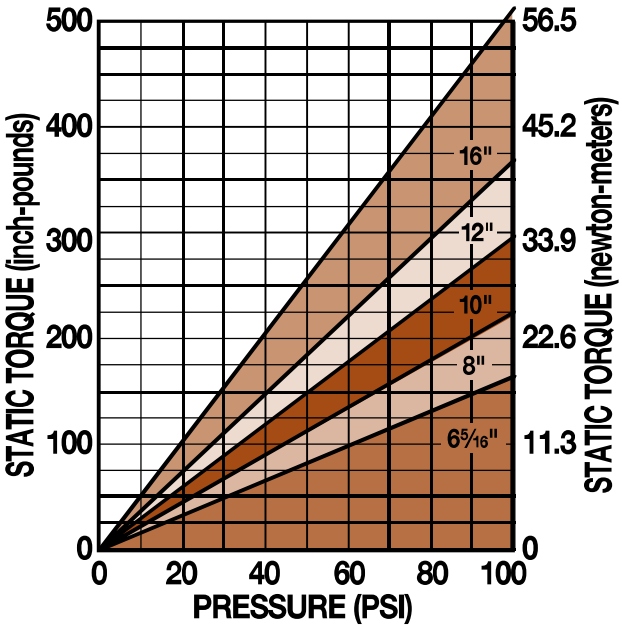
Maximum Pressure Rating:	100 PSI
Accommodates Tolomatic disc diameters:	6-5/16", 8", 10", 12", 16"
Maximum disc diameter:	none
Housing Material:	Extruded aluminum
Bolts:	Zinc plated grade 8
Seals:	Buna-N Standard
Wearable friction material:	0.8 in^3
Wearable friction material/retractable models:	0.5 in^3
Friction material:	Replaceable, high-grade
Total lining area:	3.75 in^2
Piston diameter:	1.625 in.
Fluid displacement, non-retractable:	Single acting = 0.062 in^3 Double acting = 0.062 in^3
OPTIONS	
Seals:	EPR seals
Pistons:	Retractable piston(s)
Floating bracket:	Stamped steel construction

PERFORMANCE DATA

Dynamic Torque vs Pressure



Static Torque vs Pressure



DISC SIZING EQUATIONS

DYNAMIC TORQUE (IN.-LBS.) = 1.44 x BRAKING RADIUS (IN.) x PRESSURE (PSI)
STATIC (PARKING) TORQUE (IN.-LBS.) = 0.72 x BRAKING RADIUS (IN.) x PRESSURE (PSI)
BRAKING RADIUS (IN.) = [DISC DIAMETER ÷ 2] - 0.875

Caliper Disc Brakes ORDER ONLINE

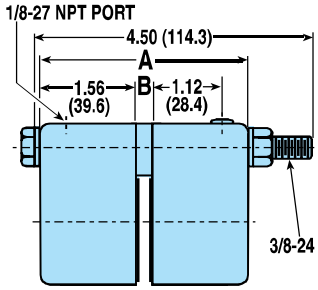
P20 SERIES - ALUMINUM

DOUBLE ACTING

FIXED MOUNT - FIXED DISC

Accommodates disc thickness: 5/32" 1/4" 3/8" 1/2"

Weight 2.0 lbs. .91 kgs.



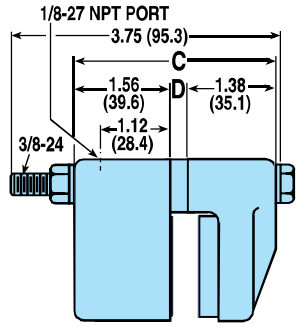
MODEL CODE	DISC THK.	A	B	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
P20DA	5/32"	3.41"	.281"	Double Acting	0720-0000
P20DAR	5/32"	3.41"	.281"	Double Acting, Retractable Pistons	0728-0000
P20DB	1/4"	3.50"	.375"	Double Acting	0721-0000
P20DBR	1/4"	3.50"	.375"	Double Acting, Retractable Pistons	0729-0000
P20DL	3/8"	3.62"	.500"	Double Acting	0720-0013
P20DLR	3/8"	3.62"	.500"	Double Acting, Retractable Pistons	0729-0001
P20DE	1/2"	3.75"	.625"	Double Acting	0725-0000
P20DER	1/2"	3.75"	.625"	Double Acting, Retractable Pistons	0719-0000

SINGLE ACTING

FIXED MOUNT - FLOATING DISC

Accommodates disc thickness: 5/32" 1/4" 3/8"

Weight 1.5 lbs. .68 kgs.



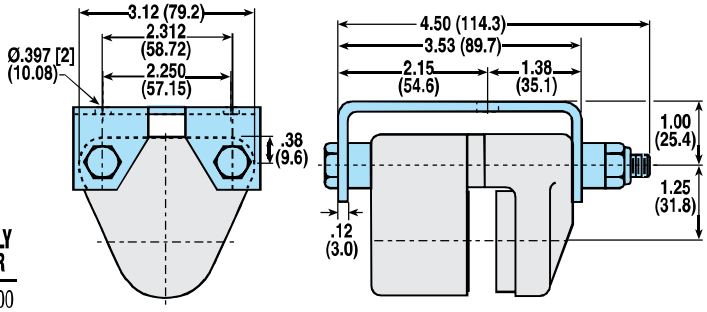
MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
P20SA	5/32"	2.94"	–	Single Acting	0724-0000
P20SB	1/4"	3.03"	.093"	Single Acting	0722-0000
P20SL	3/8"	3.16"	.219"	Single Acting	0722-0002

SINGLE ACTING WITH FLOATING BRACKET

FLOATING MOUNT - FIXED DISC

Accommodates disc thickness: 5/32" 1/4"

Weight 2.0 lbs. .91 kgs.

