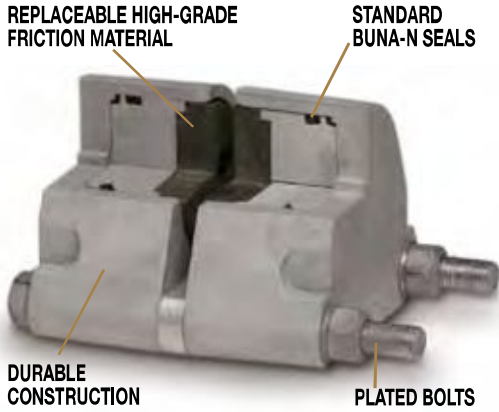


## FEATURES

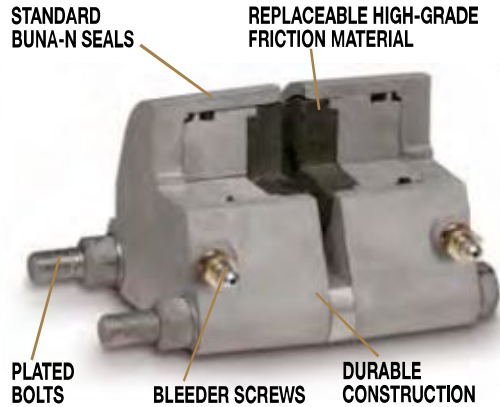
- FEATURES
- APPLICATIONS
- SELECTION GRAPHS
- PNEUMATIC BRAKES
- P10
- P20
- P220
- HYDRAULIC BRAKES
- H10
- H20
- H220
- H220I
- H441
- H960
- HYDRAULIC/MECHANICAL BRAKE COMBOS
- H/ME20
- H/ME220
- MECHANICAL BRAKES
- ME10
- ME20
- ME220
- MB3
- SPRING APPLIED BRAKES
- FS20
- FS220
- FS220I
- FS595
- DISCS HUBS & BUSHINGS
- TENSION CONTROL COMBINATIONS
- INTENSIFIER
- SELECTION WORKSHEET

### PNEUMATIC BRAKES



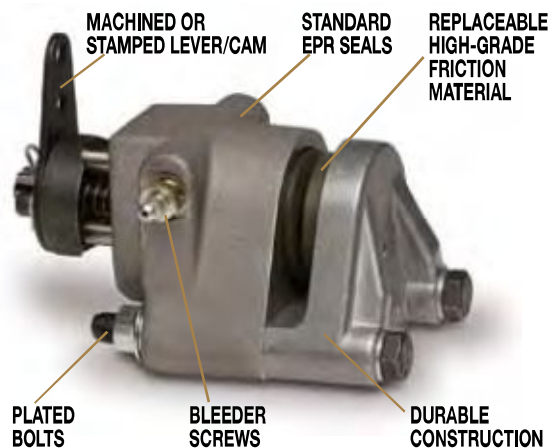
Tolomatic manufactures pneumatic brakes in three sizes: P10 Series, P20 Series and P220 Series. Available in both double acting or single acting. These brakes feature replaceable, high-grade friction material, standard Buna-N seals, aluminum construction and zinc plated bolts. Options include EPR seals, 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)

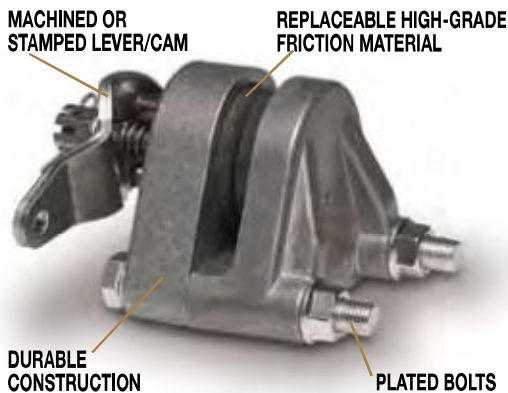
### HYDRAULIC / MECHANICAL BRAKES



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)

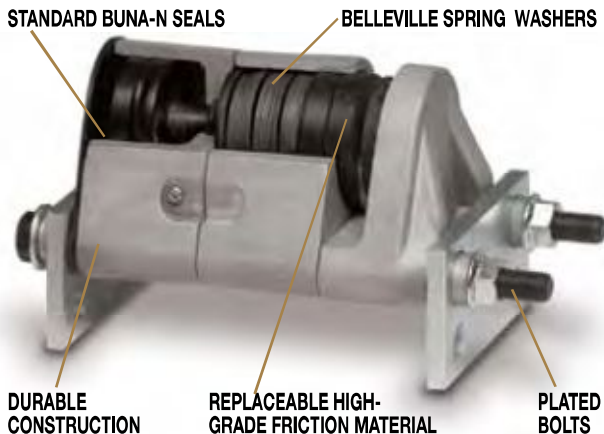
## FEATURES

### MECHANICAL BRAKES



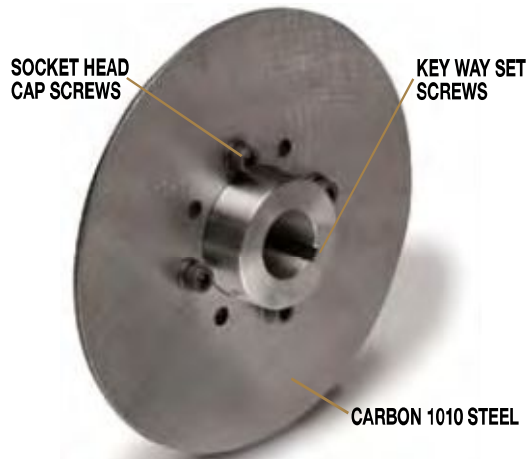
Tolomatic manufactures a broad range of mechanical brakes in these series: ME10, ME20, ME220 and MB3. Designed for use in areas that do not have access to other types of power, these single acting calipers feature replaceable, high-grade friction material, aluminum or cast iron construction (depending 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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## H10 SERIES - ALUMINUM

### AVAILABLE STYLES

#### Double Acting

FIXED MOUNT - FIXED DISC



PICTURED: 0701-0010

#### Single Acting

FIXED MOUNT - FLOATING DISC



PICTURED: 0705-0010

#### Single Acting with Floating Bracket

FLOATING MOUNT - FIXED DISC



PICTURED:  
0705-0011

### H10 SPECIFICATIONS

Maximum Pressure Rating:	1,000 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 <sup>3</sup>
Wearable friction material/retractable models:	0.13 in <sup>3</sup>
Friction material:	Replaceable, high-grade
Total lining area:	1.84 in <sup>2</sup>
Total lining area/retractable materials:	1.64 in <sup>2</sup>
Piston diameter:	1.125 in.
Fluid displacement, non-retractable:	Single acting = 0.029 in <sup>3</sup> Double acting = 0.029 in <sup>3</sup>

#### OPTIONS

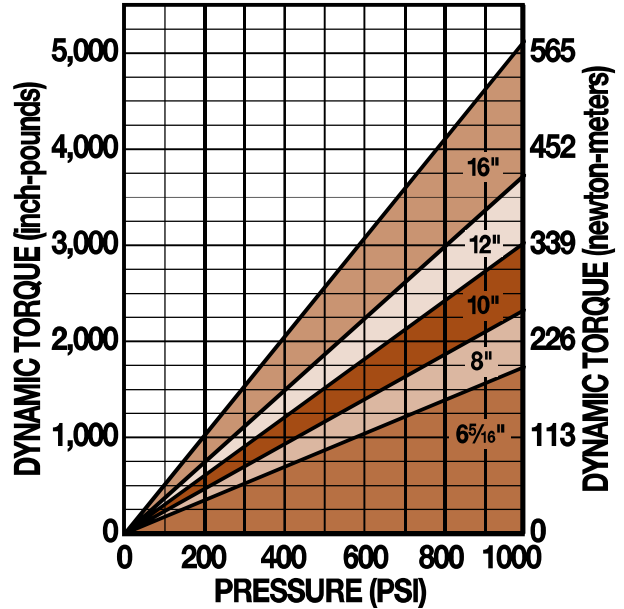
Seals:	EPR seals
Pistons:	Retractable piston(s)
Floating bracket:	Stamped steel construction

### DISC SIZING EQUATIONS

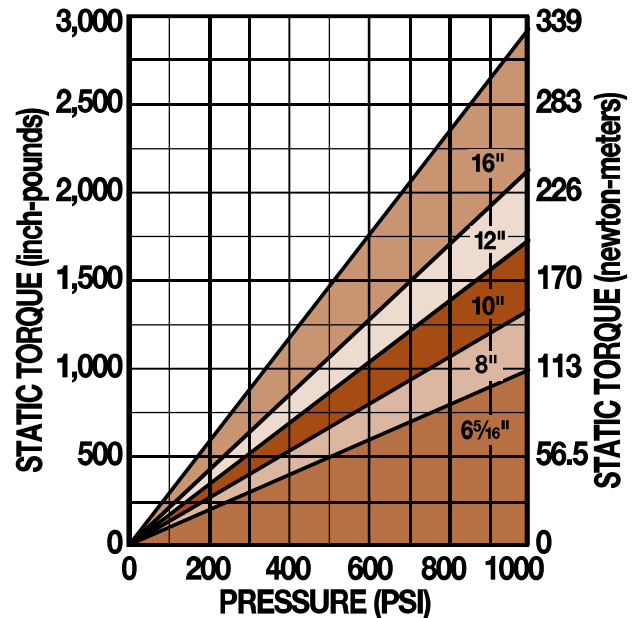
DYNAMIC TORQUE (IN.-LBS.) = 0.70 x BRAKING RADIUS (IN.) x PRESSURE (PSI)  
 STATIC (PARKING) TORQUE (IN.-LBS.) = 0.40 x BRAKING RADIUS (IN.) x PRESSURE (PSI)  
 BRAKING RADIUS (IN.) = [DISC DIAMETER ÷ 2] - 0.624

### PERFORMANCE DATA

#### Dynamic Torque vs Pressure



#### Static Torque vs Pressure

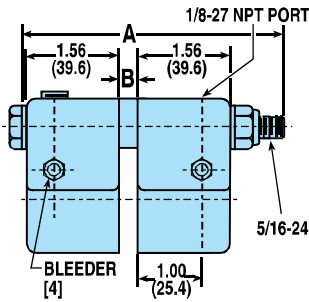


## H10 SERIES - ALUMINUM

### DOUBLE ACTING FIXED MOUNT - FIXED DISC

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

Weight 1.0 lbs. .45 kgs.

