Spring Applied Friction Brakes

Selecting a Spring Applied Brake Imperial

Determining the Brake Size

Static Applications

A static application is one in which there is no dynamic braking. In this mode the brake is used to hold the inertial load in a fixed or parked position. Match your required torque to the static torque rating of the brake. Be sure the brake torque exceeds your requirement. A service factor of 1.4 is recommended.

Dynamic Applications

A dynamic application is one in which the brake decelerates an inertial load. To properly size the brake you need to calculate the dynamic torque required. There are two methods that can be used.

$$T_d = \left[\frac{WR^2 \times N}{C \times t}\right] \times S.F.$$

Where:

- WR^2 = Total inertia reflected to the clutch/brake, lb.–in.^{2} (kg.m^2)
- N = Shaft speed at clutch/brake, RPM
- C = Constant, use 3696 for English units and 9.55 for metric units
- t = Desired stopping or acceleration time, seconds
- S.F. = Service Factor, 1.4 recommended
- T_d = Average dynamic torque, lb.–in. (N–m)

Inertia Dynamics brakes are rated by static torque. Therefore, the dynamic torque rating obtained should be converted to a static torque value:

$$T_s = \frac{T_d}{0.80}$$

NOTE:
The 80% derating factor should be used as a guide only.

Where:

- T_s = Static torque
- 0.80 = Derating factor

The brake size can also be determined using the selection charts. Find the intersection of the prime mover horsepower (HP) and shaft speed at the brake using the selection charts. (Fig. A & B). The relationship between the horsepower and speed to determine the dynamic torque required is expressed as:

$$T_d = \left[\frac{63{,}025 \times P}{N}\right] \times S.F.$$

Where:

- T_d = Average dynamic torque, lb.–in.
- P = Horsepower, HP
- N = Shaft Speed
- S.F. = Service Factor
- 63,025 = Constant

Additional formulas and conversion charts are found on pages 60 and 79.

Fig. A

Type FSBR Series Selection

HP	SHAFT SPEED AT BRAKE (RPM)																			
	100	200	300	400	500	600	700	800	900	1000	1100	1200	1500	1800	2000	2400	3000	3600	4000	5000
1/50																				
1/20																				
1/12											7									
1/8																				
1/6											15									
1/4																				
1/3																				
1/2											35									
3/4											50									
1																				
1 1/2											100									
2																				
3																				
5																				
7 1/2																				
10																				

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Determining the Brake Size

Static Applications

A static application is one in which there is no dynamic braking. In this mode the brake is used to hold the inertial load in a fixed or parked position. Match your required torque to the static torque rating of the brake. Be sure the brake torque exceeds your requirement. A service factor of 1.4 is recommended.

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$$T_d = \left[\frac{WR^2 \times N}{C \times t}\right] \times \text{S.F.}$$

Where:

- WR^2 = Total inertia reflected to the clutch/brake, kg-m²
- N = Shaft speed at inertial load, RPM
- C = Constant, use 9.55
- t = Desired stopping time, seconds
- S.F. = Service Factor, 1.4 recommended
- T_d = Average dynamic torque, N–m

Inertia Dynamics brakes are rated by static torque. Therefore, the dynamic torque rating obtained should be converted to a static torque value:

$$T_s = \frac{T_d}{0.80}$$

Where:

- T_s = Static torque
- 0.80 = Derating factor

The brake size can also be determined using the selection charts. Find the intersection of the prime mover kilowatt (kW) and shaft speed at the brake using the selection charts. (Fig. A & B). The relationship between the kilowatts and speed to determine the dynamic torque required is expressed as:

$$T_d = \left[\frac{9{,}550 \times kW}{N}\right] \times \text{S.F.}$$

Where:

- T_d = Average dynamic torque, N-m.
- P = Power, kW
- N = Shaft Speed
- S.F. = Service Factor
- 9,550 = Constant

Additional formulas and conversion charts are found on pages 61 and 79.

Fig. A

Type FSBR Series Selection

kW	SHAFT SPEED AT BRAKE (RPM)																			
	100	200	300	400	500	600	700	800	900	1000	1100	1200	1500	1800	2000	2400	3000	3600	4000	5000
.0149																				
.0373																				
.0621											7									
.0932																				
.124											15									
.186																				
.249																				
.373											35									
.559											50									
.743																				
1.12											100									
1.49																				
2.24																				
3.73																				
5.59																				
7.46																				

NOTE:
The 80% derating factor should be used as a guide only.