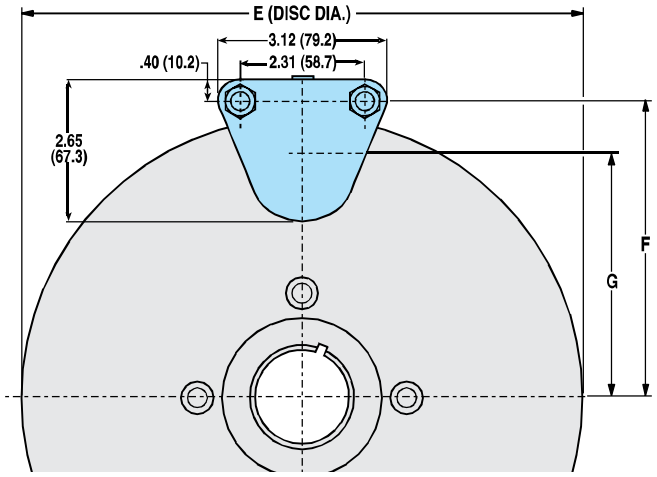


See SINGLE ACTING dimensional drawing for additional measurements

MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
P20SAF	5/32"	2.94"	–	Single Acting, Floating Bracket	0724-0001
P20SBF	1/4"	3.03"	.093"	Single Acting, Floating Bracket	0722-0001

MOUNTING DIMENSIONS

Disc Diameter	E	6.313"	8"	10"	12"	16"
	F	3.531"	4.375"	5.375"	6.375"	8.375"
Braking Radius	G	2.281"	3.125"	4.125"	5.125"	7.125"



BRAKE MODEL LETTER CODES

A 5/32" Thick Disc	**E** 1/2" Thick Disc	**P** Pneumatic Brake
B 1/4" Thick Disc	**F** Floating Bracket Mount	**R** Retractable Piston(s)
D Double Acting	**L** 3/8" Thick Disc	**S** Single Acting

Caliper Disc Brakes

ORDER ONLINE

P220 SERIES - ALUMINUM

AVAILABLE STYLES

Double Acting

FIXED MOUNT - FIXED DISC

PICTURED: 0735-0100

Single Acting

FIXED MOUNT - FLOATING DISC

PICTURED: 0733-0000

Single Acting with Floating Bracket

FLOATING MOUNT - FIXED DISC

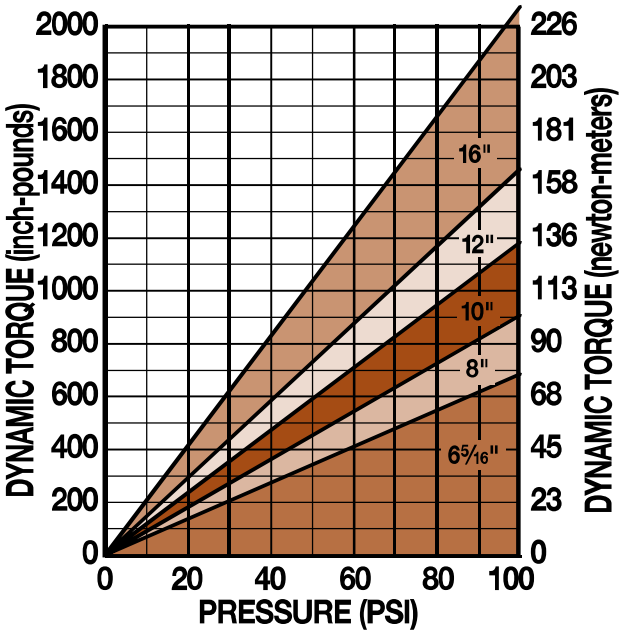
PICTURED: 0733-0022

P220 SPECIFICATIONS

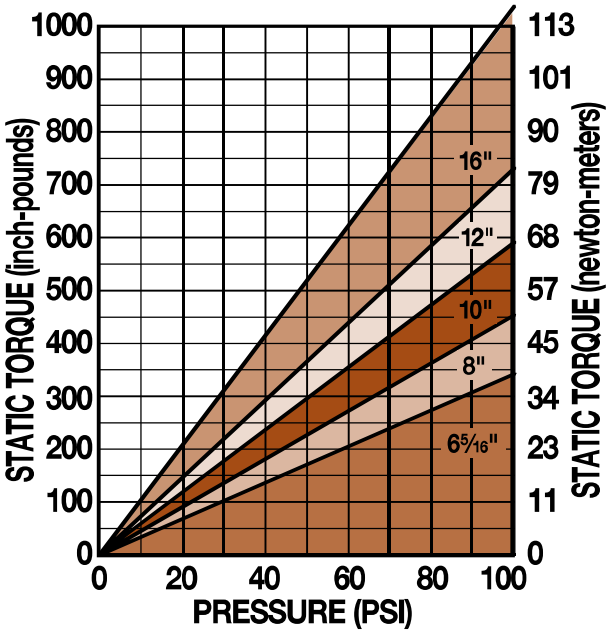
Maximum Pressure Rating:	100 PSI
Accommodates Tolomatic disc diameters:	6-5/16", 8", 10", 12", 16"
Maximum disc diameter:	16"
Housing Material:	Die cast aluminum
Bolts:	Zinc plated grade 8
Seals:	Buna-N Standard
Wearable friction material:	1.6 in^3
Wearable friction material/retractable models:	1.0 in^3
Friction material:	Replaceable, high-grade
Total lining area:	7.5 in^2
Piston diameter:	1.625 in.
Fluid displacement, non-retractable:	Single acting = 0.124 in^3 Double acting = 0.124 in^3
OPTIONS	
Seals:	EPR seals
Pistons:	Retractable piston(s)
Floating bracket:	Available

PERFORMANCE DATA

Dynamic Torque vs Pressure



Static Torque vs Pressure



DISC SIZING EQUATIONS

DYNAMIC TORQUE (IN.-LBS.) = 2.88 x BRAKING RADIUS (IN.) x PRESSURE (PSI)
STATIC (PARKING) TORQUE (IN.-LBS.) = 1.44 x BRAKING RADIUS (IN.) x PRESSURE (PSI)

Caliper Disc Brakes

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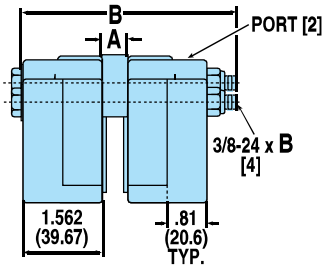
P220 SERIES - ALUMINUM

DOUBLE ACTING

FIXED MOUNT - FIXED DISC

Accommodates disc thickness: 5/32" 1/4" 1/2"

Weight 4.0 lbs. 1.82 kgs.