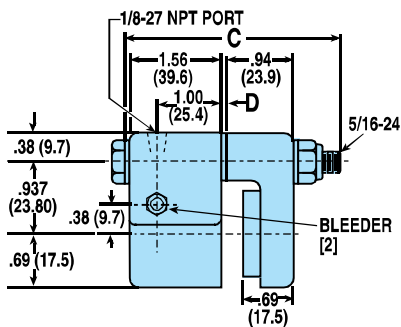


MODEL CODE	DISC THK.	A	B	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H10DAC	5/32"	3.50"	.281"	Double Acting	0701-0010
H10DACG	5/32"	3.50"	.281"	Double Acting, EPR Seals	0701-0011
H10DARC	5/32"	3.50"	.281"	Double Acting, Retractable Pistons	0708-0010
H10DARCG	5/32"	3.50"	.281"	Double Acting, Retr Pist, EPR Seals	0708-0011
H10DBC	1/4"	3.50"	.375"	Double Acting	0702-0010
H10DBCg	1/4"	3.50"	.375"	Double Acting, EPR Seals	0702-0011
H10DBRC	1/4"	3.50"	.375"	Double Acting, Retractable Pistons	0709-0010
H10DBRCg	1/4"	3.50"	.375"	Double Acting, Retr Pist, EPR Seals	0709-0011

### SINGLE ACTING FIXED MOUNT - FLOATING DISC

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

Weight .75 lbs. .34 kgs.



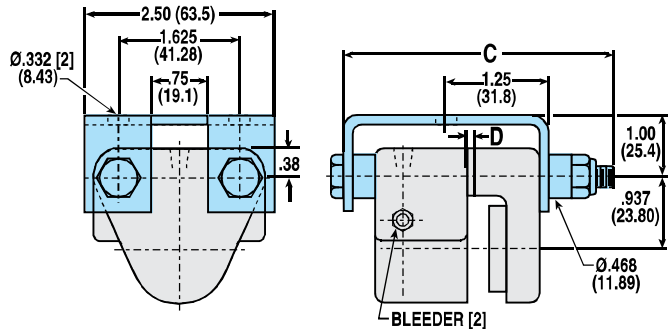
MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H10SAC	5/32"	3.00"	-	Single Acting	0705-0010
H10SACG	5/32"	3.00"	-	Single Acting, EPR Seals	0705-0008
H10SBC	1/4"	3.00"	.094"	Single Acting	0703-0010

### SINGLE ACTING WITH FLOATING BRACKET

FLOATING MOUNT - FIXED DISC

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

Weight 1.5 lbs. .68 kgs.

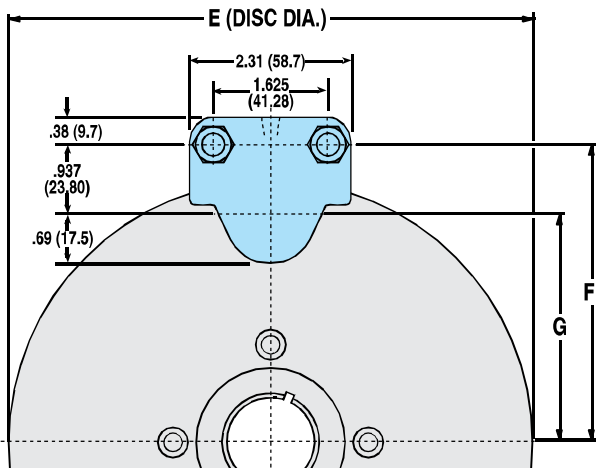


See SINGLE ACTING dimensional drawing for additional measurements

MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H10SAFC	5/32"	3.75"	-	Single Acting, Floating Bracket	0705-0011
H10SAFCG	5/32"	3.75"	-	Single Acting, FtgBrkt,EPR Seals	0705-0009
H10SBFC	1/4"	3.75"	.094"	Single Acting, Floating Bracket	0703-0013

### 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	D Double Acting	H Hydraulic Brake
B 1/4" Thick Disc	F Floating Bracket Mount	R Retractable Piston(s)
C With Bleeder Fitting	G EPR Seals	S Single Acting

CALIPER  
DISC  
BRAKES

FEATURES

APPLICATIONS

SELECTION  
GRAPHS

PNEUMATIC  
BRAKES

P10

P20

P220

HYDRAULIC  
BRAKES

H10

H20

H220

H2201

H441

H960

HYDRAULIC/  
MECHANICAL  
BRAKE  
COMBOS

H/ME20

H/ME220

MECHANICAL  
BRAKES

ME10

ME20

ME220

MB3

SPRING  
APPLIED  
BRAKES

FS20

FS220

FS2201

FS595

DISCS  
HUBS &  
BUSHINGS

TENSION  
CONTROL  
COMBINATIONS

INTENSIFIER

SELECTION

WORKSHEET

## H20 SERIES - ALUMINUM

### AVAILABLE STYLES

#### Double Acting

FIXED MOUNT - FIXED DISC



PICTURED: 0720-0010

#### Single Acting

FIXED MOUNT - FLOATING DISC



PICTURED: 0724-0010

#### Single Acting with Floating Bracket

FLOATING MOUNT - FIXED DISC



PICTURED:  
0724-0011

### H20 SPECIFICATIONS

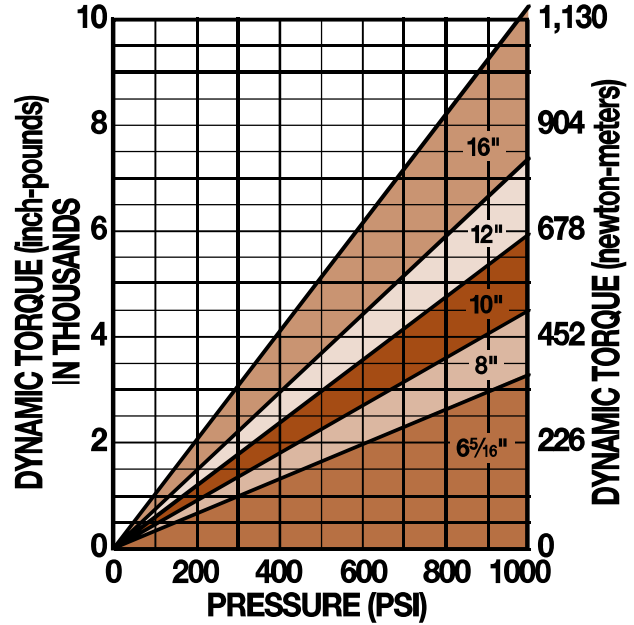
Maximum Pressure Rating:	1,000 PSI
Accommodates Tolomatic disc diameters:	6-5/16", 8", 10", 12", 16"
Maximum disc diameter:	none
Housing Material:	Extruded aluminum
Bolts:	Zinc plated grade 8
Seals:	Buna-N Standard
Wearable friction material:	0.8 in <sup>3</sup>
Wearable friction material/retractable models:	0.5 in <sup>3</sup>
Friction material:	Replaceable, high-grade
Total lining area:	3.75 in <sup>2</sup>
Piston diameter:	1.625 in.
Fluid displacement, non-retractable:	Single acting = 0.062 in <sup>3</sup> Double acting = 0.062 in <sup>3</sup>

#### OPTIONS

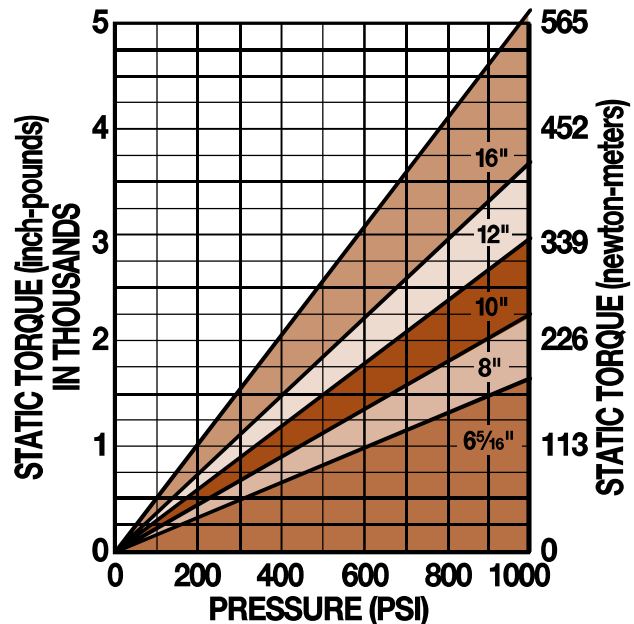
Seals:	EPR seals
Pistons:	Retractable piston(s)
Floating bracket:	Stamped steel construction