Selecting a Spring Applied Brake Imperial

Fig. B

Type FSB Series Selection

Torque Rating vs. RPM (Sizes 001 through 007) - Selection Chart

TORQUE LB.-IN.*	SHAFT SPEED AT BRAKE (RPM)																		
	100	200	300	400	500	600	700	800	900	1000	1100	1200	1500	1800	2000	2400	3000	3600	4000	5000
.50											001									
.75																				
1.0																				
2.0											003									
2.5																				
2.75																				
3.0																				
5.0																				
6.25											007									
6.5																				
6.75																				
7.0																				

*Slightly higher torque ratings may be allowable for some speeds. Consult Inertia Dynamics.

HP vs. RPM (Sizes 15 through 100) – Selection

HP	SHAFT SPEED AT BRAKE (RPM)																		
	100	200	300	400	500	600	700	800	900	1000	1100	1200	1500	1800	2000	2400	3000	3600	4000	5000
1/50																				
1/20																				
1/12											15									
1/8																				
1/6																				
1/4																				
1/3											35									
1/2																				
3/4											50									
1																				
1 1/2											100									
2																				
3																				
5																				
7 1/2																				
10																				

Selection Considerations

The required size is determined mostly from the brake torque needed. The inertia to be braked, the speed, the braking times, duty cycle, and life requirements are all considerations in brake sizing. Other conditions to be considered are ambient temperatures, humidity, dust, and contaminants which may affect the brake performance. For these reasons, brake performance should be evaluated under actual application conditions.

Brake Location

Whenever possible, the brake should be mounted to the highest-speed shaft. This will allow a brake with the lowest possible torque to be used. However, the maximum allowable shaft speed should not be exceeded.

120 VAC Operation

All brakes include full wave rectification.

Maintenance

Inertia Dynamics brakes are virtually maintenance-free. The air gap is set at the factory and requires no adjustments. The friction faces must be kept free of grease and oil for proper operation.

Fig. B

Type FSB Series Selection

Torque Rating vs. RPM (Sizes 001 through 007) - Selection Chart

TORQUE N-m	SHAFT SPEED AT BRAKE (RPM)																			
	100	200	300	400	500	600	700	800	900	1000	1100	1200	1500	1800	2000	2400	3000	3600	4000	5000
.056											001									
.085																				
.113																				
.226											003									
.282																				
.311																				
.339																				
.565																				
.706											007									
.734																				
.763																				
.791																				

kW vs. RPM (Sizes 15 through 100) – Selection

kW	SHAFT SPEED AT BRAKE (RPM)																			
	100	200	300	400	500	600	700	800	900	1000	1100	1200	1500	1800	2000	2400	3000	3600	4000	5000
.0149																				
.0373																				
.0621											15									
.0932																				
.124																				
.186																				
.249											35									
.373																				
.559											50									
.746																				
1.12											100									
1.49																				
2.24																				
3.73																				
5.59																				
7.46																				

Selection Considerations

The required size is determined mostly from the brake torque needed. The inertia to be braked, the speed, the braking times, duty cycle, and life requirements are all considerations in brake sizing. Other conditions to be considered are ambient temperatures, humidity, dust, and contaminants which may affect the brake performance. For these reasons, brake performance should be evaluated under actual application conditions.

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Spring Applied Friction Brakes

Selecting a Spring Applied Brake Imperial

Response Time - Standard Power-Off Brakes

The following is a list of typical “Pick” and “Drop” times for standard power-off brakes.
“Pick” is defined as time to electrically energize and free the brake of torque.
“Drop” is defined as time to electrically de-energize and produce torque.

SERIES	PICK TIME	DROP TIME WITH DIODE ARC SUPPRESSION	DROP TIME WITH MOV ARC SUPPRESSION
001	8	14	77
003	26	30	14
007	39	88	30
015	30	92	35
035	60	205	70
050	68	60	32
100	100	140	50
20	30	92	40
90	45	75	25
180	40	140	40
400	85	160	45
1200	138	170	50

All times are measured in milliseconds.