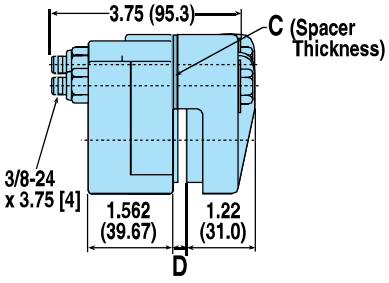
MODEL CODE	DISC THK.	A	B	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
P220DA	5/32"	.281"	4.50"	Double Acting	0735-0100
P220DAR	5/32"	.281"	4.50"	Double Acting, Retractable Pistons	0736-0110
P220DB	1/4"	.375"	4.50"	Double Acting	0735-0200
P220DBR	1/4"	.375"	4.50"	Double Acting, Retractable Pistons	0736-0210
P220DE	1/2"	.625"	5.00"	Double Acting	0735-0300
P220DER	1/2"	.625"	5.00"	Double Acting, Retractable Pistons	0736-0310

SINGLE ACTING

FIXED MOUNT - FLOATING DISC

Accommodates disc thickness: 5/32" 1/4" 1/2"

Weight 3.0 lbs. 1.36 kgs.



MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
P220SA	5/32"	–	.25"	Single Acting	0733-0000
P220SB	1/4"	.094"	.34"	Single Acting	0733-0100
P220SE	1/2"	.344"	.59"	Single Acting	0733-0200

BRAKE MODEL LETTER CODES

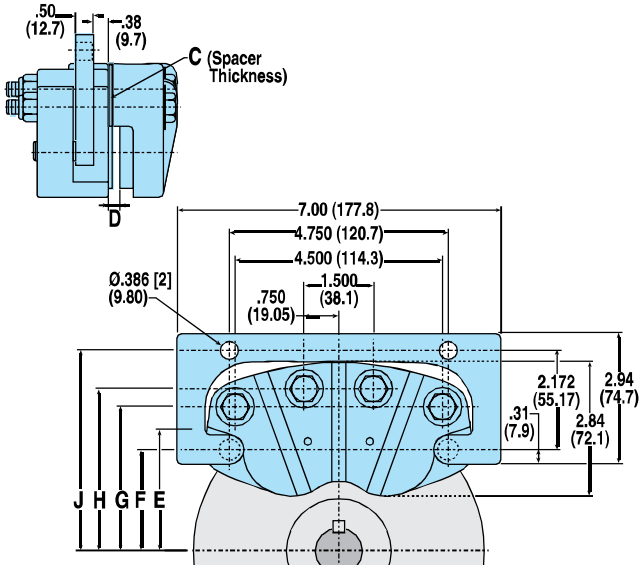
A 5/32" Thick Disc	**E** 1/2" Thick Disc	**R** Retractable Piston(s)
B 1/4" Thick Disc	**F** Floating Bracket Mount	**S** Single Acting
D Double Acting	**P** Pneumatic Brake	

SINGLE ACTING WITH FLOATING BRACKET

FLOATING MOUNT - FIXED DISC

Accommodates disc thickness: 5/32" 1/4" 1/2"

Weight 4.5 lbs. 2.04 kgs.

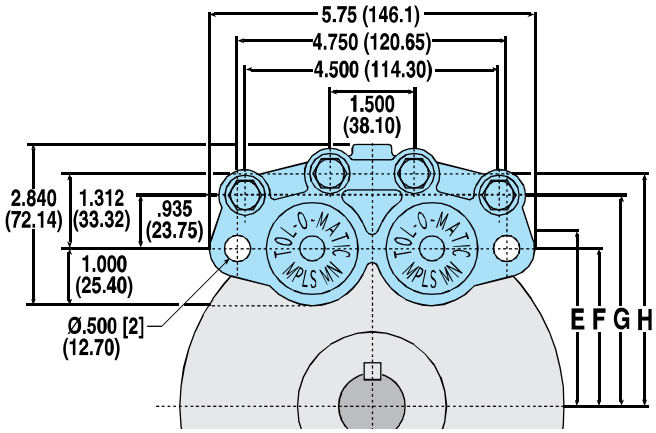


See SINGLE ACTING dimensional drawing for additional measurements

MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
P220SAF	5/32"	–	.25"	Single Acting, Floating Bracket	0733-0020
P220SBF	1/4"	.094"	.34"	Single Acting, Floating Bracket	0733-0120
P220SEF	1/2"	.344"	.59"	Single Acting, Floating Bracket	0733-0220

MOUNTING DIMENSIONS

Disc Diameter		6.313"	8"	10"	12"	16"
Braking Radius	E	2.36"	3.18"	4.14"	5.11"	7.17"
	F	2.11"	3.00"	4.00"	5.00"	7.09"
	G	3.05"	3.94"	4.94"	5.94"	8.03"
	H	3.42"	4.32"	5.32"	6.32"	8.41"
	J	4.28"	5.17"	6.17"	7.17"	9.26"



Caliper Disc Brakes

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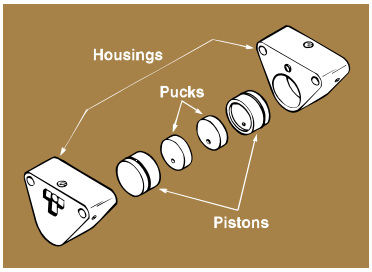
SELECTION: GENERAL

HOW CALIPER DISC BRAKES WORK

Basically, a caliper disc brake functions like an ordinary rod cylinder. Components consist of a piston, a puck (or pad) of wearable friction material, a housing, and opposing side and a disc on which the brake acts. When pressure is applied to the piston, the puck is moved into contact with the disc, causing the disc to stop rotating or, in a tensioning application, to supply constant drag. The housing contains the piston and puck and is located above the disc. There are always two sides to a caliper disc brake: One is known as the "live side" with the piston and puck; the other may be either another "live side" or it may be a "dead side" (another puck which contacts the disc when the "live side" piston is actuated).



