Sizing caliper disc brakes can be an easy process.

The goal is to determine how much braking torque is required and finding the most cost effective and efficient brake and disc diameter package. Go to the appropriate formulas for either industrial or vehicular applications and begin. Confirm your selection by faxing the sizing worksheet, page 20, to our customer service group.

INDUSTRIAL FORMULA - STOPPING

i. Calculate braking torque for application involving stopping in a specified period of time.

$$T = \frac{WK^2N}{308t}$$

Where:
- T = Torque, ft.-lb
- W = Weight of rotating member, lb.
- K^2 = Radius of gyration of rotating member, ft. (see graphics below)
- N = RPM
- t = Stopping time required, seconds.

i_a. Determine heat generation and dissipation by calculating Btu's per stop.

$$\text{Btu/stop} = \frac{WK^2N^2}{4{,}570{,}000} \quad \text{or} \quad \frac{\pi TNt}{46{,}680}$$

i_b. Determine Btu's per hour.

$$\text{Btu/hour} = (\text{Btu/stop})(\text{stops/hr})$$

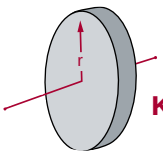
i_c. Determine square feet of exposed disc area sufficient enough to dissipate heat.

$$\text{Sq. ft. of disc area} = \frac{\text{BTU/hr}}{660}$$

i_d. See Table 1 above to select correct disc diameter.

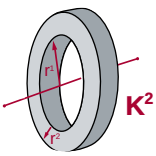
i_e. See helpful guidelines section on next page.

Solid cylinder about its own axis



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

Hollow cylinder about its own axis



$$K^2 = \frac{r^1 + r^2}{2}$$

Radius of gyration for geometrical forms references an axis at which the entire mass of the body may be considered as concentrated.

If your application involves other geometric forms consult a reference guide such as Machinery's Handbook.

TABLE 1.

Exposed areas, weights and BTU/hr of commonly used discs.

DISC DIA.	EXPOSED AREA		WEIGHT LBS.	MAX. BTU/HR @ 300° F
	SQ. IN.	SQ. FT.		
6 5/16	62.58	.43	1.37	283.8
8	100.53	.70	3.52	462.0
10	157.08	1.09	5.46	719.4
12	226.20	1.57	7.91	1036.0
16	402.12	2.79	14.07	1841.4

INDUSTRIAL FORMULA -TENSIONING

ii. Calculate braking torque for application involving tensioning or constant drag.

$$T = (L)\,(F)\,(R), \text{ inch lbs.}$$

Where:
- L = Web width, in.
- F = Tension, lb. per in. of web width
- R = Maximum roll radius, in.

ii_a. Find Btu's per hour.

$$\text{Btu/hour} = \frac{(T)\,(rpm)}{24.75}$$

rpm can be found by converting web velocity usually given in feet per minute (fpm).

$$rpm = \frac{fpm}{C}$$

Where C = Circumference at maximum roll diameter, ft.

ii_b. Calculate heat dissipation for tensioning application by determining square feet of exposed disc area required.

$$\text{Sq. ft. of disc area} = \frac{\text{Btu/hr}}{660^*}$$

* The constant of 660 is for a maximum disc temperature of 300°.

ii_c. See Table 1 above to select correct disc diameter.

ii_d. See Helpful Guidelines section on next page.

VEHICULAR FORMULA

i. Calculate braking torque (Dynamic).

$$T = \frac{WR\left[\frac{a}{g} + \frac{b}{100}\right]}{D}$$

Where:

T	=	Torque, ft.-lb./Axle, vehicle or wheel
W	=	Weight on axle including weight transfer, if any, vehicle or wheel.
R	=	Loaded tire radius, ft.
g	=	32.2
b	=	% of grade
D	=	Gear reduction, if drive line mounted
a	=	Deceleration rate, ft/sec^2.