### PERFORMANCE DATA

#### Dynamic Torque vs Pressure



#### Static Torque vs Pressure



### DISC SIZING EQUATIONS

$$\text{DYNAMIC TORQUE (IN.-LBS.)} = 1.44 \times \text{BRAKING RADIUS (IN.)} \times \text{PRESSURE (PSI)}$$

$$\text{STATIC (PARKING) TORQUE (IN.-LBS.)} = 0.72 \times \text{BRAKING RADIUS (IN.)} \times \text{PRESSURE (PSI)}$$

$$\text{BRAKING RADIUS (IN.)} = [\text{DISC DIAMETER} \div 2] - 0.875$$

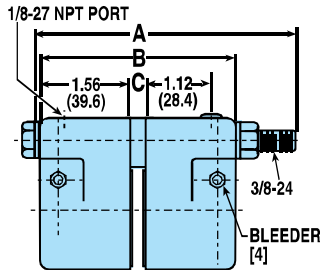
# Caliper Disc Brakes

## H2O 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.

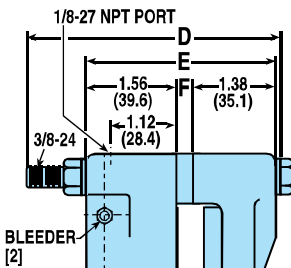


MODEL CODE	DISC THK.	A	B	C	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H20DAC	5/32"	4.50"	3.41"	.281"	Double Acting	0720-0010
H20DAGC	5/32"	4.50"	3.41"	.281"	Double Acting, EPR Seals	0720-0011
H20DARC	5/32"	4.50"	3.41"	.281"	Dbl. Acting, Retractable Pistons	0728-0010
H20DARCG	5/32"	4.50"	3.41"	.281"	Dbl. Acting, Retr Pist, EPR Seals	0728-0011
H20DBC	1/4"	4.50"	3.50"	.375"	Double Acting	0721-0010
H20DBCg	1/4"	4.50"	3.50"	.375"	Double Acting, EPR Seals	0721-0011
H20DBRC	1/4"	4.50"	3.50"	.375"	Dbl. Acting, Retractable Pistons	0729-0010
H20DBRCg	1/4"	4.50"	3.50"	.375"	Dbl. Acting, Retr Pist, EPR Seals	0729-0011
H20DLRC	3/8"	4.50"	3.62"	.500"	Dbl. Acting, Retractable Pistons	0729-0008
H20DEC	1/2"	5.00"	3.75"	.625"	Double Acting	0725-0010
H20DECg	1/2"	5.00"	3.75"	.625"	Double Acting, EPR Seals	0725-0011
H20DERC	1/2"	5.00"	3.75"	.625"	Dbl. Acting, Retractable Pistons	0719-0010
H20DERCG	1/2"	5.00"	3.75"	.625"	Dbl. Acting, Retr Pist, EPR Seals	0719-0011

### SINGLE ACTING FIXED MOUNT - FLOATING DISC

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

Weight 1.5 lbs. .68 kgs.



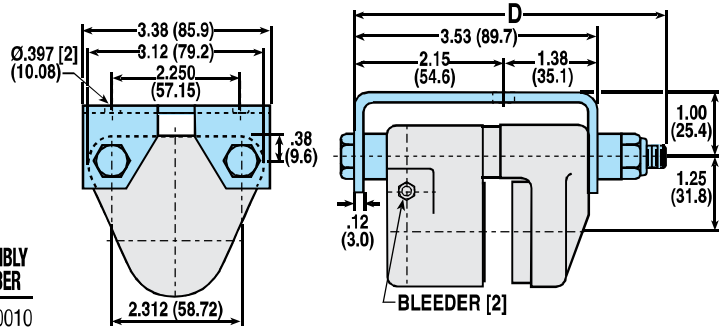
MODEL CODE	DISC THK.	D	E	F	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H20SAC	5/32"	3.75"	2.94"	-	Single Acting	0724-0010
H20SACg	5/32"	3.75"	2.94"	-	Single Acting, EPR Seals	0724-0012
H20SBC	1/4"	3.75"	3.03"	.094"	Single Acting	0722-0010
H20SBCg	1/4"	3.75"	3.03"	.094"	Single Acting, EPR Seals	0722-0013
H20SLC	3/8"	4.00"	3.16"	.219"	Single Acting	0724-0014
H20SLCg	3/8"	4.00"	3.16"	.219"	Single Acting, EPR Seals	0724-0016

### SINGLE ACTING WITH FLOATING BRACKET

FLOATING MOUNT - FIXED DISC

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

Weight 2.0 lbs. .91 kgs.

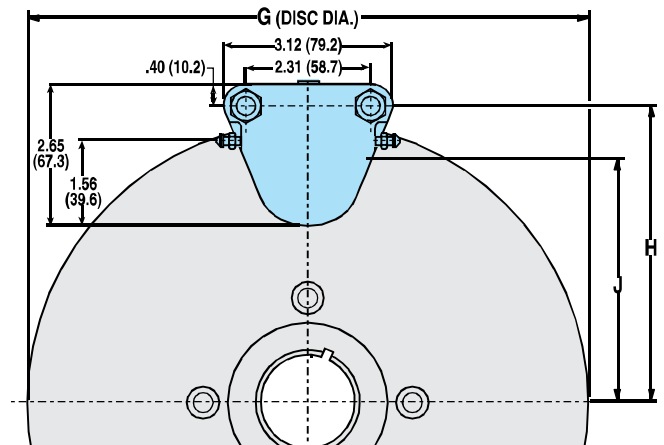


See SINGLE ACTING dimensional drawing for additional measurements

MODEL CODE	DISC THK.	D	E	F	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H20SAFC	5/32"	4.50"	2.94"	-	Sng Act, Floating Bracket	0724-0011
H20SAFCg	5/32"	4.50"	2.94"	-	Sng Act, Fltg Brkt, EPR Seals	0724-0013
H20SBFC	1/4"	4.50"	3.03"	.094"	Sng Act, Floating Bracket	0722-0011
H20SBFCg	1/4"	4.50"	3.03"	.094"	Sng Act, Fltg Brkt, EPR Seals	0722-0014

### MOUNTING DIMENSIONS

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



### BRAKE MODEL LETTER CODES

A 5/32" Thick Disc	E 1/2" Thick Disc	L 3/8" Thick Disc
B 1/4" Thick Disc	F Floating Bracket Mount	R Retractable Piston(s)
C With Bleeder Fitting	G EPR Seals	S Single Acting
D Double Acting	H Hydraulic Brake	

CALIPER  
DISC  
BRAKES

FEATURES

APPLICATIONS

SELECTION  
GRAPHS

PNEUMATIC  
BRAKES

P10

P20

P220

HYDRAULIC  
BRAKES

H10

H20

H220

H220I

H441

H960

HYDRAULIC/  
MECHANICAL  
BRAKE  
COMBOS

H/ME20

H/ME220

MECHANICAL  
BRAKES

ME10

ME20

ME220

MB3

SPRING  
APPLIED  
BRAKES

FS20

FS220

FS220I

FS595

DISCS  
HUBS &  
BUSHINGS

TENSION  
CONTROL  
COMBINATIONS

INTENSIFIER

SELECTION  
WORKSHEET

# Caliper Disc Brakes

## H220 SERIES - ALUMINUM

### AVAILABLE STYLES

#### Double Acting

FIXED MOUNT - FIXED DISC



PICTURED: 0735-0301

#### Single Acting

FIXED MOUNT - FLOATING DISC



PICTURED: 0733-0201

#### Single Acting with Floating Bracket

FLOATING MOUNT - FIXED DISC



PICTURED:  
0733-0222

### H220 SPECIFICATIONS

Maximum Pressure Rating:	1,500 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 <sup>2</sup>
Wearable friction material/retractable models:	1.0 in <sup>2</sup>
Friction material:	Replaceable, high-grade
Total lining area:	7.5 in <sup>2</sup>
Piston diameter:	1.625 in.
Fluid displacement, non-retractable:	Single acting = 0.124 in <sup>3</sup> Double acting = 0.124 in <sup>3</sup>