Disc brakes are widely used in three areas: Stopping, retarding (tensioning) and holding. In any application it is necessary to determine how much torque is required, how much heat will be generated (and thus, to be dissipated) and the anticipated service life of the linings. Once these variables are determined, then find the combination of disc and caliper that will most economically meet these requirements.

DETERMINE THE KIND OF BRAKING TO BE DONE

- Industrial
  - Tensioning
  - Constant Slip)
- Vehicular

DETERMINE PRESSURE (LEVER FORCE) AVAILABLE

All torque calculations (except for spring applied brakes) are based on the pressure (lever force) available for your application. Maximum pneumatic pressure for Tolomatic caliper disc brakes is 100 PSI. Maximum hydraulic pressure varies by model between 1,000 PSI and 2,000 PSI. Maximum lever force for mechanical brakes varies with model and lever length. Refer to individual models for pressure (lever force) ratings.

CALCULATE THE TORQUE REQUIRED

For convenience, we express the torque formulae separately for industrial applications, vehicular applications and tensioning applications. See the formulae section (pages 92-95) to determine the torque needed for your application.

CALCULATE HEAT DISSIPATION REQUIRED

The energy generated will either be expressed as BTU per hour (particularly for tensioning applications) or BTU per stop. The formulae for calculating these values are different for industrial, tensioning and vehicular braking. See the formulae section (pages 92-95) to determine the heat generated for your application.

DETERMINE MAXIMUM DISC DIAMETER

There are two criteria to determine disc diameter:

- **ENVELOPE SIZE** – how much room is allowed in the design for disc and caliper. This affects the braking radius and thus the torque that the caliper can develop.
- **HEAT DISSIPATION REQUIRED** – Cycle rate and torque are needed to determine the heat an application will generate per hour, and thus the heat that the disc will need to dissipate. Discs will normally dissipate heat at the rate of 3 BTU per hour, per square inch of disc area. This assumes a disc temperature of 220° F above ambient temperature of 80°F. Discs rotating at extreme speeds may dissipate heat at rates as high as 5 BTU per hour, per square inch of disc area. If required torque, cycle rate and small envelope size combine to create heat dissipation requirements that are greater than standard disc capabilities, your choices are:
  1.) Use a thicker disc (that will act as a heat sink).
  2.) Use multiple discs/calipers for the application.
  3.) Use a ventilated disc (to increase the heat dissipation rate).
  4.) Cool disc with forced air (to increase the heat dissipation rate).

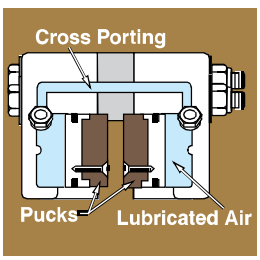
DETERMINE THE TYPE OF BRAKE ACTUATION

Choose a brake based on the type of actuation available (pneumatic, hydraulic, etc.) and whether dynamic or static braking is required for the application.

Tolomatic offers brakes actuated in 5 different ways:

- **PNEUMATIC**

  Pneumatic actuation is used in industrial and tensioning applications because pneumatic service is easily controllable and readily available in most industrial settings.



Caliper Disc Brakes

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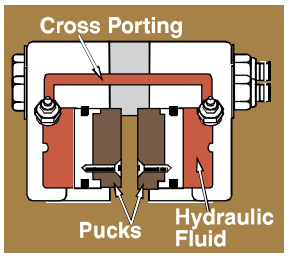
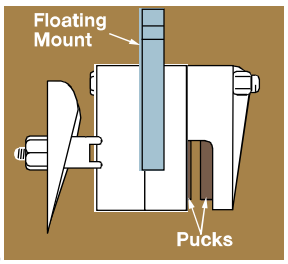
SELECTION: GENERAL

- **HYDRAULIC**



Hydraulic actuated brakes are normally used in applications where higher torque output is needed. They may be operated with a variety of fluids including the standard mineral based hydraulic oils, automotive brake fluids and non-flammable phosphate ester fluids (each requires different seals).

- **MECHANICAL**



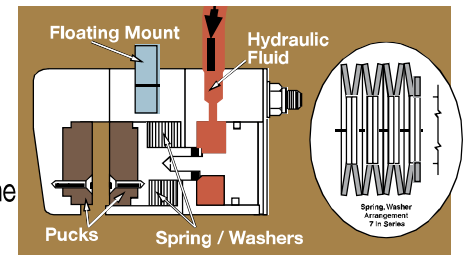
Mechanically actuated brakes are often used for emergency stopping or holding brakes or in situations where pneumatic or hydraulic pressure is not available. Mechanical caliper disc brakes operate when the cam lever is rotated. This pushes the actuating pins against the lining's backing plate thus forcing the lining into the disc.

- **HYDRAULIC / MECHANICAL COMBOS**

Combination brakes give the added flexibility to apply mechanical braking as well as hydraulic braking from one caliper.

- **SPRING APPLIED**

These brakes require pressure (normally hydraulic) to release it from the disc. Braking force is provided by a stack (or stacks) of Belleville spring washers. The conical washers are capable of storing enormous force. When the brake is pressurized the force moves a piston(s) to compress the spring washer stack(s), thus releasing the disc. Because the force applied by the spring stack is reduced as the spring washers expand, spring applied brakes are used mainly for applications that require occasional stopping or holding. They should not be used in tension-constant slip applications or cyclic stopping industrial applications.