If a is not known solve:

$$a = \frac{V}{t} = \frac{V^2}{2S}$$

Where:

V	=	Velocity of vehicle, ft./sec. at moment of applying brake.
t	=	Stopping time required, seconds.
S	=	Stopping distance of vehicle, ft.

or

i. Calculate braking torque (Parking).

$$T = \frac{WR\left[\frac{b}{100}\right]}{D}$$

i_a. Determine heat generation and dissipation.

$$E = \frac{WV^2}{2g}$$

Where:

E	=	Kinetic Energy, ft. ib.
W	=	Weight of axle, vehicle or wheel, lb.
V	=	Speed of vehicle, ft./sec.

i_b. Calculate Btu's per hour generated.

$$\text{Btu/hr. generated} = \frac{(E)\ (\text{stopping frequency/hr.})}{778}$$

i_c. Determine square feet of exposed disc area sufficient enough to dissipate heat.

$$\text{Sq. ft. of disc area} = \frac{\text{Btu/hr}}{660}$$

i_d. See Table 1 on previous page to determine disc diameter.

i_e. See Helpful Guidelines section.

i_f. After determining the caliper disc brake and disc diameter necessary for your application, please contact W.C. Branham for confirmation. All vehicular applications must be approved by W.C. Branham in writing.

Helpful guidelines

1. For best service life do not exceed disc temperature of 300° F.
2. Formulas for heat dissipation are based on 220° F temperature rise and 80° F ambient.
3. 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".

FRICTION MATERIAL LIFE EXPECTANCY

Figure 1, at right, depicts friction material life per cubic inch in horsepower hours. To determine life in hours of a brake or brakes, see below.

i. Find life in hours of brake or brakes (most commonly used in tensioning or dragging applications)

$$\text{Ft. lb/hr} = (\text{Btu/hr})\ (778)$$

i_a. Determine horsepower hours per hour.

$$\text{Hp hrs/hr} = \frac{\text{Ft. lb./hr}}{1{,}980{,}00}$$

i_b. Locate Table 2 below, and find the cubic inches of wearable material for various WCB caliper disc brakes. Calculate life in hours.

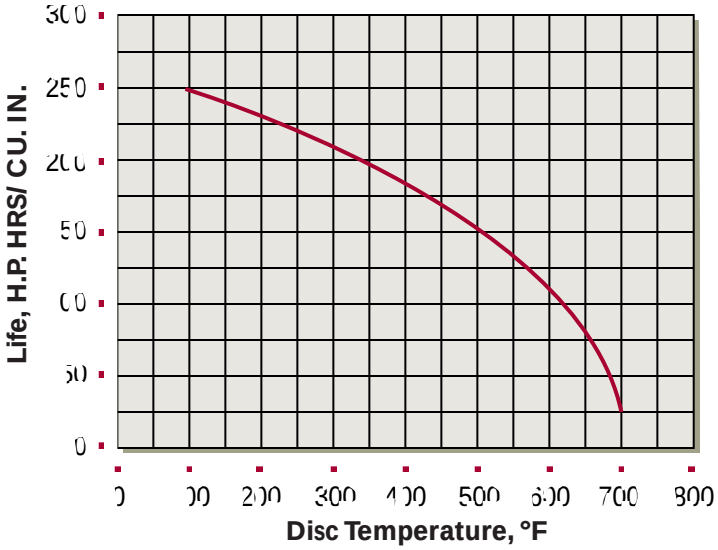
$$\text{Life in hours} = \frac{(\#\ \text{of brakes})\ (M)\ (\text{HP hrs/in}^3)}{\text{HP hrs/hr}}$$

Where:
M = Cubic inches of wearable material taken from Table 2 for desired caliper disc brake.

TABLE 2.
Wearable friction material of WCB brakes

38 Series	.46 Cubic inches
47 Series	.83 Cubic inches
47 Series (retractable)	.48 Cubic inches
200 Series	1.66 Cubic inches
200 Series (retractable)	.95 Cubic inches
493 Series	3.45 Cubic inches
962 Series	19.0 Cubic inches

Figure 1.
General Industrial Molded Friction Material



FRICTION MATERIAL LIFE EXPECTANCY

If necessary, find the amount of life in stops of a brake or brakes. Kinetic energy can be removed from a rotating mass brought to rest. Calculate as follows:

$$E_{\text{ft. lb}} = \frac{(\pi)\ (T)\ (N)\ (t)}{60} \quad \textbf{or} \quad E_{\text{ft. lb}} = \frac{(WK^2)\ (N^2)}{5872}$$

i. Calculate Horsepower hours per stop.

$$\text{Hp hrs/stop} = \frac{E}{1{,}980{,}000}$$

i_a. Find life in stops

$$\text{Life in stops} = \frac{(\#\ \text{of brakes})\ (M)\ (\text{HP hrs/in}^3)}{\text{HP hrs/stop}}$$

Where:
M = Cubic inches of wearable material taken from Table 2 for desired caliper disc brake.