#### OPTIONS

Seals:	EPR seals
Pistons:	Retractable piston(s)
Floating bracket:	Available

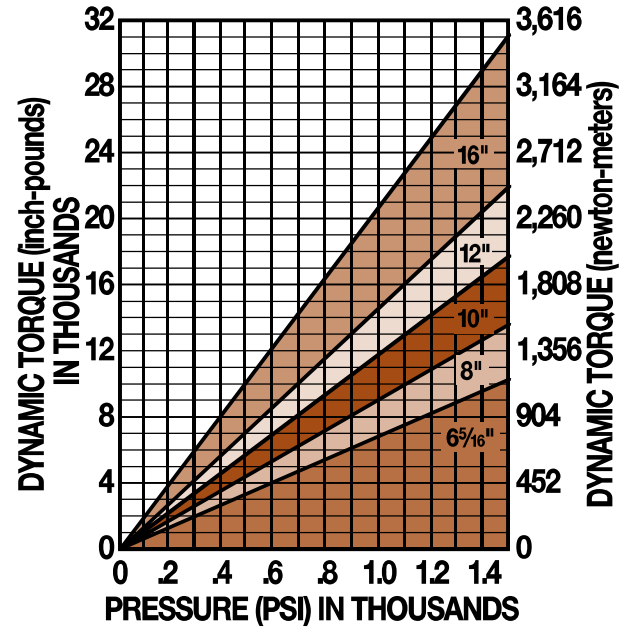
### DISC SIZING EQUATIONS

$$\text{DYNAMIC TORQUE (IN.-LBS.)} = 2.88 \times \text{BRAKING RADIUS (IN.)} \times \text{PRESSURE (PSI)}$$

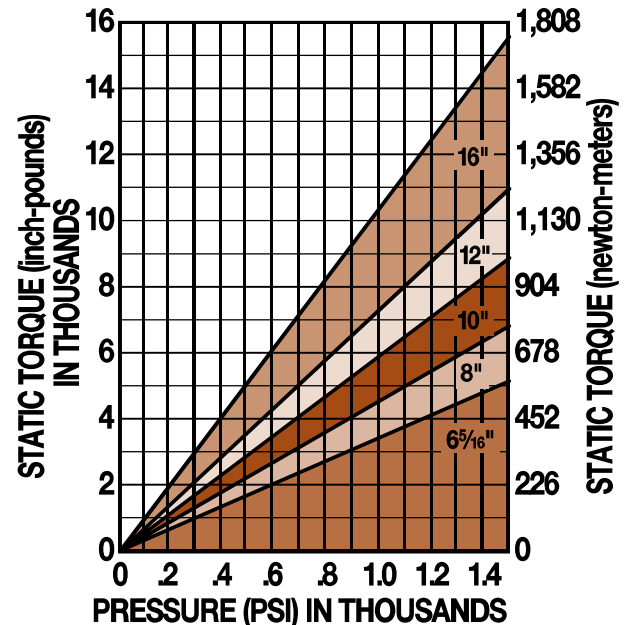
$$\text{STATIC (PARKING) TORQUE (IN.-LBS.)} = 1.44 \times \text{BRAKING RADIUS (IN.)} \times \text{PRESSURE (PSI)}$$

### PERFORMANCE DATA

#### Dynamic Torque vs Pressure



#### Static Torque vs Pressure



### BRAKE MODEL LETTER CODES

<b>A</b> 5/32" Thick Disc	<b>D</b> Double Acting	<b>H</b> Hydraulic Brake
<b>B</b> 1/4" Thick Disc	<b>E</b> 1/2" Thick Disc	<b>R</b> Retractable Piston(s)
<b>C</b> With Bleeder Fitting	<b>F</b> Floating Bracket Mount	<b>S</b> Single Acting
	<b>G</b> EPR Seals	

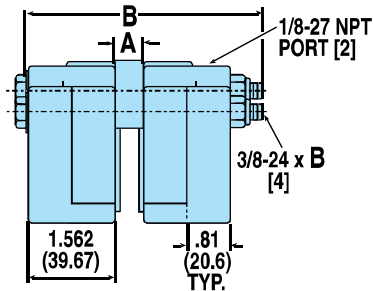
# Caliper Disc Brakes

## H220 SERIES - ALUMINUM

### DOUBLE ACTING FIXED MOUNT - FIXED DISC

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

Weight 4.0 lbs. 1.82 kgs.

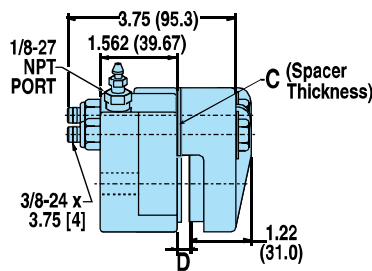


MODEL CODE	DISC THK.	A	B	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H220DAC	5/32"	.281"	4.50"	Double Acting	0735-0101
H220DACG	5/32"	.281"	4.50"	Double Acting, EPR Seals	0735-0103
H220DARC	5/32"	.281"	4.50"	Dbl Act, Retractable Pistons	0736-0111
H220DARCG	5/32"	.281"	4.50"	Dbl Act, Retractable Pistons, EPR Seals	0736-0112
H220DBC	1/4"	.375"	4.50"	Double Acting	0735-0201
H220DBCg	1/4"	.375"	4.50"	Double Acting, EPR Seals	0735-0202
H220DBRC	1/4"	.375"	4.50"	Dbl Act, Retractable Pistons	0736-0211
H220DBRCg	1/4"	.375"	4.50"	Dbl Act, Retractable Pistons, EPR Seals	0736-0212
H220DEC	1/2"	.625"	5.00"	Double Acting	0735-0301
H220DECg	1/2"	.625"	5.00"	Double Acting, EPR Seals	0735-0302
H220DERC	1/2"	.625"	5.00"	Dbl Act, Retractable Pistons	0736-0311
H220DERCG	1/2"	.625"	5.00"	Dbl Act, Retractable Pistons, EPR Seals	0736-0312

### SINGLE ACTING FIXED MOUNT - FLOATING DISC

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

Weight 3.0 lbs. 1.36 kgs.



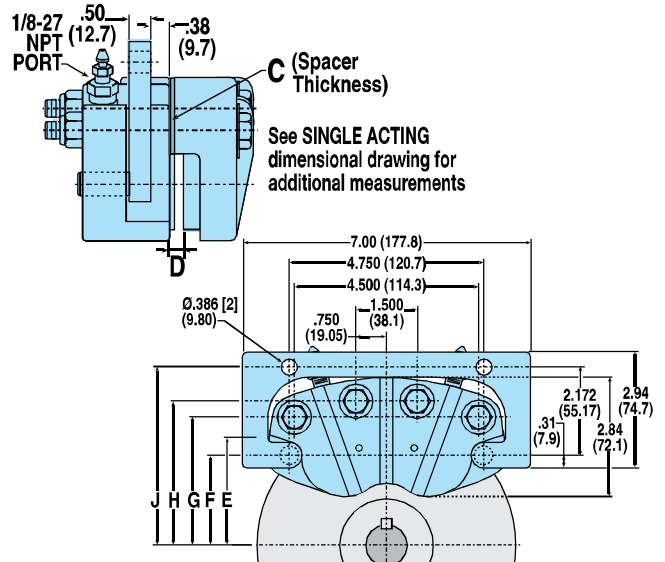
MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H220SAC	5/32"	—	.25"	Single Acting	0733-0001
H220SACG	5/32"	—	.25"	Single Acting, EPR Seals	0733-0006
H220SBC	1/4"	.094"	.34"	Single Acting	0733-0101
H220SBCG	1/4"	.094"	.34"	Single Acting, EPR Seals	0733-0102
H220SEC	1/2"	.344"	.59"	Single Acting	0733-0201
H220SECG	1/2"	.344"	.59"	Single Acting, EPR Seals	0733-0202

### SINGLE ACTING WITH FLOATING BRACKET

FLOATING MOUNT - FIXED DISC

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

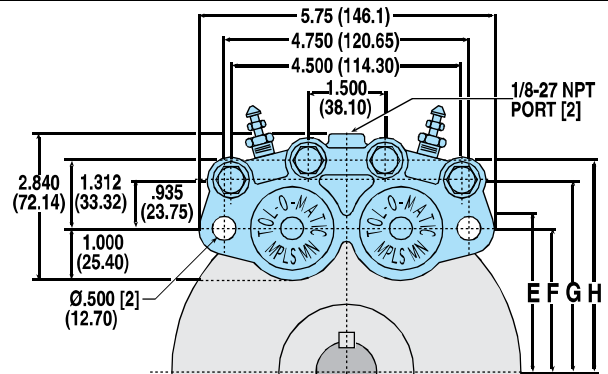
Weight 4.5 lbs. 2.04 kgs.