CHOOSE TOLOMATIC BRAKE SIZE

Tolomatic brakes are grouped by size. These sizes relate to the piston size for each brake. Because maximum pressure (lever force) generated differs between the type of brake (pneumatic, hydraulic, etc.), the maximum torque available differs. The graphs on pages 29 to 31 will be helpful in determining the approximate brake size that will work for your application. Go to each individual brake section to find the equations and performance graphs for that brake.

For easy reference, torque output equations that apply to each series of brake are shown at the bottom of the page (see example below). Each equation features:
[1.] a constant value *(A product of brake piston area, the coefficient of friction and a safety factor.)*, multiplied by
[2.] braking radius *(Common disc sizes appear on the page with the dimensional drawing.)*, multiplied by
[3.] pressure (lever force) *(You will need to determine.)*.

DISC SIZING EQUATIONS (1) (2) (3)

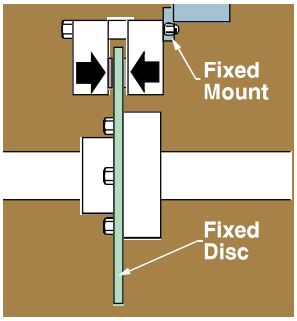
STATIC (PARKING) TORQUE (IN.-LBS.) = 6.99 X BRAKING RADIUS (IN.) X LEVER FORCE (LBS.)

BRAKING RADIUS (IN.) = [DISC DIAMETER ÷ 2] - 0.688

The performance data graphs represent these equations for common disc sizes in a convenient, visual way to quickly see how well each brake size will fit your application.

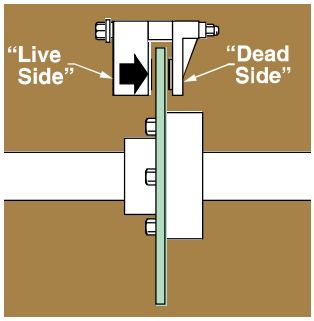
CHOOSE DOUBLE ACTING OR SINGLE ACTING BRAKE

Double Acting



- Double acting brakes feature two "live sides". Each side has a piston that actuates the lining, forcing it against the disc. Hydraulic and pneumatic brakes are available in double acting as well as single acting models.

Single Acting



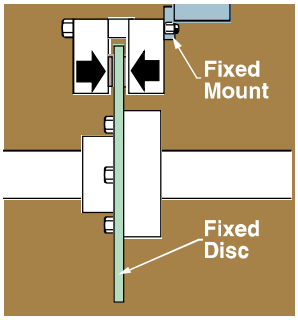
- Single acting brakes have a piston that actuates the lining on the "live side", forcing it against the disc. The "dead side" has a stationary lining attached to the housing. Since only one side has a moving piston, the brakes mounting must allow it to float. Spring applied, mechanical and hydraulic/mechanical brakes are generally single acting.

SELECTION: GENERAL

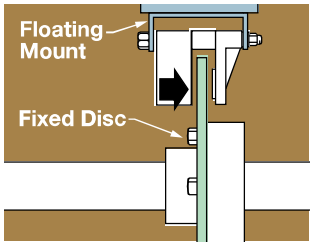
DETERMINE MOUNT FOR BRAKE AND DISC

• For Double Acting Brakes

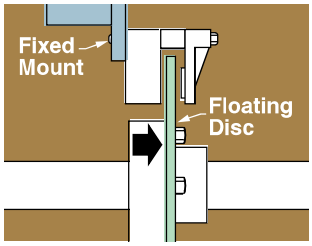
FIXED CALIPER MOUNT/ FIXED DISC – A double acting caliper can be fixed mounted since both linings have pistons to move them. The disc is also fixed mounted.



•For Single Acting Brakes



FLOATING CALIPER MOUNT/FIXED DISC – A floating mount bracket permits the caliper to shift position when braking force is applied. The disc is rigidly mounted to the shaft.



FIXED CALIPER MOUNT/ FLOATING DISC – The caliper is rigidly mounted and a floating disc mount attaches the disc to the shaft. The two forms of floating disc are:
1.) Disc and hub are mounted on a spline on the shaft. **2.)** Hub is rigidly keyed to the shaft and the disc is spring loaded to the hub, providing floating ability.

CONSIDER OPTIONS

Hydraulic brakes may operate with a variety of fluids. Tolomatic brakes use Buna-N seals most commonly. These seals are suited for use with standard mineral based hydraulic oil. EPR seals, for use with automotive brake fluids, are available for most Tolomatic brakes. Some models also give you the choice of Viton® seals, these seals are suited for use with nonflammable phosphate ester fluids.

Some Tolomatic brakes are available with retractable pistons. A brake with this feature has a small compression spring within the piston which causes it to retract from the disc when pressure is released. Retractable brakes are used in applications that require a brake with absolutely no residual drag from the linings on the disc.

Almost all Tolomatic brakes can be modified to fit a variety of disc thicknesses.

NOTE: TOLOMATIC RETRACTABLE BRAKES SHOULD NOT BE USED IN VEHICULAR APPLICATIONS WITH A MASTER CYLINDER OR WITH AN INTENSIFIER.

DETERMINE LIFE EXPECTANCY OF LININGS

Another consideration in selecting a brake is the life expectancy of the linings. This factor is particularly important if the brake is to be placed in a "hard-to-service" location, faces long intervals between servicing, or is to be used in a tensioning-constant slip application.

Basically, lining life expectancy is a factor of the amount of energy transmitted through the lining and may be measured in total number of stops or hours of life. Both measurements may be reduced to horsepower hours of heat that the lining must endure.

Tolomatic's standard lining is made of a non-asbestos organic material and has a maximum operating temperature of 300°F. An optional sintered metallic lining (depending on model) offers maximum operating temperatures from 400° to 500°F. See the formulae section to determine the lining life expectancy for your application.