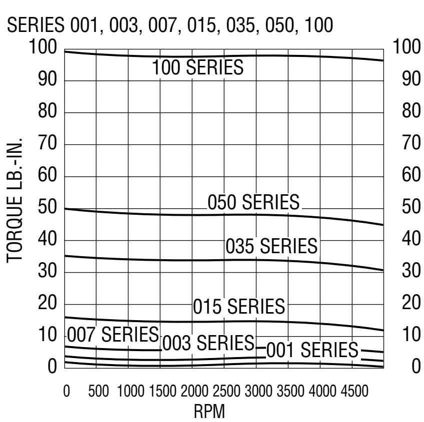
Torque Data

CLUTCHES: CLUTCH COUPLINGS: POWER ON BRAKES			
SERIES	TYPICAL OUT-OF-BOX TORQUES LB. - IN.	RATED STATIC TORQUES LB. - IN.	TYPICAL TORQUES AFTER BURNISHING LB. - IN.
001	1	1	1.5
003	3	3	4
007	7	7	9
015	15	15	18
035	35	35	42
050	50	50	60
100	100	100	120

NOTES:

1. Brakes tested at 20°C and at nominal voltage and air gap.
2. The Pick and Drop values are typical and should only be used as a guide.
3. For special applications consult Inertia Dynamics engineering.

Dynamic Torque Curve



Response Time - Standard Power-Off Brakes

The following is a list of typical "Pick" and "Drop" times for standard power-off brakes.
"Pick" is defined as time to electrically energize and free the brake of torque.
"Drop" is defined as time to electrically de-energize and produce torque.

SERIES	PICK TIME	DROP TIME WITH DIODE ARC SUPPRESSION	DROP TIME WITH MOV ARC SUPPRESSION
001	8	14	1
003	35	34	2
007	39	88	1
015	30	92	1
035	60	205	1
050	68	60	3
100	100	140	5

All times are measured in milliseconds.

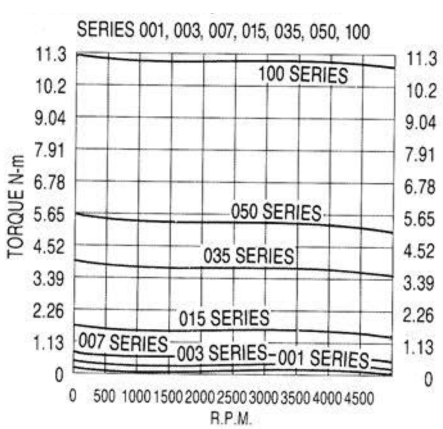
Torque Data

CLUTCHES: CLUTCH COUPLINGS: POWER ON BRAKES			
SERIES	TYPICAL OUT-OF-BOX TORQUES N-m	RATED STATIC TORQUES N-m	TYPICAL TORQUES AFTER BURNISHING N-m
001	.113	.113	.17
003	.339	.339	.45
007	.791	.791	1.0
015	1.69	1.69	2.0
035	3.95	3.95	4.8
050	5.65	5.65	6.8
100	11.3	11.3	13.6

NOTES:

1. Brakes tested at 22°C and at nominal voltage and air gap.
2. The Pick and Drop values are typical and should only be used as a guide.
3. For special applications consult Inertia Dynamics engineering.

Dynamic Torque Curve



Spring Applied Friction Brakes

Selecting a Spring Applied Brake Imperial

Maximum Recommended/ Safe Input RPM

(Note: Consult Inertia Dynamics Engineering for Special Applications)

Type: FSB and FSBR

SIZE	MAX. INPUT RPM
001 003	9,000
007 015	7,500
035 050	7,000
100	5,000

Burnishing

Burnishing is a wearing-in or mating process which will ensure the highest possible output torques. Burnishing is accomplished by forcing the brake to slip rotationally when energized. Best results are obtained when the unit is energized at 30-40% of rated voltage and forced to slip for a period of 2-3 minutes at a low speed of 100-200 RPM. Units in applications with high inertial loads and high speed will usually become burnished in their normal operating mode. Whenever possible, it is desirable to perform the burnishing operation in the final location so the alignment of the burnished faces will not be disturbed. For additional information on burnishing procedures ask for burnishing spec. #040-1069.