MODEL CODE	DISC THK.	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H220SAFC	5/32"	—	.25"	Single Acting, Floating Bracket	0733-0021
H220SAFCG	5/32"	—	.25"	Sgl Act, Floating Bracket, EPR Seals	0733-0022
H220SBFC	1/4"	.094"	.34"	Sgl Act, Floating Bracket	0733-0121
H220SBFCG	1/4"	.094"	.34"	Sgl Act, Floating Bracket, EPR Seals	0733-0122
H220SEFC	1/2"	.344"	.59"	Sgl Act, Floating Bracket	0733-0221
H220SEFCG	1/2"	.344"	.59"	Sgl Act, Floating Bracket, EPR Seals	0733-0222

### 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

FEATURES

APPLICATIONS

SELECTION  
GRAPHS

PNEUMATIC  
BRAKES

P10

P20

P220

HYDRAULIC  
BRAKES

H10

H20

H220

H2201

H441

H960

HYDRAULIC/  
MECHANICAL  
BRAKE  
COMBOS

H/ME20

H/ME220

MECHANICAL  
BRAKES

ME10

ME20

ME220

MB3

SPRING  
APPLIED  
BRAKES

FS20

FS220

FS2201

FS595

DISCS  
HUBS &  
BUSHINGS

TENSION  
CONTROL  
COMBINATIONS

INTENSIFIER  
SELECTION

WORKSHEET



## H220I SERIES - CAST IRON

### AVAILABLE STYLES

#### Double Acting

FIXED MOUNT - FIXED DISC



PICTURED: 0735-0403

#### Single Acting

FIXED MOUNT - FLOATING DISC



PICTURED: 0733-0402

#### Single Acting with Floating Bracket

FLOATING MOUNT - FIXED DISC



PICTURED:  
0733-0422

### H220I SPECIFICATIONS

Maximum Pressure Rating:	1,500 PSI
Accommodates Tolomatic disc diameters:	6-5/16", 8", 10", 12", 16"
Maximum disc diameter:	16"
Housing Material:	Cast ductile iron
Bolts:	Zinc plated grade 8
Seals:	Buna-N Standard
Wearable friction material:	2.7 in <sup>3</sup>
Friction material:	Replaceable, high-grade
Total lining area:	9.6 in <sup>2</sup>
Piston diameter:	1.625 in.
Fluid displacement:	Single acting = 0.124 in <sup>3</sup> Double acting = 0.124 in <sup>3</sup>

#### OPTIONS

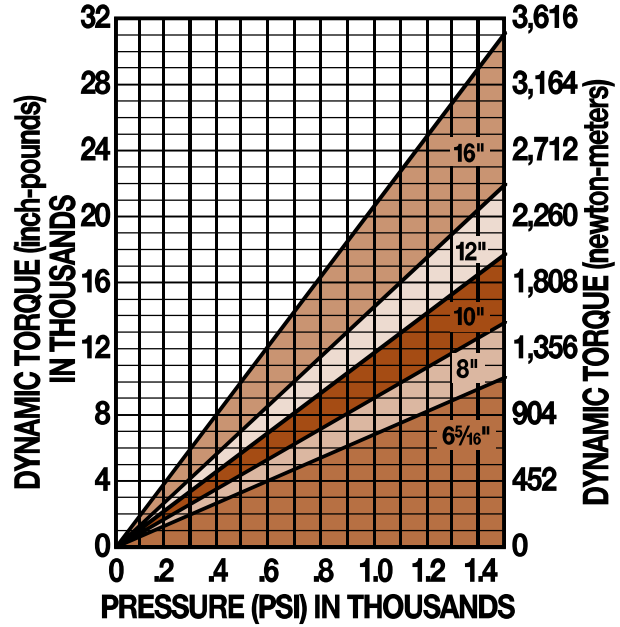
Seals:	EPR seals
Floating bracket:	Available

### DISC SIZING EQUATIONS

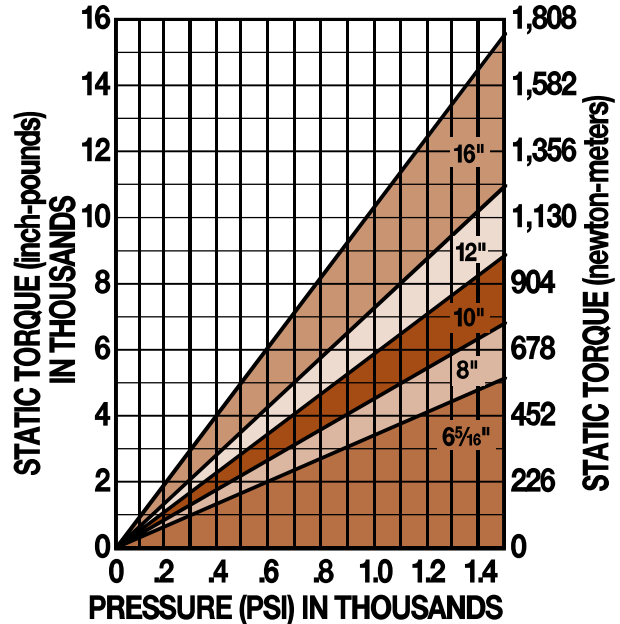
DYNAMIC TORQUE (IN.-LBS.) = 2.88 x BRAKING RADIUS (IN.) x PRESSURE (PSI)  
 STATIC (PARKING) TORQUE (IN.-LBS.) = 1.44 x BRAKING RADIUS (IN.) x PRESSURE (PSI)

### PERFORMANCE DATA

#### Dynamic Torque vs Pressure



#### Static Torque vs Pressure



### BRAKE MODEL LETTER CODES

<b>A</b> 5/32" Thick Disc	<b>E</b> 1/2" Thick Disc	<b>L</b> 3/8" Thick Disc
<b>B</b> 1/4" Thick Disc	<b>F</b> Floating Bracket Mount	<b>I</b> Iron
<b>C</b> With Bleeder Fitting	<b>G</b> EPR Seals	<b>O</b> 1-1/4" Thick Disc
<b>D</b> Double Acting	<b>H</b> Hydraulic Brake	<b>S</b> Single Acting

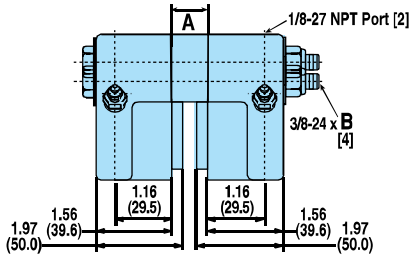
# Caliper Disc Brakes

## H220I SERIES - CAST IRON

### DOUBLE ACTING FIXED MOUNT - FIXED DISC

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

Weight 12.0 lbs. 5.40 kgs.

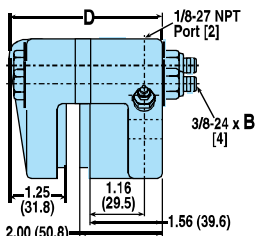


MODEL CODE	DISC THK.	A	B	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H220DACI	5/32"	1.031"	5.00"	Double Acting, Cast Iron	0735-0403
H220DACIG	5/32"	1.031"	5.00"	Double Acting, Cast Iron, EPR Seals	0735-0407
H220DBCIG	1/4"	1.125"	5.00"	Double Acting, Cast Iron, EPR Seals	0735-0408
H220DLCI	3/8"	1.250"	5.50"	Double Acting, Cast Iron	0735-0405
H220DLCIG	3/8"	1.250"	5.50"	Double Acting, Cast Iron, EPR Seals	0735-0409
H220DECI	1/2"	1.375"	6.00"	Double Acting, Cast Iron	0735-0406
H220DECIG	1/2"	1.375"	6.00"	Double Acting, Cast Iron, EPR Seals	0735-0410

### SINGLE ACTING FIXED MOUNT - FLOATING DISC

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

Weight 9.0 lbs. 4.08 kgs.



MODEL CODE	DISC THK.	B	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H220SACI	5/32"	4.00"	3.45"	Single Acting, Cast Iron	0733-0402
H220SACIG	5/32"	4.00"	3.45"	Single Acting, Cast Iron, EPR Seals	0733-0406
H220SBCI	1/4"	4.00"	3.55"	Single Acting, Cast Iron	0733-0403
H220SBCIG	1/4"	4.00"	3.55"	Single Acting, Cast Iron, EPR Seals	0733-0407
H220SLCI	3/8"	4.00"	3.67"	Single Acting, Cast Iron	0733-0404
H220SLCIG	3/8"	4.00"	3.67"	Single Acting, Cast Iron, EPR Seals	0733-0408
H220SECI	1/2"	4.50"	3.79"	Single Acting, Cast Iron	0733-0405
H220SECIG	1/2"	4.50"	3.79"	Single Acting, Cast Iron, EPR Seals	0733-0409

Call **FACTORY** for dimensions for the following models:

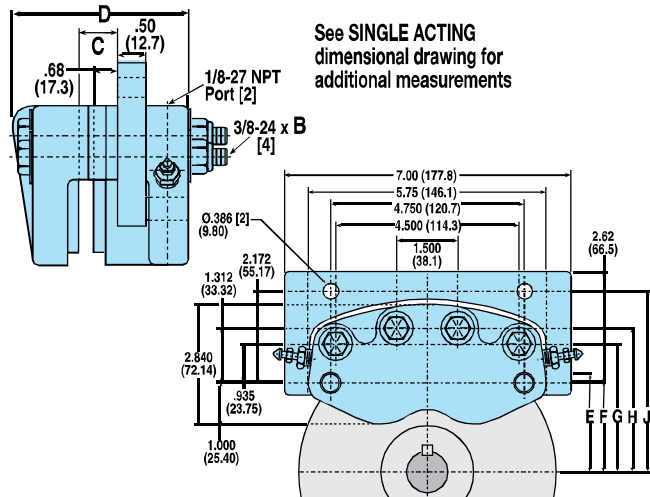
H220SOIC	1-1/4"	Single Acting, Cast Iron	0733-0226
H220SOICG	1-1/4"	Single Acting, Cast Iron, EPR Seals	0733-0227

### SINGLE ACTING WITH FLOATING BRACKET

FLOATING MOUNT - FIXED DISC

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

Weight 10.5 lbs. 4.76 kgs.