Caliper Disc Brakes

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SELECTION: FORMULAE: INDUSTRIAL

INDUSTRIAL APPLICATIONS FORMULAE

Calculation of Torque Required

Many industrial applications are concerned with rotary motions that must be brought to rest in a specified time. The torque necessary to satisfy the time requirement must be determined. A convenient formula used to calculate the torque requirement of a single shaft system is:

$$T = \frac{WK^2N}{308t} \qquad [1a]$$

Where: **T** = Torque; ft-lbs

W = Weight of rotating member; lbs.

K = Radius of gyration of rotating member; ft.

N = Speed of rotating shaft; rpm

t = Stopping time required; seconds

or: $$T = \frac{WK^2N}{3,696t} \qquad [1b]$$

Where: **T** = Torque; in-lbs

K = Radius of gyration of rotating member; in.

Industrial applications often consist of more than one rotating mass system (i.e., two or more shafts with gears, sheaves, drums, etc.) interconnected and operating at different speeds. In such systems the rotating elements must be reduced to a common base. Since the energy of a rotating mass system is a function of the square of its speed, an equivalent WK^2 of each rotating member relative to the shaft on which the brake disc is mounted can be calculated using the formulae in the Radius of Gyration Section (page 93).

Calculation of Heat Generation and Required Dissipation (Industrial)

Heat is always developed in the disc and linings of a brake when a rotating or moving body comes to rest. The kinetic energy in BTUs per stop may be expressed in the following formulae:

$$BTU/Stop = \frac{WK^2N^2}{4,570,000} \qquad \text{for a single shaft system} \qquad [4]$$

$$BTU/Stop = \frac{WK_e^2N_s^2}{4,570,000} \qquad \text{for a multiple shaft system} \qquad [5]$$

or

$$BTU/Stop = \frac{TN_St}{46,680} \qquad [6]$$

Where: **T** = Torque; ft-lbs

K = Radius of gyration of rotating member; ft.

The weight and specific heat of the lining material is very small compared to the disc and can be ignored.

Since the amount of heat dissipated per hour by the disc at a given temperature above ambient is considered as being directly proportional to the exposed area of the disc, disc thickness should be kept small. Standard thicknesses are 5/32" and 1/4".

For the best service life the disc temperature should not exceed 300°F. Higher disc temperatures can be allowed, however, there will be a reduction in the life of the friction material. See Figure 1 (page 94).

In many applications there are no restrictions to disc diameter (within reason). Convert your calculated BTU/ Stop to BTU/hr. with the following formula:

$$BTU/hr. = (BTU/stop)(stops/hr.) \qquad [7]$$

Then solve for the number of square feet of exposed disc area to dissipate the heat generated:

$$Sq.\ Ft.\ Disc\ Area = \frac{BTU/hr}{660} \qquad [8]$$

Refer to Table 1 (page 94) for selection of proper disc diameter.

NOTE: THE ABOVE FORMULA [8] IS BASED ON A 220°F TEMPERATURE RISE AND AN 80°F AMBIENT TEMPERATURE. IF A HIGHER DISC TEMPERATURE IS DESIRED REFER TO FORMULAE [14], [15], [16] IN THE TENSIONING-CONSTANT SLIP SECTION.

If there is a restriction in the disc diameter(s) and there is sufficient time between stops or multiple of stops for heat dissipation then we can size the disc to act as a heat sink.

$$Wd = \frac{BTU/hr.}{(220)(Sp)} \qquad [9]$$

Where: **Wd** = Weight of disc; lbs.

Sp = Specific heat of disc may be taken as .12 for steel; BTU/lbs.-°F

Refer to Table 1 (page 94) for selection. If your requirement falls outside of the standard(s) you may calculate the required thickness based on the maximum allowable diameter:

$$\text{Disc Thickness} = \frac{Wd}{(A)(.28)} \qquad [10]$$

Where: Thickness is in inches

A = Area of maximum allowable diameter; in^2

If it is found the disc thickness is unrealistic from an economic or space limitation standpoint, multiple discs will have to be provided or forced ventilation must be considered.

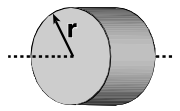
SELECTION: FORMULAE: RADIUS OF GYRATION, TENSIONING

RADIUS OF GYRATION FORMULAE

Radius of Gyration for Geometric Forms

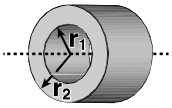
Radius of gyration is the distance from the center of rotation at which the entire rotating mass could be concentrated and still be equivalent to the actual distributed mass.

Solid Cylinder About its Own Axis



$$k^2 = \frac{r^2}{2}$$

Hollow Cylinder About its Own Axis



$$k^2 = \frac{r_1^2 + r_2^2}{2}$$

Where: K = Radius of gyration of rotating member; ft.

R = Radius of rotating member; ft.

$$WK_e^2 = WK_S^2 + WK_1^2\left[\frac{N_1}{N_S}\right]^2 + \ldots \quad [2]$$

Where: WK_e^2 = Equivalent WK^2 of the multiple shaft system; lbs-ft^2

WK_s^2 = WK^2 of the shaft assembly on which the brake disc is mounted; lbs-ft^2

WK_1^2 = WK^2 of the second shaft assembly; lbs-ft^2

N_s = speed of the shaft on which the brake disc is mounted; rpm

N_1 = speed of the second shaft; rpm

The formula for the torque required to bring the multiple shaft system to rest then becomes:

$$T = \frac{WK_e^2 N_s}{308t} \quad [3a]$$

Where: T = Torque; ft-lbs

or $$T = \frac{WK_e^2 N_s}{3{,}696t} \quad [3b]$$

Where: T = Torque; in-lbs (WK_e^2 is in lbs-in^2)

TENSIONING / CONSTANT SLIP APPLICATIONS FORMULAE

Calculation of Torque Required

Applications involving tensioning or constant drag require a different set of formulae since there is not a finite time to stop. Tensioning devices are designed to operate over an infinite period of time. The basic formula for calculating torque for web tensioning is:

$$T = (L)(F)(R) \quad [11]$$

Where: T = Torque; in-lbs

L = web width, in.