*Note: Friction material life expectancies are **calculated estimates** and do not take into consideration of any foreign contaminants which may reduce wear life. It is suggested that when life must be known accurately, field tests should be conducted.*

TABLE 3.

Cam travel data for WCB mechanical disc brakes.

M38 AND M47 SERIES BRAKES

a. 15° maximum travel when friction pads are new and with 1/32" gap on each side of disc.

b. Periodic tightening of lock nut will reduce travel of level and will allow 1/4" wear on each friction pad.

c. 90° maximum travel after 3/16" wear on each friction pad and without intermediate tightening of lock nut.

M200 SERIES BRAKES

a. Gap between friction pad faces and disc when new = .048" total.

b. Angular movement of lever required to actuate brake when new = 7° 30’

c. Maximum axial movement without intermediate adjustment = .387".

d. .208" total wear allowed before adjustment of each side.

PRESSURE RATINGS

38 Series	1000 PSI Maximum
47 Series	1000 PSI Maximum
200 Series	1500 PSI Maximum
493 Series	1500 PSI Maximum
962 Series	1000 PSI Maximum

MECHANICAL BRAKE LEVER FORCES

38 Series	450 lb. Maximum
47 Series	450 lb. Maximum
200 Series	580 lb. Maximum

Braking torque (inch/lb)

H/P 38 SERIES

Dynamic: 70 lb. of force per 100 PSI x Braking Radius (inches)

Parking/Static: 35 lb. of force per 100 PSI x Braking Radius (inches)

H/P 47 SERIES

Dynamic: 144 lb. of force per 100 PSI x Braking Radius (inches)

Parking/Static: 72 lb. of force per 100 PSI x Braking Radius (inches)

H/P 200 SERIES

Dynamic: 288 lb. of force per 100 PSI x Braking Radius (inches)

Parking/Static: 144 lb. of force per 100 PSI x Braking Radius (inches)

H 493 SERIES

Dynamic: 353 lb. of force per 100 PSI x Braking Radius (inches)

Parking/Static: 211 lb. of force per 100 PSI x Braking Radius (inches)

H/P 962 SERIES

Dynamic: 693 lb. of force per 100 PSI x Braking Radius (inches)

Parking/Static: 347 lb. of force per 100 PSI x Braking Radius (inches)

M38/M47 SERIES

Dynamic: 2.69 x Lever Force (lb.) x Braking Radius (inches).

Parking/Static: 1.75 x Lever Force (lb.) x Braking Radius (inches).

M200 SERIES

Dynamic: 7.45 x Lever Force (lb.) x Braking Radius (inches).

Parking/Static: 3.73 x Lever Force (lb.) x Braking Radius (inches).

Sizing worksheet

for industrial applications only, consult factory on vehicular applications.

Complete the following. Keep this page as an original by copying before proceeding.

Your Name: _____

Company: _____ Title: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Phone (_____) _____ Fax (_____) _____

Describe the application:

_____

_____

_____

_____

Application data:

Weight of rotating member, lb. . . . . _____
Radius of gyration of rotating member, ft. . . . . _____
RPM . . . . . _____
Stopping time required, seconds. . . . . _____
# of stops / minute . . . . . _____
Maximum allowable disc diameter. in. . . . . _____
Disc thickness, in. . . . . _____
Actuation: Mechanical • Pneumatic • Hydraulic • Spring Applied
Amount of pressure available, psi. . . . . _____
Back pressure, if any, psi. . . . . _____
Type of fluid . . . . . _____
Ambient temperature . . . . . _____
Desired friction pad life . . . . . _____
Tensioning or dragging application:
Web width, in. . . . . _____
Amount of tension per inch of web width, lb. . . . . _____
Maximum roll radius, in. . . . . _____
Web velocity, feet per minute . . . . . _____

Please submit this form via fax 715.426.1400. Attention: Customer Service Group.
We will acknowledge receipt of your criteria promptly. Our recommendation is based on information supplied by the customer. Final acceptance and approval is the responsibility of the customer. Each application should be prototyped and tested.