FSB Allowable Cycles/Minutes*

MODEL NO.	RPM	INERTIA (LB. – IN.^{2})				MODEL NO.	RPM	INERTIA (LB. – IN.^{2})			
		1	5	10	50			10	50	100	500
001	1800	60	12	6	1	035	1800	25	5	2.5	5
	3600	15	3	1.5	–		3600	5	1	.5	–
003	1800	80	16	8	2	050	1800	25	5	2.5	.5
	3600	20	4	2	–		3600	5	1	.5	–
007	1800	150	30	15	3	100	1800	50	10	5	1
	3600	150	30	15	3		3600	12	2.5	1.2	–
015	1800	150	30	15	3						
	3600	40	8	4	3						

*Chart intended as a guide. For other speeds and inertias, consult Inertia Dynamics.

FSBR Allowable Cycles/Minutes*

MODEL NO.	RPM	INERTIA (LB. – IN.^{2})			
		5	10	50	100
007	1800	30	15	3	–
	3600	8	4	.8	–
015	1800	30	15	3	–
	3600	8	4	.8	–
035	1800	50	25	5	2.5
	3600	10	5	1	.5
050	1800	50	25	5	2.5
	3600	10	5	1	.5
100	1800	100	50	10	5
	3600	25	12	2.5	1.2

*Chart intended as a guide. For other speeds and inertias, consult Inertia Dynamics.

Hi-Pot Testing

All brakes are tested 100% for Hi-Pot failures. Typical tests are at 1500 volts RMS. Do not Hi-Pot AC rectified units, since this will potentially damage the rectifiers and cause failure. For specific testing procedures, ask for Hi-Pot spec. #040-10122.

Maximum Recommended/ Safe Input RPM

(Note: Consult Inertia Dynamics Engineering for Special Applications)

Type: FSB and FSBR

SIZE	MAX. INPUT RPM
001 003	9,000
007 015	7,500
035 050	7,000
100	5,000

Burnishing

Burnishing is a wearing-in or mating process which will ensure the highest possible output torques. Burnishing is accomplished by forcing the brake to slip rotationally when energized. Best results are obtained when the unit is energized at 30-40% of rated voltage and forced to slip for a period of 2-3 minutes at a low speed of 100-200 RPM. Units in applications with high inertial loads and high speed will usually become burnished in their normal operating mode. Whenever possible, it is desirable to perform the burnishing operation in the final location so the alignment of the burnished faces will not be disturbed. For additional information on burnishing procedures ask for burnishing spec. #040-1069.

FSB Allowable Cycles/Minutes*

MODEL NO.	RPM	INERTIA ($kg\text{-}cm^2$)				MODEL NO.	RPM	INERTIA ($kg\text{-}cm^2$)			
		2.86	14.6	29	146			29.3	146	293	1463
001	1800	175	35.1	17.6	2.93	035	1800	73.2	14.6	7.32	14.6
	3600	43.9	8.78	4.39	–		3600	14.6	2.93	1.46	–
003	1800	234	46.8	23.4	5.85	050	1800	73.2	14.6	7.32	1.46
	3600	58.5	11.7	5.85	–		3600	14.6	2.93	1.46	–
007	1800	439	87.8	43.9	8.78	100	1800	146	29.3	14.3	2.93
	3600	439	87.8	43.9	8.78		3600	35.1	7.32	3.51	–
015	1800	439	87.8	43.9	8.78						
	3600	117	23.4	11.7	2.34						

*Chart intended as a guide. For other speeds and inertias, consult Inertia Dynamics.

FSBR Allowable Cycles/Minutes*

MODEL NO.	RPM	INERTIA ($kg\text{-}cm^2$)			
		14.6	29.3	146	293
007	1800	87.8	43.9	8.78	–
	3600	23.4	11.7	2.34	–
015	1800	87.8	43.9	8.78	–
	3600	23.4	11.7	2.34	–
035	1800	146	73.2	14.6	7.32
	3600	29.3	14.6	2.93	1.46
050	1800	146	73.2	14.6	7.32
	3600	29.3	14.6	2.93	1.46
100	1800	293	146	29.3	14.6
	3600	73.2	35.2	7.32	3.51

*Chart intended as a guide. For other speeds and inertias, consult Inertia Dynamics.