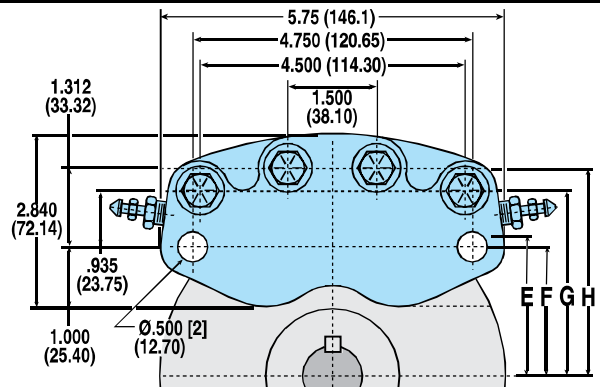


See **SINGLE ACTING** dimensional drawing for additional measurements

MODEL CODE	DISC THK.	B	C	D	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H220SAFCI	5/32"	4.00"	.83"	3.45"	Sgl Act, Floating Bracket, Cast Iron	0733-0422
H220SAFCIG	5/32"	4.00"	.83"	3.45"	SglAct, Ftg Bkt, Iron, EPR Seals	0733-0426
H220SBFCI	1/4"	4.00"	.92"	3.55"	Sgl Act, Floating Bracket, Cast Iron	0733-0423
H220SBFCIG	1/4"	4.00"	.92"	3.55"	SglAct, Ftg Bkt, Iron, EPR Seals	0733-0427
H220SLFCI	3/8"	4.00"	1.05"	3.67"	Sgl Act, Floating Bracket, Cast Iron	0733-0424
H220SLFCIG	3/8"	4.00"	1.05"	3.67"	Sgl Act, Ftg Bkt, Iron, EPR Seals	0733-0428
H220SEFCI	1/2"	4.50"	1.17"	3.79"	Sgl Act, Floating Bracket, Cast Iron	0733-0425
H220SEFCIG	1/2"	4.50"	1.17"	3.79"	Sgl Act, Ftg Bkt, Iron, EPR Seals	0733-0429

### 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

FEATURES

APPLICATIONS

SELECTION

GRAPHS

PNEUMATIC

BRAKES

P10

P20

P220

HYDRAULIC

BRAKES

H10

H20

H220

H220I

H441

H960

HYDRAULIC/  
MECHANICAL

BRAKE  
COMBOS

H/ME20

H/ME220

MECHANICAL

BRAKES

ME10

ME20

ME220

ME3

SPRING

APPLIED

BRAKES

FS20

FS220

FS220I

FS595

DISCS

HUBS &  
BUSHINGS

TENSION

CONTROL

COMBINATIONS

INTENSIFIER

SELECTION

WORKSHEET

## H441 SERIES - DUCTILE IRON

### AVAILABLE STYLES

#### Double Acting

FIXED MOUNT - FIXED DISC



PICTURED: 0774-0000

### H441 SPECIFICATIONS

Maximum Pressure Rating:	1,500 PSI
Accommodates Tolomatic disc diameters:	10", 12", 16"
Maximum disc diameter:	none
Housing Material:	Cast ductile iron
Bolts:	Zinc plated grade 5
Seals:	Buna-N Standard
Wearable friction material:	3.87 in <sup>3</sup>
Metallic:	3.38 in <sup>3</sup>
Friction material:	Replaceable, high-grade
Total lining area:	9.14 in <sup>2</sup>
Metallic:	7.36 in <sup>2</sup>
Piston diameter:	2.50 in.
Fluid displacement:	Double acting = 0.147 in <sup>3</sup> for .03 inch clearance

#### OPTIONS

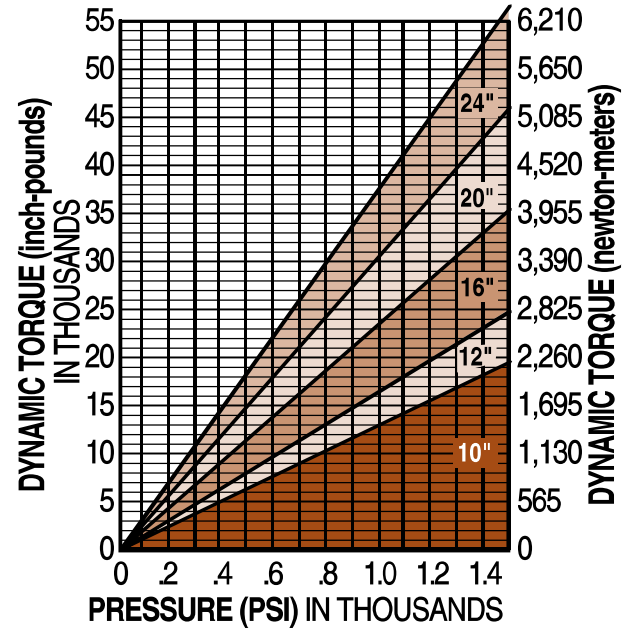
Seals:	EPR seals
Friction material:	Sintered metallic

### BRAKE MODEL LETTER CODES

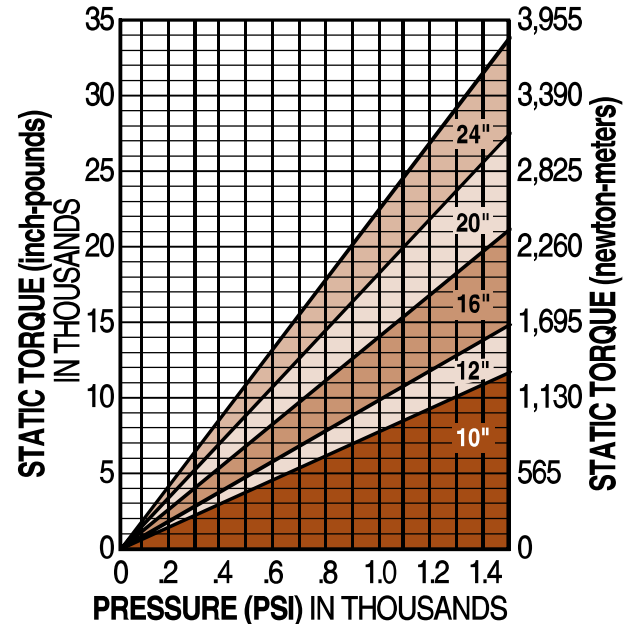
<b>D</b> Double Acting	<b>G</b> EPR Seals	<b>H</b> Hydraulic Brake
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### PERFORMANCE DATA

#### Dynamic Torque vs Pressure



#### Static Torque vs Pressure



### DISC SIZING EQUATIONS

$DYNAMIC\ TORQUE\ (IN-LBS.) = 3.53 \times BRAKING\ RADIUS\ (IN.) \times PRESSURE\ (PSI)$   
 $STATIC\ (PARKING)\ TORQUE\ (IN-LBS.) = 2.11 \times BRAKING\ RADIUS\ (IN.) \times PRESSURE\ (PSI)$   
 $BRAKING\ RADIUS\ (IN.) = [DISC\ DIAMETER \div 2] - 1.31$

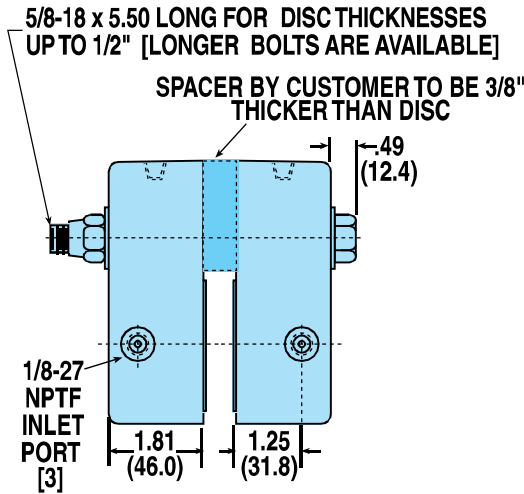
# Caliper Disc Brakes

## H441 SERIES - DUCTILE IRON

### DOUBLE ACTING FIXED MOUNT - FIXED DISC

Accommodates disc thickness: N/A

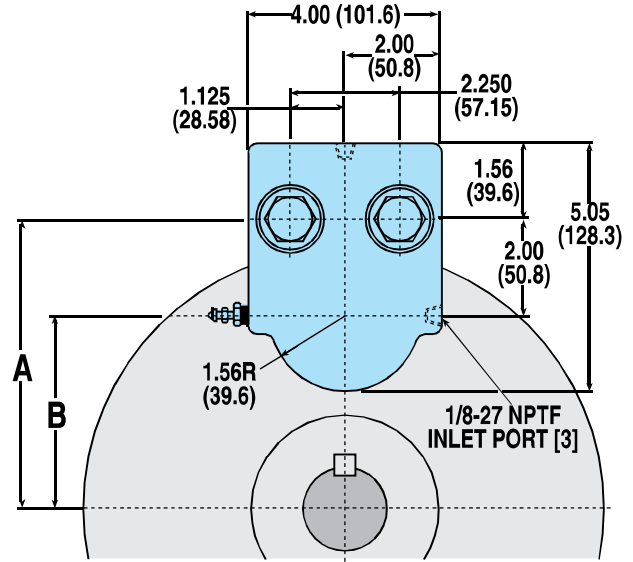
Weight 17.0 lbs. 7.71 kgs.