F = tension; lbs./inch of web width

R = maximum roll radius; in.

The basic formula for calculating BTUs generated per hour is:

$$BTU/hr. = \frac{(T)(rpm)}{24.75} \quad [12]$$

Calculation of Heat Generation and Required Dissipation (Tensioning)

In tensioning applications the amount of heat generated must be dissipated as well. Often web velocity is given in fpm, this can be converted to rpm by:

$$rpm = \frac{fpm}{C} \quad [13]$$

Where: C = Circumference of roll at maximum diameter; ft.

Therefore to solve for the sq. ft. of surface area of the disc(s):

$$\text{Sq. Ft. Disc Area} = \frac{BTU/hr}{660} \quad [14]$$

The constant of 660 is based on a maximum disc temperature of 300°F.

To develop a constant for higher disc temperature:

$$\text{Constant} = (3)(\text{temperature rise above ambient}) \quad [15]$$

The actual disc temperature becomes:

$$\text{Disc Temperature} = \text{Temperature Rise} + \text{Ambient, °F} \quad [16]$$

Refer to Table 1. Select disc or discs equal to (or greater than) calculated sq. ft. Remember the higher the disc temperature the lower the life of the friction material. See Figure 1 (page 94).

Caliper Disc Brakes

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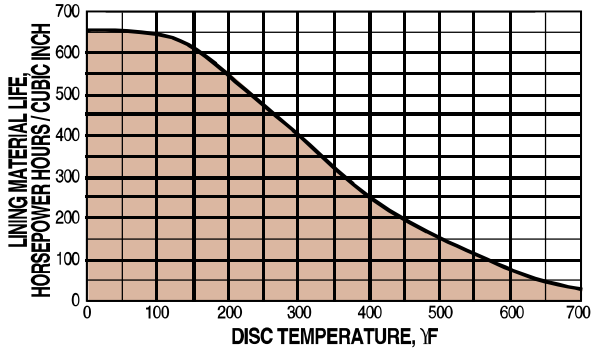
SELECTION: LINING LIFE

LINING LIFE FORMULAE

Calculating Service Life of Lining(s)

The lining life per cubic inch shown by Figure 1 below is based on horsepower hours.

FIGURE 1 – LINING MATERIAL LIFE
(REPLACEABLE HIGH GRADE FRICTION MATERIAL - NON-ASBESTOS, ORGANIC)



To find the life in hours of lining(s):

(Primarily for tensioning-constant slip applications)

$$\text{Ft-lbs/hr} = (\text{BTU/hr generated})(778) \quad [17]$$

Refer to Formula [12]

$$\text{HP hrs/hr} = \frac{\text{ft - lbs/hr}}{1{,}980{,}000} \quad [18]$$

Refer to Table 2 to determine cubic inches of wearable material of various caliper sizes.

$$\text{Life in Hours} = \frac{(\text{number of calipers})(\text{cubic in. } \textit{Table 2})(\text{HP hrs./in}^3\ \textit{Figure 1})}{\text{HP hrs. / hr.}} \quad [19]$$

To find the life of lining(s) in stops: When a rotating mass is brought to rest, the kinetic energy removed can be calculated by the following formulae:

$$E = \frac{\pi I N t}{60} \quad [20]$$

or

$$E = \frac{WK^2N^2}{5872} \quad [21]$$

Where: E = Kinetic Energy; ft-lbs

$$\text{HP hrs. / Stop} = \frac{E}{1{,}980{,}000} \quad [22]$$

$$\text{Life in Stops} = \frac{(\text{number of calipers})(\text{cubic in. } \textit{Table 2})(\text{HP hrs./in}^3\ \textit{Figure 1})}{\text{HP hrs. / Stop}} \quad [23]$$

LINING LIFE CALCULATIONS ARE ESTIMATES AND DO NOT ACCOUNT FOR FOREIGN CONTAMINANTS THAT MAY ABRADE THE LINING OR DISC AND REDUCE LIFE. WHEN THE LIFE MUST BE KNOWN ACCURATELY, FIELD TESTS SHOULD BE CONDUCTED UNDER ACTUAL OR SIMULATED SERVICE CONDITIONS.

TABLE 1 – DISC SPECIFICATIONS

DISC DIAMETER	EXPOSED AREA IN²	SQ. FT.	SQ MM	WEIGHT* LBS.	KGS.	MAXIMUM BTU / HR.	MAXIMUM JOULE/HR.
6.313	62.58	0.43	40,374	1.37	0.62	283.8	299,360
8.000	100.53	0.70	64,858	3.52	1.60	462.0	487,329
10.000	157.08	1.09	101,342	5.46	2.48	719.4	758,842
12.000	226.20	1.57	145,935	7.91	3.59	1,036.0	1,092,799
16.000	402.12	2.79	259,432	14.06	6.38	1,841.4	1,942,356

*BASED ON A STEEL DISC 1/4" THICK
(EXCEPT FOR Ø6.313 WHICH IS BASED ON A STEEL DISC 5/32" THICK).

TABLE 2 – CUBIC INCHES OF WEARABLE FRICTION MATERIAL

CALIPER SERIES	CUBIC INCHES
10	.46
20	.83
H220 Aluminum	1.66
H220 Cast Iron	2.35

CALIPER SERIES	CUBIC INCHES
FS220 Aluminum	1.66
FS220 Cast Iron w/ JK options	2.35
H440	3.32

SERIES	INCHES
FS440	1.75
H441	3.71
FS595	4.57
H960	8.00
MB3	6.06

CALIPER CUBIC

TABLE 3 – CAM TRAVEL DATA

ME10 and ME20 Calipers

1. 15° maximum travel when linings are new and with 1/32" gap each side of disc.
2. Periodic tightening of lock nut will reduce travel of lever and will allow 1/4" wear on each lining.
3. 90° maximum travel after 3/16" wear on each lining without intermediate tightening of lock nut.