MODEL CODE	DISC THK.	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H441D	N/A	Double Acting	0774-0000
H441DG	N/A	Double Acting, EPR Seals	0774-0001
SH441D	N/A	Double Acting, w/Sintered Metal Pads	0774-0002
SH441DG	N/A	Double Acting, EPR Seals, w/Sintered Metal Pads	0774-0003

### MOUNTING DIMENSIONS

Disc Diameter	10"	12"	16"	20"	24"
A	5.69"	6.69"	8.69"	10.69"	12.69"
Braking Radius B	3.69"	4.69"	6.69"	8.69"	10.69"



CALIPER  
DISC  
BRAKES

FEATURES

APPLICATIONS

SELECTION  
GRAPHS

PNEUMATIC  
BRAKES

P10

P20

P220

HYDRAULIC  
BRAKES

H10

H20

H220

H2201

H441

H960

HYDRAULIC/  
MECHANICAL  
BRAKE  
COMBOS

H/ME20

H/ME220

MECHANICAL  
BRAKES

ME10

ME20

ME220

MB3

SPRING  
APPLIED  
BRAKES

FS20

FS220

FS2201

FS595

DISCS  
HUBS &  
BUSHINGS

TENSION  
CONTROL  
COMBINATIONS

INTENSIFIER

SELECTION

WORKSHEET

## H960 SERIES - DUCTILE IRON

### AVAILABLE STYLES

#### Double Acting

FIXED MOUNT - FIXED DISC



PICTURED: 0778-0003

### H960 SPECIFICATIONS

Maximum Pressure Rating:	1,500 PSI (intermittent duty) 1,000 PSI (continuous duty)
Accommodates Tolomatic disc diameters:	12", 16"
Maximum disc diameter:	18"
Housing Material:	Cast ductile iron
Bolts:	Zinc plated grade 5
Seals:	Buna-N Standard
Wearable friction material:	9.9 in <sup>2</sup>
Friction material:	Replaceable, high-grade
Total lining area:	32.0 in <sup>2</sup>
Piston diameter:	3.50 in.
Fluid displacement:	Double acting = 0.576 in <sup>3</sup>
<b>OPTIONS</b>	
Seals:	EPR seals
Seals:	Viton® seals

### BRAKE MODEL LETTER CODES

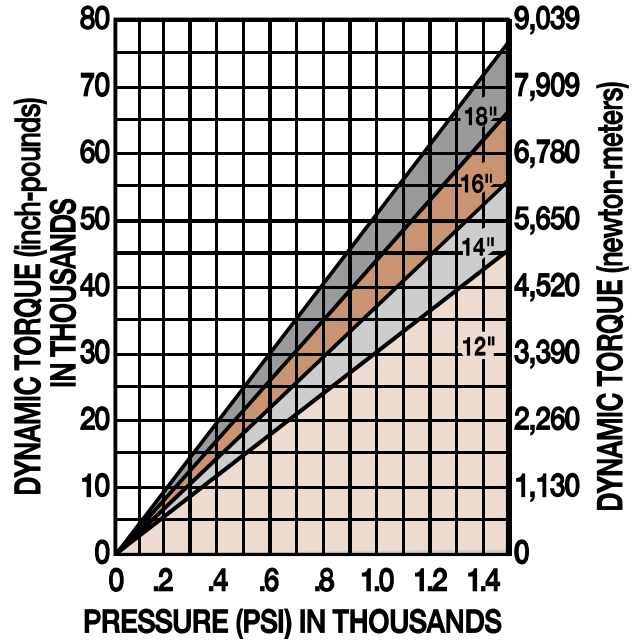
<b>C</b> With Bleeder Fitting	<b>H</b> Hydraulic Brake	<b>V</b> Viton® Seals
<b>D</b> Double Acting	<b>I</b> Iron	<b>X</b> Non-standard Disc Thickness
<b>E</b> 1/2" Thick Disc	<b>N</b> 1" Thick Disc	
<b>G</b> EPR Seals	<b>T</b> .188" Thick Disc	

### DISC SIZING EQUATIONS

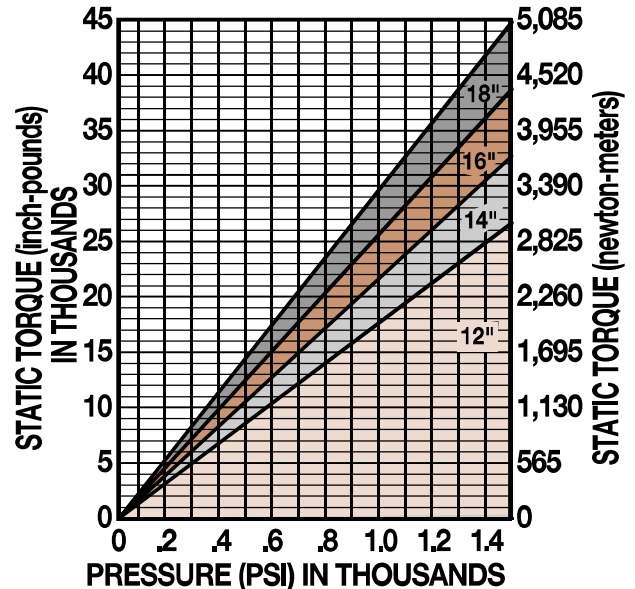
DYNAMIC TORQUE (IN.-LBS.) = 6.92 x BRAKING RADIUS (IN.) x PRESSURE (PSI)  
 STATIC (PARKING) TORQUE (IN.-LBS.) = 4.04 x BRAKING RADIUS (IN.) x PRESSURE (PSI)  
 BRAKING RADIUS (IN.) = [DISC DIAMETER ÷ 2] - 1.60

### PERFORMANCE DATA

#### Dynamic Torque vs Pressure



#### Static Torque vs Pressure



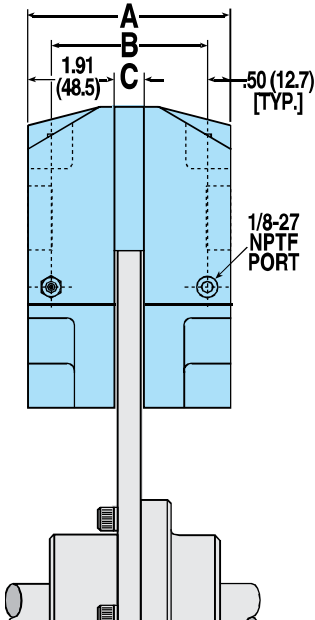
# Caliper Disc Brakes

## H960 SERIES - DUCTILE IRON

### DOUBLE ACTING FIXED MOUNT - FIXED DISC

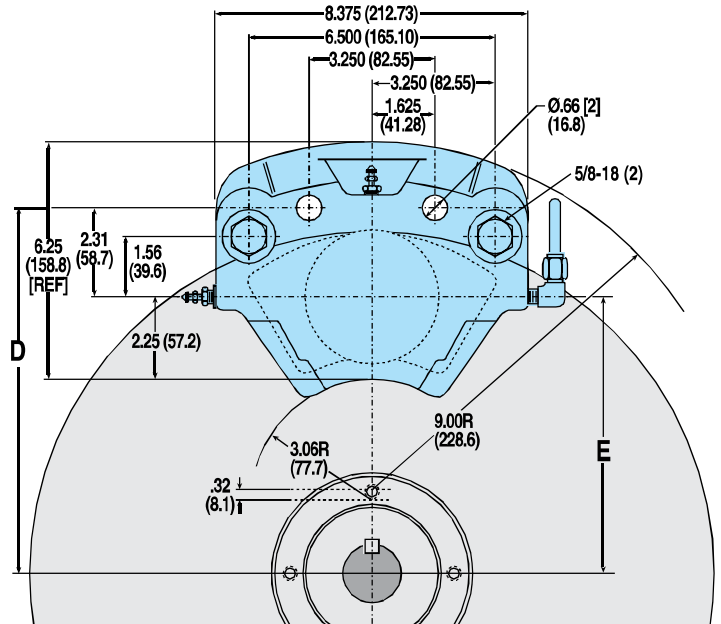
Accommodates disc thickness: 3/16" 1/2" 1" 1-1/8"

Weight 35.0 lbs. 15.88 kgs.



### MOUNTING DIMENSIONS

Disc Diameter	12"	14"	16"	18"
D	6.712"	7.712"	8.712"	9.712"
Braking Radius	E 4.40"	5.40"	6.40"	7.40"



MODEL CODE	DISC THK.	A	B	C	OPTIONS / DESCRIPTION	ASSEMBLY NUMBER
H960DTCI	3/16"	4.13"	3.13"	.31"	Double Acting, Iron	0778-0012
H960DECI	1/2"	4.45"	3.45"	.63"	Double Acting, Iron	0778-0003
H960DECIG	1/2"	4.45"	3.45"	.63"	Double Acting, Iron, EPR Seals	0778-0004
H960DECIV	1/2"	4.45"	3.45"	.63"	Double Acting, Iron, Viton® Seals	0778-0005
H960DNCI	1"	4.95"	3.95"	1.13"	Double Acting, Iron	0778-0011
H960DXCI	1-1/8"	5.08"	4.08"	1.26"	Double Acting, Iron	0778-0000

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CALIPER  
DISC  
BRAKES

FEATURES

APPLICATIONS

SELECTION  
GRAPHS

PNEUMATIC  
BRAKES

P10

P20

P220

HYDRAULIC  
BRAKES

H10

H20

H220

H2201

H441

H960

HYDRAULIC/  
MECHANICAL  
BRAKE  
COMBOS

H/ME20

H/ME220

MECHANICAL  
BRAKES

ME10

ME20

ME220

MB3

SPRING  
APPLIED  
BRAKES

FS20

FS220

FS2201

FS595

DISCS  
HUBS &  
BUSHINGS

TENSION  
CONTROL  
COMBINATIONS

INTENSIFIER

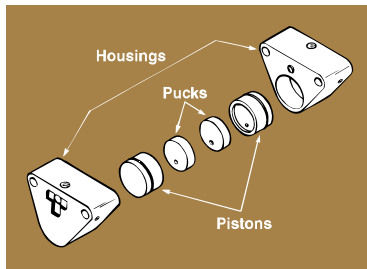
SELECTION

WORKSHEET

## 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).

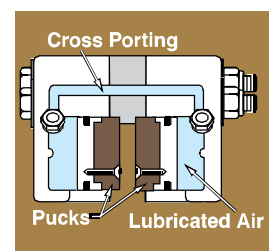
### DETERMINE THE TYPE OF BRAKE ACTUATION

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

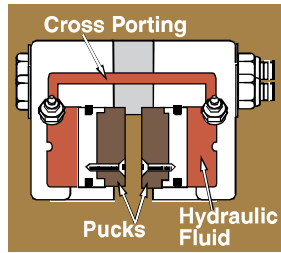
Pneumatic actuation is used in industrial and tensioning applications because pneumatic service is easily controllable and readily available in most industrial settings.



## SELECTION: GENERAL

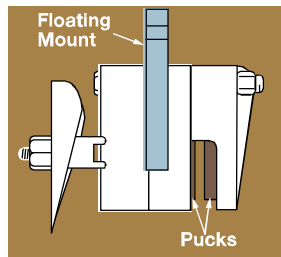
### • HYDRAULIC

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.

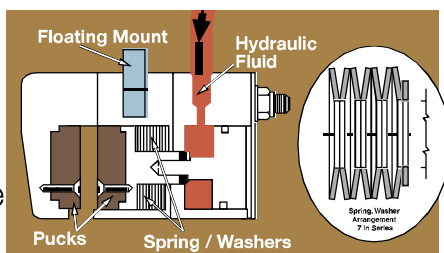


### • HYDRAULIC / MECHANICAL COMBOS

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:

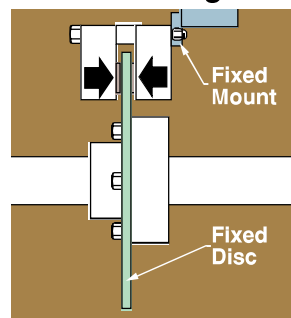
- [1.] a constant value (A product of brake piston area, the coefficient of friction and a safety factor.), multiplied by
- [2.] braking radius (Common disc sizes appear on the page with the dimensional drawing.), multiplied by
- [3.] pressure (lever force) (You will need to determine.).

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		

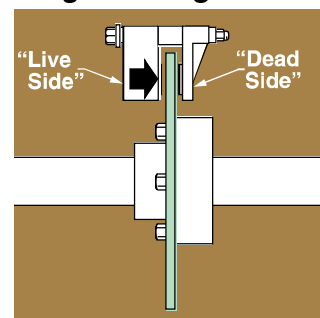
The performance data graphs represent these equations for common disc sizes in a convenient, visual way to quickly see how well each brake size will fit your application.

### CHOOSE DOUBLE ACTING OR SINGLE ACTING BRAKE

#### Double Acting



#### Single 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 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.

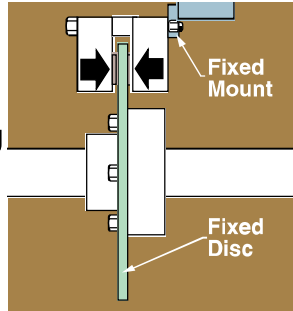


## SELECTION: GENERAL

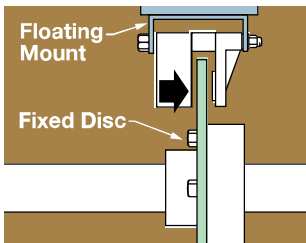
### DETERMINE MOUNT FOR BRAKE AND DISC

#### • For Double Acting Brakes

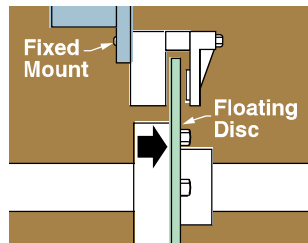
**FIXED CALIPER MOUNT/ FIXED DISC** – A double acting caliper can be fixed mounted since both linings have pistons to move them. The disc is also fixed mounted.



#### • 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.

## 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:

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

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

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:

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

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

or

$$\text{BTU/Stop} = \frac{\pi TN_s t}{46,680} \quad [6]$$

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:

$$\text{BTU/hr.} = (\text{BTU/stop})(\text{stops/hr.}) \quad [7]$$

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

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

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.

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

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:

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

Where: **Thickness** is in inches

**A** = Area of maximum allowable diameter; in<sup>2</sup>

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.

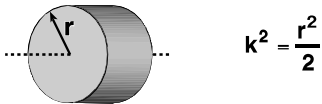
## SELECTION: FORMULAE: RADIUS OF GYRATION, TENSIONING

### RADIUS OF GYRATION FORMULAE

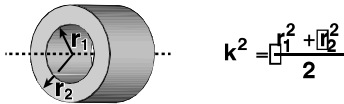
#### Radius of Gyration for Geometric Forms

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



Hollow Cylinder About its Own Axis



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

$$WK_e^2 = WK_s^2 + WK_1^2 \left[ \frac{N_1}{N_s} \right]^2 + \dots \quad [2]$$

Where: **WK<sub>e</sub><sup>2</sup>** = Equivalent **WK<sup>2</sup>** of the multiple shaft system; lbs-ft<sup>2</sup>

**WK<sub>s</sub><sup>2</sup>** = **WK<sup>2</sup>** of the shaft assembly on which the brake disc is mounted; lbs-ft<sup>2</sup>

**WK<sub>1</sub><sup>2</sup>** = **WK<sup>2</sup>** of the second shaft assembly; lbs-ft<sup>2</sup>

**N<sub>s</sub>** = speed of the shaft on which the brake disc is mounted; rpm

**N<sub>1</sub>** = 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

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

Where: **T** = Torque; in-lbs (**WK<sub>e</sub><sup>2</sup>** is in lbs-in<sup>2</sup>)

### 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:

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

#### 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:

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

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

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

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

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:

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

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).



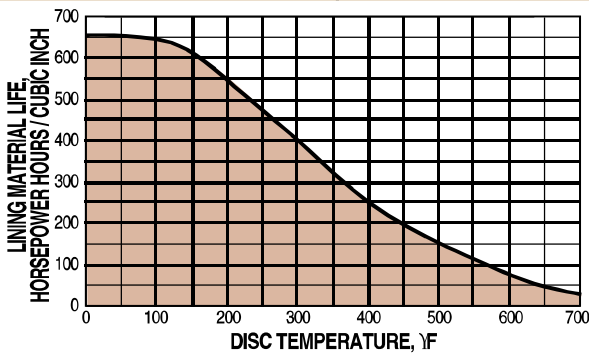
## SELECTION: LINING LIFE

### 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.

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

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:

$$E = \frac{WV^2}{60} \quad [20]$$

or

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

Where:  $E$  = Kinetic Energy; ft-lbs

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

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

**LINING LIFE CALCULATIONS ARE ESTIMATES AND DO NOT ACCOUNT FOR FOREIGN CONTAMINANTS THAT MAY ABRASE 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 IN <sup>2</sup>	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	CALIPER SERIES	CUBIC INCHES	SERIES	INCHES
				FS440	1.75
10	.46	FS220		H441	3.71
20	.83	Aluminum	1.66	FS595	4.57
H220		FS220		H960	8.00
Aluminum	1.66	Cast Iron w/ JK options	2.35	MB3	6.06
H220		H440	3.32		
Cast Iron	2.35				

CALIPER CUBIC

### TABLE 3 – CAM TRAVEL DATA

#### ME10 and ME20 Calipers

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

#### ME220 Calipers

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

#### MB3 Calipers

- 0° travel with .500" disc.
- 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

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

- Where:
- T** = Torque per Axle, 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<sup>2</sup>
  - b** = % of grade
  - D** = Gear Reduction, if drive line mounted
  - a** = Deceleration rate; ft/sec<sup>2</sup>

And

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

- Where:
- V** = Velocity of vehicle, ft./sec., at moment of brake application
  - t** = Stopping time required; seconds
  - S** = Stopping distance of vehicle; ft.

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

#### Calculation of Heat Generation and Required Dissipation (Vehicular)

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

- Where:
- E** = Kinetic Energy; ft-lbs
  - W** = Weight of axle, vehicle, or wheel; lbs.
  - V** = Design speed of vehicle; ft/sec.

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

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

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

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.

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

- 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:

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

- Where:
- Thickness** is in inches
  - A** = Area of maximum allowable diameter; in<sup>2</sup>

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.