ME220 Calipers

1. Gap between lining faces and disc when new = .048" total.
2. Angular movement required to actuate brake when new = 7° 30".
3. Maximum axial movement without intermediate adjustment = .387".
4. Wear allowed before adjustment .104" each side.

MB3 Calipers

1. 0° travel with .500" disc.
2. 90° maximum travel after .125" wear on each side of lining without intermediate tightening of the lock nut.

SELECTION: FORMULAE: VEHICULAR

VEHICULAR APPLICATIONS FORMULAE

Calculation of Torque Required

$$\textit{Dynamic}\ T = \frac{WR\left[\frac{a}{g} + \frac{b}{100}\right]}{(D)} \qquad [24]$$

Where:

T = Torque perAxle, vehicle, or wheel; in-lbs

W = Weight on axle including weight transfer, if any, vehicle or wheel; lbs.

R = Loaded tire radius; in.

g = 32.2 ft./sec^2

b = % of grade

D = Gear Reduction, if drive line mounted

a = Deceleration rate; ft/sec^2

And

$$a = \frac{V}{t} = \frac{V^2}{2S} \qquad [25]$$

Where:

V = Velocity of vehicle, ft./sec., at moment of brake application

t = Stopping time required; seconds

S = Stopping distance of vehicle; ft.

$$\textit{Parking}\ T = \frac{WR\left[\frac{b}{100}\right]}{D} \qquad [26]$$

Calculation of Heat Generation and Required Dissipation (Vehicular)

$$E = \frac{WV^2}{2g} \qquad [27]$$

Where:

E = Kinetic Energy; ft-lbs

W = Weight of axle, vehicle, or wheel; lbs.

V = Design speed of vehicle; ft/sec.

$$\text{BTU/hr. generated} = \frac{(E)\left(\text{stopping frequency/hr.}\right)}{778} \qquad [28]$$

Then solving for the number of square feet of exposed disc area to dissipate the heat generated:

$$\text{Sq. Ft. Disc Area} = \frac{\text{BTU/hr}}{660} \qquad [14]$$

The constant of 660 is based on a maximum disc temperature of 300°F.

If there is a restriction in the disc diameter(s) and there is sufficient time between stops or multiple of stops for heat dissipation then we can size the disc to act as a heat sink.

$$Wd = \frac{\text{BTU/hr.}}{(220)(Sp)} \qquad [9]$$

Where:

Wd = Weight of disc; lbs.

Sp = Specific heat of disc may be taken as .12 for steel; BTU/lbs-°F

Refer to Table 1 (page 94) for selection. If your requirement falls outside of the standard(s) you may calculate the required thickness based on the maximum allowable diameter:

$$\text{Disc Thickness} = \frac{Wd}{(A)(.28)} \qquad [10]$$

Where:

Thickness is in inches

A = Area of maximum allowable diameter; in^2

If it is found the disc thickness is unrealistic from an economic or space limitation standpoint, multiple discs will have to be provided or force ventilation must be considered.

Caliper Disc Brakes

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APPLICATION DATA WORKSHEET

Use this form to request engineering assistance. The data you furnish will enable us to understand your application and recommend* the proper braking equipment. When available, please attach prints or dimensional drawings. For best results copy this page first then fax to: (763) 478-8080 or Mail to: Tolomatic, 3800 County Road 116, Hamel, MN 55340

NAME: _____

TITLE: _____

FIRM: _____

ADDRESS: _____

CITY: _____

STATE: _____ ZIP: _____

PHONE: (_____) _____

FAX: (_____) _____

A. VEHICLE SPECIFICATIONS

PLEASE CONTACT FACTORY

B. TENSIONING DATA

_____

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_____

C. STATIONARY EQUIPMENT SPECIFICATIONS

CYCLIC STOPS? ___ Yes ___ No

W = Weight of rotating member, lbs.

R = Radius of rotating member, ft.

WK² OF ROTATING PARTS_____@RPM _____

DECELERATION NEEDED:

___ Time_____ seconds from _____RPM

___ _____ Radians per sec.²

RELEASE PRESSURE FOR SPRING-APPLIED BRAKES ..... _____psi

TYPE OF EQUIPMENT BRAKES WILL BE USED ON:

_____

_____

_____

_____

_____

MODEL: _____ PROJECT #: _____

D. GENERAL APPLICATION DATA

FREQUENCY OF STOPS:..... _____

COMPLETE OPERATING CYCLE:..... _____

MAXIMUM ALLOWABLE DISC DIAMETER:..... _____in.

MAXIMUM ALLOWABLE DISC THICKNESS:..... _____in.

TYPE OF ACTUATION: ___ Mechanical ___ Spring Applied ___ Pneumatic ___ Hydraulic

MAXIMUM HYDRAULIC OR AIR PRESSURE:..... _____psi

BACK PRESSURE: ..... _____psi

DRIVE SHAFT APPLICATIONS ONLY:

Gear ratio is_____in favor of_____, or against_____the brake

AVAILABLE DISPLACEMENT:..... _____ in.³

TYPE OF FLUID: _____MAXIMUM TORQUE: _____in.-lbs.

AMBIENT TEMPERATURES TO BE ENCOUNTERED:..... _____°F

LINING LIFE DESIRED: ..... _____

LEVER FORCE AVAILABLE..... _____lbs.

E. ADDITIONAL COMMENTS

_____

_____

_____

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_____

_____

_____

_____

_____

* Recommendation is based on information supplied by the customer. Final acceptance and approval is the responsibility of the customer after field testing or simulation of field testing on the machine it is designed for.

Tolomatic
EXCELLENCE IN MOTION®

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